



REPORT ON THE GALES
EXPERIENCED IN THE
OCEAN DISTRICT
ADJACENT TO
THE CAPE OF GOOD HOPE

(Between Lat. 30° and 50° S. and Long. 10° and 40° E.)

BY CAPTAIN H. TOYNBEE, F.R.A.S.

Presented to the Meteorological Council,

AND

PUBLISHED BY THEIR AUTHORITY.

ME 12/113/46

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ADJACENT TO

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(Between Lat. 30° and 50° S. and Long. 10° and 40° E.)

BY CAPTAIN H. TOYNBEE, F.R.A.S.

Presented to the Meteorological Council, and Published by their Authority.



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PREFACE.

THE following Report on the "Gales experienced in the Ocean District adjacent to the Cape of Good Hope" is to accompany the Meteorological Charts of that district recently published by the Meteorological Office.

The discussion, referring as it does to a great extent to technical matters of seamanship, has been left by the Meteorological Council entirely in the hands of the Marine Superintendent, Captain Toynbee, F.R.A.S.

It has been considered sufficient to discuss in detail the Gales of the months of January and July only, as typical of the summer and winter seasons respectively. A summary of the results relating to each of the twelve months of the year has, however, been added.

By order,
ROBERT H. SCOTT,
Secretary.

Meteorological Office,
June 1882.

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REPORT ON THE GALES

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OCEAN DISTRICT ADJACENT TO THE CAPE OF GOOD HOPE

(Between Lat. 30° and 50° S. and Long. 10° and 40° E.)

To THE METEOROLOGICAL COUNCIL.

GENTLEMEN,

In accordance with your instructions I have drawn up the accompanying Report on the Gales experienced in the neighbourhood of the Cape of Good Hope, which I trust may prove useful to seamen. In submitting this Report I have to express my great appreciation of the able and willing assistance which I have received from Mr. Charles Harding, Mr. Allingham, and the other members of the staff in the Marine Branch of the Office.

I remain, Gentlemen,

Your obedient Servant,

HENRY TOYNBEE,

Marine Superintendent.

Meteorological Office,
June 1882.

A.

INTRODUCTORY REMARKS.

LIST OF THE PRINCIPAL WORKS AND MEMOIRS ON THE SAME SUBJECT.

BEFORE dealing with the gales recorded in the logs of the Meteorological Office, it will be well to enumerate the principal works or memoirs which have already appeared on the subject.

Horsburgh's "India Directory," 8th edition, 2 vols., London 1864.

This work contains valuable practical remarks on the gales experienced in the district.

The following works were published by the Dutch Meteorological Institute:—

1858. A Storm and Rain chart for part of the district, *i.e.* to 37° S. This chart is on the plan introduced by Maury, but based on Dutch observations *only*. The percentages of westerly and easterly storms, calms, rain, thunder, and mist for the mean

Q 735.

A

track of ships passing through the district on the homeward-bound route have been represented by diagrams.*

1859. A paper by Lieut. K. F. R. Andrau of the Dutch Navy, on the storms of the district, with theoretical diagrams of the shape and tracks of these storms, accompanied by remarks.†

1862. A collection of charts containing percentages of storms, rain, thunder, and mist, chiefly compiled from the latest observations of Dutch sailors.‡

1874. Quarterly gale charts for the sea in the neighbourhood of S. Africa, extending to 37° S. These charts are divided into spaces of twenty miles of latitude, by one degree of longitude. The percentages of gales from the various points of the compass are shown by the relative lengths of radial lines, and their force by the character of those lines.§

Besides the above, Lieut. J. van Gogh has written a paper "On the Storms in the vicinity of the Cape of Good Hope considered in connexion with the Temperature of the Sea."|| This paper is accompanied by diagrams resembling those published by the Dutch Meteorological Institute in 1858, with the addition of the average sea temperatures for the mean track of ships homeward bound. It shows that westerly gales are most frequent in the longitude of the eastern edge of the Agulhas Bank where the temperature of the sea is very high for the latitude.

Mr. Meldrum, Director of the Royal Albert Observatory, Mauritius, has prepared and published, under the auspices of the Meteorological Society of Mauritius, Synoptic Weather Charts of the Indian Ocean for the month of February 1861. The amount of information they contain for the part of the ocean near the Cape of Good Hope now under consideration is rather meagre, but it gives decided evidence that the wind systems met with travel eastwards; and the four areas of low barometric pressure which are shown on the charts had an average rate of motion of about 20 miles an hour in that direction. The approximate rate of motion deduced from a few cases, to which reference is specially made, in the following discussion is 30 miles an hour, also in an easterly direction.

A summary of practical conclusions derived from most of the above works will be found in the Admiralty Chart of the Cape of Good Hope and adjacent coasts (No. 2095), and in the Africa Pilot, Part III., South and East Coasts, compiled by Captain A. de Horsey, R.N., and published by the Admiralty in 1878.

DATA EMPLOYED.

Only the logs belonging to the Meteorological Office have been employed in this discussion, and any apparent discrepancy which may be found between the representation

* The chart appears in "Uitkomsten van Wetenschap en Ervaring aangaande Winden en Zeestroomingen in sommige gedeelten van den Oceaan."—Utrecht, 1858.

† This paper appears in the same publication for 1859.

‡ "Verzameling van Kaarten inhoudende eene procentsgewijze opgave omtrent Storm, Regen, Donder, en Mist, grootendeels getrokken uit de jongste waarnemingen onzer Nederlandsche zeelieden."—Utrecht, 1862.

§ "Gemiddelde Barometerstand en Stormen rond Afrika's Zuidpunt."—Utrecht, 1874.

|| "De Stormen nabij de Kaap de Goede Hoop in verband beschouwd met de Temperatuur der Zee."

of gales on the wind charts lately published and this Report is due partly to the fact that no use has been made of the Dutch observations, which were not asked for in sufficient detail for this style of work; though mainly to the difference in the methods employed in the two investigations, which difference is explained below.

METHOD OF DISCUSSION.

The important fact of the relative frequency in different parts of the district of winds having the force of a gale is shown by shading the tips of the wind-roses on the Wind Charts recently published by the Office. The gales thus represented are parts of wind-systems related to areas of low barometric pressure generally moving in an easterly direction. It is therefore evident that one of these moving areas may produce the same kind of gale in many parts of the district, and that the gale in question will be recorded in the wind-rose of each region through which it passes; whereas the following discussion treats the whole course of a wind-system which was experienced by a given ship as only one gale, commencing with the falling barometer and the winds which preceded the gale, and ending with the rising barometer and the winds which followed it, even though the ship may have sailed over many hundreds of miles whilst under the influence of the system.

CLASSIFICATION OF GALES ACCORDING TO DIRECTION AND GEOGRAPHICAL POSITION.

The gales have been classified according to their direction, but those experienced by ships bound to the eastward, which are called in this work "outward-bound gales," and those experienced by ships bound to the westward, called in this work "homeward-bound gales," have been separately discussed.

Outward-bound ships generally steer to the eastward in about 40° or further South, though in the winter months they frequently take a more northerly route.

Homeward-bound ships keep near the land and seldom go to the southward of the parallel of 37° S.

The directions under which the gales have been classed are—

I. NORTH-WESTERLY, or those which commence from North or North-west, even though several of them veer to West or South-west.

These are the ordinary gales of the south temperate zone, and correspond to the South-westerly gales veering to West or North-west of the northern hemisphere.

II. SOUTH-WESTERLY, or those which commence and continue to blow from the South-westward.

These gales sometimes commence from West and veer to the South-westward.

III. NORTH-EASTERLY, or those which commence and continue to blow from the North-eastward.

A North-easterly gale is frequently followed by a sudden shift to a South-westerly gale; such instances have been classed with the "Exceptional Gales."

IV. SOUTH-EASTERLY, or those which commence and continue to blow from the South-eastward.

These gales are divided into two classes, viz.,—

(a.) Those which are preceded by Northerly to North-westerly winds and a falling barometer, the wind generally changing to the South-eastward at the time of lowest barometric pressure;

(b.) Those which are preceded by South-easterly winds. These have been subdivided into “fine weather” and “bad weather” gales.*

V. EXCEPTIONAL, or those which cannot be classed under any of the above headings. They have been grouped according to their resemblance to certain types, but are dealt with individually.

METHOD OF EXTRACTING AND CLASSIFYING DATA.

Before discussing the gales under their various headings, it may be well to explain the method which has been followed in extracting the data from the logs.

Forms have been prepared showing—

(a.) The date, position of ship, direction and force of wind, and reading of barometer at the time of the highest barometric pressure which immediately preceded the gale.

(b.) The direction, force, and duration of the various winds which blew between the time of highest barometric pressure and the commencement of the gale. Force 8 of Beaufort's scale has been taken as the lowest which represents a “gale” in this discussion.

(c.) Date, position of ship, direction and force of wind, and reading of barometer when the gale commenced.

(d.) The same when the extreme force was first reported.

(e.) The same when the lowest barometric pressure occurred.

(f.) The same when the gale ended.

(g.) The direction, force, and duration of the various winds which blew between the time of the gale's ending and the time of highest barometric pressure which immediately followed it.

(h.) Date, position of ship, direction and force of wind, and reading of barometer at the time of the highest barometric pressure which immediately followed the gale.

* Knowing that the term “Black South-easter” is in use at the Cape, I asked Mr. Gill, Her Majesty's Astronomer there, to which of these classes the term is applied, he kindly answered as follows:—“I find it difficult to give you a certain answer. A black south-easter is simply a term applied to a strong south-easterly wind or gale in which Table Mountain is covered by a thick black cloud. So far as I can collect evidence, it corresponds sometimes to a gale of type (a), sometimes to a bad-weather gale of type (b), but not to a fine-weather gale of type (c). In the common fine-weather S.E. gales the mountain is clear or capped with pure white cloud. Sometimes there occurs a fall of the barometer whilst such a gale is blowing, we then expect a change of wind to N.; if this does not come, then we have a black south-easter. Sometimes we get a black south-easter after a sudden change of wind from the N.”

Besides the above data, the changes of wind during the gale, the temperatures of sea and air at the time when the extreme force was first reported, the state of the sea, the current experienced, the occurrence of thunder and lightning, the bearing of lightning, the course and distance made by each ship *during the gale*, and various important remarks on the weather were extracted from the logs whenever recorded.

The district was divided into three strips, each containing ten degrees of longitude; all observations were grouped under the heads of outward and homeward bound gales in each strip.

The next process was to classify the gales according to their direction, and to compare those of a given direction for one strip with the similar gales in the other two, giving the separate results in a tabular form, unless there happened to be little or no difference shown between the strips, in which case the gales were only divided into those met with on the outward and those met with on the homeward passages.

Diagrams have been drawn to represent the mean data (see those for January on the left-hand side of Plate II.), whilst two or more individual gales of each type have been selected for representation as specimens. The “Exceptional gales” (Class V.) are each illustrated by a diagram.

BAROMETRIC PRESSURE AND WIND-SYSTEMS.

A reference to the diagrams on Plate II. shows that they represent various systems of barometric pressure and wind, and exhibit the relation which the one bears to the other in each kind of gale.

As allusion will be constantly made to these systems, sometimes as “wind-systems,” sometimes as “gale-systems,” it may be well to explain that all the winds which are experienced by a ship under the influence of an area of low barometric pressure, from the time that her barometer begins to fall on the one side to the time of its ceasing to rise on the other (*i.e.* all the winds along any line cutting an area of low barometric pressure), are spoken of as a wind-system, though, in fact, the entire circulation of air which is related to the area of low barometric pressure, and which is properly speaking its wind-system, does most probably comprise winds from other directions than those experienced by the ship in question.

On examining these systems it is found that ships generally experienced winds veering from N. to W. and S.W. The duration of the wind from any one quarter is much affected by local circumstances and by seasons; for instance, the winds which precede the gales are generally much more Westerly in the southern than in the northern part of the district, and in winter than in summer. The wind very often shifts quickly from N.E. to S.W., especially near the south-east coast of Africa.

It will frequently be noticed that there is but little difference in the *direction* of the various winds which are related respectively to N.W. and S.W. gale-systems, the chief difference being in the relative *forces* of those winds. With a N.W. gale the steepest

barometric gradient occurs as the barometer is falling, whilst with a S.W. gale it occurs with a rising barometer.*

Very frequently a gale begins at N.W. and veers to S.W. before it lulls; this of course shows that the gradient for the wind from each direction was steep enough to cause (or perhaps it would be more correct to say, to be related to) a gale as the gale-system passed over the ship. Such gales have been classed as North-westerly, because they commence from that quarter.

CORRESPONDENCE BETWEEN THE NORTH-WESTERLY GALES OF THE SOUTHERN HEMISPHERE AND THE SOUTH-WESTERLY GALES OF THE NORTHERN HEMISPHERE.

The North-westerly gales veering to S.W. of the S. temperate zone, correspond to the South-westerly gales veering to N.W. of the N. temperate zone. These veering winds are in fact respectively the prevailing winds of the two temperate zones, and in the southern, where there is less land than in the northern, they are more regular and lasting.

EUROPEAN GALES OFTEN RELATED TO RIDGES AND HOLLOWES OF BAROMETRIC PRESSURE MOVING TO THE EASTWARD.

Daily Weather Charts for Western Europe frequently show a long continuance of Westerly winds, which are apparently related to a number of ridges and hollows of barometric pressure moving in an easterly or north-easterly direction. As the eastern side of such a hollow passes over a place the wind is Southerly to South-westerly, with the passage of the lowest barometric pressure the wind veers more to the West, and with that of the western side of the hollow it veers to West or North-west, whilst after the ridge has passed the wind backs to W. or even to S.W. if another hollow is advancing. Of course the direction of the wind is modified by the direction in which the ridges and hollows extend, as the air has a slight tendency to flow from a ridge towards a hollow.

SOUTHERN HEMISPHERE GALES ALSO RELATED TO RIDGES AND HOLLOWES OF BAROMETRIC PRESSURE MOVING TO THE EASTWARD.

In the southern hemisphere, according to Buys Ballot's law, the higher barometer lies to the left of the observer when standing with his back to the wind; if the reader will bear this in mind when considering the gales about to be dealt with, he will find

* It may be well to explain that "barometric gradient" is the ratio between the difference of barometer readings at two stations, and the distance between those stations; for instance, with a westerly wind blowing in the Southern Hemisphere, the barometer at a given station will read higher than another which is placed 50 miles to the southward of that station, and the amount of difference will be in proportion to the force of the westerly wind.

It must be remembered that although the gradient due to the force of the wind blowing at the time affects the speed at which a ship's barometer falls, the fall in a given time is also affected by the speed at which the wind-system is travelling, and also by the ship's course and speed.

that the wind-systems of the southern hemisphere which commence at N. or N.W. and veer to S.W. are also probably related to ridges and hollows of atmospheric pressure which move to the eastward; the N. wind generally blowing as the barometer begins to fall, whilst the veering of the wind to W. or S.W. comes about the time of lowest barometric pressure, and as the barometer begins to rise.

The winds related to these ridges and hollows of barometric pressure remain Westerly throughout, though, as already remarked, they very generally veer from several points North of West to a few points South of West.

This fact, considered in connection with Buys Ballot's law, shows that barometric pressure in both ridge and hollow must decrease as the pole is approached. The district in the neighbourhood of the Cape of Good Hope, with which we are dealing, illustrates this fact. In it the prevailing wind is Westerly as ridges and hollows of barometric pressure pass over a ship, indicating that the lowest point of barometric pressure related to them does not generally lie within the district, but that the barometer reads lower as the latitude increases, at any rate down to 50° S. This fact shows that the laws laid down for handling ships in cyclones (which are supposed to be gale-systems related to approximately *circular* areas of low barometric pressure) do not apply to the gale systems which are related to the very differently shaped hollows of low pressure just alluded to. For instance, a ship on the eastern side of a cyclone in the southern hemisphere would have a Northerly wind, and would probably change that wind to North-east by running to the south; but a ship running to the south on the eastern side of a hollow of low pressure, which extended over many degrees of latitude in the southern hemisphere would not get a change of wind to North-east until she had passed to the southward of the hollow, when, as we have seen, she would generally be below 50° S. Though, in this case, running to the southward would not bring on a change to North-east, the quick eastward progress of the hollow of barometric pressure would soon cause the wind to veer to the North-westward, whether the ship ran to the southward or not. How far below 50° S. these ridges and hollows extend is not known, for observations are wanting to enable us to give an account of the way in which they terminate towards the south, *i.e.*, whether they sometimes reach the neighbourhood of the pole, or whether a point of lowest pressure exists from which the barometer begins to rise as the pole is approached. With such a rising barometer the wind would be Easterly, its force depending upon the barometric gradient.

On the July and August wind-charts for the Cape of Good Hope district there are indications of more Easterly wind in the southern part of the district than in other months, leading to the supposition that in those months a rising barometer might be met with as the pole was approached, and the observations of Her Majesty's ships "Erebus" and "Terror" under Sir James Ross show that similar conditions are found in the months of January and February, but in a higher latitude, for these indicate that the lowest barometer was met with between 70° and 75° S., the mean reading increasing as the ship passed further to the Southward.

In many cases the daily weather charts of Europe represent *light* Easterly winds at the northern ends of hollows of low pressure, when at their southern ends there are strong Westerly *gales*, showing that when the point of lowest barometric pressure is passed, and Easterly winds have set in, the gradient for those winds is but slight (*i.e.*, the rise of the barometer as the pole is approached is but gradual). This is another important difference between the elongated areas of low pressure, and a cyclone which has strong gales on all sides of its area of low barometric pressure.

Cyclones are, however, sometimes experienced in high latitudes, and will be alluded to when speaking of "Exceptional Gales."

Diagram (a) is an attempt to illustrate these ridges and hollows of barometric pressure and their corresponding winds. The southern parts of the ridges and hollows are not completed, because, as already stated, the tracks of ships do not lie far enough to the southward to enable us to decide on the usual shape of the areas of *lowest* pressure related to them. By supposing the tracks of these ridges and hollows to lie in any other direction than that indicated by the long arrows, such as towards the S.E. or N.E., it will be seen that the direction of their winds will have a corresponding modification.

It has already been stated that these ridges and hollows of barometric pressure seem to advance at a rate of nearly 30 miles an hour judging from the few cases available for calculating the time which they take in passing from one ship to another.

The cause of their movement has still to be discovered.

DIAGRAM (a).—SHOWING UNDULATIONS OF PRESSURE AND THEIR ACCOMPANYING WINDS FOR THE SOUTHERN HEMISPHERE.

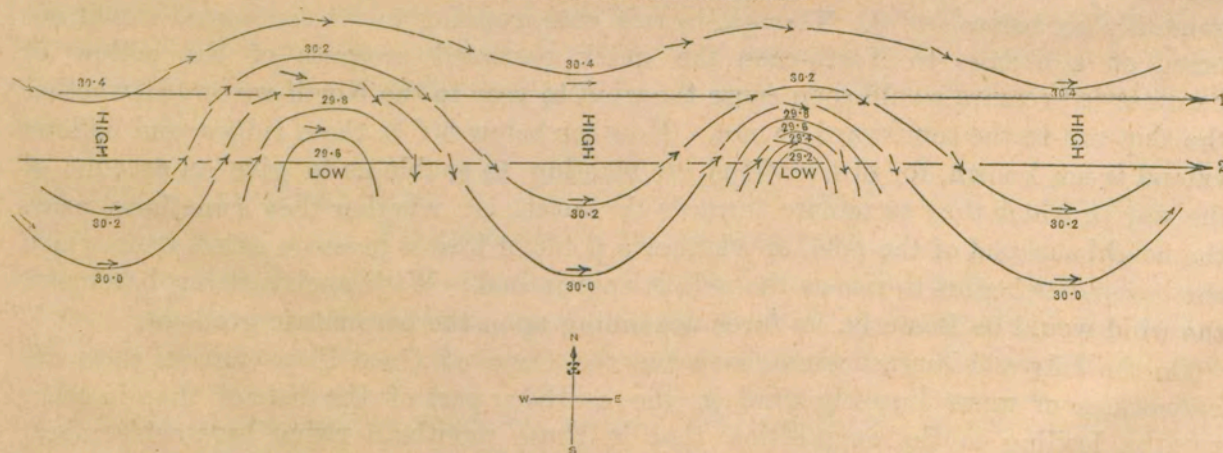


Diagram (a) illustrates what appears to be the ordinary state of barometric pressure, and the relative direction of wind in high southern latitudes. If the reader will imagine a ship to be stationary, whilst a series of wind-systems pass over her, similar to the two which are represented on the diagram and moving in the direction of the long arrows, he will see how the isobars, or lines of equal barometric pressure,

and wind-arrows will explain the changes of barometer and wind in some of the gales about to be discussed; the track of the northern arrow (No. 1) having less range in the barometer and in the direction of wind than that of the southern one (No. 2).

RELATION OF BAROMETRIC PRESSURE TO EXCEPTIONAL GALES AND THEIR TRACKS.

In some gales the wind-changes do not follow the general rule above alluded to, viz., shifting from N. through N.W. to W. or S.W. Such cases have been considered as "Exceptional," and are discussed individually, though grouped according to their similarity to known types of gales or to each other.

Here it may be well to remark that all winds which are related to areas of low barometric pressure are spoken of as "cyclonic," whatever the shape of the area of low pressure may be, but the term "cyclone" is generally confined to gales which are related to approximately circular areas of low pressure in which winds having the force of a gale blow from all points of the compass.

It is probable that some of the exceptional gales dealt with in this report were cyclones, and the following diagram has been used to illustrate them.

DIAGRAM (b).—SHOWING CYCLONIC WIND FOR THE SOUTHERN HEMISPHERE.

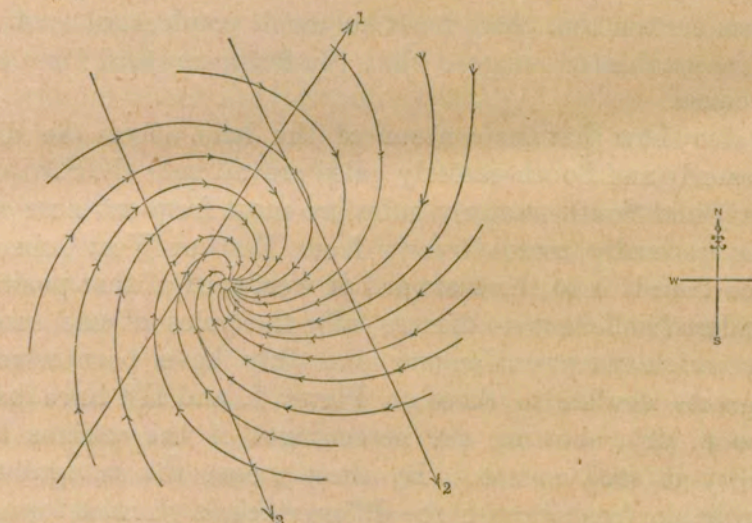


Diagram (b) is a modification of a similar diagram in Mr. Meldrum's paper "On the Form of Cyclones in the Southern Indian Ocean." It illustrates the action of wind in the cyclonic systems of the southern hemisphere, and will be referred to when endeavouring to explain some of the changes of wind and also of barometric pressure in the exceptional gales; it is supposed that the lowest barometric pressure is at the centre of the vortex. The long arrows indicate possible tracks in which such a cyclonic system may move, and the arrow-heads on the curves show the several changes of wind which a ship would experience, if such cyclonic systems passed over her on the tracks indicated.

Further research will most probably much improve our knowledge on this subject, but it is hoped that in as far as the facts are at present known, diagrams (a) and (b) will help the reader to understand the changes of wind and barometric pressure in the wind-systems of the South Temperate Zone.

INFLUENCE OF THE MEETING OF HOT AND COLD WATER ON THE NUMBER, AND OF THE
CONTOUR OF THE LAND ON THE DIRECTION OF GALES.

Before proceeding to consider the diagrams individually, it will be well to remark on the general disposition of the various gales represented on Plates I. and III. for January, and on the corresponding Plates for other months.

If a straight line be drawn along the coast-line of the south-eastern part of Africa and produced to the south-westward, it will be seen that most of the heavy gales are met with in its neighbourhood. By referring to the Current and Sea-temperature Charts just published, it will be seen that this line follows the course of the Agulhas current, by which a large body of warm water from the Indian Ocean is brought into close contact with cold water lying on the Agulhas Bank, and with other cold water to the southward of it, causing a difference of from 15° to 20° in the temperature of neighbouring waters, and a corresponding difference in the temperature of the air. It is, therefore, certain that there must be much condensation of vapour in this region, and it is reasonable to suppose that the frequency and force of the gales is partly due to this cause.

These diagrams also show that the contour of the land affects the direction of the gales, for North-westerly and South-easterly gales prevail near the S.W. coast of Africa, whilst North-easterly and South-westerly gales are most frequent near its S.E. coast. Again, the wind is generally more directly from East or West immediately to the southward of Africa than it is to the eastward or westward of that position.

It has been considered sufficient to discuss *fully* the gales of one summer and one winter month, for which purpose January and July have been selected. For the other months diagrams similar to those on Plates I. and III. have been given, and also Table 25 (see p. 98), showing the percentages of the various kinds of gales, and their probability in each month. By these means the navigator can discover the position and probable frequency of the different kinds of gales for a given month; and by referring to the full discussion of similar gales in the month of January or July he will be able to form a correct idea of the changes of the barometer and wind in such gales.

As it may be convenient to consult the account of gales of any particular class without referring to the discussion of gales of another class, it has been thought well in some cases to repeat remarks which might otherwise have been only once made.

B.
GALES OF JANUARY.

B i.
CLASS I.—NORTH-WESTERLY GALES.

Having given a general view of the character of the data we have to deal with, and stated the broad facts at present known respecting the gales of the Cape District, we are in a position to consider each type of gale separately, commencing with those from the north-westward in January.

The Introductory Remarks have explained that all gales which blow from N.W., even though some may veer to S.W., have been classified as North-westerly. It has also been stated that most of the North-westerly and South-westerly gales are related to systems of barometric pressure and wind having the same general character, the chief difference being that with a mere South-westerly gale the preceding North-westerly wind does not attain the force of a gale.

PLATE I., DIAGRAM 1.

This diagram represents all the North-westerly gales recorded in January; a line has been drawn separating those experienced by outward and homeward-bound ships; all arrows above this line show the North-westerly gales experienced by homeward-bounders, whilst those below it represent those experienced by outward-bounders. The head of each arrow shows the position in which the *extreme* force of its respective gale *commenced*, and it flies with the wind, showing the direction at the time of that extreme force. What the extreme force was is shown by the character of the arrow. Further explanations are given on the lower part of Plate I.

It will be seen that in some cases the extreme force was from a point to the southward of W., although the gale had commenced from the North-westward.

NORTH-WESTERLY GALES,—OUTWARD BOUND.

PLATE II., DIAGRAM 2.*

This diagram represents the *mean* data of 13 North-westerly gales experienced by outward-bound ships in January. Although a general explanation of Plate II. is

* Diagram 2 is described before Diagram 1 because it relates to outward-bounders, which naturally come first in the order of discussion, though the more southerly position of the track of outward-bounders requires that their diagrams should be below those of homeward-bounders, so that they may correspond in position with the arrows representing them on Plate I.

given on the margin of Plate I., it may be well to say a few words on the subject with the first reference to these diagrams.*

Diagram 2 represents the mean of the times when the different parts of each gale occurred, and also the following data:—†

- A (Anterior): The mean of the highest barometric readings which immediately preceded the gale.‡
- B (Beginning): The mean of the barometric readings, also the mean wind direction and force when the gales (force 8) began.
- C (Climax): The same, when the extreme force began.
- D (Depression): The same, when the lowest pressures occurred.
- E (End): The same, when the gale ended.
- F (Following): The mean of the highest barometric readings which immediately followed the gale.

The wind-rose on the *left* side of the diagram gives the percentages of the various winds which blew during the period from A to B.

The wind-rose on the *right* side of the diagram gives the percentages of the various winds which blew during the period from E to F.

When calms and variable winds were experienced, the observations of them have been combined, and the percentage of the sum is given in the central part of the wind-rose.

The direction in which the wind generally veers is shown by a small arrow in the wind-rose.

Below the diagram is given the order of occurrence of the various parts of the gales which are represented by B, C, and D.

With the object of discovering any difference depending on longitude, the data were separately meaned for each strip of 10° of longitude, and the following table shows the results:—

TABLE I.

Position.	Number of Gales.	Mean Duration of				Mean Distance made by Ships during Gales (B to E).	
		Preceding Winds,	Gales,	Following Winds,	Systems,		
		or Period from					
		A to B.	B to E.	E to F.	A to F.		
Between 10° and 20° E.	7	Hours. 18	Hours. 27	Hours. 29	Hours. 74	Miles. 228	Miles per Hour. = 8.4
„ 20° and 30° E.	5	23	43	21	57	328	= 7.6
„ 30° and 40° E.	1	25	14	33	72	118	= 8.4
General Mean, as shown by Diagram 2 }	—	21	32	26	79	258	= 8.0

* The method employed on Plate II. for representing the force of the wind by dashes and dots is fully explained on the margin of Plate I.; it was devised by Lieutenant C. W. Baillie, R.N., as more suitable for a diagram on a small scale than the ordinary feathered arrows.

† The hour scale is at the upper and lower margins of the Plate. The days during which the gale-systems lasted are given at the upper parts of their diagrams.

‡ The barometer scale is given along each margin of the Plate.

WINDS PRECEDING NORTH-WESTERLY GALES,—OUTWARD BOUND.

Table 1 shows that the mean duration of winds preceding North-westerly gales (A to B) was 21 hours; it also shows that this duration was longer between 20° and 40° E. than between 10° and 20° E.

A wind-rose has been drawn for each strip of 10° of longitude, though not reproduced; comparison of these wind-roses shows that the preceding winds were more Westerly between 20° and 30° E. than in the other strips; in fact none of the Northerly winds represented in the wind-rose on the left of Diagram 2, Plate II. (which relates to the whole thirty degrees of longitude), were experienced between 20° and 30° E.

DURATION, &C. OF NORTH-WESTERLY GALES,—OUTWARD BOUND.

Table 1 shows that the mean duration of North-westerly gales experienced by outward-bounders (B to E) was 32 hours; the table also shows that they lasted much longer between 20° and 30° E. than in either of the other strips of longitude; the shortest in the district lasted 6 hours, the longest 82 hours.

In considering the duration, it must be remembered that the ships experiencing the gales were moving to the eastward at an average speed of 8 miles an hour, and as the systems to which they are related seem to have been also moving to the eastward, it is reasonable to suppose that the gales experienced by outward-bounders lasted longer with them than they would have done had the ships not been moving, or had they been sailing to the westward.

As Diagram 2, Plate II., only represents *mean* results, the order in which the commencements of the gales (B), and of their extreme forces (C), occurred in relation to their times of lowest barometric pressure (D), has been given, at the foot of the diagram. This footnote shows that most of these gales had not only commenced, but had reached their extreme force before the lowest barometer reading was recorded.

The following table (2) gives the particulars of wind-direction during these gales, and shows that they veered more to the Southward in the central and eastern than in the western part of the district:—

TABLE 2.

Position.	Number of Gales.	Gales North-westerly throughout.	Mean Direction.	Gales which veered to the South-westward.*	Mean Amount of Veering.
Between 10° and 20° E.	7	2	N.W.	5	N.W., to W.S.W.
„ 20° and 30° E.	5	1	N.W. by W.	4	N.W. by W., to S.W. ½ W.
„ 30° and 40° E.	1	—	—	1	N.W., to S.W.
Total - -	13	3	—	10	

* In nearly all cases the wind veers to the Southward of West after a North-west gale, but sometimes the South-westerly wind does not attain the force of a gale.

WINDS FOLLOWING NORTH-WESTERLY GALES,—OUTWARD BOUND.

Table 1 (p. 12) shows that the mean duration of winds following North-westerly gales experienced by outward-bounders (E to F) was 26 hours; it also shows that between 20° and 30° E. on the mean only 21 hours elapsed between the end of the gale and the following high barometer.

The wind-rose on the right side of Diagram 2, Plate II., represents the percentages of these winds from the various points of the compass. There is but little difference, depending on longitude, in their directions.

SPECIMEN DIAGRAMS OF NORTH-WESTERLY GALES,—OUTWARD BOUND.

Diagrams 2A and 2B, Plate II., have been selected as specimens of the North-westerly gales experienced by outward-bounders; they represent the data of the two gales having arrows on Diagram 1, Plate I., respectively in about 41½° S., 14° E. and 49½° S., 23° E.; both attained the force of 11, and may be considered as typical heavy North-westerly gales.

In the early part of the system of Diagram 2B a check in the fall of the barometer is shown, and a corresponding veering of the wind, which backed as the barometer began to fall again. Such oscillations are frequently met with. This was the longest North-westerly gale experienced by an outward-bounder, it was also the most southern in position. The quotations from logs given with these diagrams render further explanation unnecessary.

Similar diagrams have been drawn to represent the data of each North-westerly gale. It has not been considered necessary to publish all these diagrams, but it will be well to give a few general remarks derived from a study of them.

Referring to Diagram 1, Plate I., it will be seen that, between 10° and 20° E., the North-westerly gales experienced by outward-bound ships were met with between 40° and 43° S., and that the heaviest blew in the northern part of that zone, whereas the longest was the most southern in position. Diagram 2A, Plate II., represents the heaviest of these gales.

Diagram 1, Plate I., also shows that, between 20° and 30° E., the North-westerly gales experienced by outward-bound ships were met with between 36° and 50° S.

The most northern of these gales is shown to have been very near the Agulhas Bank, it blew for 12 hours from W.N.W. to W. by S., and then shifted rather suddenly to S.S.W., having its extreme force from S. by W.; lightning in the S.S.W. preceded the change of wind to that quarter.

Another of these gales, represented by the arrow in about 48° S. and 21° E., was preceded by a fast-falling barometer with a moderate North-westerly wind; the gale commenced from W.N.W. at the time of lowest barometric reading, veering quickly to

W. by S. from which quarter it blew until the end. The barometer fell to 28·90, and rose very quickly as the gale progressed; the squalls were extremely heavy. The same gale was experienced by another ship, which was rather more than a degree further north, and about eight degrees further east. She got the beginning and end of the gale about four hours later than the more western ship; her barometer at the time of lowest reading was about 0·2 of an inch higher, and rose much more slowly; with her the extreme force only amounted to 8, and was from W.N.W.; whereas the ship to the south-westward of her, which experienced the same gale, had an extreme force of 10 from W. by S.

Hence the westerly ship experienced the gale first, and the northerly ship had it from a more Northerly direction and of less force than the southerly one. With both the gale lasted 12 hours. Some of these facts seem to be fairly represented by the differences of barometric pressure and wind shown along the arrows 1 and 2 of Diagram (a), p. 8.

The only North-westerly gale experienced by an outward-bounder between 30° and 40° E. was remarkable in its having ended before the lowest barometric reading occurred, and in its having been followed by a light Westerly wind accompanied by a slowly rising barometer. Three of the other North-westerly gales experienced by outward-bounders ended before or at the time of lowest barometer reading, and all were followed by a slowly rising barometer and moderate to light Westerly winds.

The logs of both outward and homeward-bound ships show that as the lowest barometric pressure approaches, heavy rain frequently sets in, which is a pretty sure sign that the wind is about to veer suddenly to W. or S.W., accompanied by a quick rise in the barometer, and possibly by an increase in the force of the wind.

NORTH-WESTERLY GALES,—HOMEWARD BOUND.

PLATE II., DIAGRAM 1.

This diagram represents the *mean* data of nine North-westerly gales experienced by homeward-bounders in January.* The geographical positions where their extreme forces commenced are shown by the arrows above the dividing line on Diagram 1, Plate I. As in the case of the outward-bound North-westerly gales, the data have been separately meaned for each strip of 10° of longitude, and the following table (3) shows the results:—

* The mean wind at the time of lowest pressure (D) is deduced from only eight cases, as in one there was a calm at that time.

TABLE 3.

Position.	Number of Gales.	Mean Duration of				Mean Distance made by Ships during Gales (B to E).	
		Preceding Winds,	Gales,	Following Winds,	Systems,		
		or Period from					
		A to B.	B to E.	E to F.	A to F.		
Between 10° and 20° E.	4	Hours. 44	Hours. 12	Hours. 19	Hours. 75	Miles. 22	Miles per Hour. 1.8
„ 20° and 30° E.	5	35	11	20	66	40	= 3.6
„ 30° and 40° E.	—	—	—	—	—	—	—
General Mean, as } shown by Diagram 1.	—	39	12	20	71	32	= 2.7

WINDS PRECEDING NORTH-WESTERLY GALES,—HOMEWARD BOUND.

Table 3 shows that the mean duration of winds preceding North-westerly gales experienced by homeward-bounders (A to B) was 39 hours. The wind-rose on the left side of Diagram 1, Plate II., shows that a large percentage of these winds were Easterly, whereas with outward-bounders they were nearly all Westerly.

DURATION, &c. OF NORTH-WESTERLY GALES,—HOMEWARD BOUND.

Table 3 shows that the mean duration of North-westerly gales experienced by homeward-bounders (B to E) was only 12 hours; the table also shows that this duration was nearly the same in the two 10° strips in which the gales were experienced. The shortest gale lasted 3, the longest 22 hours.

The footnote to Diagram 1, Plate II., shows that in four of the nine cases the lowest barometer reading occurred before the gales commenced, whilst with outward-bounders no such case occurred.

The following table (4) gives the particulars of wind-direction during the gales, and shows that they were more Westerly in direction and veered a point further to the Southward in the central part than on the western side of the district:—

TABLE 4.

Position.	Number of Gales.	Gales North-Westerly throughout.	Mean Direction.	Gales which veered to the South-Westward.	Mean Amount of Veering.
Between 10° and 20° E.	4	1	W.N.W.	3	N.W. by W., to S.W. by W.
„ 20° and 30° E.	5	3	all W. by N.	2	both W. by N., to S.W.
„ 30° and 40° E.	—	—	—	—	—
Total	9	4	—	5	—

WINDS FOLLOWING NORTH-WESTERLY GALES,—HOMEWARD BOUND.

Table 3 shows that the mean duration of winds following the North-westerly gales experienced by homeward-bounders (E to F) was 20 hours; the table also shows that it was nearly the same in both the ten-degree strips.

The wind-rose on the right side of Diagram 1, Plate II., shows that nearly all the winds following the gales were from W. to S.W., indicating that the barometer generally ceases rising before the Easterly winds which *precede* the gales have set in.

SPECIMEN DIAGRAMS OF NORTH-WESTERLY GALES,—HOMEWARD BOUND.

Diagram 1A, Plate II., represents the heavy gale which has its position shown by an arrow in about 35½° S. and 18½° E. on Diagram 1, Plate I.; it was remarkable in having been preceded by three days of Easterly wind which changed suddenly to W. by N., accompanied by a sharp but short rise in the barometer, before the gale commenced.

Diagram 1B represents the gale which is shown by an arrow in about 36° S. and 24½° E., on Diagram 1, Plate I.; it is a typical veering North-westerly gale.

Similar diagrams have been drawn to represent the data of each homeward-bound North-westerly gale; the following remarks which refer to Diagram 1, Plate I., have been derived from them.

The gale indicated by the most northern arrow between 10° and 20° E. came on very suddenly; it was preceded by another North-westerly gale, after which the barometer had only just ceased rising when it commenced to fall for this wind.

Another gale shown by the arrow in about 35° S. 19° E. was remarkable in having had a brisk rise in the barometer accompanied by a moderate North-westerly wind before the gale set in.

The heavy gale shown by an arrow in about 36° S. 22° E. was preceded by a light South-easterly wind with lightning in the N.W. eight hours before the North-westerly gale set in. The barometer had been nearly steady at about 29.74 in. for two days before the gale; at the time of lowest barometric pressure the wind was flying round the compass and sometimes calm; as the barometer rose a W.N.W. wind set in, which freshened to a gale, and soon veered to S.W. with a fast-rising barometer.

COMPARISON OF OUTWARD AND HOMEWARD-BOUND NORTH-WESTERLY GALES.

By comparing Tables 1 and 3 (pp. 12 and 16) it will be seen that the systems of barometric pressure (A to F) which are related to outward-bound North-westerly gales extend

over a mean period of 79 hours, which is eight hours longer than that of homeward-bounders. As there is good evidence that these systems are generally moving quickly to the eastward, and it is shown that outward-bounders average about 8 miles an hour in the same direction, it is reasonable to suppose that they would keep longer under the influence of a given system than homeward-bounders which during a Westerly gale are comparatively stationary, or move only slowly to the westward.

A further comparison, however, shows that there are more important differences, for the preceding winds experienced by outward-bounders are Westerly in direction, whereas those experienced by homeward-bounders are partly Easterly and last nearly twice as long as those of outward-bounders. Again, the North-westerly *gales* met with by outward-bounders last nearly three times as long as those met with by homeward-bounders, and their following winds are on an average six hours longer. These facts seem to show that in January (the southern summer), when Easterly winds prevail near the S. African land, North-westerly gales are much more decided in the higher latitudes, which are frequented by outward-bounders, than in the track of homeward-bounders, which lies near the coast.

The "Order of changes in the Gales" given below Diagrams 1 and 2, Plate II., shows that with outward-bounders all the North-westerly gales commenced before the time of lowest barometric reading except in the case of one which commenced at that time.

With homeward-bounders the gales most frequently commenced after the barometer had begun to rise; in fact the North-westerly gales of January experienced by homeward-bounders were more Westerly in direction than those met with by outward-bounders, and partook more of the nature of South-westerly gales, which almost always commence after the lowest barometric reading has occurred. This difference between North-westerly gales met with by outward and homeward-bounders in January does not exist in July (the southern winter), when Westerly winds extend further north than in summer.

Diagram (a), p. 8, shows how the lowest barometric pressure is likely to have passed when a North-west wind veers to W. or S.W.

Arrow 2 on Diagram (b), p. 9, shows that in the case of an area of low pressure moving to the south-eastward, the lowest pressure is likely to have passed when a North wind veers to N.W.

BAROMETER.

By comparing Diagrams 1 and 2, Plate II., it will be seen that with outward-bounders the mean lowest barometric reading (D) was about 29.41 ins., whilst with homeward-bounders it was only 29.68 ins., showing a difference of 0.27 in. This difference seems to be related to the fact that the prevailing wind was Westerly and that in the Southern Hemisphere with a Westerly wind the barometer is higher to the

northward than to the southward of a given position. There is a difference of about six and a half degrees between the mean latitudes in which the outward and homeward-bound North-westerly gales were met with.

