WEATHER FORECASTING

CAPT. H. TOYNBEE

WEATHER FORECASTING

FOR THE

BRITISH ISLANDS

BY MEANS OF

A BAROMETER, THE DIRECTION AND FORCE
OF WIND AND CIRRUS CLOUDS

BY

CAPT. HENRY TOYNBEE, F.R.A.S., F.R.G.S., F.R.Met.S.

LATE MARINE SUPERINTENDENT, METEOROLOGICAL OFFICE

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PREFACE

By request of the Council of the Meteorological Office, I was engaged during parts of the summers of 1888 and 1889 in lecturing on the use of the barometer to seafaring men at various ports in the North of Ireland and North-west of England, and have been asked to continue the work at other stations during the summer of 1890. In Liverpool the same lecture was given to ship-owners, captains, and officers; it has also been delivered at various public schools. A general desire has been expressed that it should be published.

The object of the lecture is to show what a single observer can do towards forecasting wind and weather at his station, supposing him to have a barometer, means for observing roughly the direction and force of the wind, and power to recognise cirrus clouds and the direction from which they are coming.

It is supposed that some intelligent person will undertake the forecasting for each port, as coasters and fishermen have rarely the opportunity for watching the action of the barometer in one place for any length of time. I may add that Mr. E. Kennedy, the chief light-keeper of the lighthouse at Ardglass, volunteered to do this for his port, and said that he believed the other Irish light-keepers would do the same. Long experience has proved to me that the method proposed is generally useful as an independent means for forecasting, and also as an auxiliary to the forecasts issued by the Meteorological Office.

My best thanks are due to my friend Mr. Charles Harding, of the Meteorological Office, and a member of the Council of the Royal Meteorological Society, for reading through the MS. and proof-sheets of this manual.

WEATHER FORECASTING

FOR THE

BRITISH ISLANDS

THE object of this manual is to explain how a careful observer in any part of the British Islands, who will regularly write down at certain hours the readings of the barometer, the direction and force of wind, and the motion of cirrus clouds (mares' tails), may generally form a very good judgment of coming wind and weather; and also most usefully supplement for his locality the forecasts issued by the Meteorological Office, in cases when such forecasts can be received in time to be of any use. Before going into the particulars of forecasting it will be well to say a few words on the general principles.

The Barometer

The barometer, as its name indicates, is a measurer of weight, and does, in fact, weigh the air. It is only because changes in the weight of the air accompany changes in wind and weather that the barometer has received the name of 'weather-glass.'

Wind

Wind is air moving *from* a place where the barometer is relatively high, *towards* a place where the barometer is lower.

DIAGRAM 1.

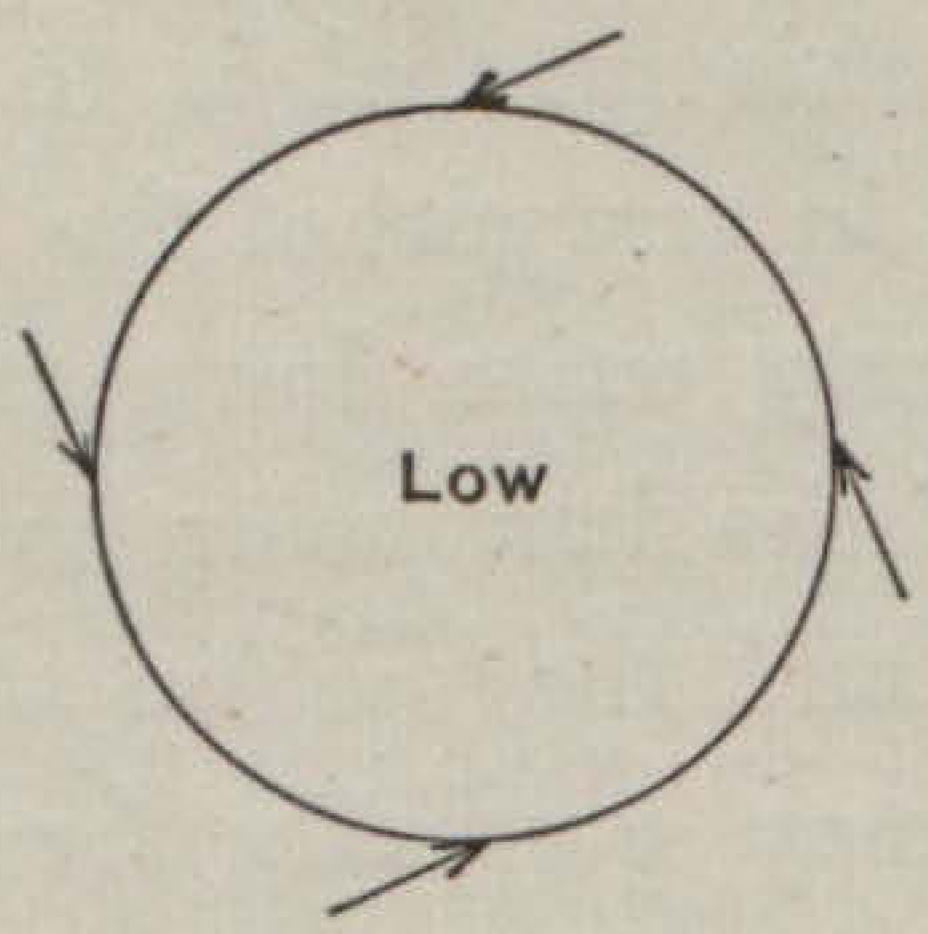


Diagram 1 shows how, in the Northern Hemisphere, the wind moves round a locality where the barometer is low. The arrows fly with the wind, and it will be seen that, whilst they circulate contrary to the hands of a watch,[1] they draw

[1] The order of circulation is reversed in the Southern Hemisphere.

slightly inwards towards the centre. It is therefore reasonable to suppose that there is an upward current of air within the area of low barometer, for, in spite of this influx of air, the barometer often keeps low, and sometimes falls lower, in the neighbourhood of the centre.

Tracks of Low Centres

These centres of low barometer often change their position at the rate of several miles an hour. The cause of this change of position is not well accounted for, but the most feasible theory seems to be that the air in front of the track is rising and causing the barometer to fall, whilst the air in the rear of the track is descending and causing the barometer to rise.[1] It also seems probable that they are sometimes carried along as subsidiaries to a larger system, and so moving with that system's prevailing wind, as an eddy in water is carried along by the tide.