On examining the diagrams of individual gales it is found that with outward-bounders a gale of force 10 may be accompanied by a barometer at 29 inches or even lower,* whilst with homeward-bounders the same force is sometimes experienced with the barometer at 29.6 or 29.7 ins. This fact should be borne in mind by the navigator, who should not give too much weight to the very low barometer readings in high southern latitudes nor too little to the higher readings experienced further to the northward. It will be seen that during the severe gales of July (the southern winter) the barometer is generally higher than during those of January.

GEOGRAPHICAL DISTRIBUTION OF NORTH-WESTERLY GALES.

Diagram 1, Plate I., shows that in the cases of both outward and homeward-bounders nearly all North-westerly gales were experienced in the western half of the district. This is generally the case on the *homeward* passage where the trend of the land seems to affect the direction of the wind. In other months N.W. gales are pretty uniformly spread along the *outward* route.

LIGHTNING.

Lightning was only recorded during three North-westerly gales in January, and these were all experienced between 20° and 30° E.; two of these blew near the Agulhas Bank and one in about 41° S.

It was seen in the N.W., once after the gale was over, and once ten hours before it commenced.

Once it was seen in the S.W. and S. ten hours before the gale shifted from W. to S.S.W.

Hence we may conclude that lightning is not frequent with North-westerly gales in January, but in two of the three cases when it was seen, it indicated the direction from which the gale was coming.

WEATHER.

The North-westerly gales experienced by both outward and homeward-bounders were sometimes accompanied by very heavy squalls; twice they were reported by outward-bounders as "tremendous," or "with hurricane force."

* The three North-westerly gales experienced by outward-bounders which were met with in the highest latitudes were each accompanied by a barometric reading of about 29 inches or lower.

SEA.

The sea was sometimes “tremendous,” or “fearfully heavy”; in the case of one homeward-bound gale it was “fearfully heavy” from S.W. twenty hours before the North-westerly gale set in.

TABLE 9.

Table 9, p. 50, gives a comparative summary of the principal facts relating to the January gales, and provides the means for comparing the data of various kinds of gales.

B ii.

CLASS II.—SOUTH-WESTERLY GALES.

PLATE I., DIAGRAM 2.

The arrows on this diagram represent the position of the ship, the extreme force of the wind, and its direction at the time when the extreme force commenced, for each South-westerly gale experienced in January.

The arrows below the dividing line are those of South-westerly gales met with by outward-bounders.

SOUTH-WESTERLY GALES,—OUTWARD BOUND.

PLATE II., DIAGRAM 4.

This diagram represents the *mean* data of seven South-westerly gales experienced by outward-bounders in January. As with North-westerly gales, the data have been separately meaned for each strip of 10° of longitude, and the following table (5) shows the results :—

TABLE 5.

Position.	Number of Gales.	Mean Duration of				Mean Distance made by Ships during Gales (B to E).	
		Preceding Winds,	Gales,	Following Winds,	Systems,		
		or Period from					
		A to B.	B to E.	E to F.	A to F.		
Between 10° and 20° E.	2	Hours. 35	H ours. 28½	Hours. 28½	Hours. 92	Miles. 290	Miles per Hour. = 10·0
„ 20° and 30° E.	4	45	24	37	106	247	= 10·3
„ 30° and 40° E.	1	112	26	50	188	280	= 10·8
General Mean, as shown by Diagram 4 }	—	52	26	36	114	264	= 10·2

WINDS PRECEDING SOUTH-WESTERLY GALES,—OUTWARD BOUND.

Table 5 shows that the mean duration of winds preceding the South-westerly gales experienced by outward-bounders (A to B) was 52 hours. Table 1 shows that the preceding winds of outward-bound North-westerly gales only lasted 21 hours; a comparison of Diagrams 2 and 4, Plate II., will show that the great cause of this difference is due to the fact that with North-westerly gales the beginning of the gale (B) occurs in the early part of the system when the barometer is falling, whilst with South-westerly gales it generally occurs some time after the lowest pressure has passed over the ship.

The wind-rose on the left side of Diagram 4, Plate II., gives the percentages of the various preceding winds. An examination of the diagram of each gale shows that the preceding winds were more Westerly on the western than on the eastern side of the district, and that the two gales having the most eastern positions were preceded by nearly all the North-easterly winds shown in the wind-rose.

DURATION, &c. OF SOUTH-WESTERLY GALES,—OUTWARD BOUND.

Table 5 shows that the mean duration of South-westerly gales experienced by outward-bounders (B to E) was 26 hours; it also shows but little difference in the three strips of longitude. The shortest lasted 8, and the longest 38 hours.

In nearly all cases the wind only veered from about W.S.W. to S.W. by W. during the gales, but in one, which is represented by Diagram 4B, Plate II., it veered from W.S.W. to S.S.E.

The footnote to Diagram 4, Plate II., shows that in nearly all cases the lowest barometric reading occurred before the gale commenced.

WINDS FOLLOWING SOUTH-WESTERLY GALES,—OUTWARD BOUND.

Table 5 shows that the mean duration of winds following South-westerly gales experienced by outward-bounders (E to F) was 36 hours. On comparing the data for each system this is found to be a fair mean for the whole.

The average direction of these winds is fairly represented by the wind-rose on the right-hand side of Diagram 4, Plate II. It shows that the wind seldom veers to the Eastward of South with the rising barometer which follows the South-westerly gales met with by outward-bounders.

SPECIMEN DIAGRAMS OF SOUTH-WESTERLY GALES,—OUTWARD BOUND.

Diagram 4A, Plate II., represents the data of the gale which has an arrow in about 45° S. 12° E. on Diagram 2, Plate I.

The same gale was experienced by another ship which was about $2\frac{1}{4}^{\circ}$ further to the northward and 4° further to the westward. This ship got the wind-changes about six hours earlier than the more easterly one, which seems to show that the system was moving to the eastward at a speed of about 30 miles per hour. She also had the barometer at the time of lowest pressure about a tenth of an inch higher, and had a much shorter gale than that represented by Diagram 4A. In other ways the diagrams resembled each other. Here the westerly ship got the gale first, whilst the southerly ship had a lower barometer and much longer gale than the northerly one.

Diagram 4B, Plate II., represents the data of the gale having the most south-eastern position between 20° and 30° E. on Diagram 2, Plate I. It is remarkable in showing a very quick rise in the barometer, and that the wind veered to S.S.E. before the gale ended.

Diagrams of the other five South-westerly gales met with by outward-bounders have been drawn though not published; most of them resemble Diagram 4A, Plate II., but the gale experienced in about $44\frac{1}{2}^{\circ}$ S. 21° E. was remarkable in having had a rather quick veering of the wind from N. to W. about the time of lowest pressure and before the gale came on. As the barometer rose the gale commenced from W. and only veered a point to the Southward of W. as it ended.

The only South-westerly gale experienced by outward-bounders between 30° and 40° E. was preceded by a moderate North-easterly wind for nearly two days, after which the wind backed quickly through E. to S.W. several hours before the lowest barometric reading occurred. When the barometer commenced to rise the S.W. wind freshened to a gale. Before the wind changed to S.W. a dense black cloud rose in that quarter. The wind was gusty and "made a peculiar noise."

SOUTH-WESTERLY GALES,—HOMEWARD BOUND.

PLATE II., DIAGRAM 3.

This diagram represents the *mean* data of 22 South-westerly gales experienced by homeward-bounders in January. The geographical positions in which their extreme forces commenced are shown on Diagram 2, Plate I., by the arrows above the line dividing the gales met with by outward and homeward-bound ships. The winds at the 22 times of lowest pressure (D) varied so much that it is not possible to represent the mean direction by an arrow in the diagram; there were, however, 54 per cent. of Westerly or South-westerly winds recorded, and in half of these cases the wind attained the force of a gale.

The following table (6) shows mean results for each strip of 10° of longitude:—

TABLE 6.

Position.	Number of Gales.	Mean Duration of				Mean Distance made by Ships during Gales (B to E).	
		Preceding Winds,	Gales,	Following Winds,	Systems,		
		or Period from					
		A to B.	B to E.	E to F.	A to F.		
Between 10° and 20° E.	3	Hours. 74	Hours. 12	Hours. 12	Hours. 98	Miles. 130	Miles per Hour. = 10.8*
„ 20° and 30° E.	16	47	21	17	85	34	= 1.6
„ 30° and 40° E.	3	49	20	31	100	46	= 2.3
General Mean as shown by Diagram 3 }	—	51	19½	18	88½	49	= 2.5

WINDS PRECEDING SOUTH-WESTERLY GALES,—HOMEWARD BOUND.

Table 6 shows that the mean duration of winds preceding the South-westerly gales experienced by homeward-bounders (A to B) was 51 hours. The table also shows that between 10° and 20° E. this duration amounted to 74 hours, and the individual diagrams show that it was the same for each of the three gales experienced there. The wind-rose on the left side of Diagram 3, Plate II., shows that the direction of these preceding winds was chiefly Easterly, and a comparison of the individual diagrams shows that there was more Easterly and North-easterly wind preceding the gales which blew between 10° and 20° E. than elsewhere. We may therefore conclude that between 10° and 20° E. in January, the preceding winds last longer and are more Easterly than in the other parts of the district, whilst it will be seen by the table that the South-westerly gales and their following winds are shorter there.†

It has already been remarked that South-westerly gales have more hours of preceding winds than North-westerly, because they generally commence after the barometer has begun to rise, instead of with the falling barometer, as is the case with most North-westerly gales.

DURATION, &c. OF SOUTH-WESTERLY GALES,—HOMEWARD BOUND.

Table 6 shows that the mean duration of South-westerly gales experienced by homeward-bounders (B to E) was 19½ hours. The table also shows that these gales were

* The greater speed between 10° and 20° E. is accounted for by the fact that a South-westerly wind there is fair for homeward-bounders steering to the N.W.

† It should be remembered that N.E. or Easterly winds are favourable for sailing to the westward, so that when they preceded South-westerly gales (which was generally the case with homeward-bound ships) they blew over a part of the sea which extended several degrees to the north-eastward or eastward of the arrow showing where the extreme force of the S.W. gale commenced.

much shorter between 10° and 20° E. than in the remainder of the district. The shortest in the district lasted 4 hours, it was in about 34½° S. 17½° E.; the longest lasted 64 hours, and was in about 35¾° S. 22° E.

The following table gives the particulars as to direction of wind during the gales :—

TABLE 7.

Position.	No. of Gales.	Not changing.		Veering.		Backing.		Veering and Backing.	
		No.	Mean Direction.	No.	Mean Amount.	No.	Mean Amount.	No.	Mean Direction.
10° to 20° E.	3	2	S.S.W.	1	W., to W.S.W.	—	—	—	—
25° to 30° E.	16	5	S.W. by W.	8	W.S.W., to S.S.W.	2	S.W. by S., to W. by S.	1	S.W. by W.
30° to 40° E.	3	—	—	2	W.S.W., to S.S.W.½ W.	1	S.S.W., to S.W.	—	—
Total	22	7	—	11	—	3	—	1	—

This table shows that half the gales veered three or four points to the Southward.

WINDS FOLLOWING SOUTH-WESTERLY GALES,—HOMEWARD BOUND.

Table 6 shows that the mean duration of winds following the South-westerly gales experienced by homeward-bounders (E to F) was 18 hours; also that it increases as you pass from West to East.

The average direction of these winds is fairly represented by the wind-rose on the right side of Diagram 3, Plate II. The chief difference being that there was a smaller percentage of Southerly and South-easterly; but a larger percentage of South-westerly winds between 20° and 30° E. than in either of the other two strips.

SPECIMEN DIAGRAMS OF SOUTH-WESTERLY GALES,—HOMEWARD BOUND.

Diagram 3A, Plate II., represents the data of the gale having the most north-eastern position between 20° and 30° E. on Diagram 2, Plate I.; 14 of the 22 South-westerly gales experienced by homeward-bounders resembled this one in having had a falling barometer with a North-easterly or Easterly wind, and in the wind having veered quickly to S.W. about the time of lowest barometric pressure: sometimes the wind flew from one direction to the other in a few minutes. Diagram 2, Plate III., shows that there were several exceptional gales near the S.E. coast of Africa, in which a North-easterly gale changed quickly into a South-westerly gale. The chief difference between these exceptional gales and Diagram 3A is that with the exceptional gales the North-easterly as well as the South-westerly wind attained the force of a gale.

The action of barometer and wind in these gales seem to be fairly accounted for by supposing that the prevailing North-easterly winds near the S.E. coast of Africa are interfered with by areas of low barometric pressure travelling to the eastward. Such

areas have a Northerly wind on their eastern, and a Southerly wind on their western sides, as illustrated by Diagram (a), p. 8.

Diagram 3B, Plate II., represents the data of a heavy gale which blew near the southern edge of the Agulhas Bank (see its arrow in about 22° E. on Plate I., Diagram 2). It was one of those persistent Westerly gales which are so common on the south-eastern edge of the Agulhas Bank, though more especially during the southern winter. It will be seen that after the barometer had begun to rise at the beginning of the South-westerly gale, the rising was checked and the wind backed to W. with a falling barometer, the final rise taking place as the gale veered to S.W. The diagram shows that this gale was also preceded by a North-easterly wind, and that it changed from the North-eastward to the South-westward in a few hours.

Similar diagrams have been drawn for the other 20 South-westerly gales, from which the following remarks have been derived:—

It has already been stated that—

14 of the 22 gales resembled Diagram 3A; we now add that—

- 4 „ „ had Southerly winds with the falling barometer;
- 2 „ „ had preceding Easterly winds, which backed through S.E. to S.W.
Such changes in wind and barometer would be experienced by a ship over which passed a wind-system similar to that of Diagram (b), p. 9, on a track represented by its arrow No. 3.
- 1 „ „ was preceded by Westerly winds and calms;
- 1 „ „ was preceded by winds varying from S. to E., then from S. to W.
It was the most northern in position between 10° and 20° E., where the ship was approaching the S.E. Trades.

Reference will now be made to some of the more important of these gales.

The arrow in about $34\frac{1}{2}^{\circ}$ S. $17\frac{1}{2}^{\circ}$ E. on Diagram 2, Plate I., represents a gale which was also experienced by another ship in a position about a degree further S. and half a degree further E.; in both cases the gale was short, but the more south-easterly ship felt it slightly stronger and longer. The action of their barometers and direction of their winds were very similar.

Again, the heavy gale represented by the thick unshaded arrow in about $35\frac{1}{2}^{\circ}$ S. 21° E. was also experienced by another ship in a position about a degree further N. and four degrees further E. With the south-westerly ship the gale attained a force of 10, and lasted 12 hours; whilst the north-easterly ship had only a force of 8, and the gale lasted only two hours. The last-named ship had also a good deal of Southerly and Easterly preceding wind, whereas the more southerly ship had only Westerly preceding winds. This difference in the direction of preceding winds may have been related to the fact that the barometer fell nearly two-tenths of an inch lower with the north-easterly than with the south-westerly ship. With the north-easterly ship the change of preceding wind from the Eastward to the Westward was indicated by lightning in both quarters before it came. The south-westerly ship got the gale about six hours before the north-easterly one.

Hence we learn that the system was probably moving to the eastward at a rate of about 30 miles an hour, and that neither the duration nor strength of the gale were so great near the land as they were further to the southward.

Referring once more to Diagram 2, Plate I., the gale represented by the most North-easterly arrow between 30° and 40° E. was also felt by two other ships, one in about $31^{\circ} 42'$ S. $39^{\circ} 35'$ E., the other in about $34^{\circ} 35'$ S. $34^{\circ} 45'$ E. Each ship experienced a sudden change of wind. The changes are given below in the order of time:—

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21st, 9.30 p.m.	-	In about $34^{\circ} 32'$ S. $35^{\circ} 50'$ E., sudden shift of wind from N. by E. to S.W., lowest bar. 29.60.
22nd, 1.30 a.m.	-	„ $31^{\circ} 56'$ S. $35^{\circ} 10'$ E., „ „ N.N.W. to S.W., „ 29.66.
22nd, 1 p.m.	-	„ $31^{\circ} 42'$ S. $39^{\circ} 37'$ E., „ „ W.N.W. to S.S.W., „ 29.75.

Here we see that the most southern ship got the sudden shift first, and that four hours later it reached the ship which was about two and a half degrees to the northward of her, whilst it took $11\frac{1}{2}$ hours more before it reached the most eastern ship.

These facts seem to indicate that the system to which this gale was related had a north-easterly track, and by supposing the northern half of such a system as that represented by Diagram (b) (p. 9) to pass to the north-eastward over three ships similarly placed, the changes of wind and action of the barometer actually experienced would be fairly represented, for the most southern ship had the lowest and the most northern the highest barometer. Again, the most southern ship had the preceding wind from N. by E., whilst the most northern one had it from W.N.W. It is, however, very difficult to get the truth from so small an amount of data as is available in this case, for material changes may have taken place within the storm area itself.

The most southern ship had lightning in the S.S.W. an hour and a half before the change came, and this continued for eight hours.

The next ship had heavy thunder and vivid lightning at the time of the change from N.N.W. to S.W.

The most eastern ship had lightning in the W.N.W. at 3 a.m. of the 22nd when the wind veered from N.W. to W.N.W., but she recorded none at the time of the sudden change from W.N.W. to S.S.W.; she also had the preceding winds more Westerly than either of the others.

COMPARISON OF OUTWARD AND HOMEWARD-BOUND SOUTH-WESTERLY GALES.

By comparing Tables 5 and 6 (pp. 21 and 24) it will be seen that the systems of barometric pressure (A to F) which are related to South-westerly gales experienced by outward-bound ships in January last about 26 hours longer than those experienced by homeward-bounders. As remarked when alluding to North-westerly gales, it is most probable that part of this difference is due to the fact that outward-bounders run to the eastward in company with the systems which are travelling fast in the same direction, whilst homeward-bounders are generally nearly stationary during Westerly gales.

By comparing the duration of the different parts of the systems as given in the diagrams and tables, it will be found that the mean duration of preceding winds is much the same with the South-westerly gales met with by both outward and homeward-bound ships, and that the chief difference lies in the duration of the winds which follow the gales, as these continue twice as long with outward as with homeward-bound ships. The *gales* met with by outward-bound ships are also longer than those experienced by homeward-bounders, the difference being about six hours. The gales and following winds being chiefly from S.W., last a shorter time with homeward than with outward-bound ships during the southern summer, not only because outward-bound ships are generally moving fast to the eastward in company with the wind systems, so that they remain longer under their influence, but also because in summer the S.E. Trades extend into the northern part of the district and interfere with the Westerly winds there; the same amount of interference does not extend so far south as the track of outward-bounders, which is proved by the larger percentage of Easterly preceding wind met with on the homeward than on the outward route.

The "Order of changes in the Gales" given below Diagrams 3 and 4, shows that in nearly all cases the South-westerly gales experienced by both outward and homeward-bounders commenced after the lowest pressure had passed, warning the navigator to expect the strongest part of a S.W. wind after the barometer has begun to rise. It has already been remarked (when speaking of North-westerly gales) that as the South-westerly wind generally lies on the north-western or western side of an area of low barometric pressure, and as such areas generally move on an easterly track, it is reasonable to suppose that a South-westerly wind will come with a rising barometer.

BAROMETER.

Diagram 2, Plate 1, shows that the extreme force of South-westerly gales met with on the outward route was more Westerly in direction than that of those met with on the homeward route.

A comparison of Diagrams 3 and 4, Plate II., and a reference to Table 9, page 50, show that the barometer fell about three-tenths of an inch lower in the South-westerly gales experienced by outward-bound ships than in those experienced by homeward-bounders. There was a difference of about eight and a half degrees between the mean latitudes in which they were met with, which probably accounts in a great measure for the difference in the barometer readings.

GEOGRAPHICAL DISTRIBUTION OF SOUTH-WESTERLY GALES.

South-westerly gales are pretty uniformly distributed along the track of outward-bound ships, but with homeward-bounders they are most frequently met with near the S.E. coast of Africa, where the trend of the land and the atmospheric disturbance caused by the warm Agulhas current are favourable to them.

LIGHTNING.

The following table gives the various facts respecting lightning in relation to South-westerly gales:—

TABLE 8.—LIGHTNING.

No lightning was recorded in any of the seven South-westerly gales met with by outward-bound ships.

Lightning was recorded in 12 of the 22 South-westerly gales met with by homeward-bound ships, as follows:—

Position.	Number of Gales.	Number of Gales in which Lightning was seen.	Time when Lightning was seen, in Hours from Beginning of Gale.		Bearing of Lightning.	Remarks.
			Before.	After.		
10° to 20° E. -	3	None.	Hours.	Hours.	—	—
			32	—		
			25	—		
			1	—		
			20	—		
20° to 30° E. -	16	10	8	—	S.W.	The lightning occurred 12 hours before the wind changed from N.E. to S.W.
			0	—	S.E. and N.	At the time of wind's changing from E. to W.
			14	—	S.W.	1½ hours after sudden shift of wind from N. to S.W.
			4	—	Not given.	Lightning was also seen 48 hours before gale, and 16 hours before shift of wind from N.E. to N.W.
			—	8	S.W.	Wind was W. at the time, but veering from N. to S.W.
			—	—	Not given.	With commencement and during gale.
			—	—	W.S.W. and E.N.E.	As winds shifted from E.N.E. to W.S.W.
			—	—	Not given.	At shift of wind from E. to N.W. cir.-c. rose in N.W. four hours before shift.
			—	9½	"	The lightning was at the time of extreme force; 16 hours later when the wind had lulled to S.W. 4, the sky was covered with cir. in most peculiar bands and tufts, apparently moving slowly from S.S.W., eight hours later it was calm.
			70 & 54	—	S.	The gale ended 2½ hours after lightning was seen.
30° to 40° E. -	3	2	20	—	N.N.W. and S.S.E.	As wind changed to E. after North-westerly and variable airs.
			—	—	S.S.W.	1½ hours after lightning was seen the wind shifted suddenly from N. by E. to S.W. Another ship had the same gale; in her case lightning came as the wind shifted from N.N.W. to S.W. when the gale also commenced.
Total -	22	12	9	2		

NOTE.—These cases of lightning are given in the order of latitude, beginning with the gales in the northern part of each strip.

WEATHER.

Extremely heavy squalls and gusts were very common in these South-westerly gales. The heavy gale on the edge of the Agulhas Bank in about $34\frac{1}{2}^{\circ}$ S. and nearly 26° E. was marked by hot and cold blasts as it set in; there were at the same time strong rippings on the sea, which was at a temperature of $76^{\circ}\cdot 5$, whilst half an hour previous it had been only 73° .

SEA.

In some cases the sea was "tremendous," the eastern edge of the Agulhas Bank (where there is a strong current setting to the south-westward) is remarkable for its extremely high and confused seas, more especially in South-westerly gales, which blow counter to the current.

TABLE 9.

Table 9, p. 50, gives a comparative summary of the principal facts relating to these gales. A similar table for July is given on p. 94, so that the data of summer and winter gales can be compared.

B iii.

CLASS III.—NORTH-EASTERLY GALES.

PLATE I., DIAGRAM 3.

The arrows on this diagram represent the position of the ship, the direction and extreme force of the wind at the time when the extreme force commenced, for each North-easterly gale experienced in January.

A line divides the one North-easterly gale experienced by an outward-bound ship from the six met with by homeward-bounders.

NORTH-EASTERLY GALE,—OUTWARD BOUND.

PLATE II., DIAGRAM 6.

This diagram represents the only North-easterly gale recorded by outward-bound ships in January; its accompanying extract from the log shows that there was a sudden shift of wind from N. by E., to S.W. by W.; the South-westerly wind did not quite attain the force of a gale, which is the only reason why it was not classed with the Exceptional gales of the same neighbourhood which had a South-westerly gale following a North-easterly one.

The diagram shows that all the preceding winds were North-easterly or Easterly, that the gale only attained the force of 8, and that it lasted only four hours. It also shows that the gale ended about 11 hours before the lowest barometer was recorded, and that with the lowest barometer came a sudden shift of wind to S.W. After the gale the wind remained South-westerly until the barometer ceased rising.

NORTH-EASTERLY GALES,—HOMEWARD BOUND.

PLATE II., DIAGRAM 5.

This diagram represents the mean data of four North-easterly gales experienced by homeward-bounders; there were in fact six of these gales in January, as shown by the six arrows above the dividing line on Diagram 3, Plate I., but the two most northern in position have not been included in the mean, because:—

- (a.) That in $31^{\circ} 20'$ S. $32^{\circ} 35'$ E. had otherwise such defective data that it had to be rejected.
- (b.) That in $30^{\circ} 46'$ S. $37^{\circ} 2'$ E., although a N.E. gale, was so peculiar that it has been thought right to combine it with the Exceptional gale which immediately followed it. It is represented by the first part of Diagram 3A, Plate V., and the remarks relating to it are on page 45.

WINDS PRECEDING NORTH-EASTERLY GALES,—HOMEWARD BOUND.

The wind-rose on the left side of Diagram 5, Plate II., shows that nearly all the winds preceding these gales were Easterly or North-easterly. The diagram shows that they lasted about 21 hours (A to B).

DURATION, &c. OF NORTH-EASTERLY GALES,—HOMEWARD BOUND.

These were short gales, their average length being only four hours, the longest lasting six, and the shortest two hours. During three of them the wind was N.E. by E., whilst in the fourth and most easterly in position, it was N.E. by N. They were generally slight, only one having attained the force of 9.

WINDS FOLLOWING NORTH-EASTERLY GALES,—HOMEWARD BOUND.

The space between E. and F. on Diagram 5, Plate II., shows that the winds following the N.E. gales which were met with on the homeward route lasted 53 hours. The wind-rose on the right side of the diagram shows that most of the following winds were Southerly or South-westerly. The gales generally ended before the lowest barometer reading occurred, but the wind generally remained North-easterly until that time, when, in nearly all cases, it changed quickly, sometimes suddenly, to S.W., and often veered to S. and S.E.

SPECIMEN DIAGRAMS OF NORTH-EASTERLY GALES,—HOMEWARD BOUND.

Diagram 5A, Plate II., represents the data of the most southern of the two gales shown by arrows near the eastern edge of the Agulhas Bank (see Diagram 3, Plate I.); it was a typical North-easterly gale. The gales which blew in 34° S. 29° E. and $31\frac{1}{2}^{\circ}$ S. $32\frac{1}{2}^{\circ}$ E. resembled it in having had a change of wind at the time of lowest barometric pressure.

Diagram 5B, Plate II., represents the data of the gale indicated by the arrow shown on Diagram 3, Plate I. in $33\frac{1}{2}^{\circ}$ S. 34° E. It is peculiar in having a North-easterly wind several hours after the barometer had commenced rising. The gale which blew in $34\frac{1}{2}^{\circ}$ S. 25° E. resembled Diagram 5B in the action of the barometer and direction of the wind, though no lightning was recorded with it, and the wind was gusty.

COMPARISON OF OUTWARD AND HOMEWARD-BOUND NORTH-EASTERLY GALES.

A comparison of Diagrams 5 and 6 shows that the one North-easterly gale experienced by an outward-bound ship was similar in character to those met with by homeward-bounders.

All were preceded by Easterly or North-easterly winds and commenced before the barometer had attained its lowest point; in fact, all ended some hours before the lowest

pressure occurred, excepting in the case of the gale represented by Diagram 5B, Plate II., which ended at the time of lowest pressure. All were followed by South-westerly to South-easterly winds.

It has already been remarked that North-easterly gales which were quickly followed by South-westerly gales have been classed as "Exceptional gales."

BAROMETER.

A comparison of Diagrams 5 and 6, Plate II., shows that in the North-easterly gale experienced by an outward-bounder the barometer reading was about 0.15 inch lower than the mean of those recorded by the four homeward-bound ships. The outward-bounder was about six and a half degrees further south than the mean position of the four homeward-bounders.

GEOGRAPHICAL DISTRIBUTION OF NORTH-EASTERLY GALES.

All North-easterly gales met with in the district in January were experienced off the S.E. coast of Africa. The diagrams for other months show that this is generally the case throughout the year; and it is supposed that the trend of the coast has much to do with this fact. It is well known that an area of high barometric pressure exists at the southern verge of the S.E. Trades in the Indian Ocean. It is also known that during the southern summer the barometer is lower over the heated land than it is during the winter, hence the normal state of atmospheric pressure in January is a relatively low pressure over the land, and high pressure over the sea at some distance from the S.E. coast of Africa. Such a disposition of pressure would be related to prevailing North-easterly winds near the coast, and the Wind Chart for January shows that such winds do prevail there.

LIGHTNING.

Lightning was experienced by five of the seven ships which had North-easterly gales.

The outward-bounder and two of the homeward-bounders had lightning in the N.W., about seven hours after the N.E. gale had ended, and seven hours before the wind shifted from the North-eastward to the South-westward.

One homeward-bounder had lightning in the N.W. as the N.E. gale commenced, and again in the S. four hours after the gale had ended, and ten hours before the shift of wind from N.N.W. to S.

From the above facts it seems probable that lightning will not give warning of a coming North-easterly gale, but that it will generally occur several hours before the wind changes to a Southerly quarter. The frequent occurrence of lightning in the N.W. may be due to the fact that, in the cases here dealt with, the land lay in that direction.

WEATHER.

No record is given of squalls during these gales, though in one case smart gusts are mentioned. The weather seems to have been generally fine, in two cases its fineness was a subject of special remark.

SEA.

Heavy seas were not experienced during the North-easterly gales, though very heavy seas were generally met with when they were followed quickly by South-westerly gales.

TABLE 9.

Table 9, p. 50, shows how short and slight North-easterly gales were in comparison with those from other directions.

B iv.

CLASS IV.—SOUTH-EASTERLY GALES.

PLATE III., DIAGRAM 1.

The arrows on this diagram represent, for each South-easterly gale experienced in January, the position of the ship, extreme force of the wind, and its direction at the time when the extreme force commenced. These gales are divided into two classes, viz.:—

(a.) Those which were preceded by Northerly or Westerly winds.

(b.) " " " " South-easterly winds.

Those belonging to the first-class are distinguished by asterisks close to their arrows.

SOUTH-EASTERLY GALES,—OUTWARD BOUND.

Diagram 1, Plate III., shows that there were only two South-easterly gales experienced by outward-bounders in January, one was preceded by Northerly, the other by Southerly winds, so that each is represented by a diagram on Plate IV.

SOUTH-EASTERLY GALE PRECEDED BY NORTHERLY WIND,—OUTWARD BOUND.

Diagram 3, Plate IV., represents the data of the only South-easterly gale preceded by a Northerly wind which was recorded by an outward-bounder; its arrow will be seen on the eastern side of Diagram 1, Plate III.* It resembled South-westerly gales in having had its preceding wind from the Northward with a falling barometer, and in its having commenced after the barometer had begun to rise. The remarks from the log which are given under the diagram make further explanation unnecessary.

SOUTH-EASTERLY GALE PRECEDED BY SOUTH-EASTERLY WIND,—OUTWARD BOUND.

Diagram 3A, Plate IV., represents the data of the only South-easterly gale preceded by South-easterly winds which was recorded by an outward-bounder.

The commencement of the diagram would be more correctly given at 4 p.m. or even 8 p.m. of the 2nd, when there had been a slight rise in the barometer, and after which time the preceding wind was South-easterly, but it seems desirable to show how the South easterly wind had been preceded by a slowly falling barometer and a moderate breeze from the N., which had died to a calm. The continued and increasing fall of the barometer, after the wind had changed from N. to S.E., was a strong indication of the

* As more space is required for representing the two kinds of South-easterly gales, their diagrams on Plate IV. extend to the southward of their geographical position on Plate III.

coming gale. The action of the barometer and the backing of the wind to S. and S.W. seem to indicate that this gale was related to an area of low barometric pressure moving to the southward or south-eastward.

By turning to Diagram (b), page 9, it will be seen that such an action of barometer and wind would be experienced by a ship which had a cyclonic wind passing over her in the direction indicated by the large arrow No. 3. The extreme severity of this gale, as shown by the remarks on its diagram which are quoted from the log, supports the idea that it was cyclonic.

SOUTH-EASTERLY GALES,—HOMEWARD BOUND.

The five arrows above the dividing line on Diagram 1, Plate III., represent all the South-easterly gales which were experienced by homeward-bound ships in January. The asterisks show that the two on the eastern side of the district were preceded by Northerly winds, whilst the three on the western side were preceded by Southerly winds. They are each represented by a diagram.

SPECIMEN DIAGRAMS OF SOUTH-EASTERLY GALES PRECEDED BY NORTHERLY WINDS,—HOMEWARD BOUND.

Diagrams 1 and 1A, Plate IV., represent the data of the two gales whose arrows are shown in the north-east corner of Diagram 1, Plate III. Both show that the gales commenced after the lowest barometric pressure had passed, also that they were of short duration; the one lasting only six and the other five hours, whereas it will be shown that the South-easterly gales which were preceded by South-easterly winds lasted much longer, and differed from those preceded by Northerly winds in other ways.

COMPARISON OF OUTWARD AND HOMEWARD-BOUND SOUTH-EASTERLY GALES PRECEDED BY NORTHERLY WINDS.

By comparing Diagrams 1 and 1A, with Diagram 3, Plate IV., a great resemblance is observed between the South-easterly gale preceded by Northerly wind which was experienced by an outward-bounder, and similar gales experienced by homeward-bounders; the only important difference being that the barometer fell lower in the first than in the other cases, which was no doubt due to difference of latitude, the outward-bounder being about nine degrees further south than the mean position of the homeward-bounders.

SOUTH-EASTERLY GALES PRECEDED BY SOUTH-EASTERLY WINDS,—HOMEWARD BOUND.

As there are only three of these gales, a separate diagram is given for each. Diagram 1, Plate III., shows that they were all near the Cape of Good Hope. January forms part of the season for "South-easters" in Table Bay, and no doubt these gales were related to those winds.

SPECIMEN DIAGRAMS OF SOUTH-EASTERLY GALES PRECEDED BY SOUTHERLY WINDS,—HOMEWARD BOUND.

Diagrams 2, 2A, and 2B, Plate IV., represent all the gales of this class which were experienced by homeward-bounders. By comparing them with Diagrams 1 and 1A of the same Plate, it will be seen that they differ greatly from those which were preceded by Northerly winds; for instance, they commenced, and in two cases ended, whilst the barometer was falling, whereas those preceded by Northerly winds did not commence until the lowest barometric pressure had passed. Again, they generally lasted much longer than those preceded by Northerly winds, their respective durations being 16, 4, and 28 hours, as compared with 5 and 6 hours (p. 36). Lastly, they had a very moderate force and were accompanied by fine weather; whereas of the two preceded by Northerly winds, the one had a heavy thunderstorm, the other, heavy squalls.

COMPARISON OF OUTWARD AND HOMEWARD-BOUND SOUTH-EASTERLY GALES PRECEDED BY SOUTHERLY WINDS.

By comparing Diagram 3A with Diagrams 2, 2A, and 2B, Plate IV., it will be seen that the outward-bound South-easterly gale preceded by Southerly winds was a much longer and more severe gale than any of those met with by homeward-bounders. It was experienced in nearly the same longitude, but about five degrees further to the southward, and was accompanied by a much lower barometer. The wind and barometer changes seem to indicate that it was related to a cyclonic system moving to the southward or south-eastward; whilst the fine-weather South-easterly gales experienced near the Cape of Good Hope by homeward-bounders seem to have been due to an intensifying of the normal difference of atmospheric pressure which exists between the heated land of Africa in summer with its low pressure and the permanent area of high atmospheric pressure lying over the sea to the southward of the S.E. Trades in the Atlantic.

BAROMETER.

It has already been remarked that the South-easterly gales experienced by outward-bounders were accompanied by lower barometric readings than those experienced by homeward-bounders. Part of this difference is no doubt due to difference of latitude, but the number of gales recorded is so small, that we cannot draw general conclusions.

GEOGRAPHICAL DISTRIBUTION OF SOUTH-EASTERLY GALES.

As before stated, in January the South-easterly gales preceded by Northerly winds were met with on the eastern side of the district, whilst those preceded by Southerly winds blew on its western side, and a reference to the diagrams of other months shows that this disposition of the two kinds of S.E. gales is general throughout the year, though it is not nearly so decided in winter as in summer.

LIGHTNING.

In the case of South-easterly gales preceded by Northerly winds, the outward-bounder had lightning in the N.W. (wind N.N.W.) six hours before the gale, and four hours before the lowest barometric reading was noted. One of the homeward-bounders had lightning in the S.W. (wind N.) 10 hours before the gale and four hours before the wind shifted to S.E.; the other did not report lightning.

In the case of South-easterly gales preceded by Southerly winds the outward-bounder had lightning in the N.E. at the time of lowest barometric reading, 20 hours after the gale commenced, and when it was blowing from S. Diagram (b), p. 9, shows that with a ship on arrow 3 having the wind S. the centre of the cyclonic system would bear north-eastwards, and the lowest pressure would be experienced at the same time. Hence the lightning may have been at the centre of a cyclonic system. No lightning was reported by the three homeward-bounders which had South-easterly gales preceded by South-easterly winds; it has already been shown that they were fine-weather gales, and related to a different kind of wind-system from that of the outward-bounder.

WEATHER.

Nearly all the South-easterly gales preceded by Northerly winds were accompanied by squalls as well as lightning.

The South-easterly gale preceded by a Southerly wind which was experienced by an outward-bounder, and is considered to have been cyclonic, was very severe, and seems to have been accompanied by squalls as well as by lightning.

The three South-easterly gales preceded by Southerly winds which were experienced by homeward-bounders were fine-weather gales, no squalls or lightning being reported, though one had a heavy gust which lasted 20 minutes, the sky being quite clear.

SEA.

The only South-easterly gale which had a very heavy sea was experienced by an outward-bounder. It was preceded by a southerly wind, and is supposed to have been cyclonic. It was accompanied by an "awful" sea from S. and S.E.

TABLE 9.

Table 9, p. 50, contains a summary of certain data already alluded to, and gives the means for comparing the data of different kinds of gales.

B v.

CLASS V.—EXCEPTIONAL GALES.

Besides the 63 gales experienced by outward and homeward-bounders in January which have been classified under the heads of North-westerly, South-westerly, North-easterly, and South-easterly, there were 10 experienced on the outward and 15 on the homeward route, which are considered too exceptional to be classed under any of those headings, and have been dealt with separately.

PLATE III., DIAGRAM 2.

The Exceptional gales met with by both outward and homeward-bounders are represented by arrows on this diagram, those of the two routes being separated by the irregular line which runs through it.

For the convenience of reference each strip of 10° of longitude is lettered thus: P = 10° to 20° E.; Q = 20° to 30° E.; R = 30° to 40° E. The arrows showing the position and direction of the extreme force of each gale are lettered a, b, c, &c., in each strip, commencing with the most northern one; for instance, P a, indicates the most northern arrow between 10° and 20° E.

As these gales frequently change from one quarter to another, and often suddenly, the various directions of the wind are represented by arrows, numbered in the order of the time of occurrence of those directions; the position of each arrow being determined by that of the first occurrence of the extreme force. Sometimes a sudden shift is experienced from a moderate wind in one direction to a gale in another, or a moderate breeze, differing in direction, occurs between the two parts of one of these gales; in these cases the moderate wind is represented by an arrow of half the usual length, which is also numbered in the order of its occurrence. Further explanations are given at the foot of the diagram.

EXCEPTIONAL GALES,—OUTWARD BOUND.

The ten Exceptional gales met with by outward-bounders in January have been classified under the following heads: A. North-Westerly (3); B. North-Easterly to South-Westerly (5); C. South-Westerly (1); D. Southerly backing to N.W. (1). They will be alluded to in the order here given, and as the quotations from the logs are sometimes long, they are given in the letterpress. The Course and Distance made by the ship during each gale (*i.e.*, during the time between B and E), are given with its diagram.

A.—NORTH-WESTERLY.

Referring to Diagram 2, Plate III., the arrows P b, Q k, and R i represent the extreme forces of North-westerly Exceptional gales.

PLATE IV., DIAGRAM 4. (P b.)*

The position in which the extreme force of this gale commenced lies a little west of the district under discussion, so that the arrow P b, is on the left margin of Diagram 2, Plate III.

The gale was peculiar in having been very Northerly in direction. There was heavy rain at midnight, 26th, just before the extreme force was experienced, and when the wind commenced veering to the Westward.

Temperature at climax (C): sea 56°; air 59°.

PLATE IV., DIAGRAM 4A. (Q k.)

This gale was peculiar in having commenced from the North-west after the barometer had risen for several hours. The temperature of the sea varied from 57° to 47°.

Temperature at climax (C): sea 52°; air 48°.

PLATE IV., DIAGRAM 4B. (R i.)

This gale was remarkable in having had the extreme force from North-west with a fast rising barometer. By referring to Diagram (b), p. 9, it will be seen that such changes of barometer and wind would be experienced on the north-eastern side of a wind-system similar to that of the diagram, if it were moving to the southward.

The following are extracts from the log:—

17th, Noon. - Breeze suddenly increased, with heavy rain.
 „ 5 p.m. - Terrific squall; hove-to.
 „ Midt. - Tremendously high and breaking sea.
 Temperature at climax (C): sea 48°; air 50°.

B.—NORTH-EASTERLY TO SOUTH-WESTERLY.

Referring to Diagram 2, Plate III., the arrows P c, Q l, R g, R h, and R j represent the extreme forces of these gales; in the case of R j, the gale changed from E. by S., to W.S.W.

PLATE IV., DIAGRAM 5. (P c.)

This gale was remarkable in its having backed from N.E. through E. to S.W. The force of the wind was slightly below that of a gale as it backed; as the barometer rose it seems to have changed suddenly from E. by S. to S. by W., though no remark is given in the log to show this. The extreme force of 9 came from S. by W. A cyclonic system similar to that represented by Diagram (b), p. 9, would produce similar changes of wind if its centre passed to the northward of a ship on its way to the eastward or south-eastward.

Throughout the gale this ship reported snow, rain, and sleet; she also passed many icebergs. It will be noticed that the ship was in 49° S.

Temperature at climax (C): sea 37°; air 40°.

NOTE.—The records of this barometer are difficult to understand. At 4 a.m., 13th, no rise was shown, and then an extreme one at 8 a.m. It has been thought best to omit the 4 a.m. reading in drawing the diagram.

* For the convenience of reference to the position in which the extreme force of each gale commenced, the letters which indicate the position of its arrow on Diagram 2, Plate III., will be given in brackets with each Exceptional Gale.

PLATE IV., DIAGRAM 5A. (Q l.)

This gale veered gradually from N.E. to W., and then flew suddenly from W. to S.byW., when the extreme force (10) commenced, this lasted eight hours blowing chiefly from S.byE. Heavy squalls with rain and mist were experienced throughout the gale. It seems to have been related to a cyclonic system similar to that represented by Diagram b, p. 9, the centre of which passed to the southward of the ship on an easterly or north-easterly track.

Temperature at climax (C): sea 43°; air 45°.

PLATE IV., DIAGRAM 5B. (R g.)

This gale blew with a force of 10 from both N.E. and S.W., it was remarkable in having had a peculiar oscillation in the barometer after the lowest pressure had passed and the wind had shifted to S.W. The oscillation was accompanied by a backing of the wind to N.W., from which quarter it veered quickly to S.W. again, with a rising barometer, and freshened into a gale.

The following are extracts from the log:—

5th, 4 a.m. - Squally, with heavy rain.
 6th, 8 p.m. - Very unsteady airs, with lightning in the N.W.
 Temperature at climax (C): sea 59°; air 60°·5.

NOTE.—The lightning in N.W. was followed, in four hours, by a wind from that quarter.

PLATE IV., DIAGRAM 5C. (R h.)

This gale was remarkable for having had a very sudden change of wind from N. to S.W.

The following are extracts from the log:—

3rd, Noon - Very smooth sea, with an occasional swell from the westward. It continued smooth until 4 p.m., when it was confused.
 4th, 4 a.m. to 8 p.m. - Drizzle and very thick fog.
 „ 4 p.m. - Lightning and thunder.
 „ 6 p.m. - Wind shifted from N. to S.W.

NOTE.—The westerly swell and confused sea seem to have indicated the coming change of wind, as did also the thunder and lightning. The temperature of the sea was not given; that of the air was 50° at the time of climax (C). This gale seems to be well represented by Diagram (b), p. 9, supposing its centre to have passed to the southward of the ship on an easterly track.

PLATE IV., DIAGRAM 5D. (R j.)

This gale was remarkable for having had a very sudden fall and rise in the barometer, though the force of the gale was only 8. The wind changed very quickly from E. by S. to W.

The following remarks are from the log:—

16th, 3 p.m. - Much ice, very heavy sea, and very cold weather.
 17th, Midnight - Wind changed suddenly from E. by S. 8 to calm. At 1 a.m., 18th, it was W., and by 2 a.m. had the force of a gale. Many bad seas were shipped, and the captain decided to go the northward for finer weather and less ice.

Temperature at climax (C): sea 38°; air 36°.

Q 735.

F

NOTE.—The very sharp fall and rise of the barometer, with only a fresh gale, seem to indicate that the gale was related to a quickly moving area of low pressure; for it must be remembered that if a wind-system having a slight barometric gradient moves very quickly it may cause a quicker fall and rise of the barometer than another with a much steeper gradient and heavier gale, but moving slowly. A Northerly wind prevented the captain from going to the northward for finer weather, as he proposed, but the weather improved as he went to the eastward. This gale seems to be well represented by Diagram *b*, p. 9, supposing its centre to have had a south-easterly track, and to have passed near, but to the eastward of the ship.

REMARKS ON THE FIVE NORTH-EASTERLY TO S.W. EXCEPTIONAL GALES,—OUTWARD BOUND.

It will be seen that all these gales, most of which were heavy, were related to very low atmospheric pressures, the lowest barometer reading (D) being generally below 29 inches. It has been shown that a vessel experiencing the central or nearly the central part of such a system as that represented by Diagram (*b*), p. 9, which was moving on an easterly or south-easterly track would have changes of wind and barometer corresponding to those shown by these diagrams. The two gales which blew in about 49° S. were experienced by the same ship; in both cases the wind backed to the Eastward, she reported very bad seas, and many icebergs, which facts seem to show that she had gone too far to the southward for steady Westerly winds, and was incurring the risk of meeting ice.

C.—SOUTH-WESTERLY.

PLATE IV., DIAGRAM 6. (Q j.)

This gale might have been classed with the ordinary South-westerly gales, but is remarkable for the suddenness of the change in its previous wind from N.byE. to W.

The following remarks are from the log:—

- 3rd, 8 p.m. - Wind blowing in gusts from N. to E.; clouds rise in the W., but move from the N. Sea strong from W.N.W. and N.N.E., and very irregular.
- 4th, 0.30 a.m. - Wind shifted to W., force 5.
- „ 2 a.m. - Gale commenced. There was lightning from midnight, 3rd, to 2.30 a.m. 4th.
- At midnight, 3rd, the temperatures were: sea 61°·4; air 62°·4.
- At 4 a.m., 4th, they were: sea 59°·5; air 53°·4.

NOTE.—The first remark stating that clouds rose from the west, though they moved from the north, seems to indicate that the cloud-bank related to the area of lowest barometric pressure was seen approaching the ship. Of course in such a case the wind would remain Northerly until the lowest barometric pressure had passed, for the ship was on the eastern side of an area of low pressure approaching her from the westward. Then if (as in this case) the lowest pressure passed to the southward of the ship, the wind would change from N. to W., and afterwards to the Southward of W.

The remarkable difference of temperature between the Northerly and Westerly currents of air corresponds to a similar difference which is experienced in the Northern Hemisphere when the wind goes suddenly from S. to W. or N.W., after the lowest barometer of a wind-system has passed.

It will be seen that the lightning gave warning of the change of wind, for it occurred near the point of contact of the Northerly and Westerly currents of air, commencing just before, and continuing until after, the change.

D.—SOUTHERLY BACKING TO N.W.

PLATE IV., DIAGRAM 7. (Q i.)

This gale might, perhaps, have been dealt with as two separate gales, but it is peculiar in showing so very slight a rise in the barometer after the Southerly gale, the wind backing quickly through W. to N.W. with a falling barometer, and freshening into a gale, of force 9.

This system had a slight oscillation in the barometer and wind just after the lowest barometric reading was recorded, and before the decided rise in the barometer took place. The following are extracts from the log:—

For 24 hours previous to the gale the weather was threatening.

- Feb. 2nd, Noon - Heavy rain rising from S.W.
- „ 2 p.m. - Wind shifted from W.N.W. 8 to S.W. 3.
- „ 6 p.m. - Wind North-westerly again.

Temperature at climax (C): sea 63°; air 62°.

NOTE.—It will be seen that this gale was preceded by a South-easterly wind and rather fast-falling barometer; also that the lowest pressure related to this part of the system came as the gale set in from S., and that the wind was backing to S.W. as the barometer rose. Such changes would take place with a ship having the western half of a cyclonic system pass over her as it moved on a southerly track. The further backing of the wind to N.W., and its freshening to a gale, accompanied by a second fall of the barometer, seem to show that the north-eastern side of another system came over the ship before the barometer had time to rise to its usual height after a gale. The centre of the second system seems to have had an easterly track, and to have passed to the southward of the ship. It has already been remarked that heavy rain during a gale, especially if it occurs about the time of lowest pressure, is very likely to be accompanied or followed by a sudden change of wind, and this gale gives another illustration of the fact.

EXCEPTIONAL GALES,—HOMEWARD BOUND.

The 15 exceptional gales met with by homeward-bounders in January have been classified under the following heads:—

A. Northerly (1); B. North-Westerly (2); C. North-Easterly to South-Westerly (8); D. South-Westerly (3); E. Easterly (1). They will be alluded to in the order here given.

A.—NORTHERLY.

PLATE V., DIAGRAM 1. (R b.)*

This was a very short and slight N. gale, which blew as the wind veered from N.E. to N.W. No other wind of the system attained the force of a gale, which is remarkable, because after the lowest barometric pressure had passed the barometer rose very quickly, which generally indicates that the gradient is steep enough for a South-

* It may be well to repeat here that, for the convenience of reference to the position in which the extreme force of each gale commenced, the letters which indicate the position of its arrow on Diagram 2, Plate III., will be given in brackets with each exceptional gale.

westerly gale, and we can only suppose that the rapid rise of the barometer was chiefly caused by the speed at which the whole system advanced. By comparing this diagram with Diagram 3d, Plate V., it will be seen that with a similar rise of the barometer a severe South-westerly gale is sometimes experienced. The following are extracts from the log:—

- 30th, 8 p.m. - Gloomy, with lightning.
 „ Midnt. - Gloomy, with very vivid lightning.
 31st, 9 a.m. - Squally.

Temperature at climax (C): sea 77°; air 76°.

B.—NORTH-WESTERLY.

Referring to Diagram 2, Plate III., the arrows Q d and Q e represent the extreme forces of these gales.

PLATE V., DIAGRAM 2. (Q d.)

This gale was very short and was slight in force. It was followed by two days of light or moderate but variable winds as the barometer rose slowly, then by a short South-westerly gale when the barometer had nearly ceased rising. The two parts of the gale might perhaps have been treated as separate gales, but it was thought better to give them in one diagram to illustrate their peculiarity. The following are extracts from the log:—

- 16th, 8 p.m. - Looking ugly in the W.N.W. with very vivid forked lightning and heavy thunder.
 19th, 3 p.m. - Wind very fresh, and increasing with heavy rain and very heavy squalls. Close reefed at 4 p.m.

Temperature at climax (C): sea 70°; air 70°.

NOTE.—Here again the bearing of lightning indicated the direction in which the wind was going to change.

PLATE V., DIAGRAM 2A. (Q e.)

This was a North-westerly gale which commenced with a rising barometer and veered to S.W., then backed to N.W., the barometer still rising. The following are extracts from the log:—

- 14th, 4 p.m. - Gradually clouding from the north-westward.
 „ 10 p.m. - Lightning commencing in the E., then coming from the whole heavens.
 15th, 4 a.m. - Lightning gradually clearing off to the southward.

Temperature at climax (C): sea 75°·7; air 74°·2.

NOTE.—It will be seen that the lightning preceded the change of wind from N.W. to S.W.

C.—NORTH-EASTERLY TO SOUTH-WESTERLY.

Referring to Diagram 2, Plate III., the arrows Q a, Q b, Q c, Q f, Q h, R a, R d, R e represent the extreme forces of these gales.

PLATE V., DIAGRAM 3. (Q a.)

This was one of the gales so common near the S.E. coast of Africa which shift from N.E. to S.W., often very suddenly. The following are extracts from the log:—

- 20th, 5 p.m. - A heavy appearance to the westward, not clouds.
 „ 8 p.m. - The darkness, lightning, and thunder passing over to the eastward.
 21st, 1 a.m. - A violent descending squall struck us from the Northward; this lasted an hour, and in the time veered to the S.E. round by the W.
 „ 3 to 5 a.m. - Wind almost calm; lightning noted at 4 a.m.
 „ 6 a.m. - A strong wind sprang up from the Westward with squalls and rain.

Approximate temperature at climax (C): sea 75°; air 74°.

PLATE V., DIAGRAM 3A. (Q b.)

It will be seen that the wind-system of this gale extends over five and a half days, during which time the ship advanced from 30° 8' S., 40° 30' E. to 35° S., 27° 34' E. Nearly the whole of this distance was made before 1 a.m. of the 11th, when the wind flew from N.E. to S.W. The system might have been divided into two, as it really was a North-easterly gale followed by a North-easterly to South-westerly gale, but as there was no decided rise of the barometer between the two North-easterly gales and the second was followed by such a very severe South-westerly gale, it was thought best to give the data in a continuous diagram. The following are extracts from the log:—

- 8th, 2 p.m. - Sky almost cloudless.
 „ 6 p.m. - Clouds from W.N.W.
 9th, Noon - Hazy, but looking fine and wind moderating.
 „ 4 p.m. - Wind fell light and hauled to the Southward.
 „ 8 p.m. - Lightning.
 „ Midt. - Fine, but lightning in S.W.
 10th, 4 a.m. - Wind freshening from the Eastward and gradually hauling to the North-eastward.
 „ 3 p.m. - Made the land about St. John's River; steered along the land at a distance of about 6 or 7 miles and saw the surf break furiously on the beach.
 „ 8 p.m. - Weather overcast, with lightning. Temperature of sea, 72°; of air 78°.
 „ Midt. - Buffalo River light bearing N.W.; distant about 11 miles.
 11th, 1 a.m. - Wind flew to S.W.; hove-to on starboard tack under lower main topsail.
 „ 6 a.m. - Moderating; set the three lower topsails and wore ship to the north-westward.
 „ 8 a.m. - Gale freshening, sky quite clear; in fore and mizen topsails.
 „ Noon - Furious gale and cloudless sky, ship continually dipping lee rail under; took in main topsail.
 „ 2.30 p.m. - Ship fell over on her beam ends, water almost up to the weather bulwarks; fearing she was going altogether, cut away topmasts and mizen-mast.
 „ 5 p.m. - Awful gale; foresail blew adrift; got the ship before the wind; the mountainous sea rolled quite over her.
 „ Midt. - Gale moderating; sea rolling completely over us; sky still cloudless.
 12th, Noon - Sea 74°; air 70°.

NOTE.—The barometer was not recorded between noon of the 11th, and 8 a.m. of the 12th, but a remark in the log states that it was rising. Most probably the rise was much quicker during the height of the South-westerly gale than it was after it lulled.

PLATE V., DIAGRAM 3B. (Q c.)

This gale blew from about W.S.W. for two and a half days. The following are extracts from the log:—

3rd, 8 p.m. - Lightning. Also at 4 and 8 a.m. of the 4th.

Temperature at climax (C.): sea 70°; air 67°.

NOTE.—There were heavy squalls and passing showers throughout the gale. It will be noticed that the lightning gave warning of the change of wind from N.E. to W.

PLATE V., DIAGRAM 3C. (Q f.)

There were about 24 hours of light to moderate wind (chiefly South-westerly) between the North-easterly and South-westerly parts of the gale, the important fact being that although the wind was South-westerly, the barometer did not rise decidedly until the gale from that direction set in. The following are extracts from the log:—

11th, 6 p.m. - North-easterly wind suddenly dropped when the wind veered quickly to W.N.W. and S.S.W. then backed to the Westward.

12th, 8 p.m. - Lightning in N.E.; sudden shift of wind with squalls.

Temperature at climax (C.): sea 73°·5; air 66°.

NOTE.—There was scarcely any cloud with the North-easterly part of this gale, but the weather was misty. The direction of the sudden shift of wind recorded at 8 p.m. of the 12th is not given; it was most probably from W.S.W. to S.S.W.

PLATE V., DIAGRAM 3D. (Q h.)

The following are extracts from the log:—

30th, 8 p.m. - Very hazy, with vivid lightning in the W.

„ 11 p.m. - Wind shifted several points in a heavy squall. Upper clouds from S.W. lower fast from the northward.

31st, 2 a.m. - Very vivid lightning; wind fell light and shifted from N.N.E. to W by N. from which quarter it freshened to a gale; it then veered to S.W. and blew a hard gale.

Temperature at climax (C.): sea 70°; air 73°.

NOTE.—Here again the lightning preceded the shift of wind, as did also the motion of the upper clouds.

PLATE V., DIAGRAM 3E. (R a.)

This gale was preceded by a light Southerly wind and slowly falling barometer for a day and a half before the N.E. wind set in. The following are extracts from the log:—

4th, Midt. - Lightning in N.N.W. with heavy rain.

5th, 0.30 a.m. - Sudden shift of wind from N.E. to N.N.W.

„ 3.30 „ - „ „ N.N.W. to W.S.W. in heavy rain.

Temperature at climax (C.): sea 70°; air 70°.

NOTE.—Here heavy rain as well as lightning preceded the sudden shift of wind, the bearing of the lightning indicating the direction from which the wind was coming.

PLATE V., DIAGRAM 3F. (R d.)

The following are extracts from the log:—

14th, 9 a.m. - A long high swell from S.W.

„ 8 p.m. - Weather cloudy and misty, with lightning.

„ Midt. - Gloomy.

15th, 4 a.m. - Wind flew from N.E. to N.W. in a shower.

„ Noon - Very heavy gusts from S.W.; close reefed.

Temperature at climax (C.): sea 77°; air 79°.

NOTE.—Here a South-westerly swell, lightning, and gloomy weather preceded the shift of wind. It will be seen that the barometer reading at 9 a.m., 15th, is considered to be doubtful.

PLATE V., DIAGRAM 3G. (R e.)

This gale resembles that represented by Diagram 3A, in showing a slight oscillation in the barometer and shift of wind to the Southward, followed by a change to N.E. before the final fall of the barometer occurred. The gale commenced from the Northward at the time of lowest pressure, and the barometer rose before the shift to West came. The following are extracts from the log:—

9th, 8 a.m. - Heavy bank of stratus in S.S.W., wind N.N.W.

„ 4 and 8 p.m. - Lightning.

10th, 8 p.m. and Midt. Lightning.

11th, 3.30 a.m. - Wind suddenly increased; force 8 to 10.

„ 7 „ - Wind veered to W.

„ 10 „ - „ W.S.W.

„ Noon - Temperature: sea 73°; air 75°.

12th, Noon - „ „ 76°; „ 70°.

REMARKS ON THE EIGHT NORTH-EASTERLY TO SOUTH-WESTERLY
EXCEPTIONAL GALES,—HOMEWARD BOUND.

It will be seen that more than half the Exceptional gales experienced by homeward-bounders in January were of the North-easterly to South-westerly type, and that they were all met with off the S.E. coast of Africa. In nearly all cases the North-easterly parts of these gales were experienced to the eastward of 30° E., though in five of the eight the change to South-west occurred to the westward of that meridian. The practical lesson to be derived from these facts is that a ship experiencing a North-easterly gale in this part of the sea should expect a change to S.W. as the meridian of 30° E. is approached.

When remarking on the position of N.E. gales (p. 33) attention was called to the fact that N.E. winds prevail near the S.E. coast of Africa, and to the causes of these winds. Knowing that there is a permanent tendency for N.E. winds in this part of the sea, it is reasonable to suppose that the force of those winds will be intensified, when, from independent circumstances, conditions of barometric pressure favourable for Northerly winds are produced there. Such a disposition of pressure is indicated on

Diagram (a), page 8, which represents areas of low pressure moving to the eastward, and shows that Northerly winds prevail on their eastern sides and Southerly winds on their western sides, so that when the eastern side of such an area enters the district alluded to, its Northerly wind is likely to be intensified by the prevailing tendency for N.E. wind which exists there. Again as there is a strong tendency for S.W. winds near the eastern edge of the Agulhas Bank,* this tendency is likely to intensify the S.W. wind which blows on the western side of a travelling area of low barometric pressure as it passes that position on its way to the eastward.

In this near proximity of two parts of the sea, which are respectively characterized by prevailing N.E. and S.W. winds, we seem to have a cause for the severe and dangerous North-easterly to South-westerly Exceptional Gales just described.

Diagram 3A, Plate V., represents the severest of these gales, and, together with the remarks quoted from the log (p. 45), deserves the attention of navigators. The diagram shows that between the two parts of the North-easterly gale, there was a flaw of light Southerly to Easterly wind which lasted about 12 hours; it also shows that at the time of lowest barometric pressure the wind flew to S.W. and freshened into a gale, of force 11, which threw the ship on her beam-ends.†

It is worthy of notice that the surf, which was most probably caused by a south-westerly swell, was seen breaking furiously on the beach nine hours before the wind changed to S.W.

Similar gales are met with in this locality at all seasons of the year, so that it is not to be wondered at that the Dutch East India Company, who had doubtless paid dearly for their experience, made a standing order for their captains to take in the mainsail and otherwise prepare for a sudden shift of wind when the North-easterly wind set in.

D.—SOUTH-WESTERLY.

Referring to Diagram 2, Plate III., the arrows Q g, R c, and R f represent the extreme forces of these gales.

* According to Buys Ballot's law a S.W. wind in the Southern hemisphere has a relatively high barometer to the westward and low barometer to the eastward of any position where it is blowing. As South-westerly winds are very common near the eastern edge of the Agulhas Bank, it seems evident that there is a tendency for a relatively high barometer to exist over the cold water on and to the westward of the Agulhas Bank, and for a relatively low barometer over the warm water of the Agulhas Stream which runs along the eastern edge of that bank. Such a disposition of pressure would tend to intensify the South-westerly winds which are related to the travelling areas of low pressure already alluded to and help to produce the severe S.W. gales which follow so quickly after N.E. gales, and which form, together with them, the Exceptional Gales on which we are remarking.

† When she was thrown on her beam-ends she was on the port tack heading to the north-westward, so that the South-westerly gale acting on her masts, was laying her over to the north-eastward at the same time that the strong south-westerly current was driving the lower part of her hull to the south-westward. These two forces would tend to put her on her beam-ends and their effect should be considered by those who are handling a ship in this locality.

PLATE V., DIAGRAM 4. (Q g.)

This gale was peculiar in having blown continuously from the West for 20 hours with very little change in the barometer.

The following are extracts from the log:—

11th, 10.30 a.m. - Heavy squalls.

12th, 2 a.m. - Heavy gusts and a heavy W. sea.

Temperature at climax (C) : sea 69°; air 68°.

PLATE V., DIAGRAM 4A. (R c.)

This gale-system had a long continuance of South-westerly wind with a moderately steady barometer. Most of the gale blew during the early part of the South-westerly wind. The weather was squally throughout the whole system.

Temperature at climax (C) : sea 70°; air 71°.

NOTE.—The barometric observations of this log are poor.

PLATE V., DIAGRAM 4B. (R f.)

This gale-system was peculiar in having had an oscillation in the barometer and in the direction and force of the wind by which a South-westerly gale was broken into two parts.

The following are extracts from the log:—

26th, 2 p.m. - Sky quickly overcast by a sheet of rain; the barometer jumped up at the same time.

„ 8 „ - Very heavy squalls. Sea tremendously vicious, confused, and heavy.

27th, 11.30 p.m. - Wind commenced to freshen.

„ Midt. - Very vivid lightning in the N., N.E., and E.

28th, 2 a.m. - Wind freshening quickly to a gale.

E.—EASTERLY.

PLATE V., DIAGRAM 5. (P a.)

This was a very short Easterly gale which blew about the time of the lowest barometric pressure, and was peculiar in having had light Northerly to North-westerly winds as the barometer rose.

The following extracts are from the log:—

25th, 8 p.m. - When the wind fell light and changed to N. by E., there was lightning in the W.

NOTE.—This gale was preceded by clouds, but accompanied by blue sky and mist, with very heavy dew.

TABLE 9.—JANUARY GALES.

NORTH-WESTERLY TO WESTERLY

NORTH-WESTERLY TO WESTERLY

SOUTH-WESTERLY GALES,—

SOUTH-WESTERLY. GALES,—

NORTH-EASTERLY GALES,—

NORTH-EASTERLY GALES,—

SOUTH-EASTERLY GALE,—OUTWARD

SOUTH-EASTERLY GALE,—OUTWARD

SOUTH-EASTERLY GALES,—HOMEWARD BOUND.

SOUTH-EASTERLY GALES.—HOMEWARD

TABLE 9.—JANUARY GALES.

GALES,—OUTWARD BOUND.

GALES,—HOMEWARD BOUND.

OUTWARD BOUND.

HOMEWARD BOUND.

OUTWARD BOUND.

HOMEWARD BOUND.

BOUND. PRECEDED BY NORTHERLY WINDS.

BOUND. PRECEDED BY SOUTHERLY WINDS.

PRECEDED BY NORTHERLY AND WESTERLY WINDS.

BOUND. PRECEDED BY SOUTH-EASTERLY WINDS.

G 2

C.
GALES OF JULY.

Having fully discussed the gales of January (a summer month), it is now proposed to do the same for July (a winter month), and as the July discussion may be consulted when that for January has not been previously read, some important points will be repeated. It may be well to say that the Introductory Remarks (pp. 1 to 10) refer to both months.

C i.
CLASS I.—NORTH-WESTERLY GALES.

The Introductory Remarks (p. 3) show that all gales which blew from N.W., even though some may have veered to S.W., have been classified as North-westerly gales. They also show that most North-westerly and South-westerly gales are related to similar systems of barometric pressure and wind, in which the wind veers from N. or N.W. to S.W., the chief difference being that with gales classed as South-westerly, the North-westerly wind of the system does not attain the force of a gale.

. PLATE VI., DIAGRAM 1.

This diagram represents all the North-westerly gales of July; a line has been drawn separating the gales experienced by outward and homeward-bound vessels; all arrows above this line show the position of gales experienced by vessels going to the westward, whilst those below it represent the gales experienced by vessels going to the eastward. Each arrow shows by its head the position in which the extreme force of its respective gale *commenced*, and the arrow is supposed to fly with the wind, showing the direction at the time of extreme force.

What the extreme force was is shown by the character of the arrow. For further explanation see the lower part of Plate VI.

It will be seen that in some cases the extreme force was from a point to the Southward of West, though the gale had commenced from the North-westward. The trend of the land evidently affects the direction of extreme force in these gales, for it is Northerly off the S.W. coast of Africa, North-westerly to Westerly off the S. coast, and Westerly to South-westerly off the S.E. coast.

NORTH-WESTERLY GALES,—OUTWARD BOUND.

PLATE VII., DIAGRAM 2.*

This diagram represents the *mean* data of the 30 North-westerly gales experienced by outward-bound ships in July.

With the object of discovering any difference depending on longitude the data were separately meaned for each strip of 10° of longitude, and the following table shows the results :—

TABLE 10.

Position.	Number of Gales.	Mean Duration of				Mean Distance made by Ships during Gales (B to E).	
		Preceding Winds,	Gales,	Following Winds,	Systems,		
		or Period from					
		A to B.	B to E.	E. to F.	A. to F.		
Between 10° and 20° E.	10	Hours. 34	Hours. 25	Hours. 38	Hours. 96	Miles. 197	Miles per Hour. = 8.2
„ 20° and 30° E.	10	38	24	25	85	193	= 8.0
„ 30° and 40° E.	10	26	27	40	91	217	= 8.7
General Mean as shown by Diagram 2	—	32	25	35	91	202	= 8.3

The above table shows a remarkable agreement between the different strips of longitude as to the duration of the gales and systems. By comparing Table 10 with Table 1 (p. 12), it will be seen that in the case of N.W. gales met with on the outward passage, the average length of gale-systems is greater in July than in January, though the length of the gales is greatest in January, especially between 20° and 30° E.

WINDS PRECEDING NORTH-WESTERLY GALES,—OUTWARD BOUND.

Table 10 shows that the mean duration of winds preceding North-westerly gales experienced by outward-bound ships (A to B) was 32 hours. The wind-rose on the left side of Diagram 2, Plate VII., gives the percentage of preceding winds from the various points of the compass. The small arrow in the wind-rose shows that these winds veer from N.E. to W. The percentages of preceding winds were calculated for each strip of 10° of longitude, but no important difference was shown between them.

* A general explanation of Plate VII. is given on the margin of Plate VI. Diagram 2 is alluded to before Diagram 1 for the reasons assigned in the footnote to p. 11.

It must be borne in mind that North-westerly gale-systems often follow each other very closely, especially in the winter, and when the barometer has ceased rising at the end of one gale-system it begins to fall for the next, so that the S.W., W., and N.W. winds which blow as the wind is backing under the influence of the advancing gale-system are recorded as preceding winds of the coming gale; this fact accounts for most of the S.W. and W. winds which precede N.W. gales, the winds immediately preceding them being of course Northerly and North-westerly.

DURATION, &C. OF NORTH-WESTERLY GALES,—OUTWARD BOUND.

Table 10 shows that the mean duration of North-westerly gales experienced by outward-bound ships (B to E) was 25 hours; this time was nearly the same for each strip of longitude.

The following table (11) gives further particulars as to the direction of wind during these gales :—

TABLE 11.

Position.	Number of Gales.	Gales North-Westerly throughout.	Mean Direction.	Gales which veered to the South-Westward.	Mean Amount of Veering.
Between 10° and 20° E.	10	2	N.W. by W.	8	N.W. by W. to S.W. by W.
„ 20° and 30° E.	10	5	N.W. by W.	5	W.N.W. to S.W. by W.
„ 30° and 40° E.	10	6	N.W.	4	N.W. by W. to S.W. by W.
Total	30	13	—	17	—

It must be remembered that these are fair-wind gales for outward-bounders, and that during the 25 hours of their mean duration the ships averaged a distance of 202 miles to the eastward, so that as the systems to which the gales were related were also moving to the eastward at a probable speed of 20 to 30 miles an hour, it is reasonable to suppose that the gales lasted longer than they would have done had the ships been hove-to or bound to the westward. This fact is well illustrated by a comparison of the barometer and wind diagrams of steamers steering E. and W. between America and Europe.

As Diagram 2, Plate VII., only represents mean results, it has been thought well to give at the foot of the diagram the order in which the commencements of the gales (B) and their extreme forces (C) occurred in relation to the times of lowest barometric pressure (D). This footnote shows that most of the North-westerly gales met with by outward-bound ships had not only commenced, but their extreme forces had set in before the lowest pressure was experienced. Five of the seven cases in which the extreme force followed the lowest barometric pressure occurred between 20° and 30° E.

WINDS FOLLOWING NORTH-WESTERLY GALES,—OUTWARD BOUND.

Table 10 shows that the average time between the ends of the gales and the following highest pressures (E to F) was 35 hours. This time varied from 25 hours between 20° and 30° E. to 40 hours between 30° and 40° E.

The wind-rose on the right-hand side of Diagram 2, Plate VII., shows that Westerly to South-westerly winds prevailed after the gales were over, and that they frequently veered more Southerly before the barometer had ceased to rise.

SPECIMEN DIAGRAMS OF NORTH-WESTERLY GALES,—OUTWARD BOUND.

Diagrams 2A and 2B of Plate VII. have been selected as specimens; they represent two of the heaviest North-westerly gales experienced by outward-bounders.*

Diagram 2A illustrates the ordinary veering of the North-westerly gales of these latitudes from the North-westward to the South-westward. Such a change indicates that the north-eastern, northern, and north-western sides of an area of low barometric pressure moving in an easterly direction passed over the ship. Diagram (a), p. 8, illustrates the action of the barometer and wind in connexion with such wind-changes. The foot-note to Diagram 2A shows that the wind shifted from N.W. to W. in heavy rain. This sudden shift in rain is very characteristic of these gales, and the change should be prepared for when heavy rain comes with a fast-falling barometer in a North-westerly gale; with the change of wind there generally comes a quick rise of the barometer. A similar change comes when the South-westerly gales of the northern hemisphere shift to W. or N.W.

Diagram 2B gives an instance of the barometer rising briskly whilst the gale was still North-westerly, though it was veering from N.W. to W.byN. during the rise. This fact seems to indicate that the area of low pressure to which the gale was related was moving in a south-easterly direction. The changes of wind and barometer given on Diagram 2B, would be experienced by a ship over which passed a wind-system similar to that represented by Diagram (b), p. 9, along its track No. 2. The extreme force of this gale is represented by the most southern arrow on Diagram 1, Plate VI.

NORTH-WESTERLY GALES,—HOMEWARD BOUND.

PLATE VII., DIAGRAM 1.

This diagram represents the *mean* data of 48 North-westerly gales experienced by homeward-bound ships in July. The geographical positions in which their extreme forces commenced are represented above the dividing line on Diagram 1, Plate VI.

* The position where the extreme force commences (C) is given with each diagram, so that its corresponding arrow can be found on Diagram 1, Plate VI.

As usual, the data have been separately meaned for each strip of 10° of longitude, and the following table shows the results:—

TABLE 12.

Position.	Number of Gales.	Mean Duration of				Mean Distance made by Ships during Gales (B to E).	
		Preceding Winds,	Gales,	Following Winds,	Systems,		
or Period from							
A to B.	B to E.	E to F.	A to F.				
Between 10° and 20° E.	17	Hours. 39	Hours. 27	Hours. 19	Hours. 85	Miles. 34	Miles per Hour. = 1.3
„ 20° and 30° E.	27	24	43	19	86	48	= 1.1
„ 30° and 40° E.	4	23	22	15	60	63	= 2.9
General Mean as shown by Diagram 1, Plate VII. -	—	30	35	19	84	44	= 1.3

A glance at Diagram 1, Plate VI., shows that most of the North-westerly gales were experienced in the western half of the district, and in the neighbourhood of the Agulhas Bank, whilst Table 12 shows that although the mean time which elapsed between the occurrence of the two highest barometer readings (A to F) is nearly the same between 20° and 30° E. as between 10° and 20° E., the duration of gales (B to E) is more than half as long again between 20° and 30° E. as between 10° and 20° E. Many of the long gales exhibit oscillations both in the direction of wind and the height of barometer; for instance, the wind veers to W. or more to the Southward, and the barometer rises slightly, then the wind backs a little to the Northward of W., and the barometer falls again; this will be followed by another veering of wind and rising of the barometer; there are sometimes two or more such changes before the wind falls below the force of a gale. Such gales are very frequent near the Agulhas Bank in July, which may account for the greater duration of gales in that neighbourhood. Diagram 1A, Plate VII., represents the longest of the oscillating gales alluded to; it lasted for five days, during the whole of which time the wind was blowing with the force of a gale, and the diagram shows four oscillations of the barometer. Had there been intervals when the force of the wind was below that of a gale at the times of highest barometer during these oscillations they would have divided the record into several gales.

WINDS PRECEDING NORTH-WESTERLY GALES,—HOMEWARD BOUND.

Table 12 shows that the mean duration of winds preceding North-westerly gales experienced by homeward-bound ships (A. to B.) was 30 hours.

The wind-rose on the left-hand side of Diagram 1, Plate VII., gives the percentage

of these winds, which blew from the various points of the compass. There seems to be a close agreement between these preceding winds and those of North-westerly gales experienced by outward bounders.

DURATION, &C. OF NORTH-WESTERLY GALES,—HOMEWARD BOUND.

Table 12 shows that the average duration of North-westerly gales met with on the homeward route was 35 hours. The table also shows that their mean duration was much greater between 20° and 30° E. than in the other parts of the district. This space includes the strong warm Agulhas current which sets to the south-westward on the eastern edge of the Agulhas Bank where heavy Westerly gales are notorious, especially during the southern winter. The remarks accompanying that table show that these long gales are subject to oscillations in the direction of the wind and in the height of the barometer, though the force of a gale continues throughout. It must be remembered that Westerly gales are opposed to the course of homeward-bound ships, causing them to remain almost stationary, so that no part of the duration of the gale can be imputed to the ship's speed, as in the case of North-westerly gales experienced by outward bounders. In fact the small amount of westing which a ship may chance to make during a gale would tend to shorten its duration, as the gale systems are generally moving to the eastward.

The foot-note to Diagram 1, Plate VII., shows the order of changes in the gales and gives a general idea of the amount of difference which existed between individual gales. The differences are chiefly due to the fact that in several of these homeward-bound North-westerly gales the extreme force did not come until the wind had veered to nearly West, or even to the Southward of West, when the barometer was rising. The tendency for the gales to veer to the Southward increases with the longitude, as does also the tendency for the extreme force to follow the lowest barometric pressure. The diagram shows the mean time of extreme force and of lowest pressure to be the same.

The following Table (13) gives particulars as to the direction of wind during these gales:—

TABLE 13.

Position.	Number of Gales.	Gales north-westerly throughout.	Mean Direction.	Gales which veered to the south-westward.	Mean Amount of Veering.
Between 10° and 20° E.	17	6	N.W.	11	N.W. to S.W. by W.
„ 20° and 30° E.	27	5	W.N.W.	22	N.W. by W. to S.W. by W.
„ 30° and 40° E.	4	1	N.W. by N.	3	N.W. by N. to S. by W.
Totals - -	48	12	—	36	—

WINDS FOLLOWING NORTH-WESTERLY GALES,—HOMEWARD BOUND.

Table 12 shows that the mean duration of winds following the North-westerly gales experienced on the homeward route was 19 hours, and that this mean duration was much the same for each strip of ten degrees of longitude.

The wind-rose on the right side of Diagram 1, Plate VII., shows that the direction of wind following these gales was generally South-westerly, agreeing well with that of winds following the North-westerly gales met with on the outward route. A comparison of the wind-roses for each strip of ten degrees of longitude was made; it showed that winds following the North-westerly gales met with between 30° and 40° E. were more Southerly than elsewhere, indicating that they were affected by the trend of the land.

SPECIMEN DIAGRAMS OF NORTH-WESTERLY GALES,—HOMEWARD BOUND.

Diagrams 1A and 1B of Plate VII. represent the individual data of two of the 48 north-westerly gales of which the mean data are represented in Diagram 1.

Diagram 1A has already been alluded to as a gale which lasted five days, and as representing oscillations of barometer and wind direction which frequently occur in these gales.* The same gale was experienced by another ship about a hundred miles further to the eastward. Her log was not so well kept as that from which Diagram 1A was drawn, but it showed corresponding changes in the barometer and some of the wind oscillations. The gale ended with the more eastern ship about four hours later than with the more western one, indicating that the gale-system had an eastward progress of about 25 miles an hour.

Diagram 1B, Plate VII., represents a case in which a North-westerly gale shifted rather suddenly to W.S.W. after a thunderstorm had passed; it was experienced off the S.E. coast of Africa, where sudden changes are very common, as will be shown when dealing with Exceptional gales. This gale was peculiar in having had a falling barometer after the wind had changed from N.W. to W.S.W. Quotations from the log are given with the Diagram.

The North-westerly gales met with near the Agulhas Bank during the southern winter have a world-wide notoriety, and numerous quotations respecting them might be given from logs, but perhaps one more case will suffice. The following quotations are from the log of a ship in 34° 23' S. 26° 3' E.; see the arrow representing its extreme force on Diagram 1, Plate VI.

- “6th, 6 a.m. Struck by a violent squall, showing its approach by a heavy nimbus rising in the west, with lightning issuing from it.
- 9 a.m. A terrific gale and furious squalls, sea raging wildly.
- Noon. Gale blowing with incredible fury, attended by the same fearful squalls.”

A ship about 115 miles to the westward of this one got the first violent squall about 2 a.m., which indicates that the squall was moving eastwards at a speed of nearly 30 miles an hour.

* Such oscillations frequently appear on the daily weather charts of these islands and Western Europe, where they are shown to be due to small barometric depressions, which are subsidiary to the larger depression that rules the wind generally prevailing at the time.

COMPARISON OF OUTWARD AND HOMEWARD BOUND NORTH-WESTERLY GALES OF JULY WITH EACH OTHER AND WITH THOSE OF JANUARY.

WINDS PRECEDING GALES.

In July the North-westerly gales experienced on both the outward and homeward routes have a large preponderance of North-westerly to Westerly winds preceding them. The same is the case on the outward route in January, but on the homeward route in that month much of the preceding wind is Easterly. The Easterly wind is accounted for by January being a summer month, when the S.E. trades prevail in the northern part of the district.

DURING GALES.

It will be seen that on both the outward and homeward routes North-westerly gales almost invariably commence before the lowest barometric pressure is experienced, and on the outward route the extreme force has generally commenced before that epoch. On the homeward route the extreme force often comes with or even after the lowest barometric reading has been recorded. This difference seems to be related to the fact that on the homeward route the wind generally veers Westwards or even South-westwards before the extreme force blows, and the wind seldom veers to W. before the barometer has commenced rising.

The foot-note to Diagram 1, Plate II., shows that on the homeward route in January the lowest barometric pressure frequently occurs before the N.W. gales commence.

WINDS FOLLOWING GALES.

In both January and July the winds following North-westerly gales lasted longer on the outward than on the homeward route, but especially in July. On both outward and homeward routes they blew from S.W. to S., hence it is reasonable to suppose that winds from these directions will generally follow N.W. gales in all months, and will continue until the barometer has ceased to rise.

DURATION OF GALES AND OF SYSTEMS.

The following table shows the mean duration of North-westerly gales and their systems for the months of January and July. The data are shown graphically in Diagrams 1 and 2 of Plates II. and VII.

TABLE 14.

North-Westerly Gales.					January.	July.
					Hours.	Hours.
Mean duration of Gales experienced by outward-bounders					32	25
" " " homeward-bounders					12	35
Mean duration of Gale-systems experienced by outward-bounders					79	91
" " " homeward-bounders					71	84

Table 14 shows that the longest N.W. gales were experienced on the homeward route in July. Table 12 shows that they were especially long between 20° and 30° E., *i.e.*, in the neighbourhood of the Agulhas Bank. Notwithstanding the fact that N.W. gales are so much longer on the homeward than on the outward route in July, the gale-systems are longer on the outward than on the homeward route.* It has already been said that this difference is probably due to the fact that outward-bound ships run to the eastward in company with the gale-systems which are generally moving quickly in the same direction. Table 14 shows that the shortest N.W. gales were experienced on the homeward route in January, a month when Easterly winds prevail along that route.

BAROMETER.

Diagrams 1 and 2, Plate VII., and Table 22 (p. 94), show that with the N.W. gales met with on the outward route in July, the mean of the lowest barometer readings is about 0·17 inch lower than it is with those met with on the homeward route; this occurs although the extreme force of the gales met with by homeward-bound ships is greater than that of those met with by outward-bounders. The difference is no doubt due to the fact that Westerly winds prevail in the whole district, and that with Westerly winds in the southern hemisphere the barometer must be higher to the northward than to the southward of a given position. It will also be seen that the barometer was decidedly higher during the North-westerly gales of July (the Southern winter), than during those of January (the Southern summer). Part of this difference may be due to the fact that outward-bound ships went further to the southward in January than in July, but this was not the case with homeward-bound ships, and a comparison of the mean barometric pressure over the whole district for the two months (which is given on the Wind Charts), shows that the barometer averages about 0·14 inch higher in July than in January.

GEOGRAPHICAL DISTRIBUTION OF NORTH-WESTERLY GALES.

Diagram 1, Plate VI., shows that North-westerly gales prevail on, and to the westward of, the Agulhas Bank, and that outward-bounders have more of such gales to the southward and south-westward of that Bank, where the warm current meets the cold water to the southward of it, than elsewhere. The January diagram shows the same fact. The diagrams of both months also show that off the S.W. coast of Africa the extreme force of North-westerly gales commences from a more Northerly direction than in other parts of the district, and a comparison of Diagrams 1 and 2, on both Plates I. and VI., shows that the position of most North-westerly gales lies to the westward of that of most South-westerly gales; probably the trend of the land is the chief cause of both these differences.