[1] If it be the case that the southerly winds in front of our centres of low barometer are rising, whilst the northwesterly winds in their rear are descending, then the ascending and descending currents would meet in what Mr. Abercromby calls the trough of the storm, and this meeting of warm with cold air would give rise to the heavy rain (commonly called 'the clearing-up shower') which invariably occurs as a trough passes over a station.

Experience shows that these systems of wind, blowing round and into an area of low barometer, generally move along a track which has a high barometer to its right, and another area of low barometer to its left. This fact shows that they may be subsidiary to a larger system.

Wind Force

The speed or force of a wind depends on the amount of barometer-difference in a given distance, which is called 'barometric gradient,' and is spoken of as being steep or shallow according to the amount of difference. Mr. Scott, Secretary of the Meteorological Office, says in his book, 'Weather Forecasts and Storm Warnings' (p. 48), 'No very precise relation has as yet been established between the amount of the gradient and the force of the wind, but as a convenient figure to be remembered it may be repeated that a gradient of 0·02 inch per 15 miles indicates the probability of as much wind as an ordinary yachtsman likes to meet with.'

Now, remembering that the force of a wind depends upon the amount of difference between barometers at a given distance from each other, if we can show that there are certain localities where the barometer is generally high and others where it is generally low, then, if a low-barometer system appears between such high and low barometer areas, the winds on the side of that system which is nearest to the high barometer will be stronger than those on the side which is nearest the low barometer. Such a case occurs in the northern part of the Atlantic Ocean, where, in the latitude of the Azores and to the southward of them, the barometer is generally high, there being an accumulation of air on the northern verge of the north-east trades. The position of this area of high barometer is pretty constant, although it changes its latitude with the sun, coming north in summer and receding south in winter.

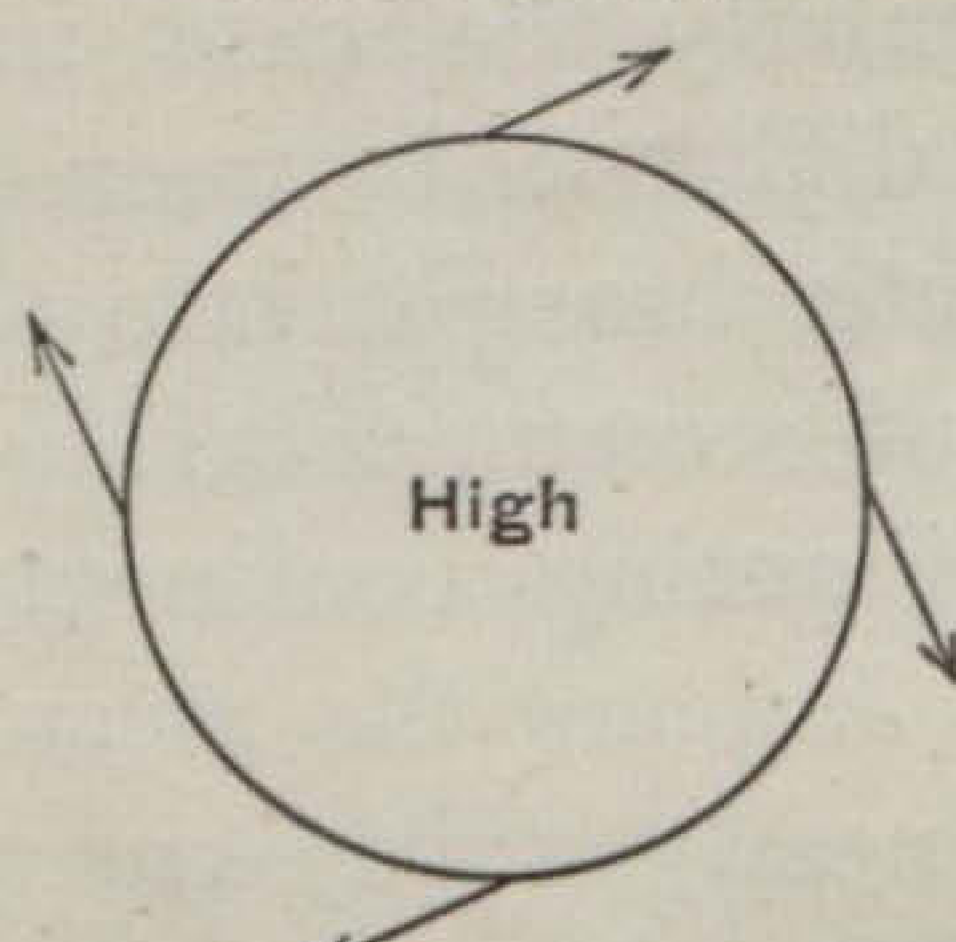
To the southward of Iceland there is a part of the Atlantic where the barometer is generally lower than it is in the space surrounding it. This is more particularly the case in winter, when there is a great difference between the temperature of the warm water brought into that neighbourhood by the Gulf Stream, and that of the cold air over the neighbouring continents and islands. Over Siberia in January the mean height of the barometer is nearly thirty-one inches, whilst south of Iceland and Greenland it is about twenty-nine and a half inches, which fact well accounts for our prevailing south-west winds in winter.

Knowing these facts, it is easy to realise that the storm-centres which come from the Atlantic towards our west coasts pass along the northern side of the large area of high barometer which prevails in the neighbourhood of the Azores, and have the area of low barometer which prevails to the southward of Iceland to the northward of them. They are therefore, as it were, subsidiary to the larger system which is situated in the Atlantic, more especially in winter, and their westerly winds are generally stronger than their easterly winds, owing to the fact that the greater barometer difference or gradient is on their southern sides.

Winds round an Area of High Barometer

Diagram 2 shows how the wind blows round a place where the barometer is high. The arrows

DIAGRAM 2.



fly with the wind, and it will be seen that they circulate *with* the hands of a watch,[1] but at the

[1] The order of circulation is reversed in the Southern Hemisphere.

same time they draw out from the centre. As such a circulation frequently goes on for a long time, whilst the barometer still keeps high, and sometimes rises higher, it is reasonable to suppose that the area of high barometer is supplied with air from above, which settles down on the earth and spreads out on all sides to supply the demand created by the upward currents of neighbouring or more distant low-barometer areas.