* The exceptional length of *gales* on the homeward route is no doubt chiefly due to the disturbing effect of the warm water of the Agulhas current.

TABLE 15.—LIGHTNING.

Lightning was recorded in 11 of the 30 outward-bound North-westerly gales as follows:—

Position.	No. of Gales.	Number of Gales in which Lightning was seen.	Time when Lightning was seen, in Hours from Beginning of Gale.		Bearing of Lightning.	Remarks.			
			Before.	After.					
10° to 20° E. -	10	1	Hours. 3	Hours. —	South-eastward.	—			
20° to 30° E. -	10	5	{ 2 5 2 16 16	—	Not recorded.	—			
				—	South-westward.	—			
				—	Westward.	—			
				—	North-westward.	—			
				—	N.	Very bright.			
30° to 40° E. -	10	5	{ 6 — 28 —	3	Westward.	—			
				—	Westward.	—			
				13	Not recorded.	—			
				—	"	—			
				6	"	—			
						8	3		
				30	11				

Lightning was recorded in 12 of the 48 homeward-bound north-westerly gales as follows:—

Position.	No. of Gales.	Number of Gales in which Lightning was seen.	Time when Lightning was seen, in Hours from Beginning of Gale.		Bearing of Lightning.	Remarks.
			Before.	After.		
10° to 20° E. -	17	2	Hours. —	Hours. 2	Not recorded.	—
			—	32	"	—
			4	—	South-eastward to S.S.W.	Corposants on upper yards in middle of gale.
			4	—	South-eastward.	—
			5	—	South-eastward.	—
			12	—	North - westward, south - westward, southward, south-eastward, Zenith.	—
20° to 30° E. -	27	10	—	4	S., South-eastward.	—
			16	—	Eastward.	—
			—	46	Not recorded.	—
			—	20	"	—
			4	—	Southward to south-westward.	Sheet.
			34	—	North-westward.	Sheet.
30° to 40° E. -	4	0	—	—	—	—
			7	5		

NOTE.—The times are recorded in the order of latitude, beginning with the most northern ship which experienced lightning in each 10° strip.

Table 15 shows that in July a larger percentage of lightning was recorded with the N.W. gales met with between 20° and 30° E. (where there is the greatest intermingling of hot and cold water) than elsewhere. Table 15 also shows that lightning was chiefly seen in a westerly direction during N.W. gales met with on the outward route, and in a south-easterly to southerly direction during similar gales experienced on the homeward route.

In January lightning was only recorded three times during the 22 N.W. gales met with, but the three records were made between 20° and 30° E.

WEATHER.

Very severe squalls were common in these gales, especially in those near the Agulhas Bank, and, as before remarked, navigators should be prepared for a rather sudden shift of wind to W. or S.W. when heavy rain comes with a fast falling barometer during a North-westerly gale.

SEA.

The confusion and height of the seas experienced in these gales are notorious, more especially in those near the edge of the Agulhas Bank, where ships have been known to lose their masts through excessive rolling during a calm which followed a gale. On the bank, and out of the current, the sea is more regular, though often very high. With the gale represented by Diagram 2A, Plate VII., a sea 45 feet high was remarked upon, and Admiral FitzRoy stated, by a note in the log recording the fact, that he had measured a sea 60 feet high.

TABLE 22.

Table 22 (p. 94) gives a comparative summary of the principal facts relating to the July gales. Table 9 (p. 50) gives a similar summary for January, affording an opportunity for comparing the principal facts relating to summer and winter gales.

C ii.

CLASS II.—SOUTH-WESTERLY GALES.

PLATE VI., DIAGRAM 2.

This diagram represents the position of the ship, the extreme force and direction of the wind at the time when the extreme force commenced, of each South-westerly gale experienced in July. The arrows below the dividing line represent gales met with by ships on the outward passage, whilst those above it represent gales experienced on the homeward passage.

SOUTH-WESTERLY GALES,—OUTWARD BOUND.

PLATE VII., DIAGRAM 4.

This diagram represents the mean data of 19 South-westerly gales experienced by outward-bounders in July. The geographical positions in which their extreme forces commenced will be found below the line dividing the arrows on Diagram 2, Plate VI. The data have, as usual, been separately meaned for each strip of 10° of longitude, and the following table (16) shows the results:—

TABLE 16.

Position.	Number of Gales.	Mean Duration of				Mean distance made by Ships during Gales (B to E).	
		Preceding Winds,	Gales,	Following Winds,	Systems,		
		or Period from					
		A to B.	B to E.	E to F.	A. to F.		
Between 10° and 20° E.	7	Hours. 46	Hours. 18	Hours. 17	Hours. 81	Miles. 181	Miles per Hour. = 10·1
„ 20° and 30° E.	8	45	21	20	86	175	= 8·3
„ 30° and 40° E.	4	44	26	11	81	193	= 7·4
General Mean as shown by Diagram 4, Plate VII. -	—	45	21	17	83	181	= 8·7

The above table shows a very fair agreement between the gales met with in the different strips of longitude, considering the small number of gales experienced.

WINDS PRECEDING SOUTH-WESTERLY GALES,—OUTWARD BOUND.

Table 16 shows that the mean duration of winds preceding South-westerly gales (A to B) was 45 hours. Table 10 (p. 54) shows that with the North-westerly gales met

with on the outward route the preceding winds lasted only 32 hours. It has already been said, when speaking of the gales of January, that this difference arises from the fact that N.W. gales generally commence in the early part of a gale-system when the barometer is falling, whilst S.W. gales very commonly do not commence until the barometer has risen for some hours.

The wind-rose on the left side of Diagram 4, Plate VII., gives the percentages of the various winds which preceded these gales, and shows that (as in the case of N.W. gales) they were chiefly North-westerly, *i.e.*, veering from N. to W. Between 10° and 30° E. there was very little difference in the direction of the preceding winds, but between 30° and 40° E. they were more Southerly in direction than they were further to the westward.

DURATION, &c. OF SOUTH-WESTERLY GALES,—OUTWARD BOUND.

Table 16 shows that the mean duration of S.W. gales met with on the outward route was 21 hours; it also shows that they lasted longer on the eastern than on the western side of the district. Table 17 gives particulars respecting the direction of the wind during these gales. It shows that most of the gales veered a few points to the Southward during the time they were blowing, and that those met with between 30° and 40° E., were more Southerly in direction than those experienced further to the westward.

TABLE 17.

Position.	No. of Gales.	Not Changing.		Veering.		Backing.		Veering and Backing.	
		No.	Mean Direction.	No.	Mean Amount.	No.	Mean Amount.	No.	Mean Direction.
10° to 20° E.	7	0	—	5	W. by S. to S.W. by S.	2	S.W. to W.S.W.	0	—
20° to 30° E.	8	4	W. by S.	4	W. by S. to S.W.	0	—	0	—
30° to 40° E.	4	1	S.W.	2	S.W. by W. to S. by W.	0	—	1	S.W. by W.
Total	19	5	—	11	—	2	—	1	—

WINDS FOLLOWING SOUTH-WESTERLY GALES,—OUTWARD BOUND.

Table 16 shows that the mean duration of winds following the S.W. gales experienced on the outward route (E. to F.) was 17 hours. The wind-rose on the right side of Diagram 4, Plate VII., gives the percentages of the various winds which followed these gales, and shows that the wind frequently veers to S. before the barometer ceases to rise after a S.W. gale. The following winds, as well as the preceding winds and the gales just mentioned, *i.e.* the whole gale-systems, were found to be more Southerly in direction on the eastern than on the western side of the district.

SPECIMEN DIAGRAMS OF SOUTH-WESTERLY GALES,—OUTWARD BOUND.

Diagram 4A., Plate VII., represents a S.W. gale which commenced as the barometer was falling; the foot-note to Diagram 4 shows that there were 6 such gales amongst

the 19 experienced on the outward route in July, whilst the foot-note to Diagram 3 shows that 19 of the 34 S.W. gales met with on the homeward route in July commenced before the lowest barometer reading was recorded. This fact will be alluded to when comparing the S.W. gales of January and July. The commencement of the extreme force of the gale represented by Diagram 4A, was experienced about a degree to the southward of the Agulhas Bank. It is one of the gales which did not change in direction.

Diagram 4B represents a S.W. gale in which the wind blew for 16 hours from S. by W. with a rising barometer, and then backed to W.S.W. with a falling barometer. Had the force of the wind fallen below that of a gale at the time of high barometer before the wind backed to W.S.W., the data of Diagram 4B would have been treated as two gales, in which case the last one would have been classed (like that represented by Diagram 4A) as a S.W. gale which commenced with a falling barometer. It has been already said that this backing of the wind in a gale accompanied by a second fall in the barometer is probably caused by a small subsidiary area of low barometric pressure moving round the larger one to which the first part of the gale was related. Such subsidiary depressions causing corresponding changes in the wind are frequently shown on Daily Weather Charts for Europe.

SOUTH-WESTERLY GALES,—HOMEWARD BOUND.

PLATE VII., DIAGRAM 3.

This diagram represents the mean data of thirty-four South-westerly gales experienced by homeward-bound ships in July. The geographical positions where their extreme forces commenced are represented by the points of the arrows above the line which divides the arrows on Diagram 2, Plate VI. The following table gives the mean duration of the different parts of the gale-systems for each strip of 10° of longitude:—

TABLE 18.

Position.	Number of Gales.	Mean Duration of				Mean Distance made by Ships during Gales (B to E).	
		Preceding Winds,	Gales,	Following Winds,	Systems,		
		or Period from					
		A to B.	B to E.	E to F.	A to F.		
Between 10° and 20° E.	2	Hours.	Hours.	Hours.	Hours.	Miles.	Miles per Hour.
„ 20° and 30° E.	19	70	10	19	99	20	= 2.0
„ 30° and 40° E.	13	38	23	17	78	45	= 2.0
		46	24	15	85	34	= 1.4
General Mean, as shown by Diagram 3 }	—	43	22	17	82	39	= 1.7

WINDS PRECEDING SOUTH-WESTERLY GALES,—HOMEWARD BOUND.

Table 18 shows that the mean duration of winds preceding the S.W. gales experienced on the homeward-route (A to B) was 43 hours.

The wind-rose on the left side of Diagram 3, Plate VII., shows that these winds ranged from N.E. to N.W. and W., whilst a comparison of the individual diagrams shows that there were more North-easterly and Northerly winds preceding the S.W. gales which were met with between 10° and 20° E. and between 30° and 40° E. than there were preceding those met with between 20° and 30° E. Between 20° and 30° E. the winds preceding such gales were chiefly North-westerly to Westerly. The two S.W. gales met with between 10° and 20° E. had respectively 91 hours and 50 hours of preceding winds; the former were chiefly Easterly to North-easterly in direction, whilst the latter gradually veered from N.E. through N. to W.

DURATION, &c. OF SOUTH-WESTERLY GALES,—HOMEWARD BOUND.

Table 18 shows that the mean duration of South-westerly gales experienced on the homeward-route (B to E) was 22 hours. The two gale-systems met with between 10° and 20° E., which had such very long preceding winds, had very short gales, the one lasting only 8, the other 12 hours. The shortness and small number of S.W. gales met with between 10° and 20° E. indicate that the local circumstances in July are unfavourable for such gales.

The following table gives the particulars as to the direction of wind during these gales:—

TABLE 19.

Position.	No. of Gales.	Not Changing.		Veering.		Backing.		Veering and Backing	
		No.	Mean Direction.	No.	Mean Amount.	No.	Mean Amount.	No.	Mean Direction.
10° to 20° E.	2	—	—	2	W.S.W. to S.S.W.	—	—	—	—
20° to 30° E.	19	3	W. by S.	14	W. by S. to S.S.W.	—	—	2	W.S.W.
30° to 40° E.	13	3	S.W. by S.	7	S.W. by W. to S.S.W.	3	S.S.W. to S.W.	—	—
Total	34	6	—	23	—	3	—	2	—

Table 19 shows that most of the gales veered about five points to the Southward during the time they were blowing.

WINDS FOLLOWING SOUTH-WESTERLY GALES,—HOMEWARD BOUND.

Table 18 shows that the mean duration of winds following the S.W. gales experienced on the homeward route (E. to F.) was 17 hours.

The wind-rose on the right side of Diagram 3, Plate VII. shows that these winds were chiefly South-westerly to South-easterly in direction. A comparison of the individual diagrams shows that they were much more Westerly between 20° and 30° E. than elsewhere in the district; this was also the case with the winds preceding these gales;

it has already been remarked that the difference is probably due to the trend of the land.

SPECIMEN DIAGRAMS OF SOUTH-WESTERLY GALES,—HOMEWARD BOUND.

Diagram 3A, Plate VII., represents the data of a gale which was met with in $34^{\circ} 35' S.$, near the S.E. coast of Africa; it shows that the extreme force came after the barometer had commenced rising; it also shows that the barometer oscillated a good deal during the gale. The remarks from the log which accompany the diagram record "terrific hail squall and a frightful cross sea."

Diagram 3B, Plate VII., represents the data of a gale which was experienced on the Agulhas Bank in 22° E. The wind was South-westerly throughout the whole gale-system, and the extreme force commenced before the lowest barometer was recorded.

Diagram 3c, Plate VII., represents the data of a gale which blew in $31^{\circ} 50' S.$, near the S.E. coast of Africa. It commenced by a sudden shift of wind from N.N.E. to S.S.W. in a fearful squall. It has already been remarked that shifts of wind from N.E. to S.W. are common in this part of the sea. When the wind has the force of a gale from both directions, then the two parts are classed as one Exceptional gale.

COMPARISON OF OUTWARD AND HOMEWARD-BOUND SOUTH-
WESTERLY GALES OF JULY WITH EACH OTHER AND WITH
THOSE OF JANUARY.

WINDS PRECEDING GALES.

In July the winds which precede South-westerly gales on the outward route generally range between N. and W., whilst the corresponding winds on the homeward route range between N.E. and S.W. through N. and W. In January the preceding winds are more Easterly than in July, as might be expected considering that January is a summer month.

DURING GALES.

The foot-notes to Diagrams 3 and 4, Plate VII. show that, in July, S.W. gales generally commence before the lowest barometer reading is recorded, but that the extreme force generally comes after the barometer has been rising for some time.

In January S.W. gales generally commence after the barometer has begun to rise.

As the wind veers from W. to S.W. in the Southern Hemisphere the barometer generally rises, this fact is well illustrated by Diagram (a.) p. 8; it accounts for S.W. gales which are accompanied by a rising barometer; but S.W. gales accompanied by a falling barometer are not so easily accounted for; they seem to be due to the fact that the area of low barometric pressure to which they are related is in the act of becoming deeper, or they may be due to "secondary disturbances" causing an oscillation in the barometer and wind as illustrated by Diagram 4B, Plate VII., and explained in the remarks on that diagram (*see* p. 66).

WINDS FOLLOWING GALES.

In both January and July the winds following S.W. gales were generally more Southerly in direction on the homeward than on the outward route. They lasted a much shorter time in July than in January, indicating that gale-systems follow each other more quickly in winter than in summer.

DURATION OF GALES AND OF SYSTEMS.

The following table shows the relative mean duration of South-westerly gales and of their systems during the months of January and July. These data are shown graphically in Diagrams 3 and 4 of Plates II. and VII.

TABLE 20.

South-Westerly Gales.				January.	July.		
				Hours.	Hours.		
Mean duration of south-westerly gales experienced by outward-bounders				-	-	26	21
" " " homeward-bounders				-	-	20	22
Mean duration of south westerly gale-systems experienced by outward-bounders				-	-	114	83
" " " homeward-bounders				-	-	89	82

Table 20 shows that the longest S.W. gales were experienced on the outward route in January, and Table 5 shows that their lengths in that month were much the same in each strip of 10° of longitude. January had also the longest S.W. gale-systems. In July the gales and gale-systems both of the outward and homeward routes agreed respectively in length.

BAROMETER.

Diagrams 3 and 4, Plate VII., and Table 22 (p. 94), show that the mean of the lowest barometric pressures recorded during S.W. gales met with on the outward route is about $\cdot 2$ of an inch lower than the corresponding mean of pressures recorded on the homeward route; this, as already remarked, when speaking of N.W. gales, is probably due to difference of latitude. A comparison of Tables 9 (p. 50) and 22 (p. 94) shows that the S.W. gales of January (both on the outward and homeward routes) are accompanied by lower barometer readings than the corresponding gales of July. It has already been remarked that the Barometer Charts show that the mean barometric pressure over the whole district under discussion is about $0\cdot 14$ of an inch higher in July than it is in January.

GEOGRAPHICAL DISTRIBUTION OF SOUTH-WESTERLY GALES.

Diagram 2, Plate VI., shows that on both the outward and homeward routes the S.W. gales of July were most frequent over the warm water which is met with on the E. and S. sides of the Agulhas Bank. In January the mean outward route lay nearly 4° to the southward of that in July, and therefore further from the region of

warm water, the result being that there was no special grouping of the S.W. gales met with by outward-bound ships in January, but they were pretty equally distributed in longitude.

TABLE 21.—LIGHTNING.

Lightning was recorded in 7 of the 19 outward-bound South-westerly gales as follows:—

Position.	Number of Gales.	Number of Gales in which Lightning was seen.	Time when Lightning was seen, in Hours, from Beginning of Gale.		Bearing of Lightning.	Remarks.
			Before.	After.		
10° to 20° E. -	7	3	Hours. 12 — —	Hours. — 10 2	Not recorded. " "	— — —
20° to 30° E. -	8	3	24-10 — —	— 4 —	W., S.W., and S. All round. South-westward.	Much thunder and lightning. Much thunder and lightning. —
30° to 40° E. -	4	1	— — —	— 4 —	South-eastward.	—
	19	7	3	4		

Lightning was recorded in 13 of the 34 homeward-bound S.W. gales as follows:—

Position.			Hours.			
			Hours.	Hours.		
10° to 20° E. -	2	—	— 4 13	— — —	Not recorded. W. by S. to S. All round.	— — Much dull sheet lightning.
20° to 30° E. -	19	6	20 — — — — 8 16 6	— 10 11 4 — — —	Eastward. Not recorded. Southward. South westward. Westward. South-westward to North-westward.	— — Faint. Vivid lightning. — Very vivid lightning.
30° to 40° E. -	13	7	4 — 5 1	— 4 — —	Not recorded. " " Eastward.	— — — —
	34	13	9	4		

NOTE.—The above times are recorded in the order of latitude, beginning with the most Northern ship which experienced lightning in each 10° strip.

Table 21 shows that in July the largest percentage of lightning was seen on the homeward route, and between 30° and 40° E. ; whilst Table 8 shows that in January it occurred on the same route, but between 20° and 30° E.

WEATHER.

The specimen diagrams show that the South-west gales of July were accompanied by " terrific hail-squalls," " hurricane-like squalls," " furious squalls and rain," &c. " Terrific squalls " were also recorded with the South-west gales of January.

SEA.

The very high sea accompanying South-west gales is notorious, more especially in those experienced by homeward-bounders near the south-eastern edge of the Agulhas Bank, where the wind and current are opposed to each other, and where Diagram 2, Plate VI., shows that the gales are most abundant.

TABLE 22.

Table 22 (p. 94) gives a comparative summary of the principal facts relating to these gales in July. Table 9 (p. 50) gives a similar summary for January. These tables afford an opportunity for comparing the gales of a summer with those of a winter month.

C iii.

CLASS III.—NORTH-EASTERLY GALES.

PLATE VI., DIAGRAM 3.

This diagram represents the position of the ship, the direction and extreme force of the wind at the time when the extreme force commenced for each North-easterly gale recorded in July. Here it may be well to remark that, although there are only five North-easterly gales represented on Diagram 3, Plate VI., there were several gales which commenced at N.E. and changed suddenly to South-westerly or Southerly gales. These have been dealt with as "Exceptional gales," and will be found on Diagram 2, Plate VIII. They were generally experienced in the same part of the sea as North-easterly gales.

NORTH-EASTERLY GALE,—OUTWARD BOUND.

There was only one N.E. gale met with on the outward route in July, the position of the ship when its extreme force commenced is shown by the arrow below the dividing line on Diagram 3, Plate VI.

PLATE VII., DIAGRAM 6.

This diagram represents the only North-easterly gale met with on the outward route in July. It shows that the gale commenced with a falling barometer and ended before the lowest barometer reading occurred. As the point of lowest barometric pressure passed over the ship, the wind veered to N., and as the barometer rose it veered to N.W. Referring to Diagram (b), p. 9, its No. 2 arrow illustrates these changes of wind and barometer by supposing a cyclonic wind system to pass over a ship on a S.E. track. The diagram of this N.E. gale resembles Diagram 5, Plate IX., (an Exceptional gale), the chief difference between them being that Diagram 5 shows stronger winds than Diagram 6, Plate VII., and its N.W. wind attained the force of a gale.

NORTH-EASTERLY GALES,—HOMEWARD BOUND.

PLATE VII., DIAGRAM 5.

This diagram represents the mean data for the four North-easterly gales experienced by homeward-bounders, which are shown in position by arrows above the dividing line on Diagram 3, Plate VI.

WINDS PRECEDING NORTH-EASTERLY GALES,—HOMEWARD BOUND.

The wind-rose on the left side of Diagram 5, Plate VII., shows that all the winds preceding these gales were North-easterly in direction. The space from A to B on the diagram shows that their mean duration was 16 hours.

DURATION, &c. OF NORTH-EASTERLY GALES,—HOMEWARD BOUND.

The space from B to E on Diagram 5, Plate VII., shows that the mean duration of these gales was nine hours. They were all of nearly the same length, their mean direction was N.N.E., and the wind was steady in direction, seldom changing more than two points during the gale. The gales commenced with a falling barometer and ceased before the lowest reading was recorded. When they ceased the fall of the barometer became less rapid than before. One attained the force of 10, the other three only the force of 8. No squalls were reported with them.

WINDS FOLLOWING NORTH-EASTERLY GALES,—HOMEWARD BOUND.

The space between E and F on Diagram 5, Plate VII., shows that the winds following the N.E. gales, met with on the homeward route, lasted 47 hours. The wind-rose on the right side of the diagram shows that after the gales the wind veered by N. through W. and S.W. to South, the barometer rising as the wind went to W. and S.W. These following winds were very similar in the three gales which were met with near the S.E. coast of Africa, but the winds following the gale which blew near the south-eastern edge of the Agulhas Bank, and which is represented by Diagram 5A, Plate VII., were chiefly North-westerly and Westerly; this difference in direction gives another illustration of the wind's tendency to draw along the neighbouring land.

SPECIMEN DIAGRAMS OF NORTH-EASTERLY GALES,—HOMEWARD BOUND.

Diagrams 5A and 5B, Plate VII., well represent this type of gale. It has already been remarked that the winds following 5A were more Westerly in direction than those following 5B, possibly in accordance with the trend of the nearest land.

COMPARISON OF OUTWARD AND HOMEWARD-BOUND NORTH-EASTERLY GALES OF JULY WITH EACH OTHER AND WITH THOSE OF JANUARY.

There is great similarity between the North-easterly gales met with on the outward and homeward routes in both January and July. They set in shortly after the barometer has commenced falling, they are of short duration, and generally end before, or at the time of, the lowest barometer reading. They are followed by North-westerly to South-westerly winds. The following table gives the mean duration of N.E. gales

and of their systems during the two months. It shows that the gales are longer, though the systems are shorter, in winter than in summer.

North-Easterly Gales.	January.	July.
	Hours.	Hours.
Duration of a North-easterly gale experienced by an outward-bounder in each month -	4	6
Mean duration of North-easterly gales experienced by homeward-bounders -	4	9
Duration of a North-easterly gale-system experienced by an outward-bounder in each month	69	60
Mean duration of North-easterly gale-systems experienced by homeward-bounders -	78	72

Tables 9 (p. 50) and 22 (p. 94) show that N.E. gales are moderate in force, as the force of 10 was only once attained in either month—it occurred on the homeward route in July.—The force of 9 was also only once experienced—it was met with on the homeward route in January.—In both cases the gales were met with near the south-eastern edge of the Agulhas Bank.

It must be remembered that N.E. gales which are followed by N.W., or more generally by S.W., gales, as the barometer rises, have been classed as “Exceptional Gales,” and have been discussed separately.

BAROMETER.

The diagrams show that N.E. gales are generally accompanied by a relatively high, though falling, barometer. Diagram 5, Plate VII., shows that with homeward-bounders in July the N.E. gales had ended before the barometer had fallen below 30 inches.

Tables 9 and 22 show that in both months the barometer was higher during N.E. gales met with on the homeward than during those met with on the outward route. These tables also show that the barometer was about .2 of an inch higher during the N.E. gales of July (the winter) than it was during those of January (the summer).

GEOGRAPHICAL DISTRIBUTION OF N.E. GALES.

The diagrams numbered 3 on Plates I. and VI. show that in both January and July North-easterly gales are met with off the S.E. coast of Africa. The “Exceptional Gales” (already alluded to) which commence from N.E., also prevail in that part of the district. It has already been remarked that the Wind Charts of the district show that N.E. winds which do not attain the force of a gale also prevail there.

LIGHTNING.

No lightning was recorded with any of the N.E. gales in July, but in January it was recorded in 5 out of 7. This was probably summer lightning which was seen in the N.W. over the land.

WEATHER.

The weather seems to have been generally fine during the N.E. gales of both January and July. Once, in January, gusts were reported, but squalls are not mentioned.

SEA.

Heavy seas from N.E. were not reported either in January or July, but a heavy swell from the W. or S.W. often meets a N.E. gale and causes a confused sea.

TABLE 22.

Table 22 (p. 94) gives a comparative summary of the principal facts relating to these gales, and Table 9 (p. 50) gives a similar summary for January.

C iv.

CLASS IV.—SOUTH-EASTERLY GALES.

PLATE VIII., DIAGRAM 1.

This diagram represents for each South-easterly gale experienced in July the position of the ship, extreme force, and direction of the wind at the time when the extreme force commenced. It will be seen that two arrows fly from S. by W.; this arises from the fact that, although their extreme forces commenced at S. by W., the gales were chiefly South-easterly in direction.

S.E. gales are divided into two classes, viz.:—

- (a.) Those which are preceded by Northerly or Westerly winds. Their arrows are distinguished by asterisks.
- (b.) Those which are preceded by South-easterly winds.

SOUTH-EASTERLY GALES,—OUTWARD BOUND.

The eight arrows below the dividing line on Diagram 1, Plate VIII., represent the S.E. gales met with on the outward route in July; of these five were preceded by Northerly or Westerly winds and three by South-easterly winds.

SOUTH-EASTERLY GALES PRECEDED BY NORTHERLY OR WESTERLY WINDS,—OUTWARD BOUND.

Diagram 2, Plate IX., represents the mean data of the five South-easterly gales which were preceded by Northerly or Westerly winds. It shows that the mean duration of the North-westerly winds preceding these gales (A to B) was 55 hours. The foot-note to the diagram shows that four of the five gales did not commence until the barometer had begun to rise, which accounts for the long duration of the preceding winds. The wind-rose on the left side of the Diagram shows that these winds ranged between N. and W.

DURATION OF SOUTH-EASTERLY GALES PRECEDED BY NORTHERLY OR WESTERLY WINDS,—OUTWARD BOUND.

Diagram 2, Plate IX., shows that the mean duration of the five South-easterly gales, preceded by Northerly or Westerly winds (B to E), was 21 hours. They varied from 4 to 44 hours in length, and three of the five were about 17 hours long.

During one of these gales the wind veered four points to the Eastward; during two it did not change, whilst during the other two it was nearly steady, as it only backed one and two points respectively to the Southward.

WINDS FOLLOWING SOUTH-EASTERLY GALES PRECEDED BY NORTHERLY OR WESTERLY WINDS,—OUTWARD BOUND.

Diagram 2, Plate IX., shows that the mean duration of winds following these gales (E to F) was 21 hours. The wind-rose on the right side of the Diagram shows that they were chiefly South-easterly in direction.

SOUTH-EASTERLY GALES PRECEDED BY SOUTH-EASTERLY WINDS,—OUTWARD BOUND.

Diagram 3, Plate IX., shows that the mean duration of the South-easterly winds preceding these gales (A to B) was 11 hours. The wind-rose on the left side of the Diagram shows that they remained steady from S.E.

DURATION OF SOUTH-EASTERLY GALES PRECEDED BY SOUTH-EASTERLY WINDS,—OUTWARD BOUND.

Diagram 3, Plate IX., shows that the mean duration of the three South-easterly gales preceded by South-easterly winds (B to E) was 51 hours. During each gale the wind backed about six points, the barometer beginning to rise, with the wind about S., as in the case of Diagram 3A. The changes of wind and action of the barometer in these gales seem to indicate that cyclonic systems on easterly or south-easterly tracks passed over the ships, and that their centres passed to the northward of the ships. Arrow No. 3 of Diagram (b), p. 9, illustrates such a case. In the case represented by Diagram 3A, Plate IX., the wind veered to S.E. again before the gale ended, but the other two ended at S. by W.

The three gales were accompanied by thunder and lightning, in two it was violent with very heavy rain; in one the shift to S.S.W. was sudden, and came with the extreme force of 9. In the same gale, after the barometer had risen and the gale had ended, a slight and sudden fall of the barometer occurred, accompanied by a very severe thunderstorm, and a sudden shift of wind from N.W. to S.W. in a furious gust, which immediately moderated.

WINDS FOLLOWING SOUTH-EASTERLY GALES PRECEDED BY SOUTH-EASTERLY WINDS,—OUTWARD BOUND.

Diagram 3, Plate IX., shows that the mean duration of winds following these gales (E to F) was 36 hours, and the wind-rose on the right side of the diagram shows that their direction was chiefly South-easterly.

SPECIMEN DIAGRAMS OF SOUTH-EASTERLY GALES,—OUTWARD BOUND.

Diagram 2A, Plate IX., represents a South-easterly gale which was preceded by a Northerly to North-westerly wind. The remarks accompanying the diagram show that the change from N.W. to S.E. occurred in a squall, and was preceded by lightning.

Diagram 3A, Plate IX., represents a South-easterly gale which was preceded by a South-easterly wind. It will be seen that during the gale the wind backed to S.S.W. with a falling barometer, and veered to the South-eastward again as the barometer rose.

SOUTH-EASTERLY GALES,—HOMEWARD BOUND.

The four arrows above the dividing line on Diagram 1, Plate VIII., represent all the South-easterly gales which were experienced by homeward-bound ships in July. As in the case of those met with on the outward route, they belong to two classes, viz. :—

- (a.) Those which are preceded by Northerly or North-westerly winds, their arrows are distinguished by asterisks.
- (b.) Those which are preceded by South-easterly winds.

SOUTH-EASTERLY GALES PRECEDED BY NORTHERLY OR WESTERLY WINDS,—HOMEWARD BOUND.

Diagram 1, Plate IX., represents the mean data of the three South-easterly gales experienced by homeward-bounders which were preceded by Northerly or Westerly winds.

It shows that the mean duration of winds preceding these gales (A to B) was 56 hours. The foot-note to the Diagram shows that none of them commenced until the barometer had begun to rise, which accounts for the long duration of the preceding winds. The wind-rose on the left side of the diagram shows that the direction of these winds ranged from N.E. through N. to W. and S.W.

DURATION OF SOUTH-EASTERLY GALES PRECEDED BY NORTHERLY OR WESTERLY WINDS,—HOMEWARD BOUND.

Diagram 1, Plate IX., shows that the mean duration of the three South-easterly gales preceded by Northerly or Westerly winds, which were met with on the homeward route (B to E) was 9 hours; their lengths range from 6 to 14 hours. During two the wind remained steady throughout, in one from S.E. by E., in the other from S. by E., whilst in the third it backed from E.S.E. to S.S.E., as shown by diagram 1A, Plate IX.

WINDS FOLLOWING SOUTH-EASTERLY GALES PRECEDED BY NORTHERLY OR WESTERLY WINDS,—HOMEWARD BOUND.

Diagram 1, Plate IX., shows that the mean duration of these winds (E to F) was 27 hours. The wind-rose on the right side of the diagram shows that nearly all were South-easterly.

SPECIMEN DIAGRAMS OF SOUTH-EASTERLY GALES,—HOMEWARD BOUND.

Diagram 1A, Plate IX., represents one of the three South-easterly gales which were preceded by Northerly or Westerly winds. The position of the ship when the extreme force commenced is shown on Diagram 1, Plate VIII., by a thick black arrow near the south-eastern edge of the Agulhas Bank. Besides the remarks which accompany the diagram, the following report was made by the keeper of the log, Mr. Samuel Hodding, Second Officer of the P. & O. Company's barque "Indus" :—

"Weather experienced on the night of the 18th and morning of the 19th of July 1868 in about lat. $36^{\circ} 30'$ S. and long. $22^{\circ} 30'$ E. It had been blowing N.N.W., force 7, from noon of the 18th with a heavy confused sea. The wind moderated quickly after 8 p.m., and the sea became more and more confused. At 9.30 p.m. it fell absolutely calm, with a perfect mountain of a sea running, which caused the ship to roll in a most alarming manner, and to take on board immense bodies of water. Soon after 10 p.m. a light breeze, made in puffs from the S.S.E., which freshened and enabled us to get the ship off the wind to bow the sea, as she momentarily threatened to roll the masts away. The night was dark and gloomy, with lightning at intervals in every quarter."

"The breeze rapidly freshened, and shortly after midnight a hard South-easterly gale burst on us with incessant violent squalls of hail and rain, accompanied by thunder and vivid blinding lightning. The sea was most heavy and confused, rolling on board in large masses, this, with the violent motion of the ship, causing the water to rush from side to side with a force that threatened to wash away everything it came across. The gale increased, and the roar of the wind stifled every other sound but the thunder, which (taking place immediately after the flash) could only be faintly heard at times during the height of the storm."

"The sea, which had become highly luminous, presented a very imposing appearance. . . . The ship steered wildly, an unusual thing for her even in the heaviest seas, . . . and at 2.30 a.m., 19th, she broached-to and obliged us to round-to under storm canvas."

"The ship, although hove-to, continued to take in tons of water over both rails."

"Corposants were seen at the mastheads and upper yardarms until daybreak, when the wind and sea first began to moderate. The storm in its full strength lasted six hours, during which time the ship remained in a very critical state, principally on account of the awful sea which rolled on board and loaded the decks with a weight of water that would have burst the hatches of many ships built less strongly."

"The barometer and thermometer gave good warning of the bad weather, and fortunately we were well prepared."

"I much regret that the instrumental observations recorded in the register have been so meagre, especially with regard to the sea temperature, for by reference to the log it may be seen that the bad weather took place at the meeting of the Mozambique and Polar currents. No observations being taken between midnight, 18th, when the surface temperature was 67° , and noon, 19th, when it was 58° . I cannot say whether the change from warm to cold was sudden or not, but think we did not get into cold water until after daybreak, as everybody observed during the night how warm the sea was that washed about the deck."

In St. Helena Mr. Hodding learnt that "the Dutch barque 'Stad Leyden' was close to the land on the night of the 18th, and only experienced a heavy squall of four hours' duration." This fact supports the opinion so generally held, viz., that the gales are much more severe near the edge of the Agulhas Bank than they are on the bank itself and near the land.

Diagram 1b, Plate IX., represents the only South-easterly gale preceded by South-easterly winds which was recorded by homeward-bounders in July. It was experienced off the S.W. coast of Africa and was one of the fine-weather gales which are met with in this part of the sea and often end in the S.E. trades. Further particulars respecting this kind of gale are given with the January remarks (*see* p. 37).

COMPARISON OF OUTWARD AND HOMEWARD-BOUND SOUTH-EASTERLY GALES OF JULY WITH EACH OTHER AND WITH THOSE OF JANUARY.

SOUTH-EASTERLY GALES PRECEDED BY NORTHERLY OR WESTERLY WINDS.

The S.E. gales preceded by Northerly or Westerly winds which were met with on the outward and homeward routes in July were very similar in their character, as shown by Diagrams 1A and 2A, Plate IX. These gales were preceded by a rather sudden change of wind from N.W. to S.E. after the lowest barometer reading had occurred.

The following Table (a) shows their mean duration, and the mean duration of the gale-systems which comprise them. From it we learn that South-easterly gales preceded by Northerly or Westerly winds are much longer in duration on the outward than on the homeward route. Also that they are much longer in July than in January. The gale-systems are also longer on the outward than on the homeward route.

TABLE (a).

South-Easterly Gales preceded by Northerly or Westerly Winds.	January.		July.	
	No. of Gales and Systems.	Mean Duration.	No. of Gales and Systems.	Mean Duration.
Gales met with by outward-bound ships	-	Hours.		Hours.
" " homeward-bound ships	1	11	5	21
	2	6	3	10
Gale-systems met with by outward-bound ships	1	104	5	97
" " homeward-bound ships	2	70	3	92

SOUTH-EASTERLY GALES PRECEDED BY SOUTH-EASTERLY WINDS.

The S.E. gales of this district which are preceded by South-easterly winds are of two distinct characters, viz. :—

- (1.) Bad-weather gales.—These are accompanied by a decided fall of the barometer and stormy weather, such as lightning and squalls. They are sometimes very severe, and are probably related to the south-western sides of cyclonic systems which are advancing to the south-eastward. These gales differ very materially from the S.E. gales which are preceded by Northerly or Westerly

winds, for they commence as the barometer is falling, and last very much longer. January has only one and July has three of these gales; all recorded in the two months were met with on the outward route.

- (2.) Fine-weather gales.—These are generally confined to the neighbourhood of the S.W. coast of Africa, where they are related to the “South-easters” which are common in Table Bay and False Bay, more especially in the summer, and may almost be considered to be the S.E. Trades intensified by local circumstances. January has three and July only one of these gales.

The following Table (b) shows that the bad-weather S.E. gales which are preceded by South-easterly winds last more than twice as long as the fine-weather S.E. gales of the same class.

TABLE (b).

South-Easterly Gales preceded by South-Easterly Winds.	January.		July.	
	No. of Gales and Systems.	Mean Duration.	No. of Gales and Systems.	Mean Duration.
Gales met with by outward-bound ships	1*	Hours.	3*	Hours.
" " homeward-bound ships	3†	42	1†	51
		16		24
Gale-systems met with by outward-bound ships	1*	112	3*	98
" " homeward-bound ships	3†	105	1†	112

* These were bad-weather South-easterly Gales preceded by South-easterly Winds.
† " fine-weather " " "

BAROMETER.

In the case of S.E. gales preceded by Northerly or Westerly winds the barometer begins to rise before the gale sets in.

In the case of S.E. gales preceded by South-easterly winds and accompanied by fine weather which are met with near the Cape of Good Hope, the fall of the barometer is very slight, as shown by the January Diagrams 2, 2A, 2B, Plate IV., and by the July Diagram 1b, Plate IX. In the case of stormy S.E. gales preceded by South-easterly winds the fall of the barometer is sometimes quick, as shown by Diagram 3A, Plate IV. This diagram indicates that in these latitudes a falling barometer with a S.E. wind is a very useful warning.

GEOGRAPHICAL DISTRIBUTION OF S.E. GALES.

S.E. gales preceded by Northerly or Westerly winds are more prevalent on the eastern than on the western side of the district; this difference is more decided in

January than in July. It has already been remarked that S.E. gales accompanied by fine weather are most frequently met with near the Cape of Good Hope.

LIGHTNING.

Of the five South-easterly gales preceded by Northerly or Westerly winds experienced by outward-bounders in July, only one recorded lightning; it was seen from N. to S.E., and occurred near the time when the wind changed from the northward to S.E., *i.e.*, about twelve hours before the gale commenced. In January there was only one such gale, and lightning was seen in the N.W. while the wind was N.N.W., six hours before the S.E. gale commenced.

Of the three similar South-easterly gales experienced by homeward-bounders in July, two recorded lightning, and both before the gale commenced. One reported it in the S.E. to N.E., and again all round, during a calm which occurred between the North-westerly and South-easterly winds. In January there were two such gales, one of which reported lightning several hours before the gale commenced.

Of the three South-easterly gales preceded by South-easterly winds, experienced by outward-bounders, all reported lightning; two had it about nineteen hours after the gale commenced; in one case it preceded a shift of wind to S.S.W. when the extreme force was experienced. One had lightning in the N.E. two hours before the gale commenced. The only gale of this kind met with in January had lightning at the time of the lowest barometer reading and during the strength of the gale.

The one fine weather South-easterly gale preceded by South-easterly winds experienced by a homeward-bounder in July, and the three similar gales met with in January were not accompanied by lightning.

WEATHER.

As already remarked, S.E. gales preceded by S.E. winds, and accompanied by fine weather, were met with near the S.W. coast of Africa. In other parts of the district those preceded by S.E., as well as those preceded by Northerly winds, were generally accompanied by squalls which were sometimes described as "furious." The squalls were generally more severe in July than in January.

SEA.

In both months "awful" seas were reported in connection with some S.E. gales which were accompanied by bad weather.

TABLE 22.

Table 22 (p. 94) gives a comparative summary of the principal facts relating to the S.E. gales of July, and Table 9 (p. 50) gives a similar summary for January.

C v.

CLASS V.—EXCEPTIONAL GALES.

Besides the 148 gales experienced by outward and homeward-bounders in July which have been classified as North-westerly, South-westerly, North-easterly, or South-easterly, there were 15 met with on the outward and 16 on the homeward route, which are considered too exceptional to be classified under any of those headings; they have therefore been dealt with separately, as in the case of similar gales met with in January.

PLATE VIII., DIAGRAM 2.

All Exceptional gales are represented on this diagram; those of the outward and homeward routes are separated by the irregular line which runs through it. For the convenience of reference, each strip of 10° of longitude is lettered thus:— $P = 10^\circ$ to 20° E.; $Q = 20^\circ$ to 30° E.; $R = 30^\circ$ to 40° E. The arrows showing the position and direction of the extreme forces of the gales are also lettered a, b, c, &c. in each division, commencing with the most northern one; for instance, P a indicates the most northern arrow between 10° and 20° E.

As these gales frequently change from one quarter to another, and often suddenly, the various directions of the wind are represented by arrows, numbered in the order of the time of occurrence, the position of the arrows related to a given gale being determined by that of the first occurrence of the extreme force. Sometimes a sudden shift in direction is experienced from a wind of moderate force to a gale, or a moderate breeze, different in direction, occurs between two parts of an Exceptional gale; in these cases the moderate wind is represented by an arrow of half the usual length, which is numbered in the order of its occurrence. Further explanation is given at the foot of the diagram.

EXCEPTIONAL GALES,—OUTWARD BOUND.

The 15 Exceptional gales met with by outward-bounders in July have been classified under the following heads:—A. Northerly (2); B. North-Easterly to North-Westerly (3); C. North-Westerly (*i.e.*, resembling the ordinary North-Westerly in some points) (6); D. Southerly followed by North-Westerly (1); E. Easterly to Southerly (3). They will be alluded to in the order in which they are given above. As the quotations from the logs are sometimes long, they are given in the letterpress. The course and distance made by the ship during each gale (*i.e.*, during the time between B and E) are given with its diagram.

A.—NORTHERLY.

Referring to Diagram 2, Plate VIII., the arrows P e and R j represent the extreme forces of Northerly Exceptional gales.

PLATE IX., DIAGRAM 4. (P e.)*

This was a slight Northerly gale; the wind was very steady in direction, though gusty. The barometer fell but slightly, and the gale ended in heavy rain, falling in very large drops. It was followed by a wind oscillating between N. and W.

PLATE IX., DIAGRAM 4A. (R j.)

This was a very slight and short Northerly gale. At 4 a.m. of the 28th the wind shifted suddenly from N. by E. to S. by W. in heavy rain. There was a heavy dew previous to the rain.

B.—NORTH-EASTERLY TO NORTH-WESTERLY.

Referring to Diagram 2, Plate VIII., the arrows P f, Q h, and R m represent the extreme forces of the outward-bound Exceptional gales which have been classed as North-easterly to North-westerly.

PLATE IX., DIAGRAM 5. (P f.)

The arrow P f will be found on the margin of Plate VIII. and to the westward of the district; the ship was, however, in 14° E. when the gale ended. The following is from the log:—

29th, 9 a.m. - Gale a little harder, attended by very heavy gusts.

Temperature at climax (C): sea, 45°; air, 48°.

This gale was remarkable in its having had a fast rising barometer with a North-westerly wind, the changes of barometer and wind, considered together with the ship's course to the eastward and south-eastward, seem to indicate that it was related to an area of low pressure moving to the south-eastward, and that the lowest pressure passed near, but to the westward of the ship. Its track seems to be fairly indicated by No. 2 arrow on Diagram (b), [p. 9].

PLATE IX., DIAGRAM 5A. (Q h.)

The following is quoted from the log:—

4th, 9 a.m. - When the wind backed to N.N.E. 9 it was accompanied by thunder, lightning, very heavy rain, and hail. About ten hailstones having a diameter of about an inch fell on the poop.

Temperature at climax (C): sea, 66°; air, 765°.

Here again we have a rising barometer with a North-westerly wind, indicating a south-easterly track for the area of low pressure, as in the last case.

* For the convenience of reference to the position in which the extreme force of each gale commenced, the letters which indicate the position of its arrow on Diagram 2, Plate VIII., are given in brackets with each Exceptional gale.

PLATE IX., DIAGRAM 5B. (R m.)

The following is quoted from the log:—

30th, 4 a.m. - Long streaks of cir.-c. converging in the W.

There were squalls during the strongest part of this gale, and the sea was confused. As in the case of the other gales of this class, the barometer rose with a North-westerly wind, indicating a south-easterly track for the area of lowest pressure.

C.—NORTH-WESTERLY.

Referring to Diagram 2, Plate VIII., the arrows P c, P d, Q i, R h, R k, and R n, represent the extreme forces of the outward-bound Exceptional gales which have been classified as resembling the North-westerly type.

PLATE IX., DIAGRAM 6. (P c.)

The following are extracts from the log:—

23rd, 10.30 a.m. - Wind shifted quickly to W. by S., and soon backed to N.W. by W.

„ 7 p.m. - Dull lightning in S.W.

24th, 5 p.m. to Midt. Lightning in all directions; wherever there is a nimbus lightning flashes every two or three minutes.

Temperature at climax (C): sea, 66°; air, 64°.

This gale was peculiar in its having backed to the Northward with a slightly rising barometer after the lowest pressure had passed.

PLATE IX., DIAGRAM 6A. (P d.)

This was a regular veering North-westerly gale, which, after veering to S.W., backed to N.W. again without falling below the force of a gale. It was peculiar in having had a quick fall of the barometer with a North-westerly gale which was followed by a quick rise in the barometer and a gale from S.W.; then came a slight fall of the barometer with another North-westerly gale which was followed by moderate North-westerly winds.

PLATE IX., DIAGRAM 6B. (Q i.)

During this gale the direction of the wind was unsteady, and it was squally. It resembles an ordinary North-westerly gale veering to S.W., which was followed by a slightly backing South-westerly gale, without any intervening lull in the force of the wind below that of a gale, and accompanied by a fresh fall of the barometer.

Temperature at climax (C): sea, 64°; air, 59°.

PLATE IX., DIAGRAM 6C. (R h.)

The following are extracts from the log:—

4th, Midt. - Constant lightning in the S.W.

5th, 4 a.m. - „ „ „ S.W. and N.W.

„ Noon - Very heavy bank in W.

„ 6 p.m. - Lightning in S.E.

Another outward-bounder in nearly the same latitude, but about 6° further West, had the lowest pressure of this gale at 4 a.m., 5th, or eight hours earlier than R h. This would give the lowest pressure a rate of progress to the eastward of about 38 miles an hour, but as the barometers were only read at four-hourly periods this is a very rough estimate.

The more westerly ship had vivid forked lightning and deafening peals of thunder, with heavy rain at the time of extreme force. In her case the lowest pressure was accompanied by a lull in the wind to force 4 and a change to S.W., so that she did not report the peculiarity of a rising barometer with a North-westerly wind.

PLATE IX., DIAGRAM 6D. (R k.)

The following remarks are quoted from the log:—

- 8th, 8 p.m. - Blowing a whole gale, with vivid lightning. Hail squalls of great force.
9th, 4 a.m. - Heavy gale, with lightning and hail.
Temperature at climax (C): sea, 48° ; air, 49° .

No remark is given in the log on the change of wind from N. to W., though it seems to have been rather sudden.

PLATE IX., DIAGRAM 6E. (R n.)

The following is from the log:—

- 19th, 8 a.m. - Ugly weather and very cold. Snow for two hours.

This gale was experienced in a high latitude.

The wind changes and action of barometer seem to indicate that an area of low barometric pressure passed over the ship on a south-easterly route, and that the point of lowest pressure passed rather near and to the westward of her. Arrow 2, Diagram (b), p. 9, illustrates such a track.

D.—SOUTHERLY FOLLOWED BY NORTH-WESTERLY.

PLATE IX., DIAGRAM 7. (R i.)

This was a severe Southerly gale, which lulled as the barometer rose, and backed into a North-westerly gale as the barometer fell again; it was blowing at the same time as the South-westerly gale represented by Diagram 4B, Plate VII.; the action of the barometer was very similar with both ships. Diagram 4B, Plate VII., shows the lowest barometer and beginning of the Southerly gale at noon of June 30th in $39^{\circ} 21' S.$, $32^{\circ} 31' E.$, whereas Diagram 7, Plate IX., had the lowest barometer and beginning of the Southerly gale at 3 p.m. of June 30th in $40^{\circ} 20' S.$, $34^{\circ} 40' E.$, which indicates roughly that the lowest pressure was progressing to the eastward at a rate of about 30 miles an hour. The ships' courses differed, and at noon of the 3rd July the more northern ship had advanced to $35^{\circ} 30' S.$, $41^{\circ} E.$, whilst the other was in $40^{\circ} S.$, $45^{\circ} 37' E.$, so that they had greatly increased their distance from each other as the gale progressed.

E.—EASTERLY TO SOUTHERLY.

Referring to Diagram 2, Plate VIII., the arrows P g, Q j, and R l represent the extreme forces of the outward-bound Exceptional gales which have been classified as Easterly to Southerly.

PLATE X., DIAGRAM 1. (P g.)

The following remarks are from the log:—

- 5th, 1.30 a.m. - Wind shifted to N.W., drizzling rain.
„ 3.30 „ - Wind shifted to W.S.W., a strong breeze after 20 minutes heavy rain.
„ 7 to 9 a.m. - Wind flying about from W. to S.E., sometimes nearly calm, at others a gale with a heavy sea.
„ 1 to 4 p.m. - Freshened rapidly to a strong gale.
Temperature at climax (C): sea, 55° ; air, 57° .

It seems probable that this gale was related to an area of low barometric pressure moving to the eastward, or slightly to the southward of east, and that the lowest pressure passed over, or slightly to the southward of, the ship. The changes of wind and barometer are fairly represented by supposing that the phenomena shown in Diagram (b), p. 9, passed over a ship on an easterly track.

PLATE X., DIAGRAM 1A. (Q j.)

The following remarks are from the log:—

- 29th, 10 p.m. - Gloomy, with heavy rain and very heavy squalls.
„ Midnight - Gloomy and squally, with vivid lightning and drizzle. Wind E.N.E. 5 to 8.
30th, 2 a.m. - Heavy squalls and rain with lightning. Wind S. by W. 9 to 10.
Temperature at climax (C): sea, 56° ; air, 49° .

The wind seems to have gone suddenly from E.N.E. to S. by W. at 2 a.m., 30th. The only remark given at that time is, “Cross swells from E.S.E. and S.S.W.” This gale was followed by a backing of the wind to W.N.W. with a falling barometer, the North-westerly wind soon freshened to a gale. The changes of wind and barometer are well shown by supposing such a system as that represented by Diagram (b), p. 9, to have passed over the ship on an easterly route, and that the centre passed slightly to the northward of the ship.

PLATE X., DIAGRAM 1B. (R l.)

The following remarks are from the log:—

- 26th, 4 a.m. - Misty weather with heavy rain and lightning.
„ 9 a.m. - Wind fell nearly calm and remained so for about 30 minutes, rain falling in torrents, then the wind shifted from E.S.E. to W., a strong gale. The sky cleared and sun came out.

At noon of the 26th there was another ship 3° to the northward, and 6° to the westward of this ship. She was running to the eastward with the wind W.N.W. 6, which freshened to 8 by midnight and lulled to 6 by 4 p.m. the next day. She experienced none of the Easterly wind represented in this diagram. The changes in

the barometer and that of the wind from E.S.E. to West, are fairly represented by supposing that the centre of a system resembling Diagram (b), p. 9, passed near to or over the ship on a south-easterly track. It is quite possible that a ship steering to the eastward in a more northerly latitude may have missed the Easterly wind of the system.

This gale continued for eight more days with very slight intermissions in the force below a gale, the wind backing to the North-westward, then veering to the South-westward, with corresponding fallings and risings of the barometer. This is a good illustration of the action of the barometer and wind in the "Brave Westerly Winds of these latitudes," which are spoken of by Maury.

EXCEPTIONAL GALES,—HOMEWARD BOUND.

The sixteen Exceptional gales met with by homeward-bounders in July have been classified under the following heads:—

- A. North-Easterly and Northerly shifting to the Southward (6); B. Northerly (1); C. North-Easterly to North-Westerly (1); D. North-Westerly to South-Easterly (1); E. Westerly to Southerly (1); F. Westerly to North-Westerly (2); G. Southerly (2); H. North-Westerly (1); I. South-Westerly (1).

They will be alluded to in the order in which they are given above.

A.—NORTH-EASTERLY AND NORTHERLY SHIFTING TO THE SOUTHWARD.

Referring to Diagram 2, Plate VIII., the arrows Q a, Q b, R b, R c, R d, and R g represent the extreme forces of the six Exceptional gales experienced on the homeward route which have been classified as North-easterly or Northerly shifting to Southerly.

PLATE X., DIAGRAM 2. (Q a.)*

The following remarks are quoted from the log:—

- 1857.
- 3rd, Midnight - North-easterly wind increasing to a gale with fitful gusts. A north-easterly sea rising and meeting the south-westerly swell which has become heavier since sunset. Vapourish dark cum. passing swiftly across the moon from N.N.W. Saw two flashes of lightning at W.S.W.
- 4th, 4 a.m. - Sudden squalls and ugly weather; sea very turbulent.
- " Daylight - Very ugly-looking sky; str. rising slowly from N. to the zenith and then becoming fixed, but altering their form strangely, and having a circular motion.
- " 9 a.m. - Clouds in zenith nearly stationary.
- " 4 p.m. - Wind shifted suddenly from the North-westward to the South-westward in a squall.
- " Midnight - Strong South-westerly gale and squally with very heavy sea; lightning in N.E. and S.E.

* For convenience of reference to the position in which the extreme force of each gale commenced, the letters which indicate the position of its arrow on Diagram 2, Plate VIII., are given in brackets with each Exceptional gale.

PLATE X., DIAGRAM 2A. (Q b.)

The following remarks are quoted from the log:—

- 1872.
- 26th, 2 a.m. - Meeting a westerly sea. NOTE.—The Diagram shows that the Westerly wind soon followed.
- " 4 a.m. - Strong N.N.E. wind, and fine.
- " 6.30 a.m. - Wind falling light and veering to the Westward.
- " 6 p.m. - Fine clear weather, but blowing a whole gale.
- 27th, 4 a.m. - Very heavy westerly, and south-westerly sea.
- " 4 p.m. - Heavy gale and severe squalls.
- Temperature at climax (C): sea, 64°; air, 62°.

The diagram shows that this gale was preceded by a N.N.E. wind which changed quickly to a South-westerly gale, the South-westerly gale being followed by a backing of the wind to W., from which quarter the extreme force came. The backing was accompanied by a check in the rise of the barometer. The gale then veered again to S.W., and ended as S.W. gales usually do.

PLATE X., DIAGRAM 2B. (R b.)

The following remarks are quoted from the log:—

- 1857.
- 5th, Noon - Swell from W.N.W. and E.N.E.
- 6th, 8 p.m. - Wind W. force 5.
- " 8.15 p.m. - Squall from S.S.W. force 9; it came from a high cumulus cloud.
- " 10 p.m. - Strong gale from S. with a heavy cross sea. Cir. from N.W., cum. from S.
- 7th, Noon - Cannot make sail on account of the head (south-westerly) sea, which is running very high and steep.

PLATE X., DIAGRAM 2C. (R c.)

The following remarks are quoted from the log:—

- 1863.
- 15th, 2 p.m. - Long heavy swell from S.S.W. Wind E.N.E. 3.
- 16th, 2 p.m. - Ugly appearances to the south-westward. Wind N.N.E. 8.
- " 4 p.m. - Wind W.N.W. 8; hail, very heavy rain, and thunder, with sharp chain lightning. Mizzen-mast struck, but not damaged. The hail and very heavy rain continued until 10 p.m.
- " 6 p.m. - Gale S.S.W. 10. Ship hove-to.

PLATE X., DIAGRAM 2D. (R d.)

The following remarks are quoted from the log:—

- 1860.
- 12th, 10 p.m. & Midt. Lightning in the S. Wind N. by E. 8.
- 13th, 2 a.m. - Wind N. by W. 8; at 4 a.m. it was S. by E. 9.
- Temperature at climax (C): sea, 69°; air, 68°.

In this case the lightning gave good warning of the change of wind from N. to S. No remark is made as to whether the change was sudden or not. There are scarcely any remarks in the log.

PLATE X., DIAGRAM 2E. (R g.)

The following remarks are quoted from the log :—

- 1861.
- 6th, Noon - Beautiful weather and smooth sea.
- „ Midnight - Clear weather.
- 7th, 2 a.m. - Stiff Northerly gale and cloudy; sheet lightning in the W.N.W. All appearances of a shift to the Westward.
- „ Noon - Moderate wind; it shifted to W.S.W.
- „ 3 p.m. - Stiff gales from W.S.W. and squalls.
- „ 8 p.m. - Gale increasing; lightning in the S.S.W.
- „ Midnight - Hard gale and violent squalls.
- 8th, Noon - Hard gale and violent squalls, with a very heavy sea.

The six gales of this class blew near the S.E. coast of Africa, where most of the North-easterly gales met with by homeward-bounders were also experienced. They prove that sudden shifts of gales from North to South are common in this part of the sea. The change of wind is often preceded by a south-westerly swell and lightning. As already remarked, page 48, this is the class of gale which led the Dutch East India Company to order their Captains to take in the mainsail and otherwise prepare for a shift of wind when a North-easterly wind set in.

B.—NORTHERLY.

PLATE X., DIAGRAM 3. (R a.)

The following remarks are quoted from the log :—

- 1872.
- 24th, 8 a.m. - Whole gale and high sea. Streaks of cir. across the sky North and South.
- „ 9.30 a.m. - Hove-to.
- „ Noon - Whole gale; wind coming in gusts; sea smoother.
- Temperature at climax (C): sea, 68°; air, 70°.

This gale, like those just dealt with, was followed by a South-westerly wind, but that wind did not amount to the force of a gale, and the change was not sudden; however, it was soon followed by a strong N.E. wind and very heavy South-westerly gale, as shown by Diagram 2A, Plate X., which represents the data of a gale experienced by the same ship on the following day.

C.—NORTH-EASTERLY TO NORTH-WESTERLY.

PLATE X., DIAGRAM 4. (Q c.)

The following remarks are quoted from the log :—

- 1872.
- 30th, Noon - Moderate North-easterly gale, and very misty; a heavy bank in N.W.
- „ 8 p.m. - Strong North-easterly gale and very ugly weather, with much lightning in S.E.

- 1872.
- 30th, Midnight - North-easterly gale, moderating fast and sea gone down; vivid forked lightning in West and flash lightning in all quarters, almost blinding. Corposants on truck and top-gallant yardarms. So dark you cannot see a cable's length.
- 31st, 4 a.m. - Wind N. by W. 8, gusty, vivid lightning lasting till daylight.
- „ 10.30 a.m. - Wind North-westerly 8.
- „ 1 p.m. - Much lightning in West.
- „ Midnight - Wind N. 4; weather fine with lightning.
- Temperature at climax (C): sea, 67°; air, 67°.

This gale, like those of the same class experienced by outward-bounders, had a rising barometer as the wind veered to the North-westward, indicating a south-easterly motion for the area of low pressure related to the gale, and that its lowest pressure passed to the westward of the ship. Diagram (b), p. 9, illustrates the action of barometer and wind in such a gale, supposing the system to pass over the ship in the direction shown by No. 2 arrow.

D.—NORTH-WESTERLY TO SOUTH-EASTERLY.

PLATE X., DIAGRAM 5. (P a.)

The following are extracts from the log :—

- 1864.
- 1st, 8 p.m. - Unsteady gale, with squally, gloomy weather, and very heavy rain.
- 2nd, 5 a.m. - Sudden shift of wind from N. by W. to S. by E., and high cross sea.
- Temperature at climax (C): sea, 63°; air, 57°.
- NOTE.—The lowest pressure passed just before the shift of wind, and was accompanied by heavy rain.

Diagram 2D, Plate X., illustrates a somewhat similar gale, though Diagram 5 shows no North-easterly gale, and its South-easterly wind did not quite attain the force of a gale.

E.—WESTERLY TO SOUTHERLY.

PLATE X., DIAGRAM 6. (P b.)

The following are extracts from the log :—

- 1856.
- 31st, 6 p.m. - Wind W. 8. Weather very thick and rainy; hard squalls and a cross tumbling sea.
- „ 10 p.m. - Wind shifted suddenly in a shower from W. by S. 9 to S. by E. 9.

It will be seen that in this as in several other gales the sudden shift came with rain, and shortly after the time of lowest barometer.

F.—WESTERLY TO NORTH-WESTERLY.

Referring to Diagram 2, Plate VIII., the arrows Q e and Q g represent the extreme forces of two gales backing from W.S.W. to W.N.W.

PLATE X., DIAGRAM 7. (Q e.)

The following are extracts from the log:—

1856.

- 16th, 2 p.m. - Heavy gale with very violent squalls; sea very high.
 „ 3 p.m. - Gale increasing to a perfect hurricane. Hove-to under storm staysails.

PLATE X., DIAGRAM 7A. (Q g.)

The following are extracts from the log:—

1871.

- 8th, 8 p.m. - Calm, with lightning in South.
 „ Midnight - Fresh Westerly wind; dismal appearance in S; lightning.
 9th, 4 a.m. - Lightning.
 10th, 8 a.m. - Very heavy squalls and rain. The wind is recorded as S.S.W. 1, so probably the change from W.N.W. to S.S.W. came in the squall.

Temperature at climax (C): sea, 60°; air, 60°.

The two gales just alluded to are remarkable in having a barometer rising fast, as the wind backed from W.S.W and W. to W.N.W.

G.—SOUTHERLY.

Referring to Diagram 2, Plate VIII., the arrows R e and R f represent the extreme forces of two Southerly gales.

PLATE X., DIAGRAM 8. (R e.)

The following are extracts from the log:—

1856.

- 1st, 9 p.m. to Midt. Heavy squalls and passing showers, with much dull-yellow lightning in the S.S.E.
 2nd, 4 a.m. - Much dull lightning in S.S.E.; banks of clouds rising at that point and passing over with heavy squalls and rain. Wind recorded S.W. 9, wore ship to the port tack, after which came a most furious squall followed by a succession at intervals of 20 minutes having almost hurricane force.
 3rd - A remarkable change in the set of the current from W.S.W. 29 miles the previous twenty-four hours to N. 17 miles the last twenty-four hours, after making full allowance for leeway, &c.

The temperature of the sea was 1° lower than on the previous day, though the ship had been driven about 40 miles to the northward by the gale.

PLATE X., DIAGRAM 8A. (R f.)

The following are extracts from the log:—

1868.

- 23rd 4 a.m. - Vivid lightning from S.S.W. to E.S.E.
 „ 4 p.m. - Vivid lightning, heavy thunder, and hail. The wind going round the compass, with very heavy chain lightning from N.N.W. through W. to S.S.E. of a bright pink colour, each flash taking away the sight for a few minutes; thunder breaking with violence in the zenith. Hail the size and shape of half nutmegs, with a dark spot in the centre.

The lightning continued until midnight, when the gale had set in. These Southerly gales were both experienced near the S.E. coast of Africa, and both were foretold by lightning in the south several hours before they commenced.

H.—NORTH-WESTERLY.

PLATE X., DIAGRAM 9. (Q f.)

The following are extracts from the log:—

1857.

- 1st, 8 p.m. - The weather has been very changeable, and wind veering 3 to 4 points.
 „ Midt. - Lightning. Wind W. by S. 9.
 2nd, 1 to 9 a.m. - Very heavy squalls and lightning, blowing furiously in gusts, wind N.W. by W. 11.

This gale might almost have been classified with the veering North-westerly gales. It is peculiar in having been preceded by a short N.N.E. gale.

I.—SOUTH-WESTERLY.

PLATE X., DIAGRAM 10. (Q d.)

There are no important remarks given with this gale, and no lightning was recorded. It is peculiar in having had a falling barometer with a South-westerly gale, then an almost steady barometer with a North-westerly gale. It will be noticed that the barometer was above 30 inches nearly the whole time.

Temperature at climax (C): sea, 67°; air, 64°.

TABLE 22.—JULY GALES.

No. of Gales.	No. of Ships observing Gales.	Mean of Highest Barometer preceding Gale.	Commencement of Gales.		Commencement of Extreme Force			End of Gales.	
			Mean and Range.		Mean and Range.			Mean and Range.	
			Wind Direction.	Barometer.	Wind.			Wind Direction.	Barometer.
					Direction.	Force.	Barometer.		
NORTH-WESTERLY TO WESTERLY									
30	24	in. 30.17 Range { 29.88 to 30.57	N 5 W N to N 7 W	in. 29.76 29.37 to 30.12	N 6 W N 1 W to S 3 W	9 8 to 12	in. 29.67 28.89 to 30.10	W N 3 W to S 1 W	in. 29.81 29.35 to 30.40
NORTH-WESTERLY TO WESTERLY									
48	38	30.19 Range { 29.85 to 30.55	N 4 W N 1 E to W	29.87 29.59 to 30.27	N 6 W N 1 W to S 6 W	10 8 to 12	29.80 29.45 to 30.16	S 6 W S 1 E to N 7 W	30.05 29.70 to 30.45
SOUTH-WESTERLY GALES,—									
19	17	30.17 Range { 29.83 to 30.54	S 6 W W to S 1 W	29.78 29.27 to 30.26	S 6 W W to S 1 W	9 8 to 11	29.79 29.33 to 30.26	S 4 W S 1 W to S 7 W	29.95 29.35 to 30.21
SOUTH-WESTERLY GALES,—									
34	25	30.34 Range { 29.92 to 30.59	S 5 W W to S 2 W	29.99 29.67 to 30.32	S 5 W W to S	9 8 to 11	30.00 29.70 to 30.30	S 3 W S 4 E to S 7 W	30.19 29.89 to 30.46
NORTH-EASTERLY GALES,—									
1	1	30.50	N 2 E	29.95	N 2 E	8	29.95	N 1 E	29.80
NORTH-EASTERLY GALES,—									
4	4	30.41 Range { 30.30 to 30.50	N 3 E N 3 E to N 2 E	30.23 30.17 to 30.27	N 3 E N 3 E to N 2 E	9 8 to 10	30.21 30.17 to 30.27	N 2 E N 1 E to N 3 E	30.07 30.03 to 30.14
SOUTH-EASTERLY GALES,—OUTWARD BOUND.									
5	5	30.22 Range { 29.84 to 30.56	S 2 E S 1 E to S 3 E	29.89 29.38 to 30.26	S 2 E S 1 E to S 3 E	9 8 to 11	29.94 29.39 to 30.26	S 2 E S to S 5 E	30.21 30.01 to 30.35
SOUTH-EASTERLY GALES,—OUTWARD BOUND.									
3	3	30.19 Range { 30.02 to 30.33	S 4 E S 3 E to S 5 E	30.07 29.88 to 30.20	S S 1 E to S 1 W	9 9 to 10	29.74 29.68 to 29.81	S 1 E S 1 W to S 3 E	29.83 29.68 to 30.01
SOUTH-EASTERLY GALES,—HOMEWARD BOUND.									
3	3	30.27 Range { 30.03 to 30.59	S 4 E S 1 E to S 6 E	29.83 29.70 to 29.97	S 3 E S 1 E to S 5 E	9 8 to 10	29.87 29.74 to 29.97	S 3 E S 1 E to S 5 E	30.05 29.98 to 30.19
SOUTH-EASTERLY GALE,—HOMEWARD									
1	1	30.56	S 5 E	30.51	S 5 E	8	30.51	S 6 E	30.35

TABLE 22.—JULY GALES.

Duration of Gales.	Duration of Extreme.	Position when Extreme Force commenced.	No. of Times the following Forces have been attained as Extremes.					Lowest Pressure.	Time between First occurrence of Extreme Force and Lowest Pressure.	Highest Pressure following Gales.	No. of Gales.
Mean and Range.	Mean and Range.	Mean and Range in Longitude.	8.	9.	10.	11.	12.	Mean and Range.	Mean and Range.	Mean and Range.	
GALES,—OUTWARD BOUND.											
hrs. 25 6 to 66	hrs. 9 2 to 32	South. 39° 35', 24° 55' 41 30 9 50 to 39 58 39 7	5	14	9	1	1	in. 29° 57' 28° 80' to 30° 01'	hrs. *+ 7 + 32 to - 13	in. 30° 22' 29° 61' to 30° 70'	30
GALES,—HOMEWARD BOUND.											
35 3 to 120	13 2 to 60	35° 15', 21° 54' 32 8 13 43 to 31 40 37 20	5	14	20	8	1	29° 73' 29° 43' to 30° 01'	0 + 24 to - 52	30° 28' 29° 85' to 30° 72'	48
OUTWARD BOUND.											
21 8 to 65	11 2 to 20	39° 15', 22° 44' 40 19 10 22 to 40 4 36 46	7	6	5	1	—	29° 72' 29° 27' to 30° 05'	*- 4 + 28 to - 32	30° 17' 29° 63' to 30° 54'	19
HOMEWARD BOUND.											
23 5 to 84	8 2 to 28	33° 35', 28° 31' 34 48 18 15 to 33 37 38 25	6	8	18	2	—	29° 92' 29° 66' to 30° 29'	- 4 + 20 to - 24	30° 36' 29° 89' to 30° 59'	34
OUTWARD BOUND.											
6	6	38° 3', 26° 16'	1	—	—	—	—	29° 76'	+ 8	30° 13'	1
HOMEWARD BOUND.											
8 7 to 10	7 2 to 10	33° 42', 28° 53' 30 25 24 20 to 32 50 31 20	3	—	1	—	—	29° 99' 29° 93' to 30° 14'	+ 23 + 19 to + 27	30° 33' 30° 18' to 30° 47'	4
PRECEDED BY NORTHERLY AND NORTH-WESTERLY WINDS.											
21 4 to 46	10 4 to 16	40° 15', 29° 38' 40 52 13 0 to 44 50 38 35	2	—	2	1	—	29° 82' 29° 34' to 30° 16'	- 12 - 4 to - 32	30° 45' 30° 10' to 30° 60'	5
PRECEDED BY SOUTH-EASTERLY WINDS.											
51 31 to 86	13 4 to 28	36° 17', 31° 50' 38 22 23 15 to 33 34 40 7	—	2	1	—	—	29° 68' 29° 04' to 29° 71'	+ 6 + 2 to + 12	30° 19' 30° 04' to 30° 30'	3
PRECEDED BY NORTHERLY AND NORTH-WESTERLY WINDS.											
10 6 to 15	5 4 to 6	35° 48', 22° 52' 35 58 19 49 to 34 39 26 1	1	1	1	—	—	29° 75' 29° 03' to 29° 84'	- 6 - 4 to - 10	30° 43' 30° 33' to 30° 52'	3
BOUND. PRECEDED BY SOUTH-EASTERLY WINDS.											
24	24	34° 5', 15° 25'	1	—	—	—	—	30° 17'	+ 72	30° 21'	1

* The sign + means that the extreme force occurred before the lowest pressure, after " "

C vii.

COMPARISON OF AIR AND SEA TEMPERATURES IN THE GALES OF JANUARY AND JULY.

Exceptional Gales differ so much in character that it has not been thought well to take an average of their temperature observations, so that these are given with each gale, but for other classes of gales the mean temperatures at the time of extreme force are given in Table 23 which follows:—

TABLE 23.

PASSAGE AND MONTH.	No. of Ships recording Temperature.	MEAN POSITION.				Mean Temperature of Air.	Mean Temperature of Sea.	Sea warmer than Air.	Sea colder than Air.	Range of Sea on Air.
NORTH-WESTERLY GALES.										
Outward—January -	12	42°	6 S.	19°	15 E.	56°	58°	2°	—	— 4 to + 7*
„ —July -	15	39°	20°	24°	42°	57°	59°	2°	—	— 8 to + 11*
Homeward—January -	9	35°	24°	21°	11°	69°	70°	1°	—	— 1 to + 6*
„ —July -	26	34°	54°	22°	16°	60°	63°	3°	—	— 1 to + 10*
SOUTH-WESTERLY GALES.										
Outward—January -	7	42°	58°	22°	43°	51°	53°	2°	—	— 4 to + 4
„ —July -	9	39°	30°	18°	36°	53°	59°	6°	—	+ 3 to + 11
Homeward—January -	19	34°	31°	25°	0°	68°	70°	2°	—	— 1 to + 8
„ —July -	22	34°	6°	27°	18°	62°	67°	5°	—	+ 1 to + 11
NORTH-EASTERLY GALES.										
Outward—January -	1	40°	30°	32°	0°	62°	66°	4°	—	+ 4
„ —July -	1	38°	3°	26°	16°	61°	60°	—	1°	— 1
Homeward—January -	2	34°	33°	28°	48°	73°	72°	—	1°	— 3 to + 1
„ —July -	2	32°	46°	29°	56°	68°	70°	2°	—	+ 1 to + 3
SOUTH-EASTERLY GALES. PRECEDED BY NORTHERLY WINDS.										
Outward—January -	1	41°	14°	36°	16°	58°	61°	3°	—	+ 3
„ —July -	2	42°	41°	25°	47°	46°	51°	5°	—	+ 2 to + 7
Homeward—January -	2	32°	26°	33°	15°	71°	71°	0°	0°	— 4 to + 3
„ —July -	1	34°	39°	26°	1°	58°	70°	12°	—	+ 12
SOUTH-EASTERLY GALES. PRECEDED BY SOUTHERLY WINDS.										
Outward—January -	1†	39°	12°	16°	46°	68°	68°	0°	0°	0°
„ —July -	2†	37°	39°	27°	41°	54°	63°	9°	—	+ 5 to + 12
Homeward—January -	3§	34°	19°	17°	16°	68°	68°	0°	0°	0°
„ —July -	—	—	—	—	—	—	—	—	—	—

* In some cases the wind had veered to W. or to the Southward of W. before the extreme force came; such a change is generally accompanied by cooler air than that which existed before it.

† These were bad-weather gales.

§ These were fine-weather gales.

The above table shows that the sea is generally warmer than the air, the exception being with North-easterly gales, which are warm winds. It also shows that the difference is generally greater in the winter than in the summer.

D.

SHORT REMARKS ON THE GALES OF EACH OF THE TWELVE MONTHS.

To the preceding full discussion of the gales of January and July (a summer and a winter month) it is now proposed to add brief remarks on the gales of each of the twelve months. To make the remarks more complete Diagrams XI. to XX. have been drawn to represent the positions and extreme forces of the various gales met with in the other ten months, and Tables 24 and 25 (pp. 97 and 98) have been compiled.

TABLE 24.—A COMPARISON OF IMPORTANT DATA FOR FOUR QUARTERLY MONTHS.

OUTWARD BOUND.

	JANUARY.			APRIL.			JULY.			OCTOBER.			YEAR. Mean of the 4 Months.		
	Number and Direction of Gales.	Duration of Gale- Systems.	Duration of Gales.	Number and Direction of Gales.	Duration of Gale- Systems.	Duration of Gales.	Number and Direction of Gales.	Duration of Gale- Systems.	Duration of Gales.	Number and Direction of Gales.	Duration of Gale- Systems.	Duration of Gales.	Number and Direction of Gales.	Duration of Gale- Systems.	Duration of Gales.
	13 N.W.	hrs. 79	hrs. 32	13 N.W.	hrs. 96	hrs. 36	30 N.W.	hrs. 91	hrs. 25	16 N.W.	hrs. 97	hrs. 21	18 N.W.	hrs. 91	hrs. 28½
	7 S.W.	114	26	7 S.W.	106	24	19 S.W.	83	21	17 S.W.	107	21	12½ S.W.	102½	23
	1 N.E.	69	4	1 N.E.	83	23	1 N.E.	60	6	3 N.E.	65	8	1½ N.E.	69	10
	1 S.E.*	104	11	2 S.E.*	128	34	5 S.E.*	97	21	0 S.E.*	—	—	2 S.E.*	110	22
	1 S.E.	112	42	1 S.E.	57	22	3 S.E.	98	51	4 S.E.	110	35	2 S.E.	94	37½
	10 Exceptional	105	25†	9 Exceptional	102	46	15 Exceptional	86	42	9 Exceptional	99	36	11 Exceptional	98	31
Number and Mean†	33	98	27	33	100	35	73	88	28	49	100	24	47	96½	29
Result of dividing the hours spent in the district by the number of Gales.	144	—	—	153	—	—	131	—	—	150	—	—	144½	—	—
Difference of the preceding lines or average time between the Gale-systems.	46	—	—	53	—	—	43	—	—	50	—	—	48	—	—

HOMEWARD BOUND.

	9 N.W.	hrs. 71	hrs. 12	8 N.W.	hrs. 91	hrs. 26	48 N.W.	hrs. 84	hrs. 35	13 N.W.	hrs. 78	hrs. 25	19½ N.W.	hrs. 80½	hrs. 24½
	22 S.W.	89	20	17 S.W.	89	22	34 S.W.	82	22	16 S.W.	76	23	22 S.W.	83	22
	4 N.E.	78	4	6 N.E.	68	8	4 N.E.	72	9	1 N.E.	96	23	4 N.E.	78½	11
	2 S.E.*	70	6	2 S.E.*	81	23	3 S.E.*	92	10	0 S.E.*	—	—	2 S.E.*	81	13
	3 S.E.	105	16	1 S.E.	77	6	1 S.E.	112	24	4 S.E.	70	11½	2 S.E.	91	14
	15 Exceptional	101	25†	6 Exceptional	112	45†	16 Exceptional	77	27	10 Exceptional	92	36	12 Exceptional	95½	33
Number and Mean†	55	88	18	40	89	24	106	81	28	44	80	26	61½	84½	24
Result of dividing the hours spent in the district by the number of Gales.	178	—	—	239	—	—	181	—	—	148	—	—	186½	—	—
Difference of the preceding lines or average time between the Gale-systems.	90	—	—	150	—	—	100	—	—	68	—	—	102	—	—

* S.E. with an asterisk indicates that the gales were preceded by Northerly or Westerly winds, without an asterisk it relates to S.E. gales preceded by South-easterly or Southerly winds.
† In calculating the duration of Exceptional gales a deduction has been made for the large number of hours of light winds or calms which sometimes occur between the two parts of a gale. This has not been considered requisite in the other kinds of gale.
‡ The means on this line are general, giving weight to the number of each kind of gale.

The foregoing table shows that the duration of gale-systems is on an average 12 hours longer, and of gales 5 hours longer with outward-bound than with homeward-bound ships.

It has already been stated that the chief cause of this difference is probably due to the fact that areas of low barometric pressure and their accompanying gale-systems generally move on an easterly track, so that outward-bound ships which are sailing to the eastward keep longer under their influence than homeward-bounders which have a westerly course.

A comparison of the last lines of the two parts of Table 24 shows that the time which elapsed between the gale-systems of the homeward route was twice as long as that which elapsed between the gale-systems of the outward route; indicating that homeward-bound ships met with more winds which were not related to travelling wind-systems than outward-bounders, or that they met with several wind-systems no part of which attained the force of a gale.

TABLE 25.—PERCENTAGES OF GALES FOR EACH MONTH.

MONTH.	Number of Days spent in District by Ships observing.	Number of Gale-systems met with.	Percentage-Ratio between the Number of Gales and the Number of Days spent in the District.	Percentage of Gales from various Directions.					
				N.W.	S.W.	N.E.	S.E.	Exceptional.	
OUTWARD PASSAGE.									
January	-	442	33	7	40	21	3	6	30
February	-	434	24	6	59	29	—	4	8
March	-	404	42	10	41	31	2	12	14
April	-	486	33	7	40	21	3	9	27
May	-	516	61	12	51	20	10	3	16
June	-	447	67	15	47	27	4	4	18
July	-	621	73	12	41	26	1	11	21
August	-	785	100	13	47	15	10	14	14
September	-	705	82	12	29	33	9	10	19
October	-	517	49	9	33	35	6	8	18
November	-	700	75	11	27	55	4	1	13
December	-	642	48	8	44	40	6	2	8
Mean for the Year	-	558	57	10.2	42	29	5	7	17

TABLE 25 continued.

MONTH.	Number of Days spent in District by Ships observing.	Number of Gale-systems met with.	Percentage-Ratio between the Number of Gales and the Number of Days spent in the District.	Percentages of Gales from various Directions.					
				N.W.	S.W.	N.E.	S.E.	Exceptional.	
HOMEWARD PASSAGE.									
January	-	707*	55*	8	16	40	7	9	28
February	-	812	45	6	11	29	20	33	7
March	-	597	30	5	27	33	10	17	13
April	-	617	40	6	20	43	15	7	15
May	-	803	88	11	41	27	5	8	19
June	-	990	131	13	43	32	8	3	14
July	-	934	106	11	45	32	4	4	15
August	-	613	88	14	38	32	6	16	8
September	-	485	73	15	25	35	12	10	18
October	-	468	44	9	30	36	2	9	23
November	-	524	44	8	23	41	2	23	11
December	-	599	53	9	9	53	8	15	15
Mean for the Year	-	679	66	9.6	27	36	8	13	16

* Two North-easterly gale arrows appear on Diagram 3, Plate I., which are not included in this table for reasons given above. (See p. 31.)

The above table gives for each month the ratio between the number of gale-systems and the number of days spent in the district by ships observing for the Office; as well as the relative frequency of gales from the various directions.

As there does not seem to be any great variety in the duration of the gale-systems met with in the various months, it seems right to suppose that the ratio of the number of gale-systems to the number of days represents approximately the relative probability of meeting with gales. For the quarterly months of January, April, July, and October we have been able to check this approximation by calculating the percentage-ratio between the number of hours spent in gales and the number of hours spent in the district. The results, which follow, agree fairly well with the figures for the respective months in the fourth column of Table 25.

January, outward passage, 8 %; homeward passage, 6 %.

April, " " 10 " ; " " 6 "

July, " " 14 " ; " " 13 "

October, " " 9 " ; " " 10 "

By comparing, as far as possible, the shading which represents gales on the Index

Charts for the District, recently published, with the figures in the fourth column of Table 25, it will be found that there is a general agreement between them as to the relative prevalence of gales met with in the various months of the year.

Plates I. and III., VI. and VIII., and XI. to XX., represent the gales of the twelve months; their arrows show for each gale the position of the ship, the extreme force, and the direction of the wind at the time when the extreme force commenced.

Plates I. and III. for January, and VI. and VIII. for July have already been discussed, but they will be briefly alluded to again, so as not to break the continuity of these remarks.

JANUARY.—PLATES I. AND III.

The data of January has already been fully discussed, as it is considered to be a typical summer month. See p. 11.

Table 25 (p. 98) shows that in January the percentage of gale-systems is 7 on the outward, and 8 on the homeward passage.

Table 24 (p. 97) shows that the average duration of gales in January is 9 hours longer on the outward than on the homeward passage.

The Plates show that North-westerly gales and South-easterly gales preceded by Southerly winds, prevail on the western side of the district, whilst South-westerly gales, South-easterly gales preceded by Northerly winds, North-easterly, and "Exceptional" gales prevail on its eastern side. It is supposed that the trend of the land and the warm water brought into the eastern half of the district by the Agulhas current have much to do with this disposition of gales.