Before applying these facts to the principle of forecasting wind and weather for the British Islands, it may be well to remark that as the air circulates round areas of both high and low barometer, it is clear that winds from all directions blow in connection with each of them. For instance, both systems have a south wind, but their south winds will have very different characters. In the case of a low barometer the south wind is on its eastern side, where the air is rising and having its vapour condensed into cloud and rain, by which means heat is given out. In the case of an area of high barometer the south wind is on its western side, where the air is descending and is comparatively cool and dry, having a tendency to take up moisture from the earth instead of giving it out.

Of course, between the south wind on the western side of an area of high barometer and the south wind on the eastern side of a distant area of low barometer, there will be a prevailing southerly wind; and in passing from the high towards the low barometer a position will be come to where the air will cease to descend. As the low pressure is approached the ascending air will be entered, and clouds and rain will be experienced; this accounts for the change in weather though the wind remains south, as an area of high barometer recedes before an area of low barometer advancing towards a station from the westward. Such a case is well illustrated by the 8 A.M. daily weather chart of September 17, 1889, which shows a cold, dry, bright southerly wind at a temperature of 50° on our east coasts, and a warm, wet, cloudy southerly wind at a temperature of 57° on our west coasts.

Tracks of Storm Centres

We have already said that systems of low barometric pressure change their positions and sometimes move very quickly, generally having a high barometer to their right and a low barometer to their left as they proceed along their tracks.[1] Considering the general disposition of barometric pressure in the northern part of the Atlantic, which has already been alluded to when speaking

[1] This rule is reversed in the Southern Hemisphere.

of wind force, we have the reason why the Atlantic storms generally move along an easterly track, and often diverge to the north-eastward as they approach our islands; in fact, they have a tendency to move as subsidiary systems round the south and east sides of a prevailing area of low barometric pressure which has its centre somewhere to the southward of Iceland.

These may be taken as the reasons why storms from the Atlantic *generally* cross or skirt our islands, moving along easterly or north-easterly tracks. But the disposition of barometric pressure over western Europe and its neighbouring seas frequently varies, and with these variations come changes in the direction of storm tracks. On this fact depends the chief difficulty in attempting to forecast the coming wind and weather for each district. To meet this difficulty the Meteorological Office receives telegrams from about sixty stations at 8 A.M. each morning, and also from a smaller number at 2 P.M. and 6 P.M. The observations thus obtained are plotted on a map to show the general disposition of barometric pressure over Western Europe. These facts indicate when a storm is approaching our western coasts, and also the track it is likely to follow.

This is the reason why 6 P.M. forecasts which appear in the morning papers of the following day are so valuable, as they tell us what weather was expected to follow that hour; from which forecasts an observer at a single station who has had some experience of weather maps can make out very fairly how barometric pressure was distributed over Europe at 6 P.M. of the previous evening, and by his own observations since that hour he can tell how a storm has moved in relation to *his* station; and so either confirm the forecast of the Meteorological Office or prove in what way it has failed, and what is likely to occur at his station in the course of the next few hours.

HOW TO FORECAST AT A SINGLE STATION, BY MEANS OF CAREFUL RECORDS OF A BAROMETER, THE DIRECTION AND FORCE OF WIND, THE MOTION OF CIRRUS CLOUDS (MARES' TAILS), ETC.

It must be understood that the following rules are based on general principles which are frequently modified by slight variations, such as an elongation in the shape of an area of low barometric pressure, and by other causes which cannot be gone into here. Still, these rules are supposed to be the best which can be drawn up from our present knowledge, and will be found very useful at most times to an isolated observer, whilst they may prevent a seaman about to leave port from running into danger.

The following data are required:—

(*a*) Four-hourly [1] readings of the barometer,

[1] I say four-hourly records of the barometer and wind because few people are likely to take them more frequently; but the oftener they are noted the better, more especially in stormy weather. A self-recording aneroid is a very useful instrument, but its readings should be occasionally compared with the mercurial barometer.

when possible, to be carefully written down, and more frequent observations in bad weather.

(*b*) Four-hourly observations of the *true* direction and force of the wind, to be carefully written down, and more frequent observations in bad weather.

(*c*) Cirrus clouds (mares' tails, see Frontispiece) should be recorded whenever visible, giving the direction from which they are coming, and a remark as to whether they move slowly or fast. Cirrus is the highest cloud visible, and is supposed to be formed of very fine crystals of ice.

From these data the following facts can generally be obtained, with a fair approximation to the truth:—

(1) THE BEARING OF THE CENTRE OF A STORM.

(2) WHETHER THE CENTRE IS APPROACHING OR LEAVING THE OBSERVER.

(3) THE TRACK ALONG WHICH THE CENTRE IS MOVING.