FEBRUARY.—PLATE XI.

Table 25 (p. 98) shows that February has 6 per cent. of gale-systems on both the outward and homeward passages; this is the smallest percentage for any month in the year.

This month has the largest number of S.E. gales in close proximity to the Cape of Good Hope. These were all fine-weather gales, although one attained the force of 10; they are related to the "South-easters" so common in Simon's Bay and Table Bay during the southern summer. They seem to be closely connected with the fact that at this season the area of high barometric pressure which exists to the southward of the S.E. Trades in the Atlantic, lies to the westward and south-westward of the Cape of Good Hope, whilst there is a relatively lower pressure over the heated land which lies to the eastward of that Cape; such a disposition of pressure forms a gradient for a S.E. wind.

Plate XI. shows that, as in January, the gales of various directions are generally so grouped as to show that the trend of the land affects them. This does not, however, hold with the North-westerly gales experienced by outward-bounders, which are very Westerly in direction and are pretty equally distributed throughout the district. Exceptional gales are still most frequent on the eastern side of the district.

MARCH.—PLATE XII.

Table 25 (p. 98) shows that March has 10 per cent. of gale-systems on the outward passage, and 5 per cent. on the homeward passage.

Diagram 2 shows that the South-westerly gales experienced on the outward route were more abundant and more Southerly in direction in the region to the south-westward of the warm Agulhas current than elsewhere.

More S.E. gales were experienced on the outward route in March than in either January or February, but, as compared with February, there is a great falling-off in the number of fine-weather S.E. gales experienced near the Cape of Good Hope. All the S.E. gales met with near the S.E. coast of Africa were preceded by Northerly winds.

Exceptional gales continue to be more frequent on the eastern than on the western side of the district.

APRIL.—PLATE XIII.

Table 25 (p. 98) shows that April has 7 per cent. of gale-systems on the outward, and 6 per cent. on the homeward passage; or nearly as low a percentage as February. The percentage of S.W. gales met with on the homeward route is greater than it is in either March or May. Diagram 2 shows that these gales lie chiefly near the S.E. coast of Africa.

S.E. gales, preceded by Northerly winds and Exceptional gales are still very much confined to the eastern part of the district.

Table 24 (p. 97) shows that the average length of the gales experienced by outward-bound ships in April was greater than that in any of the other quarterly months. The same table shows that, of the four quarterly months, April has the largest number of hours between the gale-systems both on the outward and homeward routes.

MAY.—PLATE XIV.

Table 25 (p. 98) shows that May has 12 per cent. of gales on the outward, and 11 per cent. on the homeward passage; these numbers give an increase of 5 per cent. as compared with April, so that with May the stormy season of the year has fairly set in. A comparison of Plates XIII. and XIV. illustrates this fact; it also shows that N.W. gales have increased much in number and force, more especially on the homeward route; in fact, on combining the data for the outward and homeward passages, May is shown to have the largest percentage of N.W. gales for the year.

The percentage of N.E. gales experienced by outward-bounders has also greatly increased since April, and Diagram 3 shows that all were met with on the eastern side of the district.

The most important change since April is shown in the large number of severe Exceptional gales veering from a Northerly to a Southerly direction which were experienced on the western side of the district, and in the neighbourhood of the Cape of Good Hope; so that in May, for the first time in the year, the Exceptional gales are not confined chiefly to the eastern part of the district.

There was no bad weather recorded with the S.E. gale, preceded by a S.E. wind, which had a force of 10, and which is shown on Diagram 4, near the Cape of Good Hope.

JUNE.—PLATE XV.

By comparing the means of the percentages of gales met with on the outward and homeward passages in each month (which percentages are recorded in the fourth column of Table 25, p. 98) we find that June has 14 per cent., or the largest percentage for any month in the year, though August and September have each nearly as large a percentage.

Diagram 1 gives a graphic representation of the N.W. gales met with in June showing that they were numerous and violent; those experienced on the eastern side of the district by outward-bound ships had a much more Northerly direction at the time of extreme force than those which were met with further to the westward.

Diagram 2 shows a number of S.S.W. gales in the extreme north-eastern corner of the district, where such gales are rarely met with in other months.

There was lightning in the E.S.E. 12 hours before the commencement of the S.E. gale, preceded by a S.E. wind, which had a force of 10, and which is shown on Diagram 4 near the western edge of the Agulhas Bank. The gale was accompanied by gloomy weather, rain, and a heavy sea.

As in May, Exceptional gales are more abundant and have greater force on the western than on the eastern side of the district.

JULY.—PLATES VI. AND VIII.

The data of July, which has been accepted as the typical winter month, have already been fully discussed. (See p. 53.)

Table 25 (p. 98) does not show quite so large a percentage of gales in July as in June, August, and September.*

A comparison of the Plates for the two months shows that there is a general agreement in the disposition of the gales met with in July and June; but it also shows that the number of S.E. gales experienced on the outward passage is greater in July than in June.

In July the Exceptional gales were rather more abundant on the eastern than on the western side of the district. This was the rule from January to April, but not in May and June.

Table 24 (p. 97) shows that the N.W. gales of the homeward passage in July lasted longer than in any other quarterly month. It also shows that on the outward route in July the average time between the gale-systems was shorter than in any of the other three months.

AUGUST.—PLATE XVI.

Table 25 (p. 98) shows that August is very nearly as stormy as June. It has a very large percentage of N.W. gales, and (as in June and July), those met with on the eastern part of the outward route had a much more Northerly direction at the time of

* The percentage-ratio between the number of hours spent in the district and the number of hours spent in gales in July (which is given at the bottom of p. 99) is, however, almost the same as the percentage-ratios for June, August, and September, which are given in Table 25. The shading on the Index Chart for July, lately published, also shows that month to be very stormy.

extreme force than others experienced further to the westward. The percentage of N.E. gales met with on the outward passage is much higher than that in July, and it will be noticed that a large number of the Exceptional gales commenced from the North-eastward.

The percentage of S.E. gales is high for both the outward and homeward passages, for the outward it is the highest in the year, and the gales are equally divided between those preceded by Northerly and those preceded by Southerly winds. On the homeward route the S.E. gales were chiefly those preceded by Southerly winds, eight of which were met with near the Cape of Good Hope; of these eight, three were accompanied by squalls, but in only one of them was the force of 9 experienced.

Exceptional gales were pretty uniformly spread on the outward route, but on the homeward route they were nearly all in the eastern half of the district.

SEPTEMBER.—PLATE XVII.

Table 25 (p. 98) shows that September is a stormy month, having as large a percentage of gales as August. There is a decided decrease in the percentage of N.W. and increase in that of S.W. gales as compared with August. The North-westerly gales met with on the outward route near the eastern side of the district continue to have a more Northerly extreme force than those met with further to the westward. The percentage of N.E. gales met with on the homeward passage is much greater than it is during the previous four months.

The percentage of S.E. gales is not quite so large as that for August, and nearly all were preceded by Southerly winds. Three of the four met with near the Cape of Good Hope on the homeward route attained the force of 9, but only one (which was experienced in about 33° S. 13° E.) was accompanied by squalls.

The percentage of Exceptional gales is decidedly greater than that for August, and they were uniformly spread over the outward route, but on the homeward route they were chiefly confined to the eastern half of the district.

OCTOBER.—PLATE XVIII.

Table 25 (p. 98) shows that October has only 9 per cent. of gales, which is a reduction of 5 per cent. as compared with September; the same difference exists between April and May, so that May, June, July, August, and September are clearly shown to be the five most stormy months of the year for both the outward and homeward routes.

There is a great decline in the percentage of N.E. gales since September; though most of the Exceptional gales commence from the North-eastward.

The percentage of S.E. gales has again decreased, and all met with in October were preceded by Southerly winds. Of the four met with near the Cape of Good Hope, the three nearest the land were fine weather gales, the other was accompanied by hard dry

puffs of wind, which sometimes attained the force of 9, and there was lightning towards the end of the gale.

As in most previous months, nearly all the Exceptional gales met with on the homeward route were experienced on the eastern side of the district.

Table 24 (p. 97) shows that the average duration of gale-systems met with on the outward passage is relatively great, whilst the average duration of the gales involved in those systems is shorter than that of any other quarterly month.

On the homeward passage the average duration of the gale-systems is slightly shorter than for any of the other quarterly months; it is also shorter by 20 hours than the corresponding average for the outward passage, but the gales which the systems include last longer than those of the outward passage. The average interval of time between two gale-systems taking the outward and homeward passages together is less in October than in any of the other quarterly months; this indicates that in October either few wind-systems appear which do not comprise gales, or that there is a smaller number of winds which do not belong to moving wind-systems than in any of the other three quarterly months.

NOVEMBER.—PLATE XIX.

Table 25 (p. 98) shows that November has a slightly larger percentage of gales than October on the outward route, and a slightly smaller percentage on the homeward route.

The chief difference between the two months lies in the fact that November has a much larger percentage of S.W. gales, especially on the outward route. Combining the gales of the two routes, November has the smallest percentage of N.W., and the largest percentage of S.W. gales for the year.

S.E. gales preceded by Northerly winds were again experienced in November, though none were recorded in October. There were four of this kind met with on the homeward passage, and they were the most easterly in position.

Exceptional gales were chiefly confined to that part of the sea which lies to the south-eastward and southward of the Agulhas Bank.

DECEMBER.—PLATE XX.

Table 25 (p. 98) shows that December has a slightly smaller percentage of gales than either October or November, though the three months may fairly be classed together.

December resembles November in having a very large percentage of S.W. gales. The small number of N.W. gales met with on the homeward passage is remarkable.

There were only four Exceptional gales met with on the outward passage, three of which blew in the western half of the district; on the homeward passage (as usual) they were most frequent near the S.E. coast of Africa.

E.

SUMMARY.

The gales of the District have been classified under the heads of N.W., S.W., N.E., S.E., and "Exceptional," and it is proposed to give a few practical results under the same heads in the following summary.

N.W. GALES.

All gales which commence at N.W., though many veer to West, and some even to S.W. have been classed as N.W. gales.

Frequency.—Table 25 (p. 98) shows that about a third of the gales met with in the district belong to this class; an average of 42 per cent. being experienced on the outward, and 27 per cent. on the homeward passage.

On the outward passage the percentage of N.W. gales on all gales met with is pretty uniform in most months of the year; but September, October, and November have each about 12 per cent. below the mean.

On the homeward passage the average frequency of N.W. gales is 42 per cent. during the southern winter (June, July, and August); whilst it is only 12 per cent. during the southern summer (December, January, and February). It is well known that in the summer Easterly winds prevail on the homeward route.

Position.—The N.W. gales met with on the outward passage are pretty uniformly distributed in longitude, whilst those met with on the homeward route are chiefly confined to the western half of the district.

Character.—N.W. gales generally commence with a falling barometer, and on the outward passage their extreme force generally occurs before the lowest reading is recorded. Sometimes the extreme force does not blow until the wind has veered well to the Westward, or even to the Southward of West, and the barometer has begun to rise; this occurs more especially on the homeward route.

The wind often veers to the Southward of W. as the barometer begins to rise; the change from N.W. to W. or S.W. is very commonly closely preceded by or accompanied by heavy rain, and sometimes by lightning.

Handling ships in N.W. gales.—In the course of this Report it has been shown that the N.W. gales which are met with in this district are generally related to areas of low barometric pressure which move at a speed of from 20 to 30 miles an hour on an easterly track.

It has also been remarked that the prevalence of Westerly winds throughout the district proves that the parts of these travelling areas of low barometric pressure where the pressure is *lowest* generally pass to the southward of 50° S.

Diagram (a) p. 8 (which illustrates the condition of barometric pressure and direction of wind which are related to these travelling systems) considered together with the fact that the area of lowest pressure, which forms part of such a system, generally lies to the southward of the District, seems to show clearly that it would be wrong to treat a N.W. gale of this kind as though it were similar to the N.W. wind of a tropical cyclone; for instance, it would be useless to run to the southward in the hope of changing the direction of such a N.W. gale to North and N.E., or to make any similar manœuvre.

But even supposing that these areas of low barometric pressure corresponded in size and shape to tropical cyclones, the speed at which they move to the eastward is so great in proportion to the speed of a ship, that they would generally pass by her and produce a change of wind to W. or S.W. before she could effect any important change in the wind by her change of position.

It seems therefore clear that ships cannot manœuvre so as to escape these gales, or even so as to find an important change of wind; the whole attention of the seaman must therefore be turned towards making the best use of them.

A ship bound to the eastward may carry on before them, and the faster she goes the longer she is likely to keep under their influence. They are in fact to an outward-bounder the "brave westerly winds" spoken of by Maury. The chief precaution needed lies in being prepared for a rather sudden shift of wind from N.W. to W., or S.W., as the time of lowest barometric reading approaches; this change of wind is often closely preceded by or accompanied by heavy rain. It is hardly necessary to say that the driver and mainsail should be in when the change is expected, so as to avoid the danger of being "taken by the lee."

The barometer generally falls quickly up to the time of its lowest reading, and then rises as fast or faster after the change of wind has occurred. If the barometer rises fast it is a sign that the gale will probably freshen; and it has been shown that the strongest part of a (so-called) N.W. gale sometimes comes after the wind has veered to W., or even S.W.

A ship bound to the westward must face these gales, and her best way of dealing with them is to go on the tack which brings her nearest to her port, bearing in mind that the wind is likely to veer to W. or S.W. as the gale-system passes over her. If from stress of weather, or other causes, it is thought necessary to "heave-to," the port tack should be preferred, so that the ship may "come up" and stem the sea as the wind veers to W. and S.W.

Here it may be well to say that whenever it is thought necessary to heave-to in a gale met with in the Southern Hemisphere, whatever may be the class to which that gale belongs, it is safe to be guided by the rules laid down for handling ships in Southern Hemisphere cyclones, and to consider the direction in which the wind changes

as an indication of the direction in which the gale-system is moving,* and also as an indication of the side on which its area of lowest barometric pressure will pass the ship. For instance, with a N.W. wind veering to W. in the Southern hemisphere the indication is that the gale-system is moving to the eastward, and that its area of lowest barometric pressure will pass to the southward of the ship, in which case she is in the left-hand half of the gale-system, and should heave-to on the port tack. As already remarked, this rule applies to all gales, and has been often alluded to in the course of this Report when speaking of Exceptional gales.

It is generally believed that gales are not so severe and seas are not so heavy near the land of S. Africa, as they are near the edge and to the southward of the Agulhas Bank. The foregoing pages confirm this opinion.

N.W. gales which follow N.E. gales will be alluded to when speaking of Exceptional gales.

S.W. GALES.

Frequency.—Table 25 (p. 98) shows that about a third of the gales met with in the district belong to the S.W. type; there being an average of 29 per cent. met with on the outward, and 36 per cent. on the homeward passage.

On the outward passage the percentage of S.W. gales on the whole number of gales experienced is greatest from September to December, and least from May to August inclusive.

On the homeward passage their percentage is slightly higher from September to January than in most other months.

Position.—The S.W. gales met with on the outward passage are pretty uniformly distributed in longitude, though they have a tendency to be more frequent and violent to the southward of the Agulhas Bank than elsewhere. Those met with on the homeward route are chiefly experienced near the eastern edge of the Agulhas Bank and near the S.E. coast of Africa.

Character.—The winds of the wind-systems which comprise S.W. gales are similar in direction to those which comprise N.W. gales, the first fall of the barometer coming with a Northerly wind, veering to N.W.; the chief difference between the two classes being that with S.W. gale-systems the N.W. wind does not attain the force of a gale.

S.W. gales generally set in with a rising barometer, and very frequently during, or immediately after, heavy rain. The change to S.W. is sometimes preceded by lightning.

Handling Ships in S.W. Gales.—There is no special manœuvre required in dealing with S.W. gales, excepting that in case it should be found necessary to "heave-to," the port tack should be chosen, as the wind generally veers a few points to the South-

* If a ship is sailing fast, then her own course and speed must be taken into consideration when estimating the track of a gale-system.

ward during the gales, so that a ship on the port tack would "come up" and stem the sea.

As already remarked, S.W. gales are very common near the eastern edge of the Agulhas Bank where the Agulhas current is running with great velocity to the south-westward, and so meeting the gales. The opposite directions of wind and current cause a "fearful sea," and (as already remarked), smoother water and finer weather are generally met with by ships which go on the Bank and nearer to the S. African land, though they will lose the advantage of the strong current to the S.W., and are likely to meet with a counter-current to the north-eastward.

The close proximity of these counter-currents makes it very important that a ship's position should be well ascertained when she is supposed to be near the longitude of Cape Agulhas, and before "keeping away" to the north-westward.

During a severe S.W. gale a "crank" ship (jute-laden from India), which stood to the north-westward across the Agulhas current, was thrown on her beam ends and had to cut away her masts; the counter-action of the wind on her masts to that of the current on her hull being too much for her stability.

N.E. GALES.

Frequency.—Table 25 (p. 98) shows that N.E. gales form about $6\frac{1}{2}$ per cent. of all gales met with. They are more frequent on the homeward than on the outward route. On the outward passage their percentage is larger from August to December than in other months excepting May. On the homeward passage the largest percentages fall in February, March, April, and September.

Position.—N.E. gales are generally experienced in the eastern half of the district. Those met with on the homeward route are nearly always experienced near the S.E. coast of Africa.

Character.—N.E. gales are generally short and of slight force, they set in soon after the barometer has commenced falling, and frequently lose the force of a gale before the lowest barometer occurs. They are generally followed by Southerly or South-westerly winds which set in as the barometer begins to rise. Lightning sometimes occurs before the change of wind to S.W. If the South-westerly wind freshens to a gale, which it frequently does, the N.E. and S.W. gales are here considered as parts of one "Exceptional gale."

Handling ships in N.E. Gales.—N.E. gales are generally moderate in force and accompanied by fine weather, but the chief danger in connection with them lies in the fact of their being generally followed by North-westerly, South-westerly to Southerly, or even South-easterly winds, and that in many cases these winds attain the force of a heavy gale. Sometimes the second gale sets in with a sudden change of wind. On the homeward route the change from N.E. to S.W. frequently occurs in about 30° E. Hence great precaution is needed in watching the barometer, weather, sea, &c. during a N.E. gale, more especially when it is met with near the S.E. coast of Africa.

In a N.E. gale the wind often lulls below the force of a gale before the lowest barometer reading is experienced; lightning is sometimes seen at the same time, and a swell frequently sets in from the direction of the coming wind. The change of wind generally comes with the rising barometer.

As already remarked, N.E. gales followed immediately by gales from other directions are classed as "Exceptional gales," and will be alluded to hereafter.

S.E. GALES.

Frequency.—Table 25 (p. 98) shows that S.E. gales form about 10 per cent. of all gales met with. They are most abundant on the homeward passage.

On the outward passage the largest percentages occur in the months of March, July, August, and September; whilst on the homeward passage they are most abundant in February, March, November, and December.

Position.—The S.E. gales met with on the outward passage are generally experienced in the eastern half of the district. Whilst those met with on the homeward passage seem to depend on their character for their position. For instance, the fine weather South-easterly gales which are preceded by Southerly winds are generally met with near Cape of Good Hope,* whilst S.E. gales preceded by Northerly winds changing to S.E. about the time of lowest barometric pressure are generally met with in the eastern half of the district.

Character.—S.E. gales have been divided into two classes:—

- (a.) Those preceded by Northerly or North-westerly winds, which have their arrows on the diagrams distinguished by asterisks.
- (b.) Those preceded by Southerly or South-easterly winds.

The gales of class (a) resemble South-westerly gales in their character; setting in after the lowest barometer has passed, and lightning often occurring before the wind changes from the Northward to the Southward.

The gales of class (b) have been divided into two sub-classes, viz.:—

1. The fine weather gales which are generally met with near the Cape of Good Hope, more especially during the summer months. They are accompanied by a very slight fall in the barometer, and are closely related to the South-easters which are common at that season in Table Bay and Simon's Bay.

2. S.E. gales which are related to the south-western sides of cyclonic wind-systems moving to the southward or south-eastward. These gales are generally accompanied by bad weather and are sometimes very severe; as the gales progress the wind often backs to the Westward of South; the change generally taking place after the lowest barometer has been recorded.

* S.E. gales, preceded by Southerly winds and accompanied by bad weather, are also sometimes met with near the Cape of Good Hope, and have been alluded to in the "Remarks on the Gales of each Month," which precede this summary (pp. 100 to 104).

A falling barometer when the wind is Southerly and the weather threatening, is a most useful warning in this part of the sea.

Handling Ships in S.E. Gales.—The wind-systems of S.E. gales preceded by Northerly or Westerly winds, have wind-changes corresponding to those which occur when an area of low barometric pressure passes over a given position on a north-easterly track. Track No. 1 of Diagram (b) p. 9 illustrates these changes. If it is found requisite to heave-to in such a gale the port tack should be preferred, as the ship would be in the left-hand half of the gale-system and would “come up” and stem the sea as the wind veered.

The wind changes met with in the bad-weather S.E. gales preceded by South-easterly winds are represented by track No. 3 of Diagram (b), p. 9. These gales form part of the right-hand half of a gale-system moving to the south-eastward, and the starboard tack should be preferred when it is found requisite to heave-to.

Fine-weather S.E. gales preceded by S.E. winds are easily dealt with, though they often blow with heavy gusts from Table Mountain into Table Bay, and make it very difficult for a sailing ship to reach the anchorage.

EXCEPTIONAL GALES.

Frequency.—Table 25 (p. 98) shows that about $16\frac{1}{2}$ per cent. of all gales met with were classed as exceptional, and that the proportion was much the same on the outward as on the homeward route. The diagrams show that they, in common with nearly all other kinds of gales, were much more abundant in winter than in summer.

Position.—Exceptional gales are generally more frequent on the eastern than on the western side of the district especially those met with on the homeward route.

In the winter they extend further to the westward, and at that season several were met with near the Cape of Good Hope.

Character.—Gales which have changed quickly from one quarter to another, or which from some other cause could not be classed under the previous headings, have been called “Exceptional.” Plates III., VIII., and XI. to XX. have diagrams representing their various directions in the position where the *extreme* force commenced. Plates IV., V., IX., and X. have diagrams representing the data of each Exceptional gale met with in the months of January and July, and quotations from the logs of the ships which experienced these gales are given above.

It may, however, be well to allude here to the very dangerous type of Exceptional gale which changes quickly from N.E. to N.W. or S.W.; gales of this type are frequently met with, but more especially near the S.E. coast of Africa. Diagram 3A, Plate V., gives the data of a severe Exceptional gale which shifted from N.E. to S.W., and full quotations from the log will be found on p. 45.

Horsburgh seems to refer to gales of this type in the following remark quoted from p. 89 of the 8th edition of his Directory :

“When the wind at S.E. or E.S.E. shifted to N.E. the Dutch commanders were

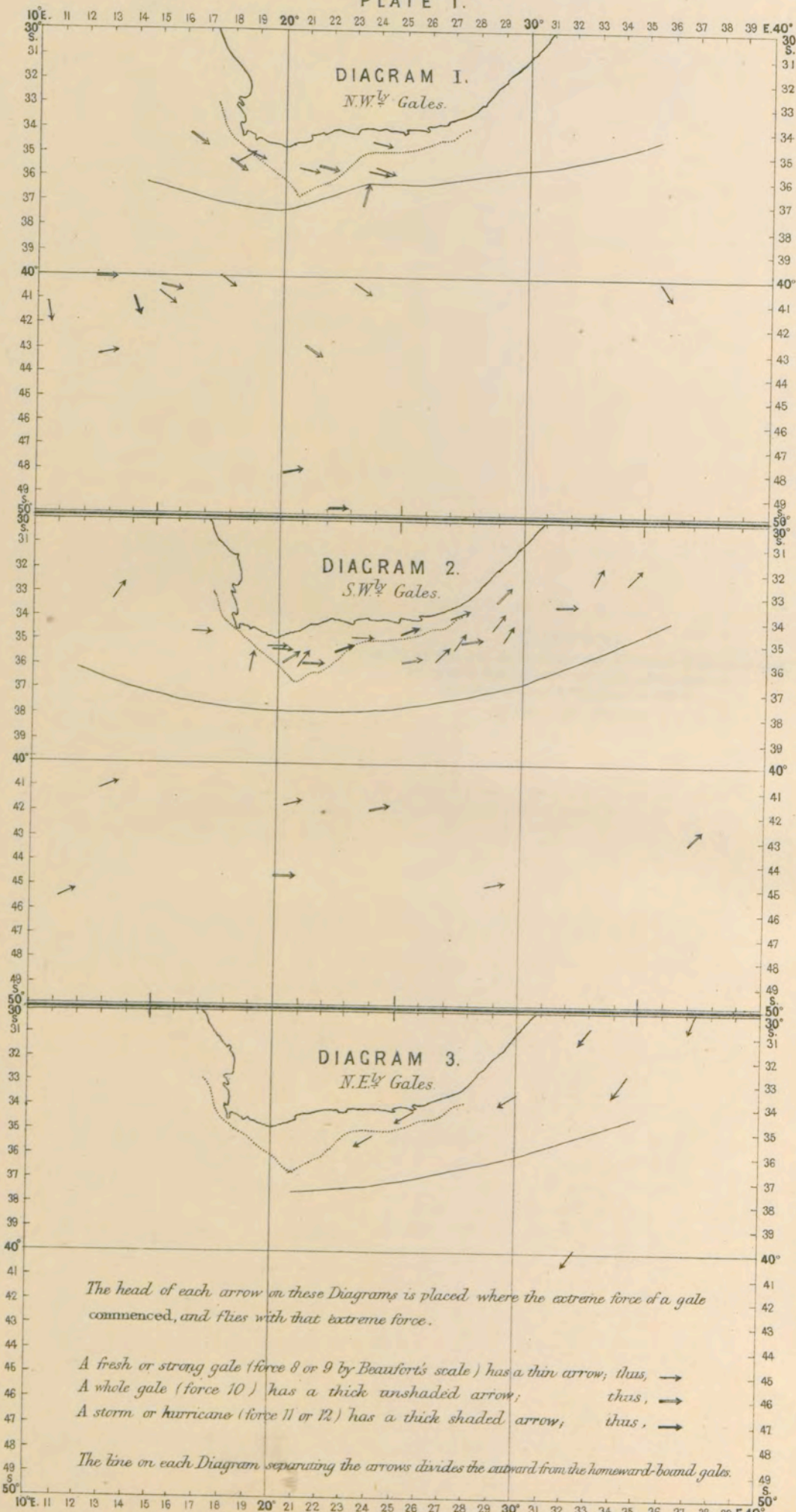
directed by their Company to take in the mainsail. If lightning appeared in the N.W. quarter they were to ‘wear’ and shorten sail; for, in the first case, they expected a hard gale at N.W., and if lightning was seen in that direction they thought the gale would commence in the sudden shift or whirlwind which might be fatal if they were taken aback.”

Handling Ships in Exceptional Gales.—It is not possible to manœuvre so as to avoid encountering the Exceptional gales which shift suddenly from one quarter to another, so that when lightning and other weather signs, or the direction of a swell, indicate such a change, the chief precaution lies in following the above instruction by reducing sail especially on the mizen and mainmasts.

The gales which only shift from N.E. to N.W. and in which the barometer begins to rise as the wind goes to N.W. seem to be related to the eastern and north-eastern quarters of cyclonic wind-systems which are moving along a south-easterly track, such as the one marked No. 2 on Diagram (b.), p. 9. In such a position a ship would be in the left-hand half of the gale-system and if compelled to heave-to should do so on the port tack.

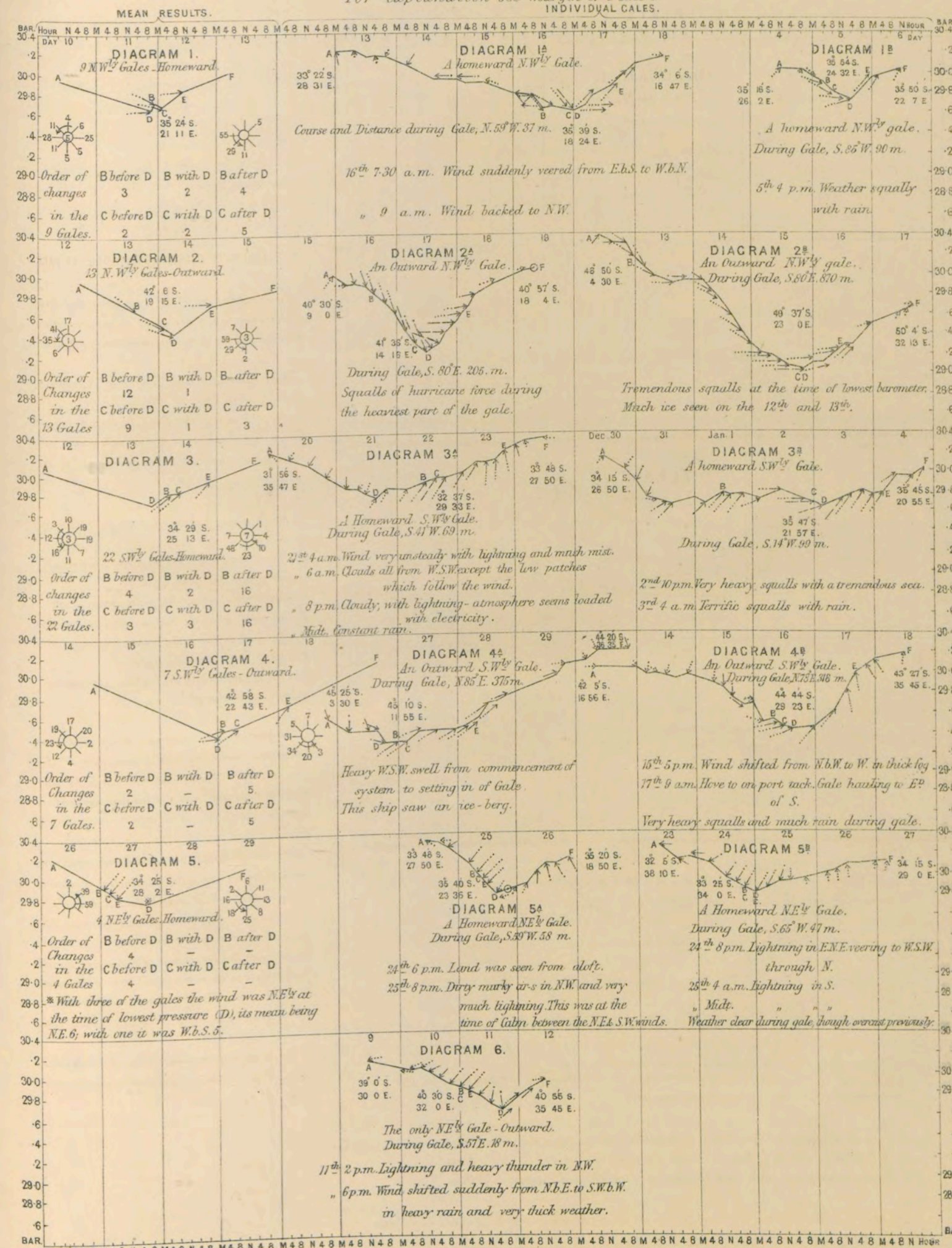
In those gales which shift quickly from N.E. to S.W. the wind generally veers through N., N.W., and W., so that in their case also the port tack should be preferred if it is thought requisite to heave-to.

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For Her Majesty's Stationery Office.
[2226.—750.—8/82.]



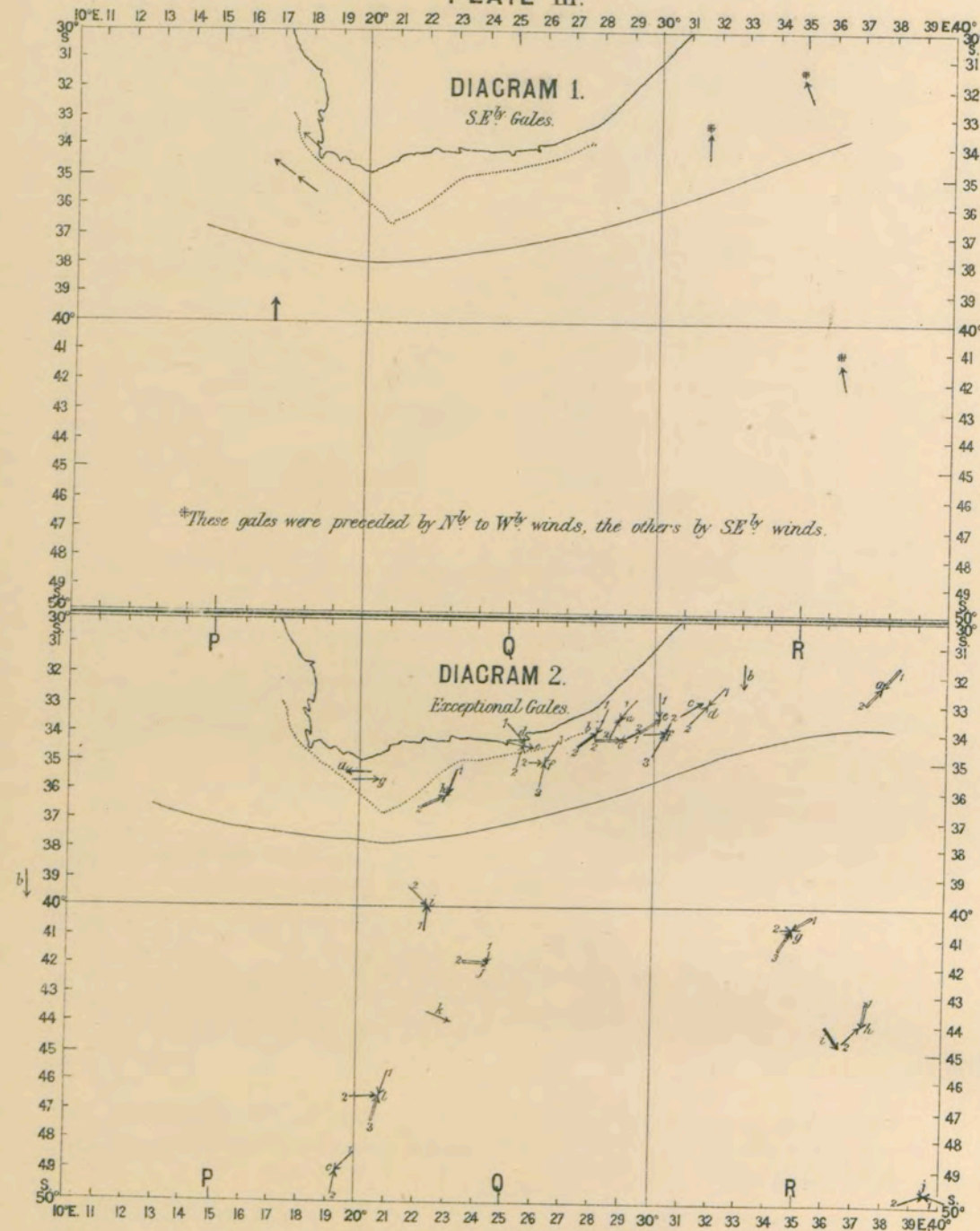
The other Diagrams represent the individual data of two or more of the most important gales of each class.

The line on each Diagram separating the arrows divides the outward from the homeward-bound gales.



JANUARY.

PLATE III.



*These gales were preceded by N^{ly} to W^{ly} winds, the others by SE^{ly} winds.

EXPLANATION OF DIAGRAMS ON PLATES IV AND V.

The Diagrams on PLATES IV and V represent the data of the Gales which are given in geographical position on PLATE III.

These data are Time, Height of Barometer, Direction and Force of Wind. The style of arrow represents the force by Beaufort's scale thus, ○ equals Calm, a dot equals 1 and a dash equals 5, hence — = 1, — = 5, — = 7, — = 12.

The data are represented at the following times :-

- A (ANTERIOR) when the highest Barometer occurs before the gale.
- B (BEGINNING) when the gale commences.
- C (CLIMAX) when the extreme force commences.
- D (DEPRESSION) when the lowest pressure occurs.
- E (END) when the gale ends.
- F (FOLLOWING) when the highest Barometer occurs following the gale.

The positions of A, C, and F are always given, also the course and distance made by the ship during the gale, i.e., during the period B to E.

SE^{ly} Gales are divided into two classes:
(a) Those preceded by N^{ly} or W^{ly} winds, see Diagrams I, I', and 3, Plate IV.
(b) Those preceded by S^{ly} or SE^{ly} winds, see Diagrams 2, 2', 2'', and 3', Plate IV.
As there are so few SE^{ly} Gales it has been considered best to represent each gale, instead of meaning those of the same class.

Exceptional gales are represented individually, and quotations from logs relating to them are given in the letter-press, as they often need to be longer than in the case of ordinary gales.

The head of each arrow on these Diagrams is placed where the extreme force of a gale commenced, and flies with that extreme force.

A fresh or strong gale (force 8 or 9 by Beaufort's scale) has a thin arrow, thus, —
A whole gale (force 10) has a thick unshaded arrow, thus, —
A storm or hurricane (force 11 or 12) has a thick shaded arrow, thus, —

The line on each Diagram separating the arrows divides the outward from the homeward-bound gales.

EXCEPTIONAL GALES frequently change from one quarter to another and often suddenly; it is therefore thought well to represent the various directions, in which cases the arrows are numbered according to time, their position being that of the first occurrence of the extreme force.

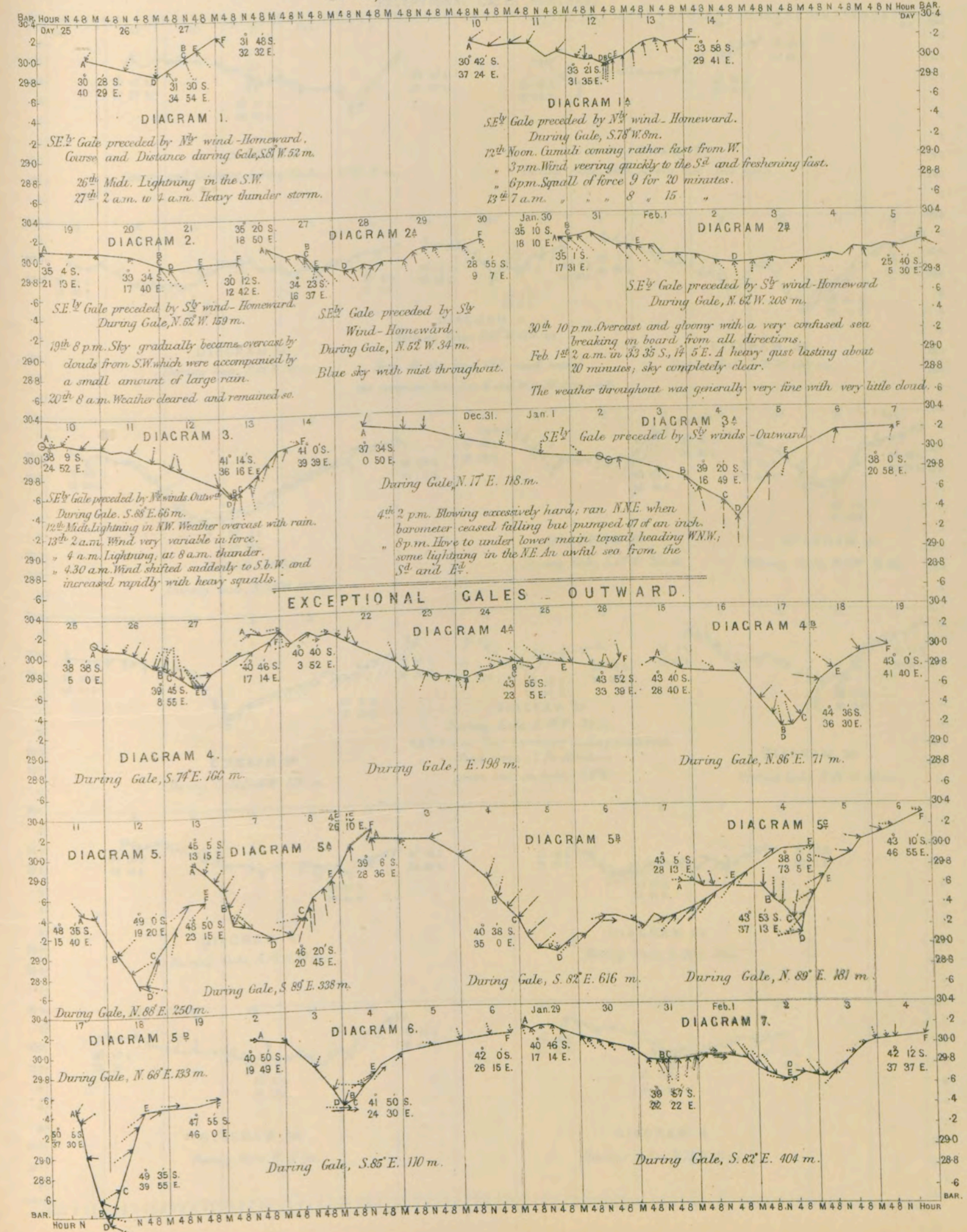
Sometimes a sudden shift occurs from a moderate wind to a gale, or a moderate wind is experienced between the two parts of an Exceptional Gale, in these cases the moderate wind is represented by an arrow of half the usual length.

The letters P, Q, R, and a, b, c, &c. are used for easy reference to the arrows.

JANUARY.

PLATE IV.

For explanation see margin of Plate III.