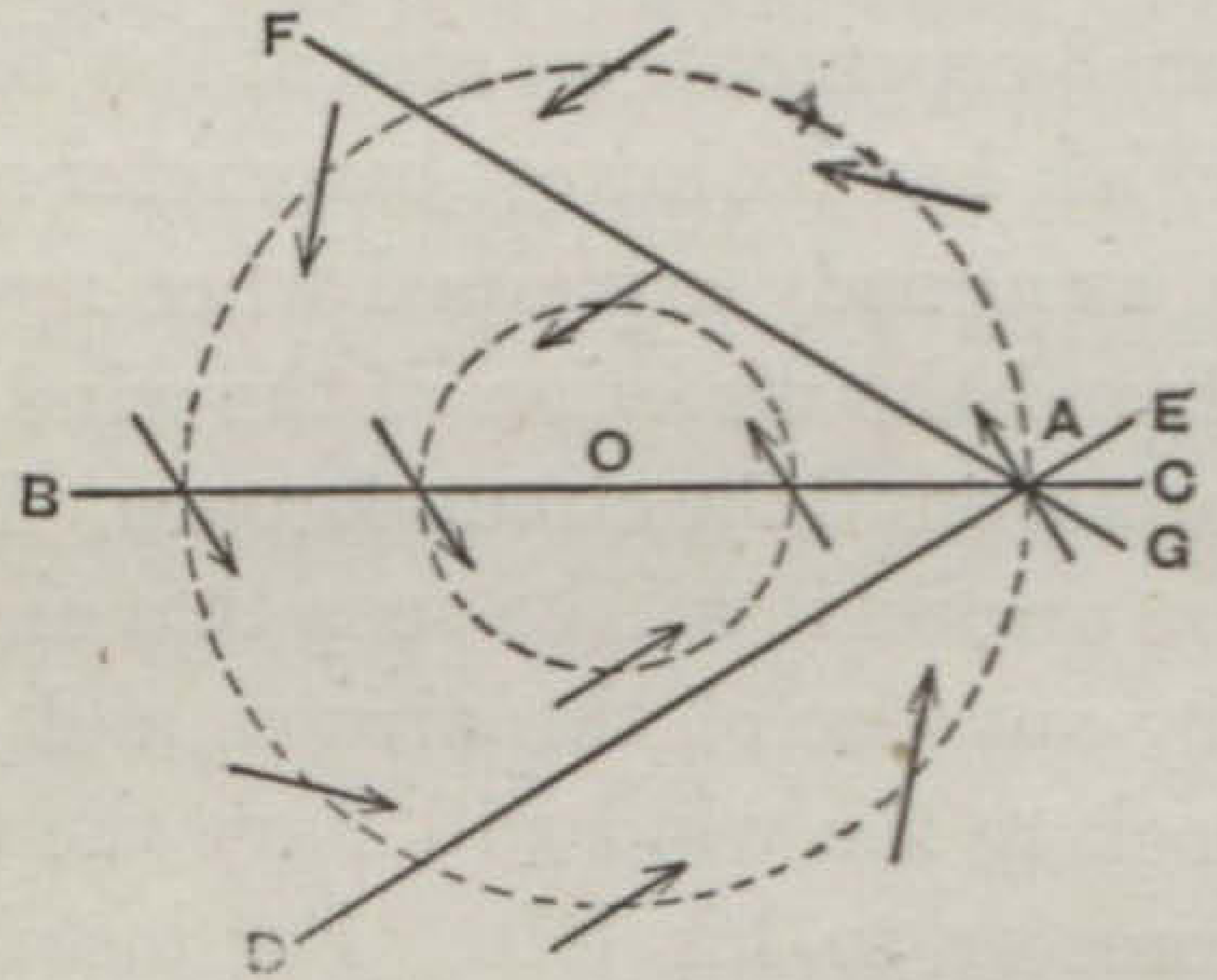
(4) THE PROBABLE CHANGES OF THE WIND.

(5) INDICATIONS OF THE APPROACH OF ANOTHER STORM.

I will now explain how these facts can be obtained, taking them in the above order.

The following Diagram (No. 3) is a repetition of Diagram 1, with a few additional arrows and lines for the sake of illustrating the changes of wind which will be experienced by an observer when the centre passes him as it moves along given tracks.

DIAGRAM 3.



In considering Diagram 3 it must be borne in mind that, roughly speaking, if a radius be drawn from the centre, O, to any arrow at its circumference, the wind may be considered to be blowing from the direction indicated by that arrow all along the radius. For instance, along B O the wind is practically north-north-west, whilst along O A it is south-south-east. Therefore, if the centre of a storm is moving directly towards an observer, the direction of the wind will remain nearly the same until the centre has passed, when a sudden change to the opposite quarter will most probably be experienced.

We will now return to the facts to be derived from the data already given.

(1) The Bearing of the Centre of a Storm

Diagram 3 represents an area of low barometric pressure which has its lowest barometer reading at the centre, as already explained when speaking of Diagram 1, and the direction of the wind is shown by the arrows around the circumference. By glancing at these arrows it will be seen that an observer stationed by any one of the arrows and standing with his back to the wind will have the centre of lowest barometer to his left. For instance, suppose an observer at A standing with his back to the south-south-east wind blowing there, and holding out his left hand, he will point west-south-west, or two points to the southward of the centre O, which bears west from A. So that with the back to the wind near any low barometric centre, the left hand will point about two points to the rear of the centre. Or, to put this in nautical language, when running before the wind in the Northern Hemisphere, the centre of the storm is about two points before the port beam.

(2) Whether the Centre is approaching or leaving the Observer

This fact is shown by the falling or rising of the barometer. Of course, similar results would be produced if the storm stood still whilst it was intensifying, and the barometer falling lower at the centre; or if it were filling up, and the barometer rising at the centre. Still, the rise or fall of the barometer at a station is generally caused by the storm's centre having changed its position.

(3) The Track along which a Storm is moving

The following three cases will suffice for illustration :—

Case a. When the centre is moving directly towards the observer.

Case b. When the centre passes to the northward of the observer, moving along a north-easterly track.

Case c. When the centre passes to the southward of the observer, moving along a south-easterly track.

In Diagram 3, O represents the centre of the storm, and A the position of the observer in all cases.

Case a. When the centre is moving directly towards the observer

Referring to Diagram 3, it will be seen that if the centre O is moving towards the observer along the line B A C, the direction of the wind will remain nearly south-south-east, though its force will increase with a falling barometer, until the centre has passed over A, when the wind will shift to north-north-west and the barometer will rise.

Now it is quite clear that the observer at A, who has been watching and recording the barometer and wind for a few hours, and finds the *direction* of the wind to be steady and the barometer to be falling, will be able to forecast that the centre is likely to continue for a time to bear west and eventually to pass over him, moving along an easterly track; also that there will be a sudden change of wind to the opposite quarter when the centre gets to the eastward of him, which change, it is well known, generally takes place in heavy rain followed by a quickly rising barometer and a clear up in the weather, though the north-west wind may, for a short time, blow stronger than did that from the south-east, as its gradients are sometimes steeper than those for a south-east wind.

Case b. When the centre passes to the northward of the observer, moving along a north-easterly track.

Supposing now that the centre O moves in a north-easterly direction, then the line D A E, in Diagram 3, which is parallel to the supposed track of the storm-centre, marks the section of the storm which will pass over the observer at A, and the wind arrows of the south-eastern and south-western parts of the circle show the various winds which will pass over A. For instance, the wind will change from south-south-east to south, south-west, west, and west-north-west; whilst the barometer will fall until the point on D A E nearest to O has passed over A—i.e., until the centre bears about north-west from A. There is frequently heavy rain as the lowest barometer passes over the station; but the weather will probably improve with the rising barometer.

It is clear that when the observer at A found that the wind was veering to south and south-west, with a falling barometer, he could forecast that the storm-centre was moving on a north-easterly track, that it would pass to the northward of his station, and that the barometer would most likely fall until the centre bore about north-west from A and the wind had veered to the westward; it would then rise with improving weather. The rate at which changes of barometer and wind-direction take place indicate whether the storm is moving quickly or slowly along its track. The rapidity of change is also affected by the distance of the storm-centre from the observer as it passes along its track; the changes being quick when the centre is likely to pass near him.

Case c. When the centre passes to the southward of the observer, moving along a south-easterly track.

Again referring to Diagram 3, and supposing that the centre O moves in a south-easterly direction, then the line F A G, which is parallel to the supposed track of the storm-centre, marks the section of the storm which will pass over the observer at A, and the wind arrows of the north-eastern to north-western part of the circle show the various winds which will be experienced by the observer at A. For instance, the wind will change from south-south-east to south-east, east, and north-east, whilst the barometer will fall until the point on F A G which is nearest to O has passed over A—i.e., until the centre bears about south-west from A, and the wind is drawing to the east, after which the barometer may be expected to rise and the weather to improve as the wind backs to the northward of east.

It has already been noticed that the barometer at a station to the northward of a storm-centre is frequently lower than it is at a station equally distant to the southward of it, in which case the gradients for easterly winds would not be so steep as those for westerly, and the easterly winds would not blow so strong as the westerly. This would be indicated by the changes in the barometer not being so rapid when the centre passes to the south-eastward of a station as they would have been had the storm-centre passed to the north-eastward of it.

(4) The Probable Changes of the Wind

The probable wind-changes are indicated by the changes which have already occurred. For instance, by referring to the cases just given, it will be seen that—

In Case *a*, the wind at A having remained steady in direction though increasing in force, with a falling barometer, it was most probable that the wind would continue to blow from south-south-east or nearly so until the centre had passed over the station, when the wind would probably shift to north-north-west or nearly so.

In Case *b*, the first changes of wind at A having indicated that the centre was moving along a north-east track, it was reasonable to suppose that it would continue to do so, and the line D A E indicates that the wind-changes would be from south to south-west, west, and north-west.

In like manner with Case *c*, the line F A G shows that, as the first wind-changes at A indicated that the storm-centre was moving to the south-eastward, it was reasonable to suppose that the wind-changes would eventually be from south-east to east and north-east.

In all three cases a careful watching of the barometer would show when the centre was nearest to the observer, after which the weather might be expected to improve.

(5) Indications of the Approach of Another Storm-centre

Experience shows that when a storm-centre has passed away (generally to the north-eastward) it is frequently followed by a mere ridge of relatively high barometer; between which ridge and the storm which has passed away the wind has veered from south-west to west and north-west, accompanied by a fast-rising barometer and generally very fine weather. This weather is often merely temporary, giving what is called a 'pet day' between two storms. The first indication of there being another storm to the westward of the ridge is given by the appearance of cirrus clouds (mares' tails, see Frontispiece), which generally move from the north-west or west. They often occur in very fine weather with a rising barometer—that is, whilst the eastern side of the ridge is passing over the observer. When the crest of the ridge has passed the barometer begins to fall and the wind backs to the southward of west as the eastern side of the incoming storm-centre approaches the observer. The best authorities seem to think that this cirrus, which is the highest cloud seen, is formed of frozen moisture which has risen over the incoming storm, and is blown ahead in advance of it by an upper current of wind.

DAILY WEATHER CHARTS AND WHAT CAN BE LEARNT FROM THEM

Diagrams 1, 2, and 3 show the broad principles on which forecasting is based. We will now consider a few daily weather charts, to illustrate the application of those principles and the variations which occur in practice.

Diagram 4 is a copy of the daily weather chart for 8 A.M. of September 1, 1887. Before going into particulars it will be necessary to give a general explanation of a daily weather chart as follows:—

(*a*) *The land* includes a large part of north-west Europe, from Iceland and Norway to the north of Spain and Italy.

(*b*) *The lines* pass through stations which have the same reading of the barometer, and are called 'isobars,' or lines of equal barometer. They are drawn for each tenth of an inch of quicksilver; the lowest reading of the barometer has a somewhat thicker line than the others. Those of thirty inches and upwards are broken, and as the mean barometer in these latitudes is about 29·9, all broken lines indicate that the barometer is above the mean. Dots are used when isobars are only probable.

(*c*) *Arrows* fly with the wind. When the force is *light* they have only one barb; when *fresh*, two barbs; when a *moderate gale*, they have one tail-feather; when a *strong gale*, two tail-feathers; and so on up to four feathers, which imply hurricane force.

(*d*) *A calm* is represented by a circle.

(*e*) *The lettering* shows whether the barometer was rising, falling, or steady at the time of the chart.

(*f*) *Tracks of storms* are shown by a line formed of crosses; at one end of a track is a small arrow-head, showing the probable direction in which the storm will move away. A track is sometimes continued beyond the date of the chart to show what became of the storm; for instance, Diagram 4 has indications of a storm which had its centre south-west of Ireland at 8 A.M. September 1, 1887, but the track on that diagram shows its positions at 6 P.M. 1st, 8 A.M. 2nd, 6 P.M. 2nd, and 8 A.M. 3rd.

(*g*) The state of the sea is shown by shading; light shading meaning 'rough,' darker shading 'high.'

We will now endeavour to show what can be learnt from a study of Diagram 4, which (as already remarked) is a picture of the state of the barometer, wind, and sea at 8 A.M. September 1, 1887. It will be seen that at that hour there was a centre of low barometric pressure to the westward of Norway; the chart of August 31 shows that this centre was west of Scotland at 8 A.M. of that day, so that the storm-centre had moved to the north-eastward about 500 miles in 24 hours. There are also indications of another centre of low pressure, approaching the south-west of Ireland from the Atlantic. At Valentia the wind was fresh from south-east and squally; the sea was rough, probably from west or south-west, though the wind was south-east, as a swell often comes, in advance of its wind, from the direction in which a storm-centre bears. It is manifest that, if a storm-centre bears south-west of you, its south-west wind will be driving the sea in your direction, even though, as often happens, its track being in some other direction, the wind producing the swell never reaches you. The barometer was falling fast, and we know by the observations which followed that the centre was over Valentia at 6 P.M. of the 1st, where the barometer was down to 28·9 and the wind was light from north.