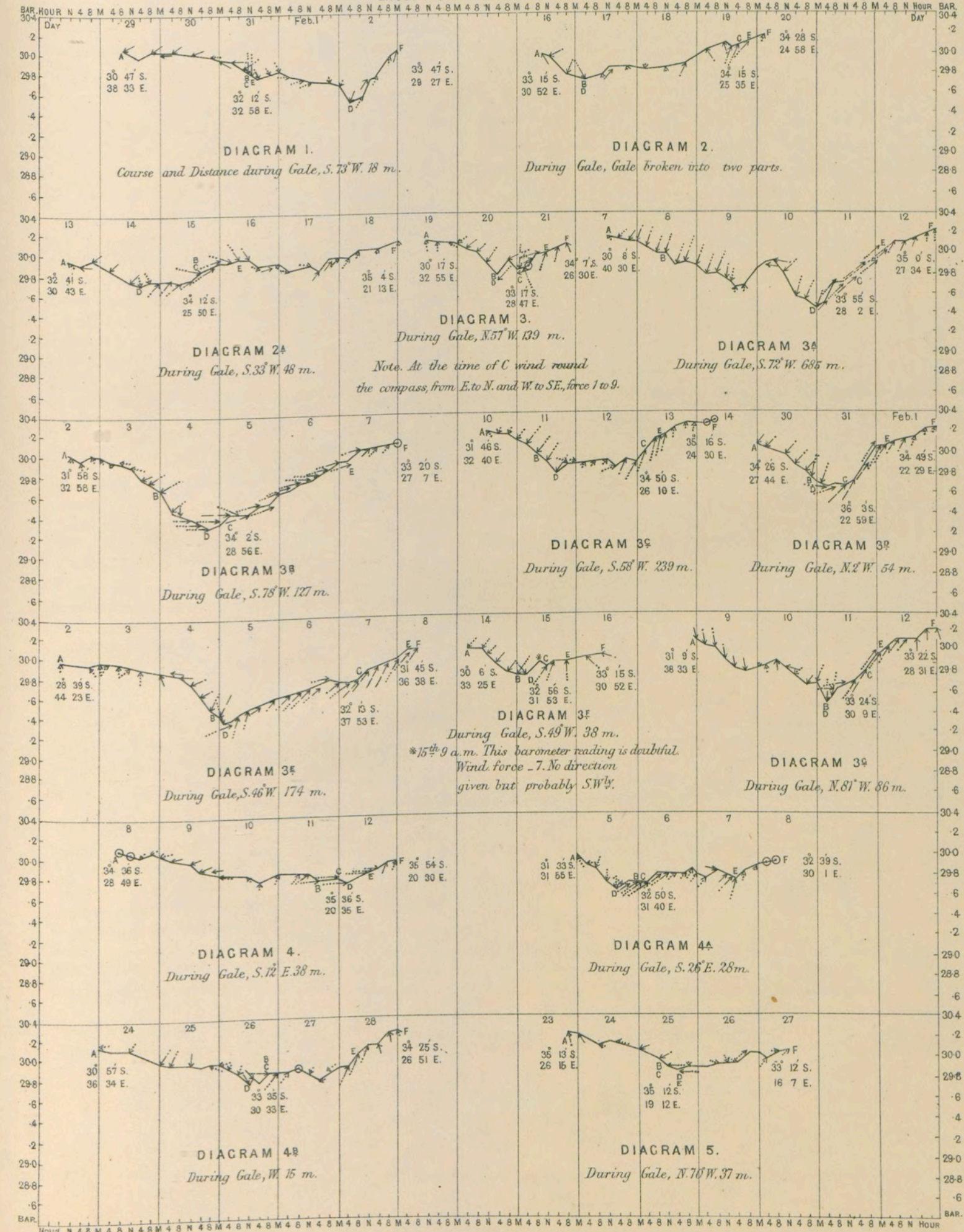


JANUARY.

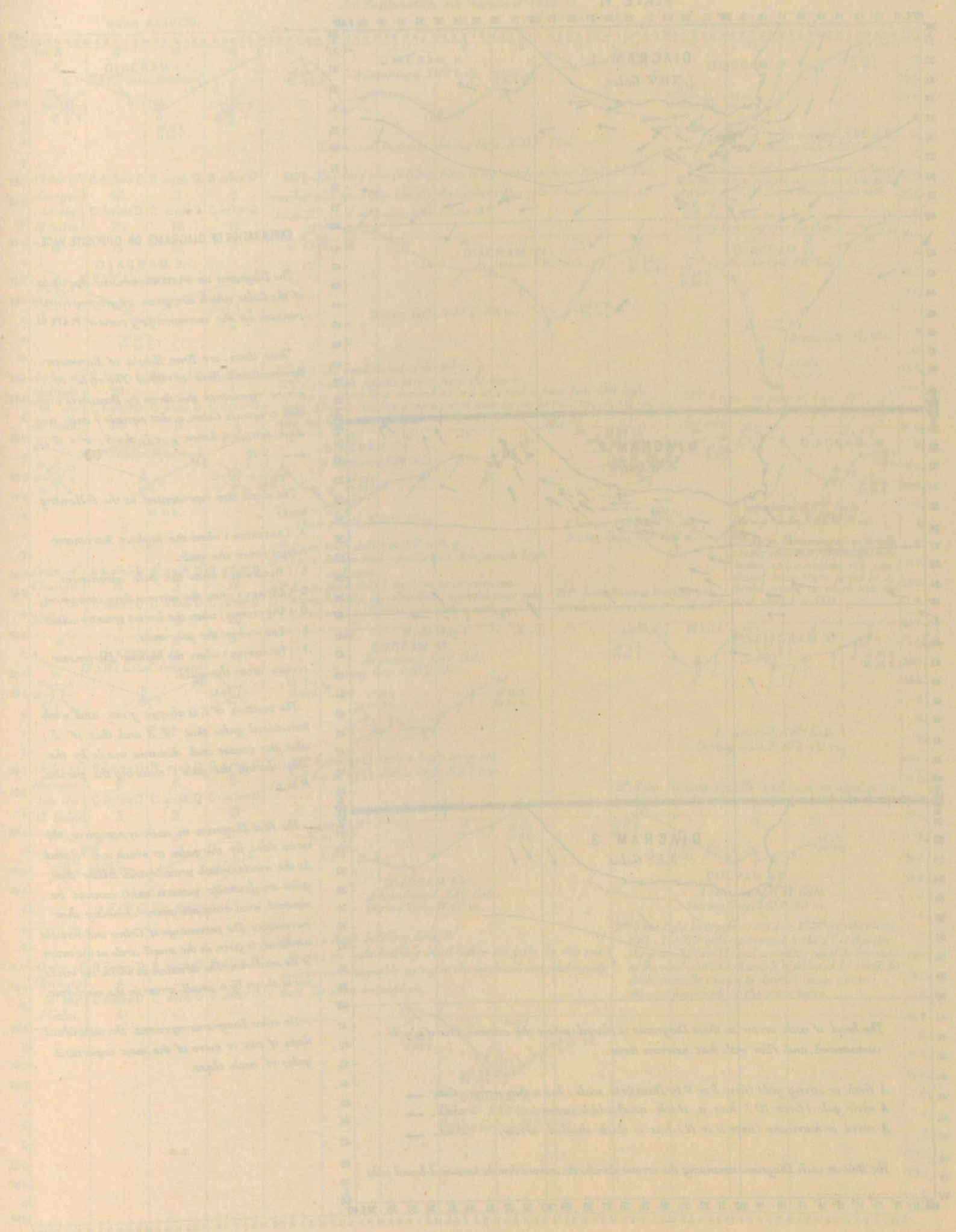
PLATE V.

For explanation see margin of Plate III.

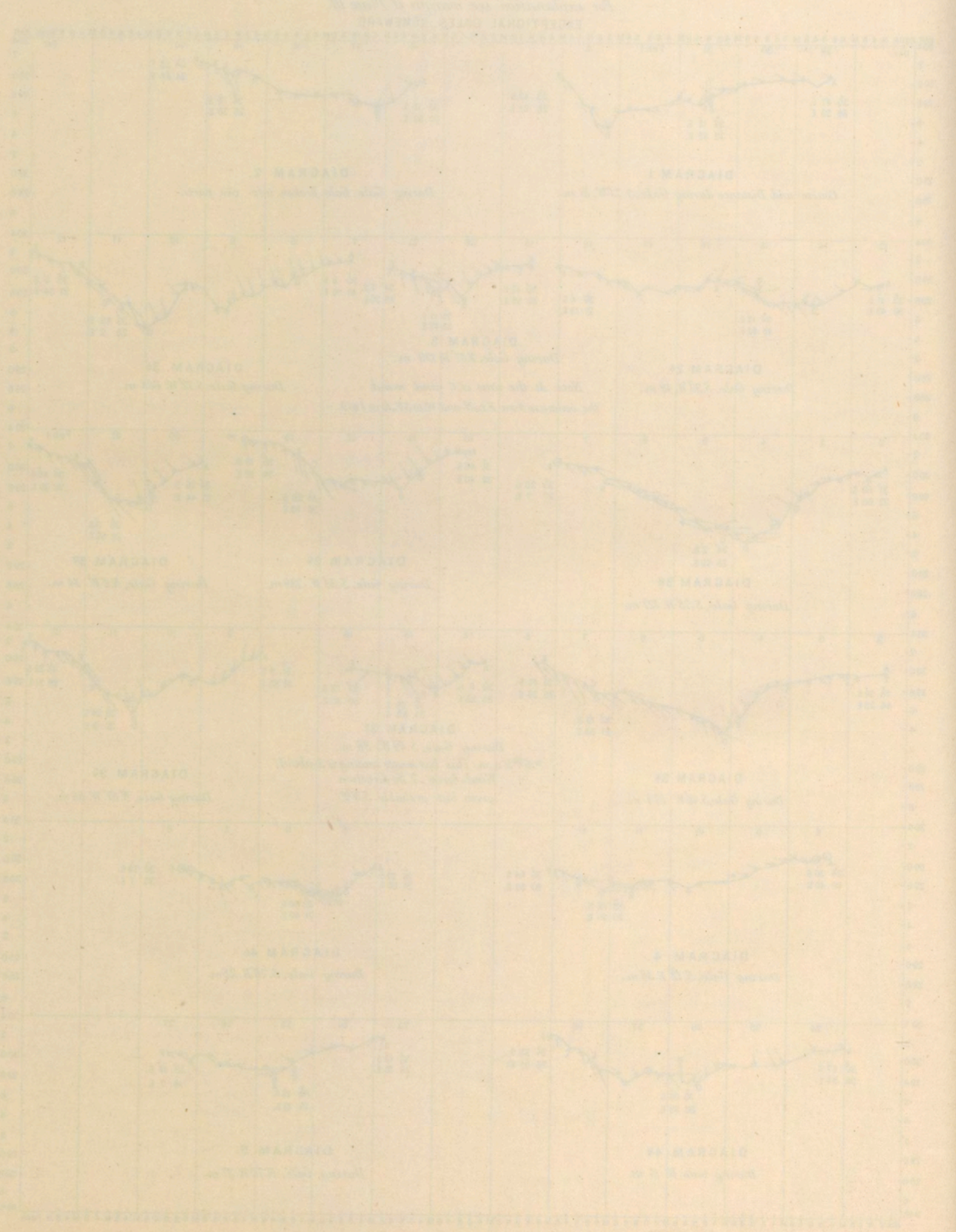
EXCEPTIONAL GALES - HOMEWARD.

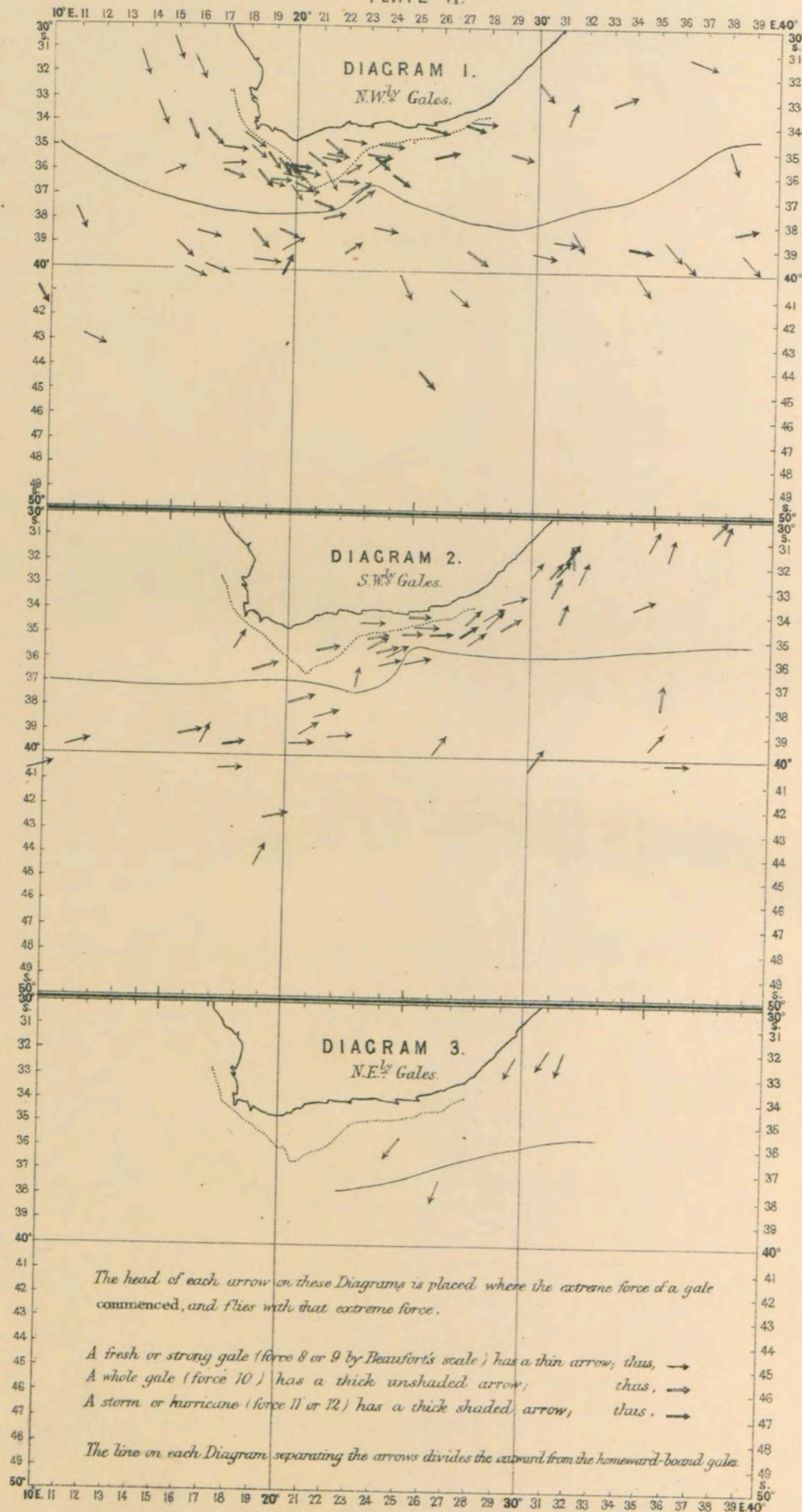


JULY 17 1871
PLATE VI



JULY 17 1871
PLATE VI



JULY.
PLATE VI.

EXPLANATION OF DIAGRAMS ON OPPOSITE PAGE.

The Diagrams on PLATE VII represent the data of the Gales which are given in geographical position on the corresponding parts of PLATE VI.

These data are Time, Height of Barometer, Direction and Force of Wind. The style of arrow represents the force by Beaufort's scale; thus, ○ equals Calm, a dot equals 1 and a dash equals 5, hence — = 1, — = 5, — = 7, — = 12.

The data are represented at the following times:—

- A (ANTERIOR) when the highest Barometer occurs before the gale.
- B (BEGINNING) when the gale commences.
- C (CLIMAX) when the extreme force commences.
- D (DEPRESSION) when the lowest pressure occurs.
- E (END) when the gale ends.
- F (FOLLOWING) when the highest Barometer occurs after the gale.

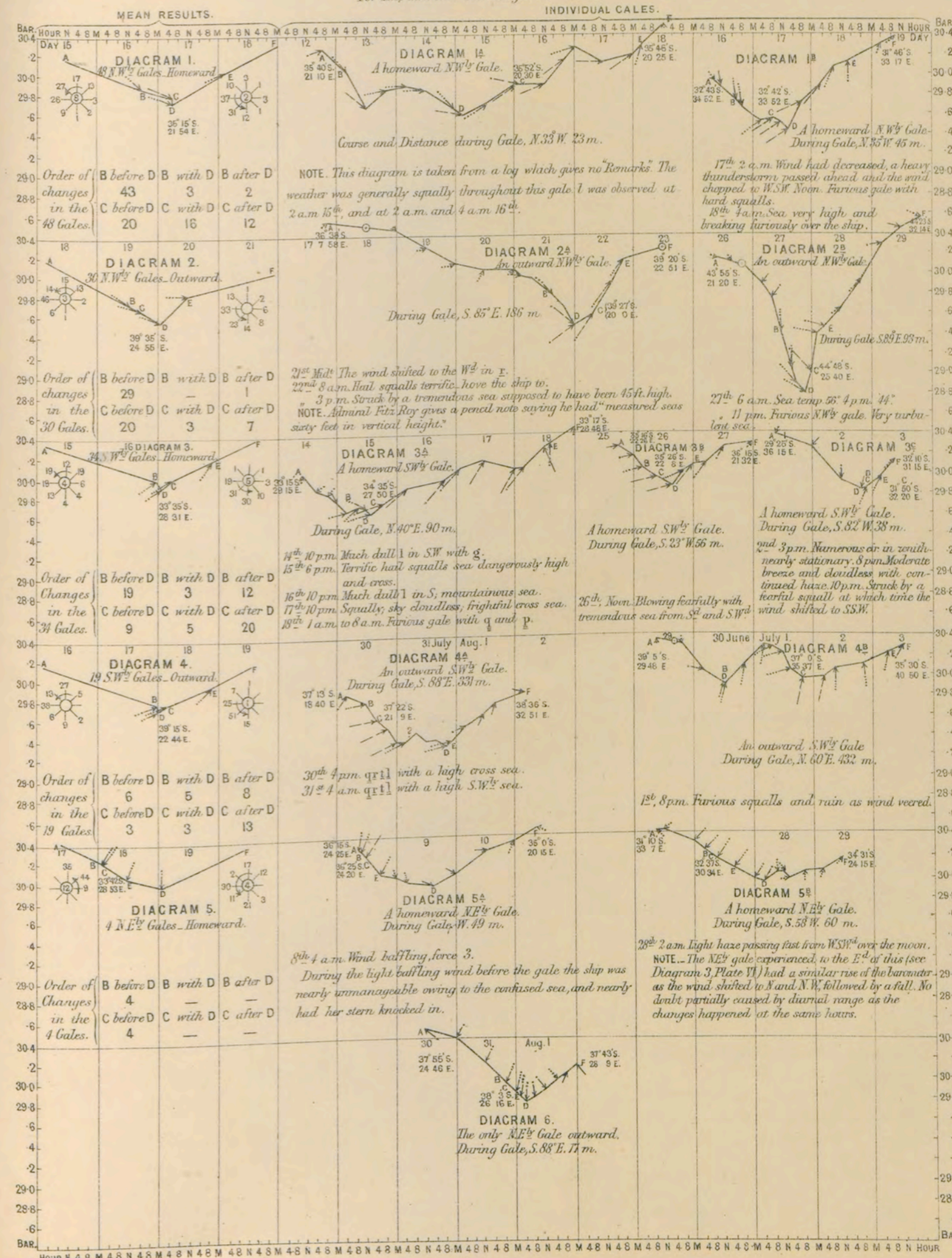
The position of C is always given and with individual gales that of A and that of F; also the course and distance made by the ship during the gale, i.e. during the period B to E.

The first Diagram in each space gives the mean data for the gales to which it is related. As the winds which precede and follow the gales are generally various, and cannot be named, wind-roses are given showing their percentages. The percentage of Calms and Variables combined, is given in the small circle at the centre of the wind-rose. The direction in which the winds veer is shown by a small arrow in the wind-rose.

The other Diagrams represent the individual data of two or more of the most important gales of each class.

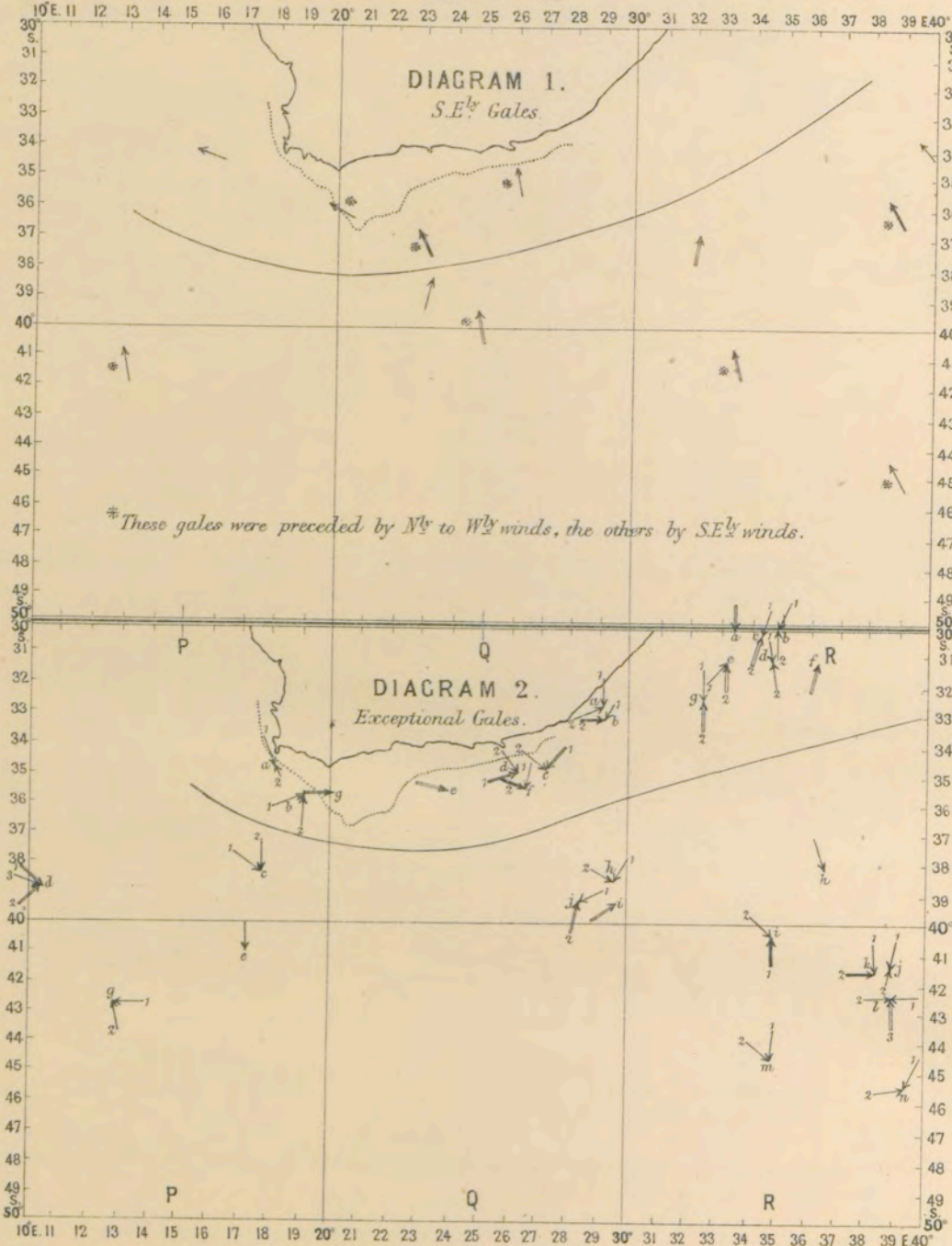
JULY.
PLATE VII.

For Explanation see margin of Plate VI.



JULY.

PLATE VIII.



EXPLANATION OF DIAGRAMS ON PLATES IX AND X.

The Diagrams on PLATES IX and X represent the data of the Gales which are given in geographical position on PLATE VIII.

These data are Time, Height of Barometer, Direction and Force of Wind. The style of arrow represents the force by Beaufort's scale thus, \circ equals Calm, a dot equals 1 and a dash equals 5; hence \cdot = 1, $-$ = 5, $-$ = 7, $-$ = 12.

The data are represented at the following times:

- A (ANTERIOR) when the highest Barometer occurs before the gale.
- B (BEGINNING) when the gale commences.
- C (CLIMAX) when the extreme force commences.
- D (DEPRESSION) when the lowest pressure occurs.
- E (END) when the gale ends.
- F (FOLLOWING) when the highest Barometer occurs following the gale.

The position of C is always given, and with individual gales that of A and that of F; also the course and distance made by the ship during the gale, i.e., during the period B to E.

- SE Gales are divided into two classes:
 - (a) Those preceded by N.W. or W. winds, see Diagrams 1^a and 2^a Plate IX.
 - (b) Those preceded by S.W. or S.E. winds, see Diagrams 1^b and 3^a Plate IX.

Diagrams 1, 2, and 3 on Plate IX represent the mean data of the two kinds of S.E. gales. The percentages of the winds which precede and follow them are given in wind-roses to the left and right of each diagram. The percentage of Calms and Variables combined is given in the small circle at the centre of the wind-rose. The direction in which the winds veer is shown by a small arrow in the wind-rose.

Exceptional gales are represented individually, and quotations from logs relating to them are given in the letter-press, as they often need to be longer than in the case of ordinary gales.

The head of each arrow on these Diagrams is placed where the extreme force of a gale commenced, and flies with that extreme force.

- A fresh or strong gale (force 8 or 9 by Beaufort's scale) has a thin arrow, thus, \rightarrow
- A whole gale (force 10) has a thick unshaded arrow, thus, \rightarrow
- A storm or hurricane (force 11 or 12) has a thick shaded arrow, thus, \rightarrow

The line on each Diagram separating the arrows divides the outward from the homeward-bound gales.

EXCEPTIONAL GALES frequently change from one quarter to another and often suddenly; it is therefore thought well to represent the various directions, in which cases the arrows are numbered according to time, their position being that of the first occurrence of the extreme force.

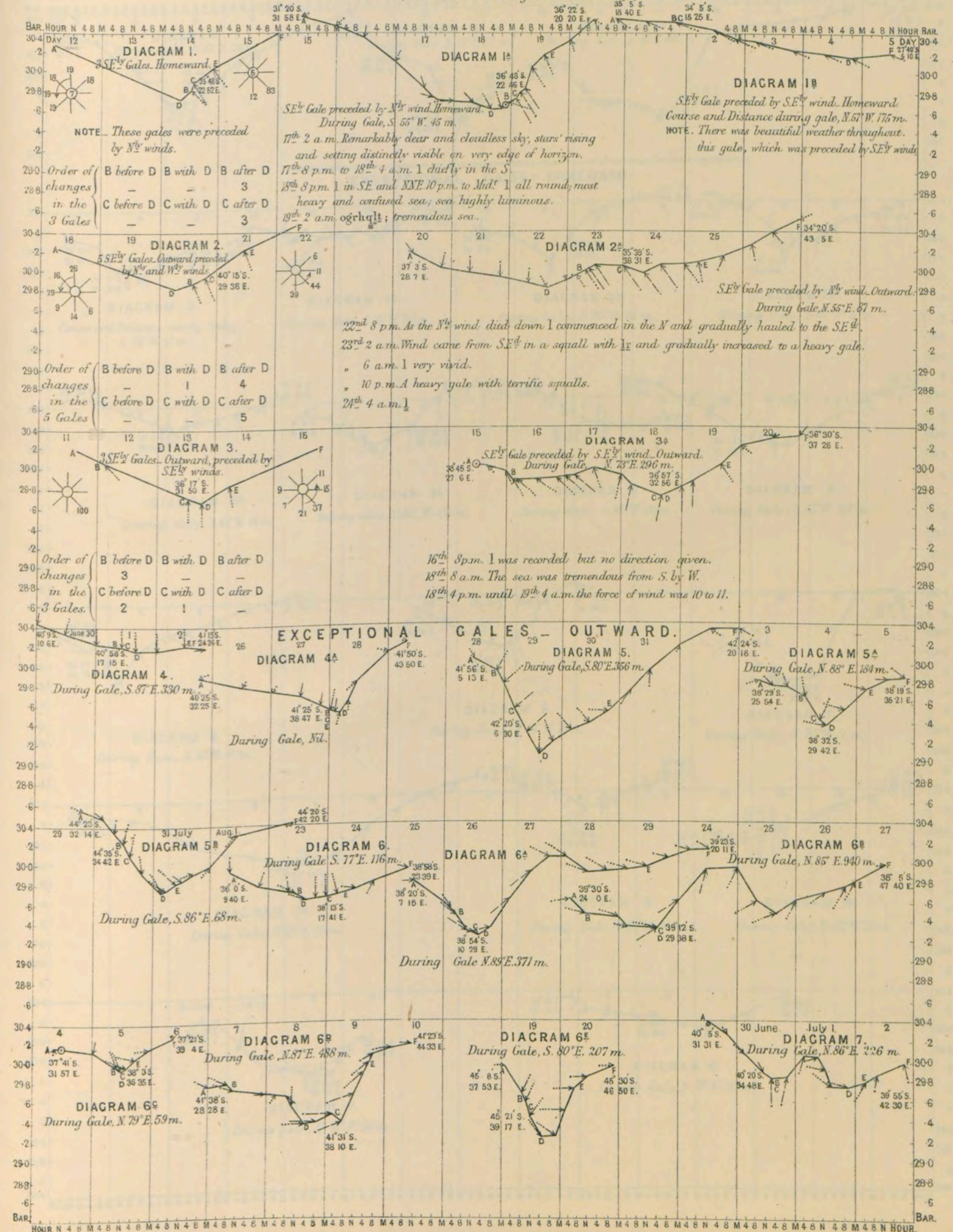
Sometimes a sudden shift occurs from a moderate wind to a gale, or a moderate wind is experienced between the two parts of an Exceptional Gale, in these cases the moderate wind is represented by an arrow of half the usual length.

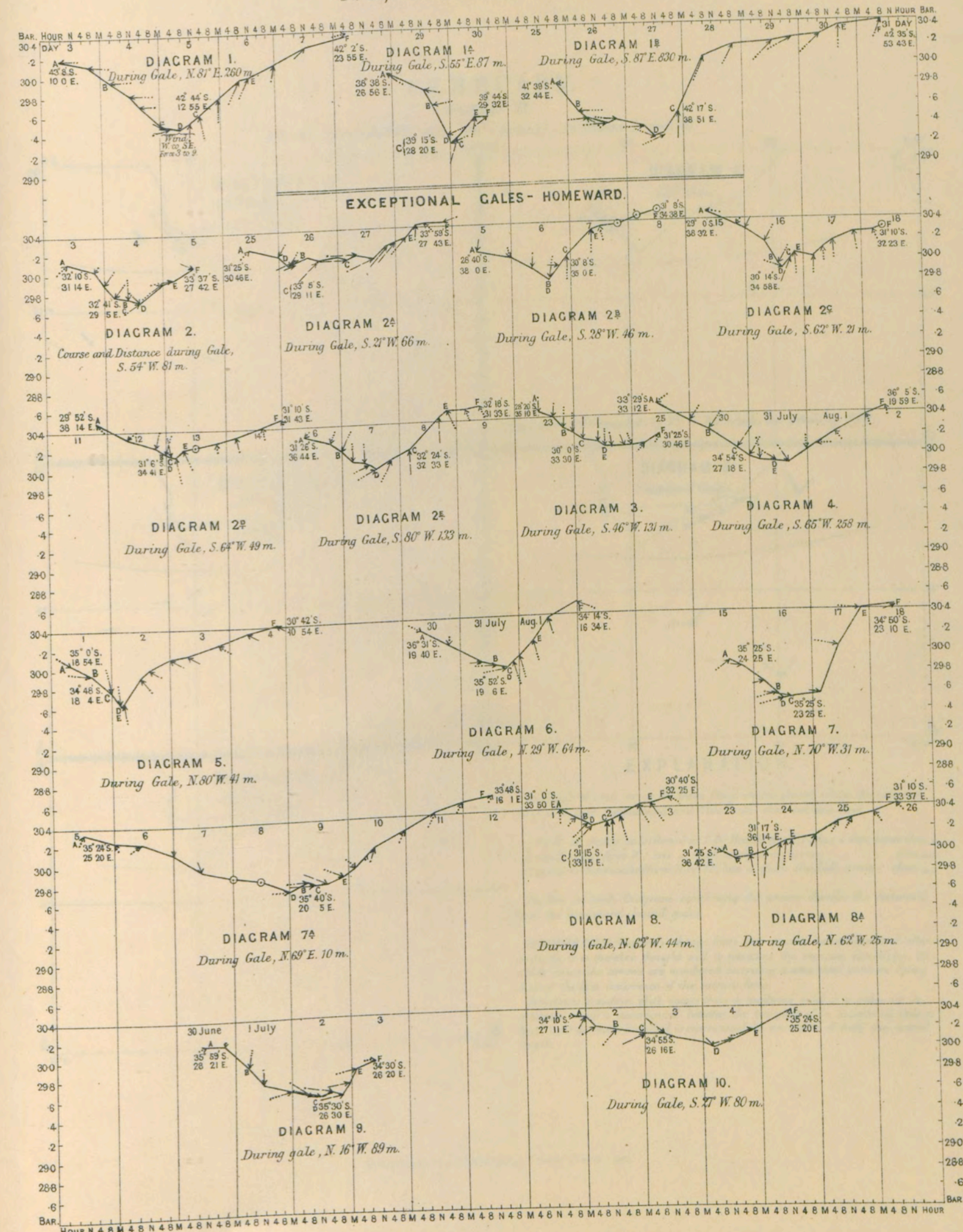
The letters P, Q, R, and a, b, c, &c. are used for easy reference to the arrows.

JULY.

PLATE IX.

For explanation see margin of Plate VIII.

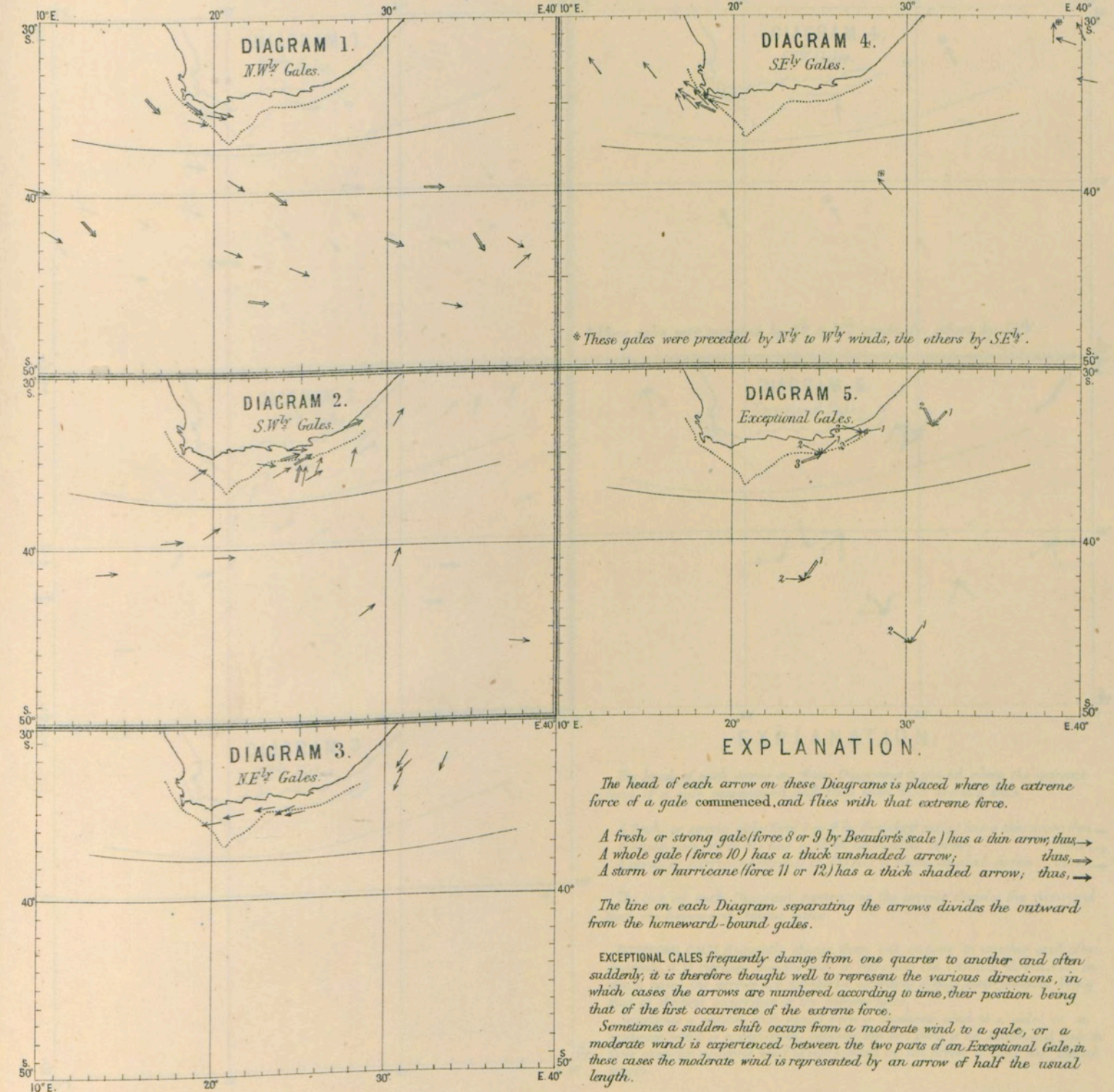




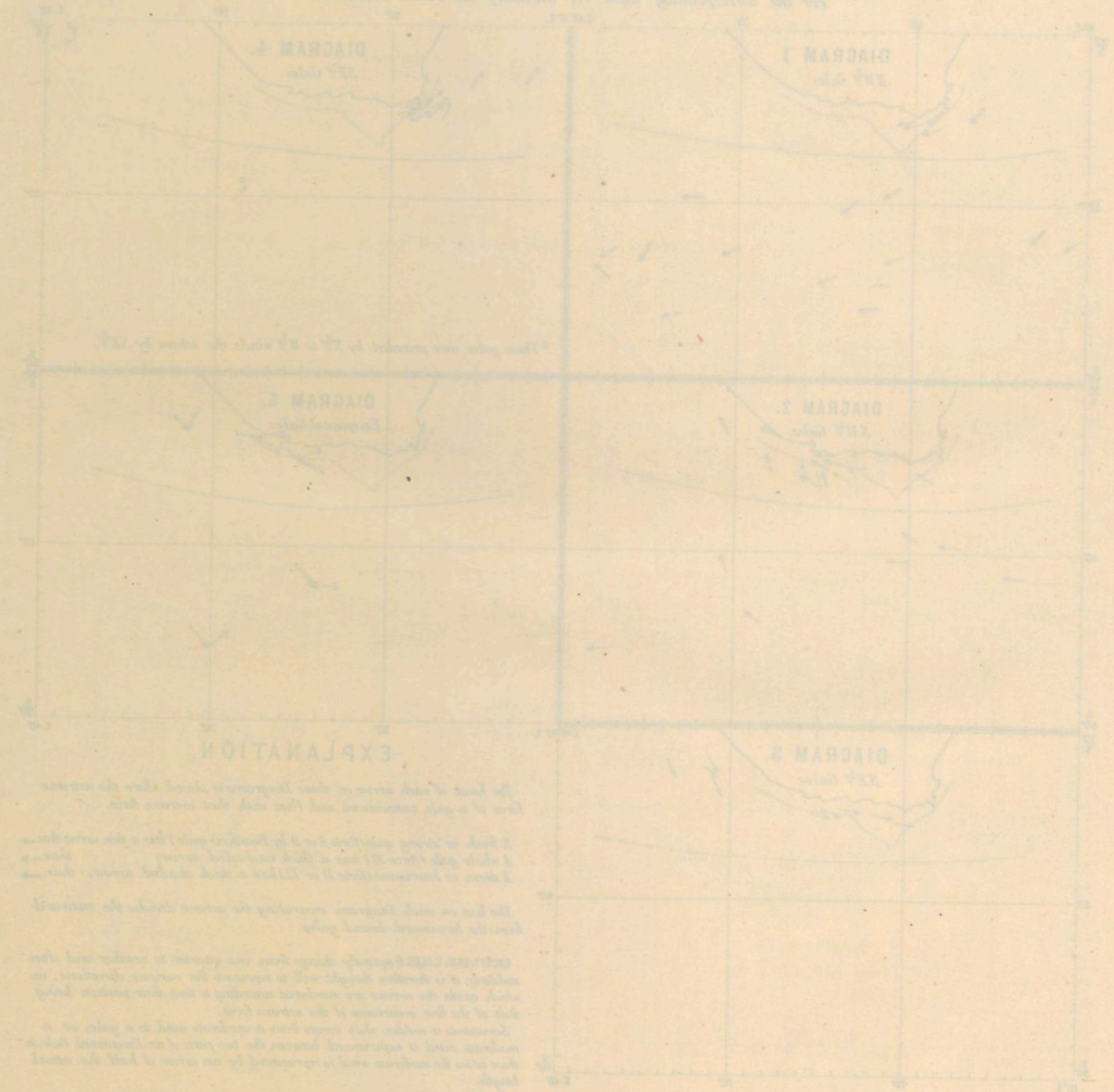
FEBRUARY.

PLATE XI.