Now let us suppose our observer to have been

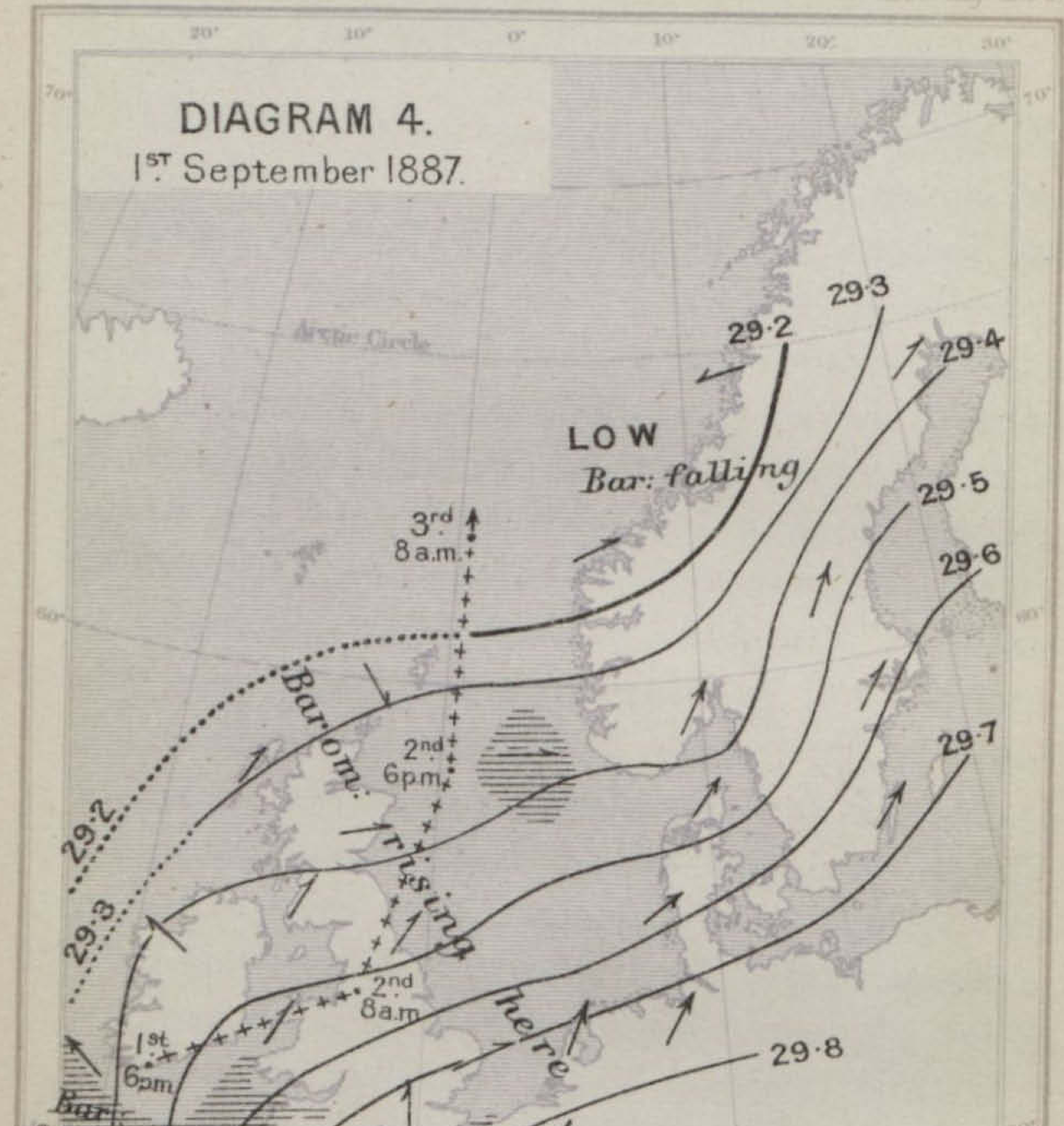


DIAGRAM 4.
1st September 1887.
Arctic Circle
LOW
Bar: falling
3rd 8 a.m.
2nd 6 p.m.
2nd 8 a.m.
1st 6 p.m.
Barom: rising here
Bar: falling fast
Very little change
HIGH
29·2
29·3
29·4
29·5
29·6
29·7
29·8
29·9
30·0
0° Meridian of Greenwich
SCALE OF MILES

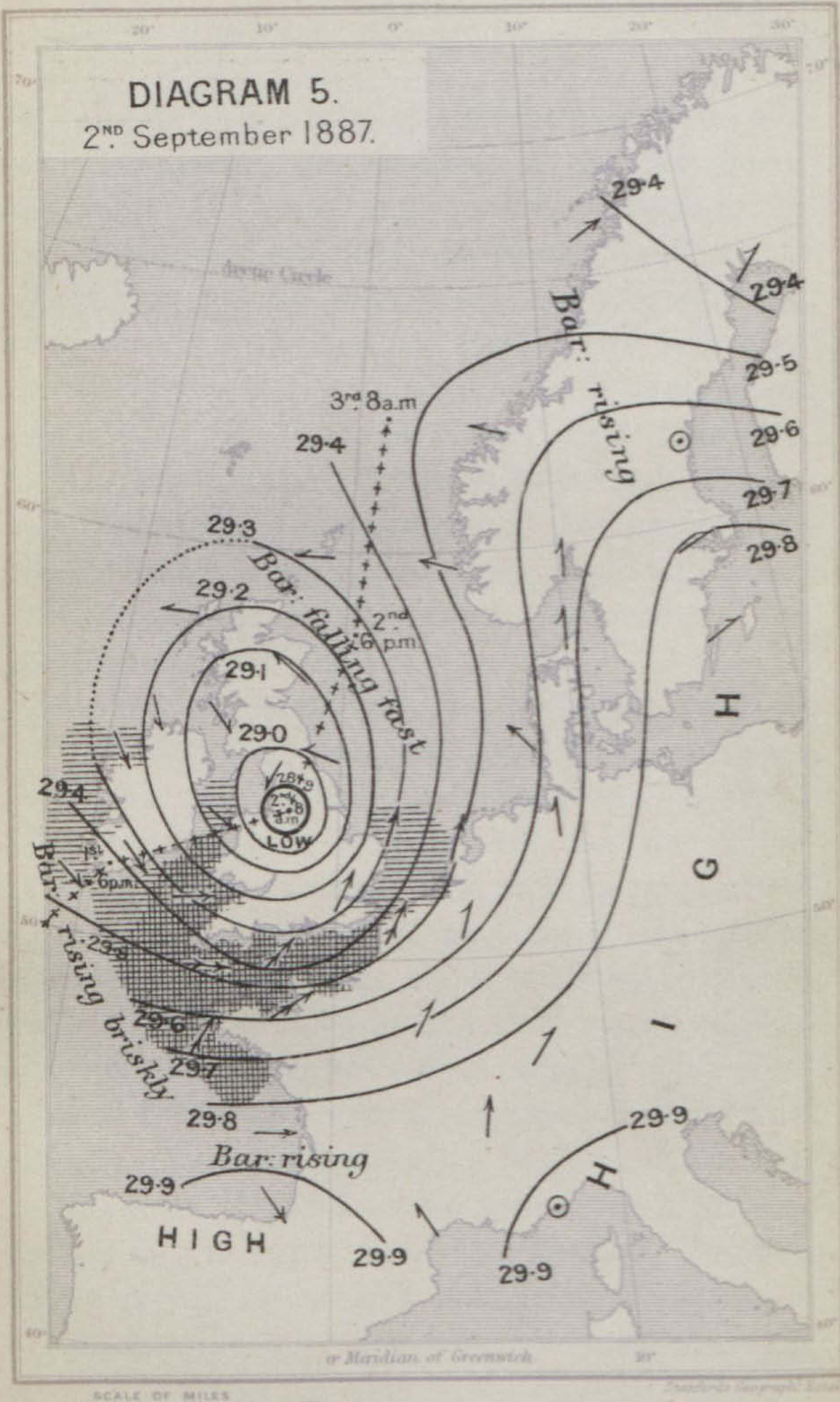


DIAGRAM 5.
2ND September 1887.
29·4
29·4
29·5
29·6
29·7
29·8
Bar: rising
3rd 8 a.m
29·4
29·3
Bar: falling fast
29·2
2nd 6 p.m
29·1
29·0
LOW
H
G
H
I
29·4
1st 6 p.m
Bar: rising briskly
29·6
29·7
29·8
Bar: rising
29·9
29·9
HIGH
29·9
29·9
H
Meridian of Greenwich
SCALE OF MILES

at Valentia at 8 A.M. of the 1st, having taken and recorded careful observations of the barometer and wind. He would have turned his back to the south-east wind and held out his left hand, which would have pointed south-west; then, by allowing two points for in-draft, he would have estimated that the centre bore west-south-west from him; and finding that the direction of the wind continued to be south-east, but increased in force, he would have foretold that the centre was coming towards him, and that when it passed over his station the wind would change to the north-westward and the barometer would begin to rise.

As already remarked, the 6 P.M. observations showed that the wind was light from north at that hour, and the barometer was down to 28·9; after which time it rose quickly, and was 29·46 at 8 A.M. the next day. It is well known that it is sometimes calm for a short time at the centre of a storm. The light north wind at 6 P.M. of the 1st seems to have been on the western edge of the calm, for there was a fresh, squally north-west wind at 8 A.M. of the 2nd. Diagram 5 shows that although Valentia had only a fresh wind, force 5, at 8 A.M. of the 2nd, there was a fresh gale of force 8 at the entrance of the English Channel, where it will be noticed the isobars are closer together than they were at Valentia, showing how the strength of the wind is related to the steepness of the gradient.

The observer at Valentia having been able to forecast at 8 A.M. of the 1st what really came to his station later on, found himself at 8 A.M. of the 2nd with a fresh north-west wind, improving weather, and a rising barometer. It will be shown hereafter that if he had seen cirrus clouds moving from the north-west, he might fairly have supposed that he was only on the eastern side of a ridge of high barometer, that its crest would soon pass over his station, and that the barometer would then fall again, with the wind backing to the south-west and eventually probably to south-east, when another storm-centre would have been approaching him from the west.

Diagram 4 itself illustrates the case of a ridge just alluded to—it occurs between the low centre off the west of Norway and the other low centre off the south-west of Ireland. At Sumburgh Head, in the Shetlands, the wind was north-west; at Stornoway and Ardrossan, west of Scotland, it was south-westerly; whilst at Mullaghmore and Valentia, in the north-west and south-west of Ireland, it was south-east. The weather was generally fine on the ridge; but I have no doubt that if it had been the practice to observe cirrus clouds at these stations they would have been reported wherever they were not obscured by lower clouds, as the eastern and northern sides of the ridge of high barometer passed over the stations. The diagram illustrates the truth of the old saying that a backing wind is a sign of bad weather, and gives the reason why it is true.

In speaking on 'Indications of the Approach of another Storm-centre' (p. 21), I have said all that is known of cirrus clouds and whence it is supposed they come.

Although the origin of the cirrus clouds which are sometimes seen as a ridge of high barometer passes a station may not be proved, the fact that they are a most valuable sign of an approaching storm is well confirmed. I noticed several cases when watching the weather during my lecturing tours; one will suffice as an illustration.

At Buncrana, on the east side of Lough Swilly, we had experienced the passage of a storm-centre over the place on a Saturday; on the Sunday we had a beautiful day, with a north-west wind and rising barometer. On my way to church I asked a resident what he thought of the weather. He answered, 'We always look to Rathmullan'—a town on the west side of the Lough—'for our weather.' So I asked him to look. After a minute's consideration he said he thought it was going to be fine. I answered, 'So should I if it were not for the large amount of cirrus clouds (mares' tails) which are in the sky,' and I called his attention to the fact that they were moving from the north-westward. From this fact I prophesied that the barometer would soon fall again, that the wind would back to the south-westward, and that we should have more rain; all of which had occurred between that time and Monday morning.