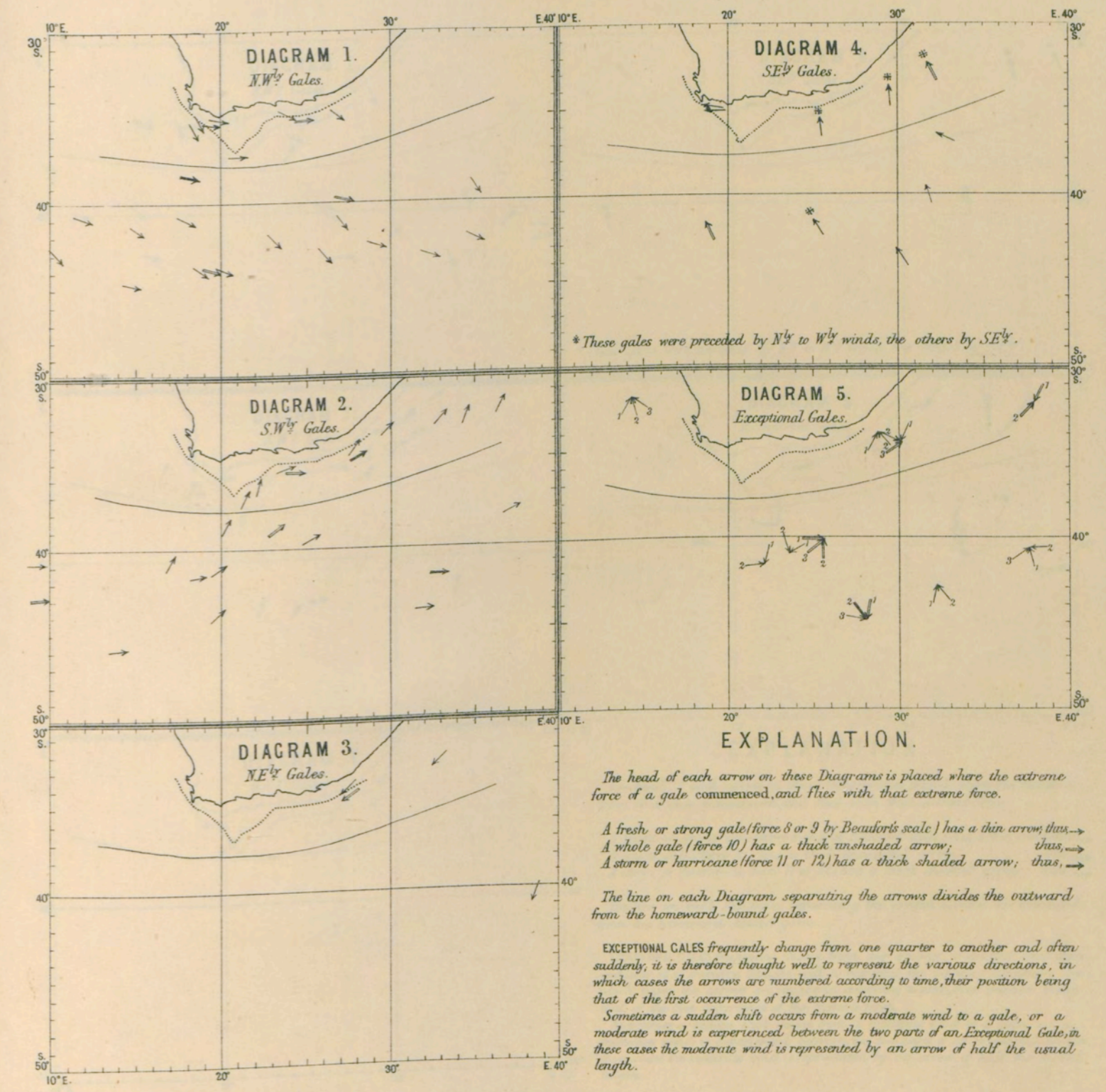
For the corresponding data for January see Plates I and III.

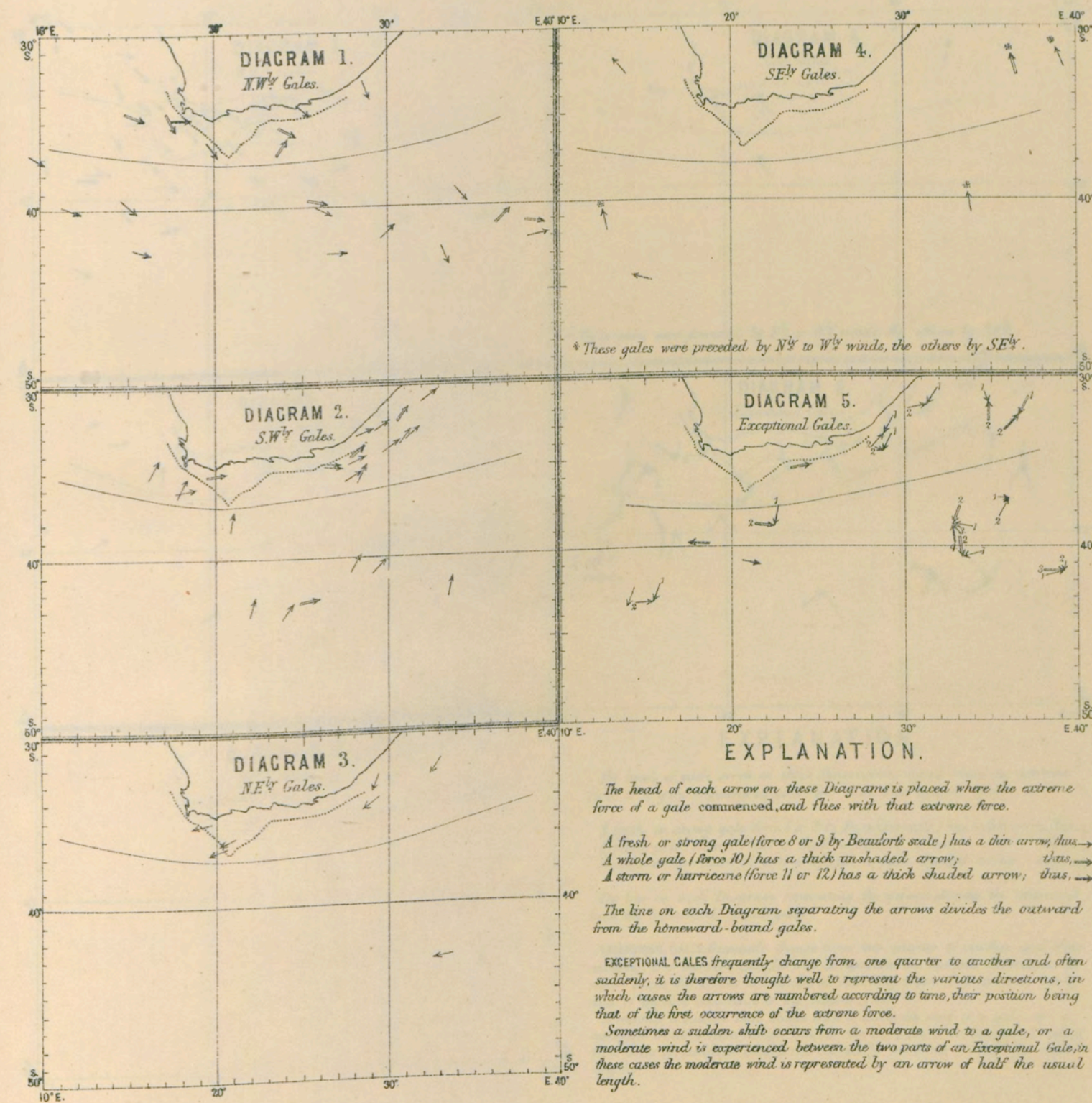


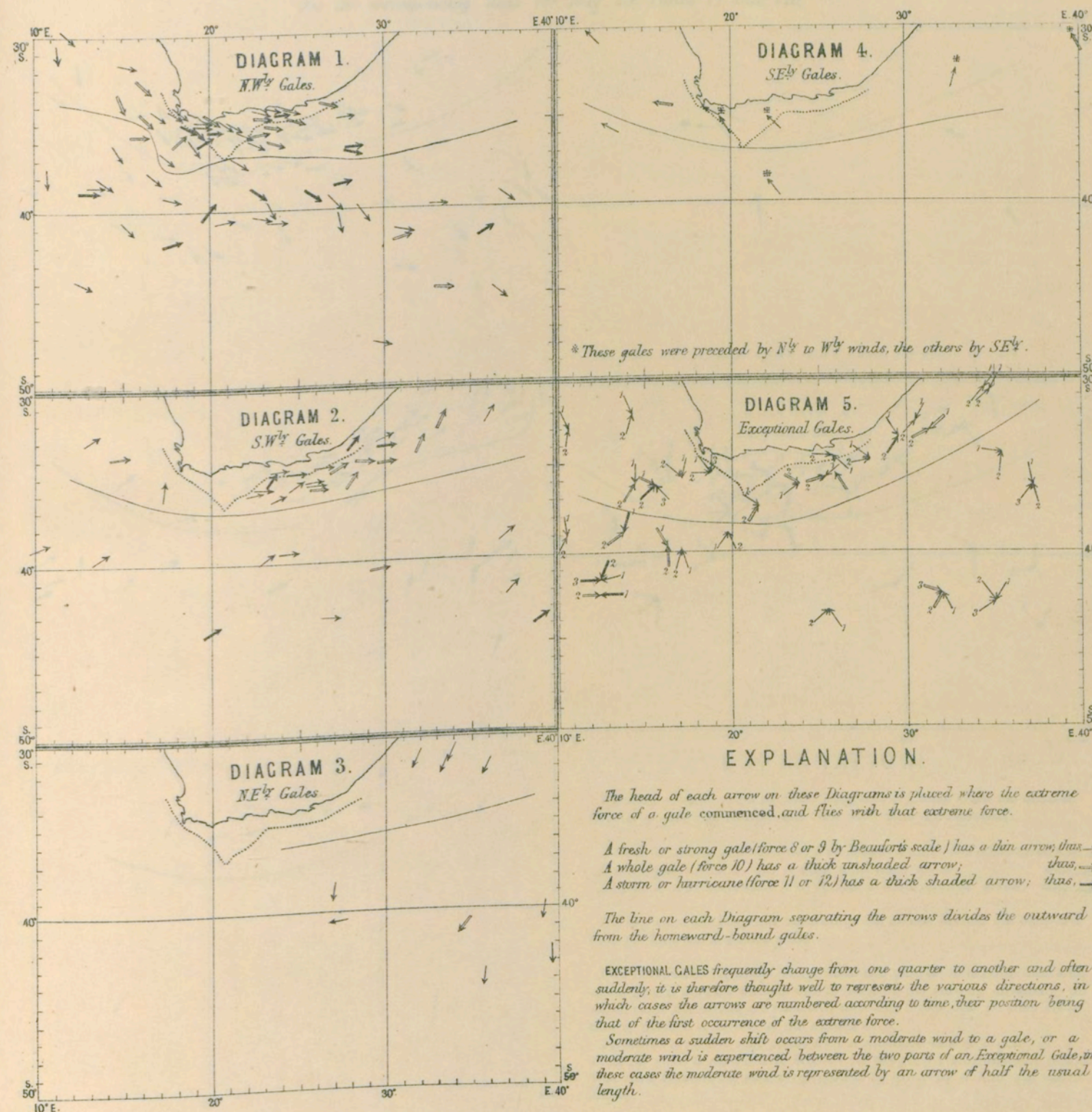
FEBRUARY. PLATE XI.



MARCH. PLATE XII.



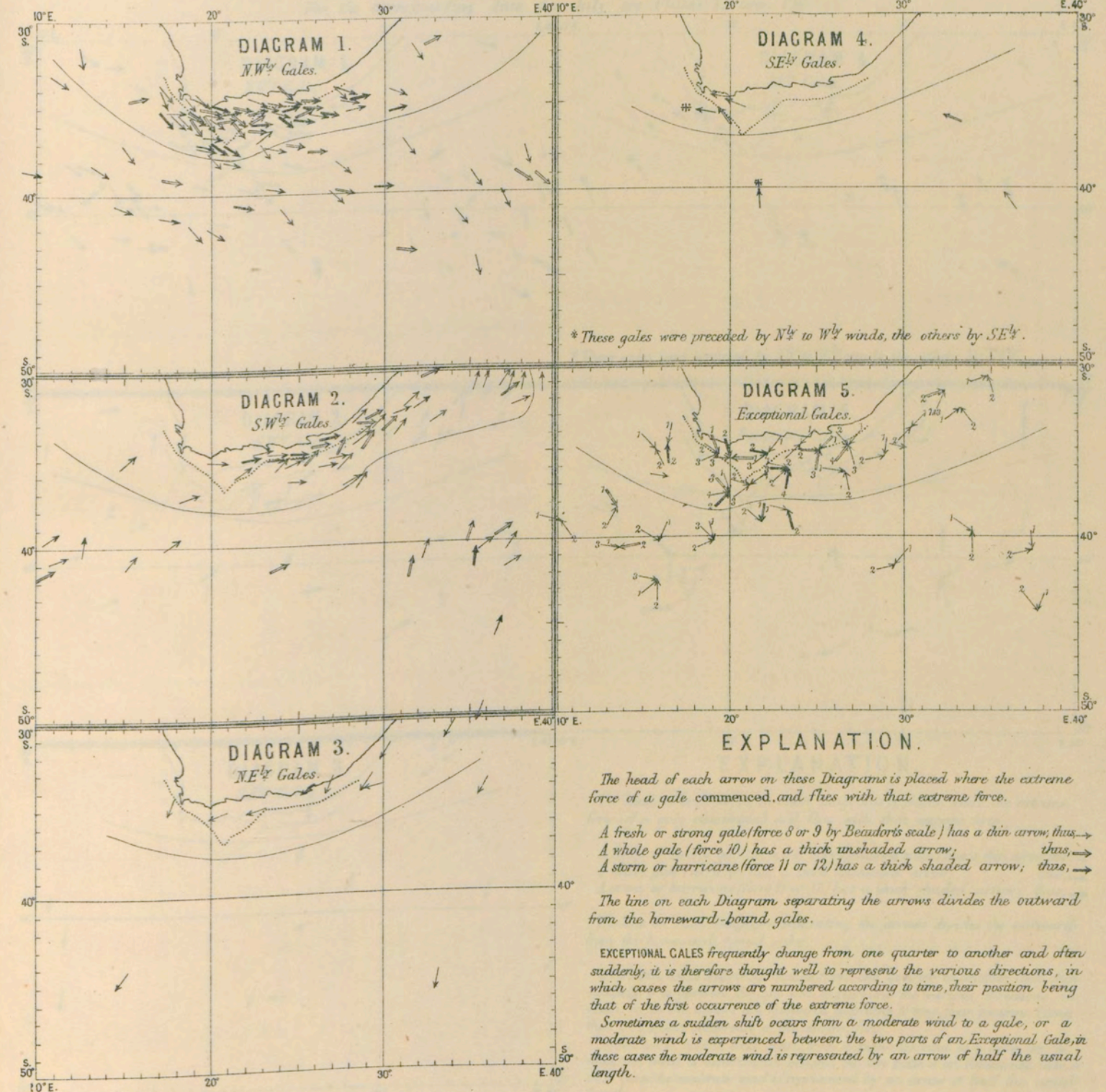




JUNE.

PLATE XV.

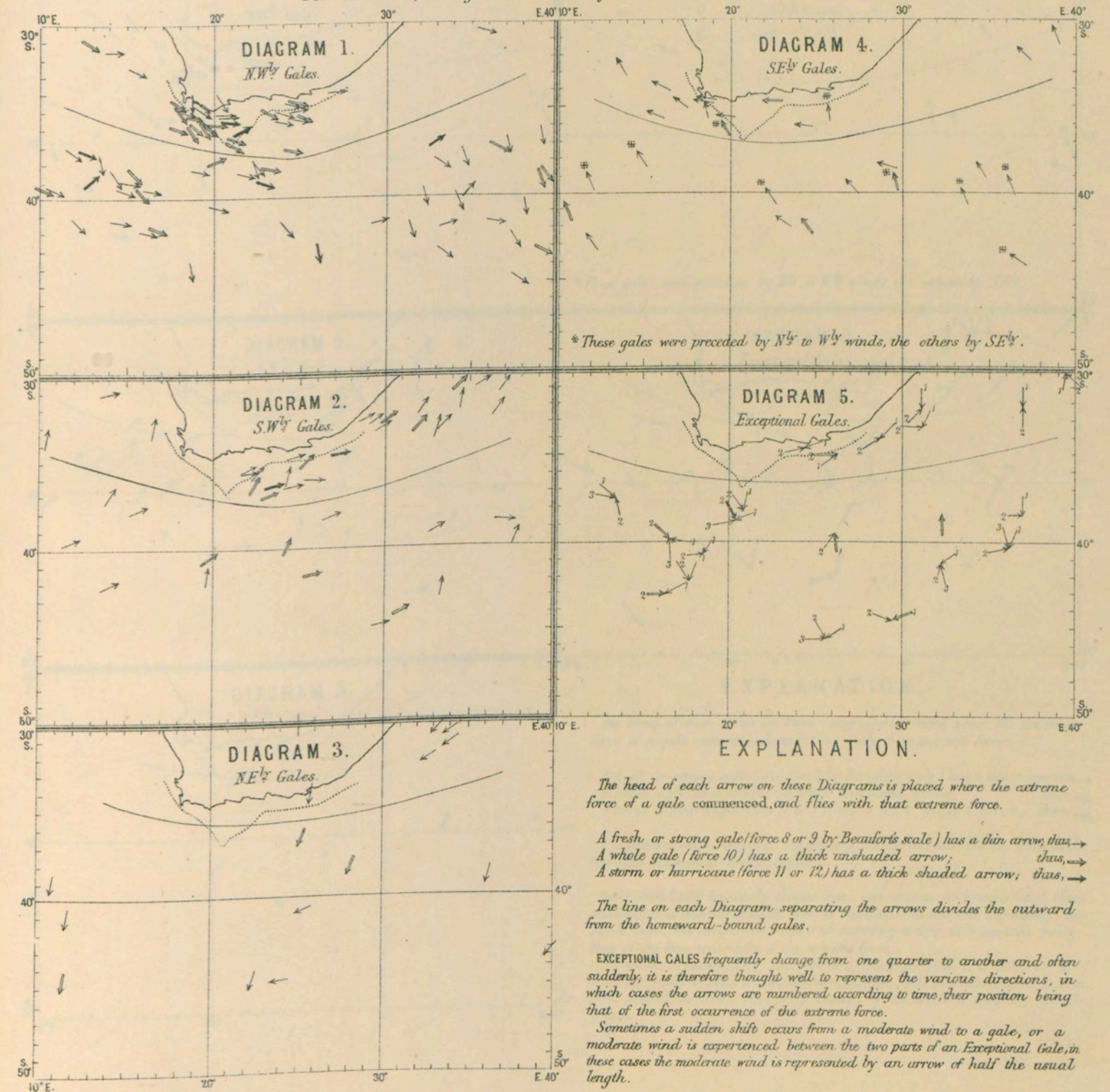
For the corresponding data for July see Plates VI and VIII.



AUGUST.

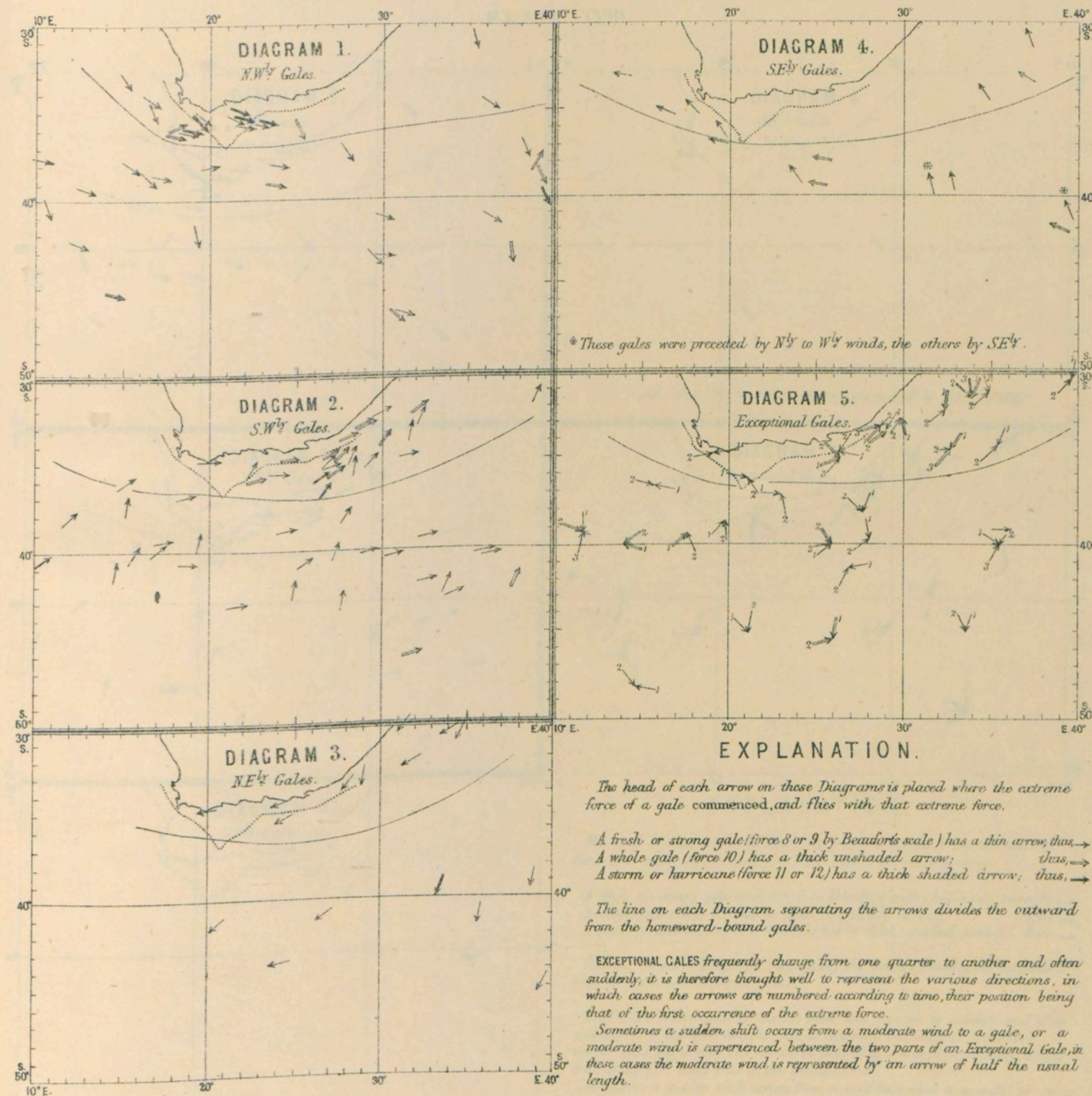
PLATE XVI.

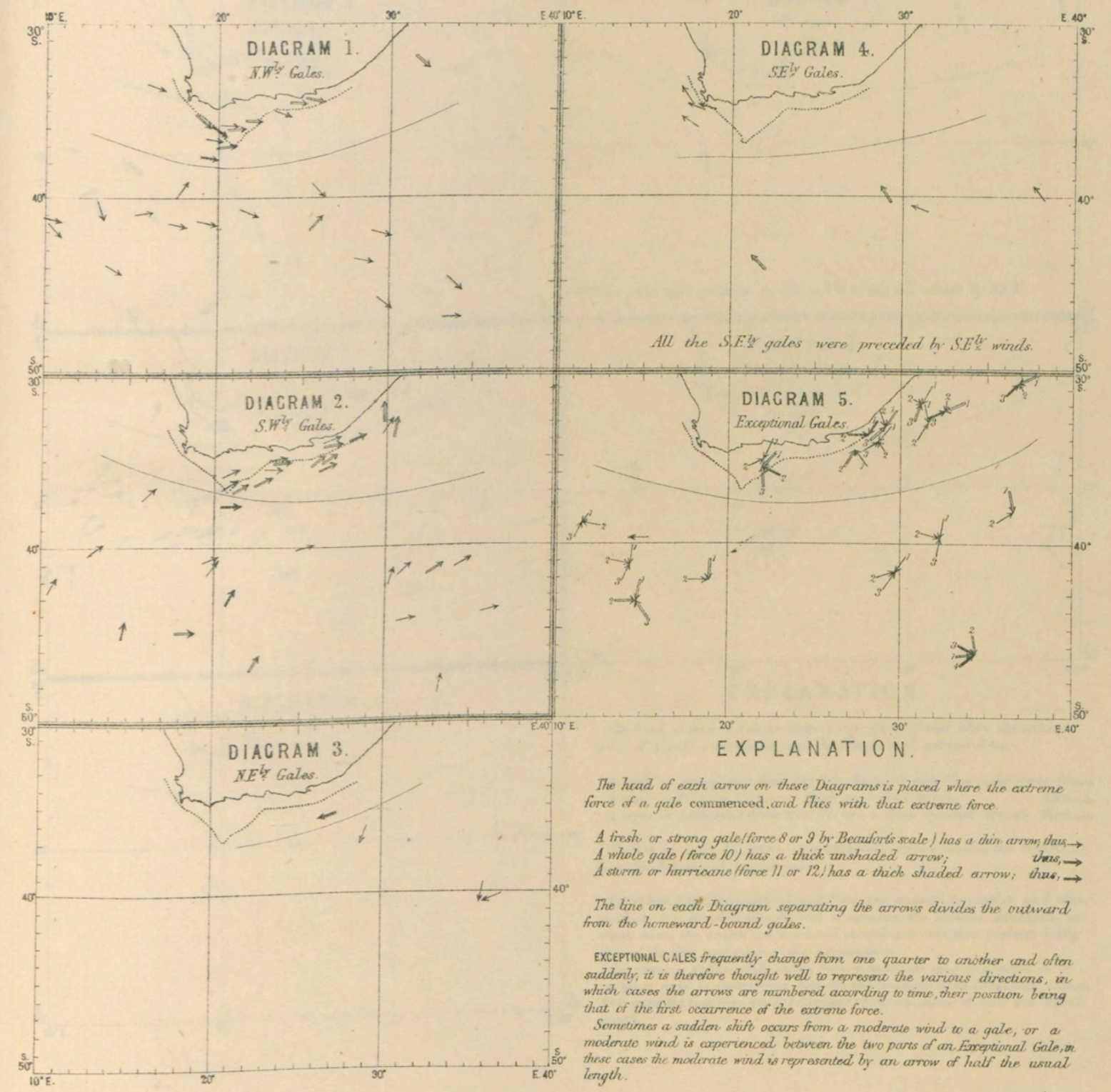
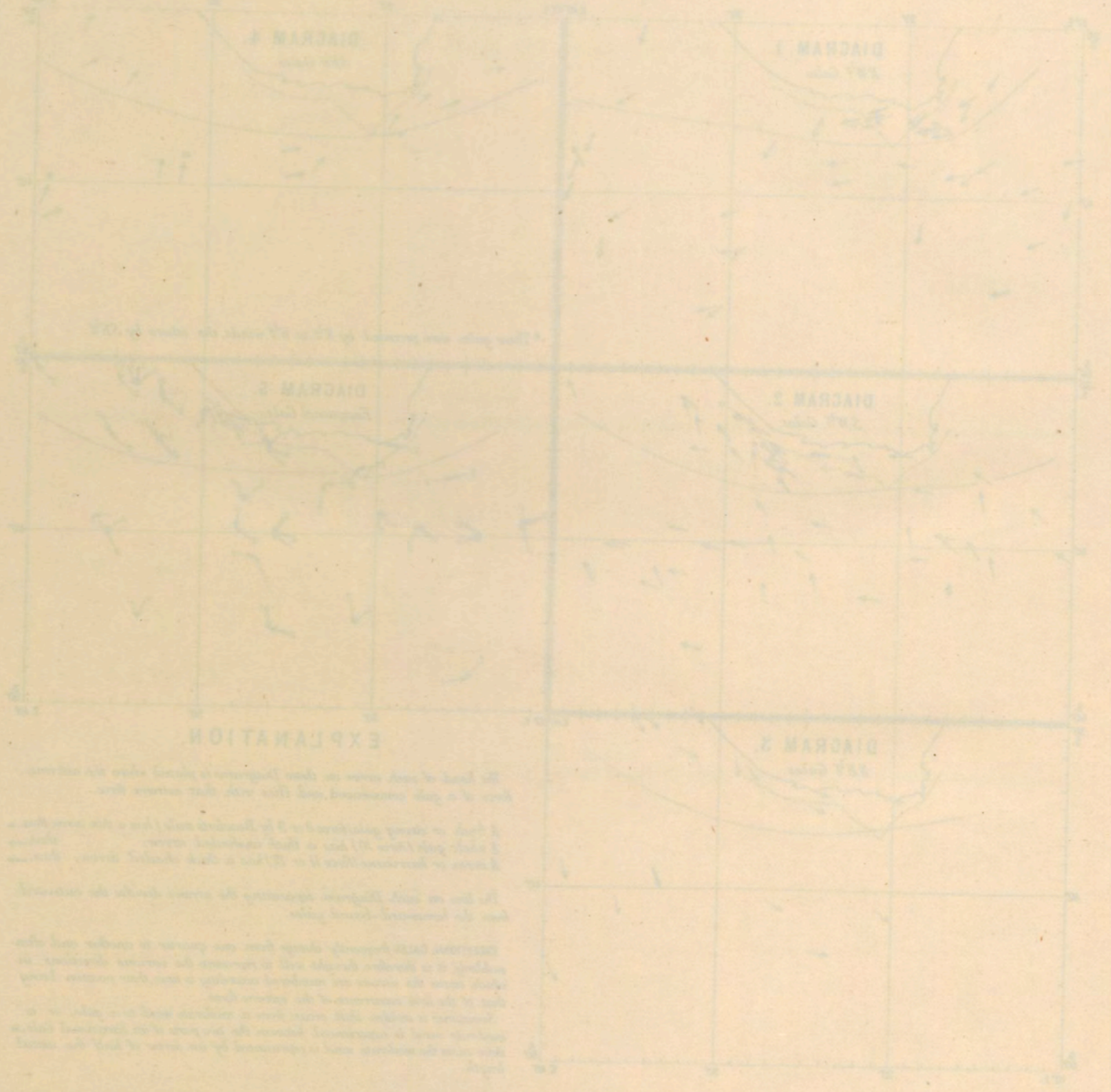
For the corresponding data for July see Plates VI and VIII.



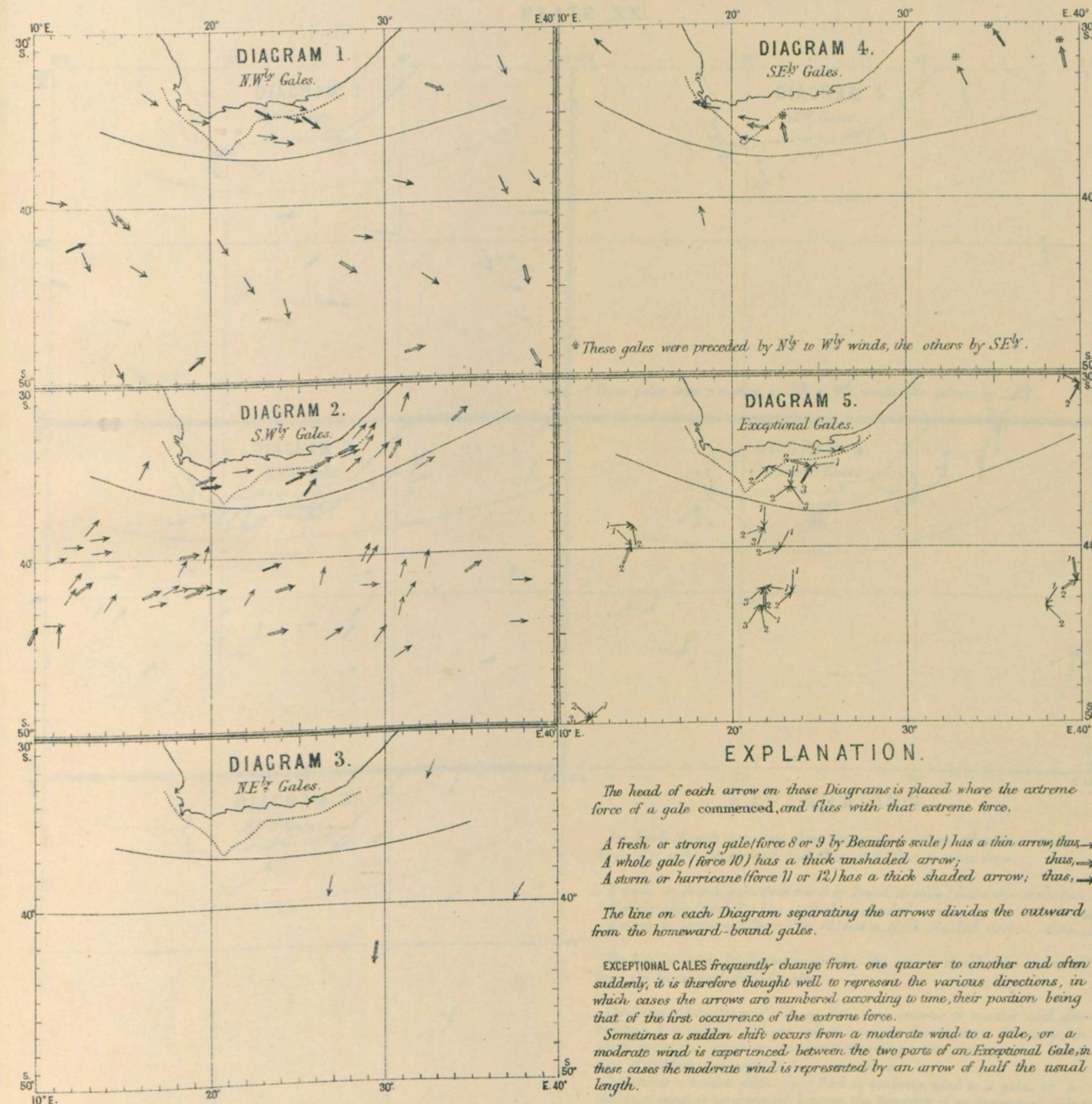
SEPTEMBER.

PLATE XVII.

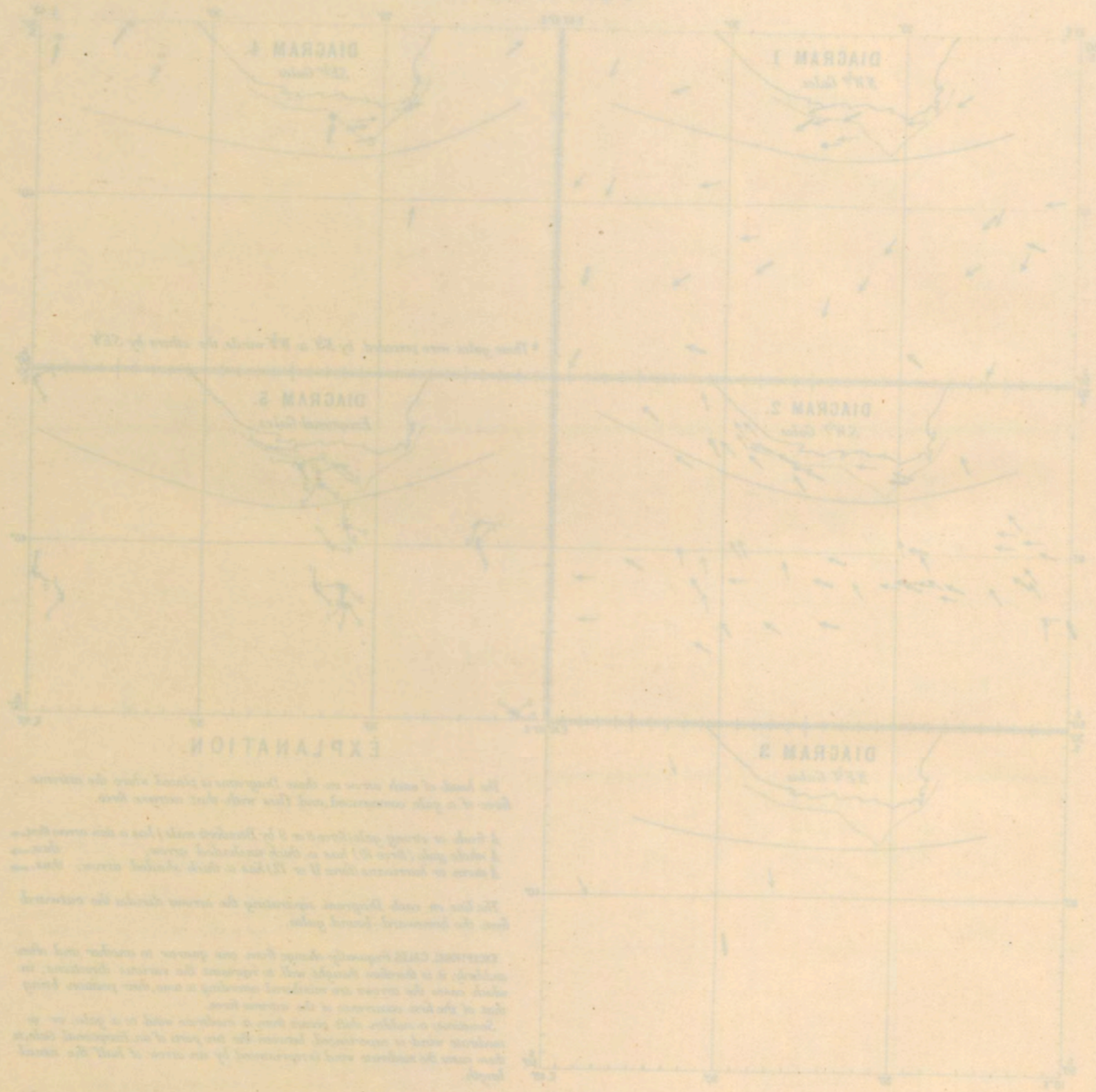




NOVEMBER. PLATE XIX.

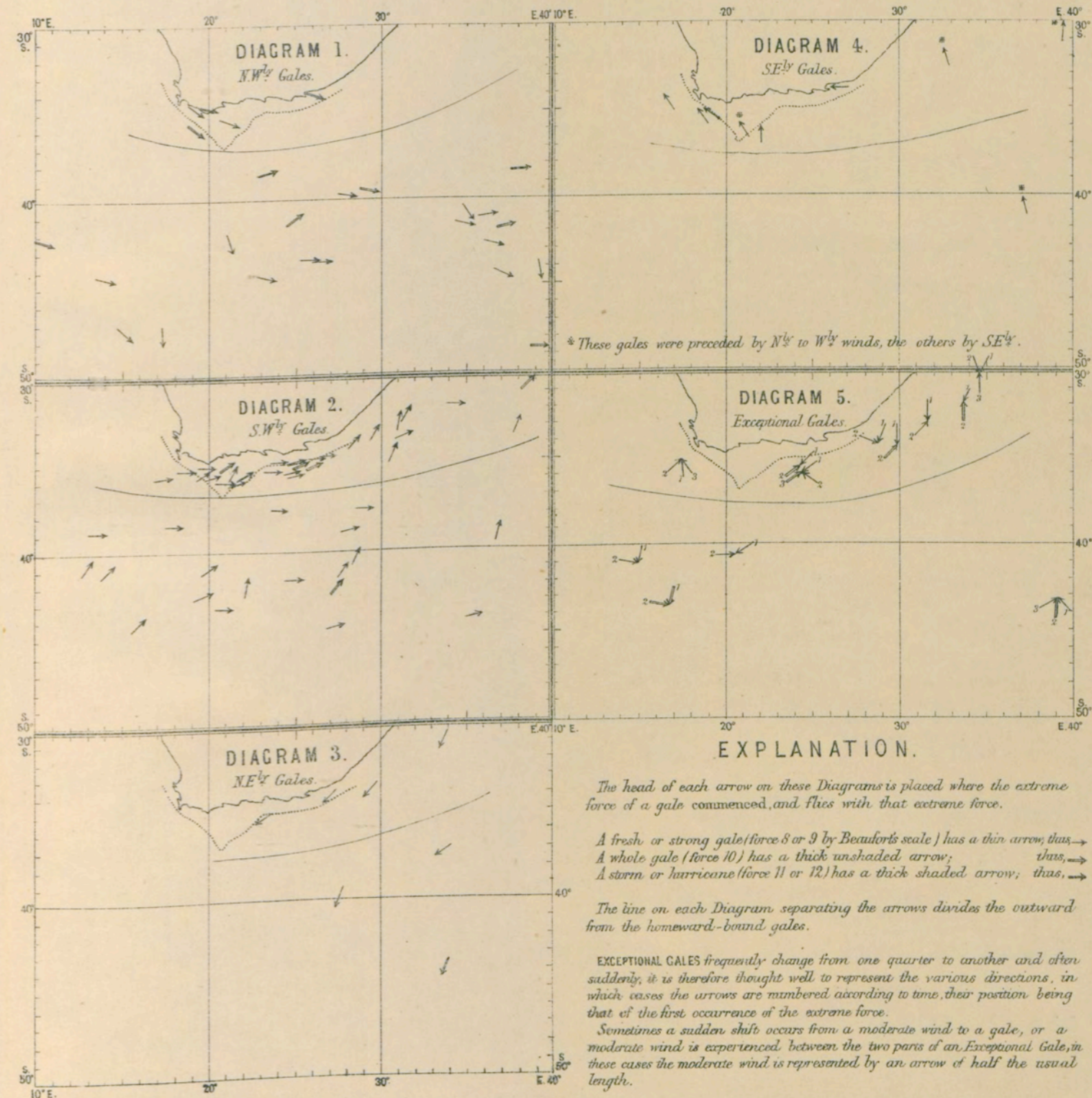


NOVEMBER.
PLATE XIX.



EXPLANATION.
The head of each arrow on these Diagrams is placed where the extreme force of a gale commenced, and flies with that extreme force.
A fresh or strong gale (force 8 or 9 by Beaufort's scale) has a thin arrow; thus, →
A whole gale (force 10) has a thick unshaded arrow; thus, →
A storm or hurricane (force 11 or 12) has a thick shaded arrow; thus, →
The line on each Diagram separating the arrows divides the outward from the homeward-bound gales.
EXCEPTIONAL GALES frequently change from one quarter to another and often suddenly, it is therefore thought well to represent the various directions, in which cases the arrows are numbered according to time, their position being that of the first occurrence of the extreme force.
Sometimes a sudden shift occurs from a moderate wind to a gale, or a moderate wind is experienced between the two parts of an Exceptional Gale, in these cases the moderate wind is represented by an arrow of half the usual length.

DECEMBER.
PLATE XX.



* These gales were preceded by N^{ly} to W^{ly} winds, the others by SE^{ly}.

EXPLANATION.

The head of each arrow on these Diagrams is placed where the extreme force of a gale commenced, and flies with that extreme force.
A fresh or strong gale (force 8 or 9 by Beaufort's scale) has a thin arrow; thus, →
A whole gale (force 10) has a thick unshaded arrow; thus, →
A storm or hurricane (force 11 or 12) has a thick shaded arrow; thus, →
The line on each Diagram separating the arrows divides the outward from the homeward-bound gales.
EXCEPTIONAL GALES frequently change from one quarter to another and often suddenly, it is therefore thought well to represent the various directions, in which cases the arrows are numbered according to time, their position being that of the first occurrence of the extreme force.
Sometimes a sudden shift occurs from a moderate wind to a gale, or a moderate wind is experienced between the two parts of an Exceptional Gale, in these cases the moderate wind is represented by an arrow of half the usual length.