Diagram 5 shows what was going on at 8 A.M., September 2, 1887—that is, twenty-four hours later than the date of Diagram 4. The storm-centre which was south-west of Ireland on September 1 had now arrived over Liverpool, having crossed Ireland moving along an east-north-east track. Had it continued moving in the same direction, it would have caused easterly winds over the north-east of England and east of Scotland, and south-westerly winds over the south-east of England. Here we have an illustration of a difficulty in forecasting. It was known at the Meteorological Office that these storm-centres frequently diverge more to the northward as they close with the land, and it was seen that the barometer was rising over Norway. Owing to these facts the east coast of Scotland was warned for easterly winds and the north-east of England for westerly winds. These warnings were correct, for the storm-centre took a more northerly course, as shown by Diagram 5, on which its position is given at 6 P.M. of the 2nd, and again at 8 A.M. of the 3rd, when it was over the sea west of Norway. It will be seen that a slight error in forecasting the probable track of this storm might have led to warning for easterly winds where westerly winds were experienced.

It will also be noticed that an observer on the north-east coast of England who was carrying out the instructions already given, would have been able to detect which side of him the centre was likely to pass, and thereby prove whether the forecast of the Meteorological Office was right or wrong, before the storm had arrived near him. For instance, suppose that the forecast had been based on the supposition that the storm would continue to move along an east-north-east track, then that coast would have been warned for a south-east wind backing to east and north-east, whereas the observer there would have noticed the wind to be veering from south-east to south, and would have been able to say that the centre was taking a more northerly course, and would most probably pass to the west, north-west, and north of him.

Diagram 5 also shows a case in which the easterly winds on the northern side of a low-barometer centre are light, whilst the westerly winds on its southern side have the force of a gale. This difference arises from the fact that the highest barometer is in the south, and the isobars, or lines of equal barometer, are much closer there —i.e., the gradient is much steeper than on the north side.

Diagram 6 shows what was going on at 8 A.M. of June 16, 1886. It represents the disposition of pressure when a centre of low barometric pressure moves to the south-eastward over the North Sea, and causes the barometer to fall on our east coasts, with a north-westerly wind and unsettled weather. It will be noticed that an area of high barometer extends north-westward from the Bay of Biscay to the south-west coast of Ireland, and that the track of the low-barometer centre leaves this high pressure to its right. Owing to this disposition of barometric pressure, as soon as the low pressure appeared to the westward of Norway, the authorities of the Meteorological Office were able to forecast that it would move to the south-eastward, which it did, causing unsettled weather on the east coast of England. On the 17th, the barometer was falling slowly along the north-west coast of France, where the wind was north-westerly. The track of the disturbance from 8 A.M. of the 15th to 8 A.M. of the 18th is shown on the diagram.

Diagram 7 shows what was going on at 8 A.M.,

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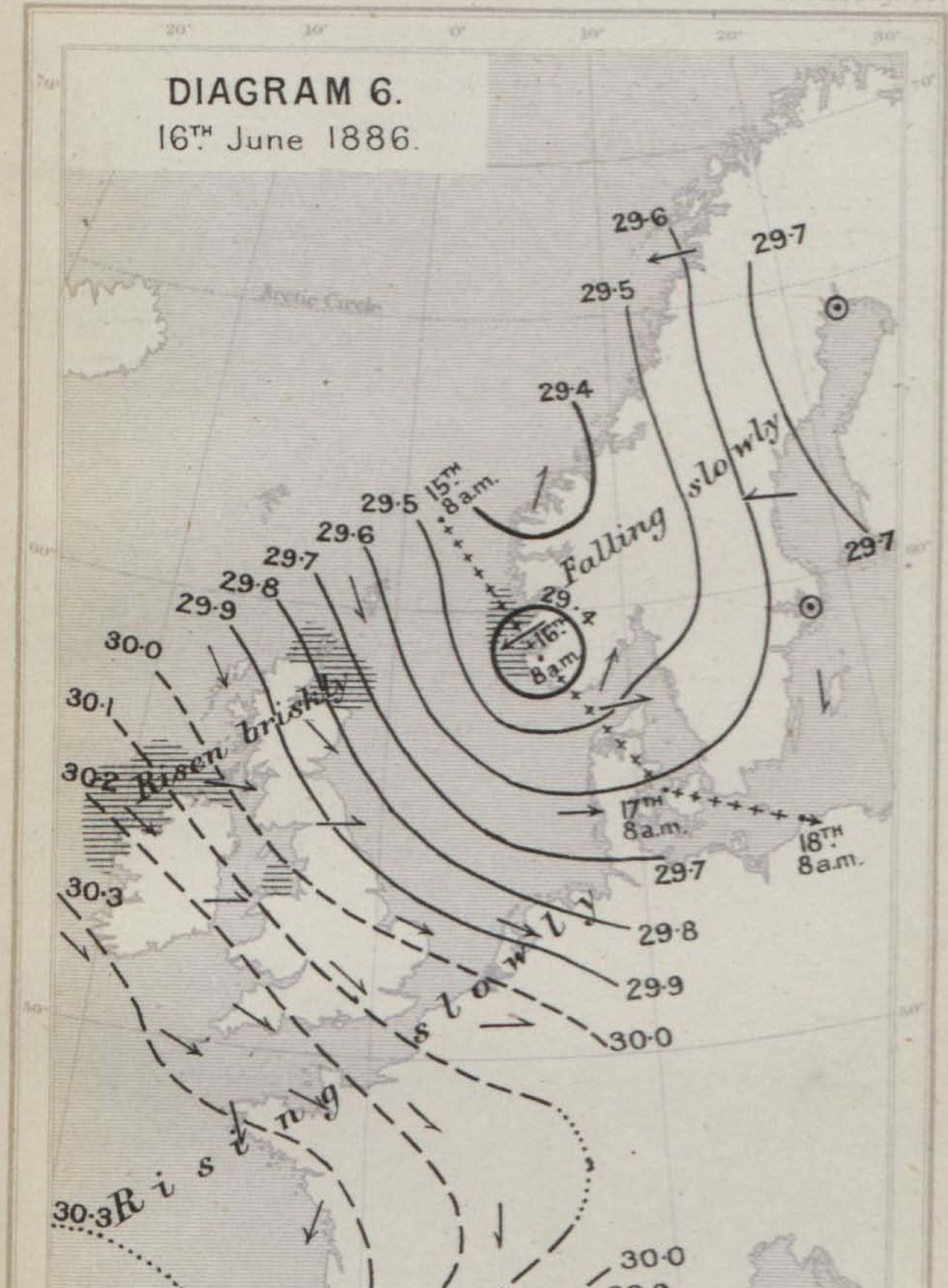

DIAGRAM 6.
16th June 1886.

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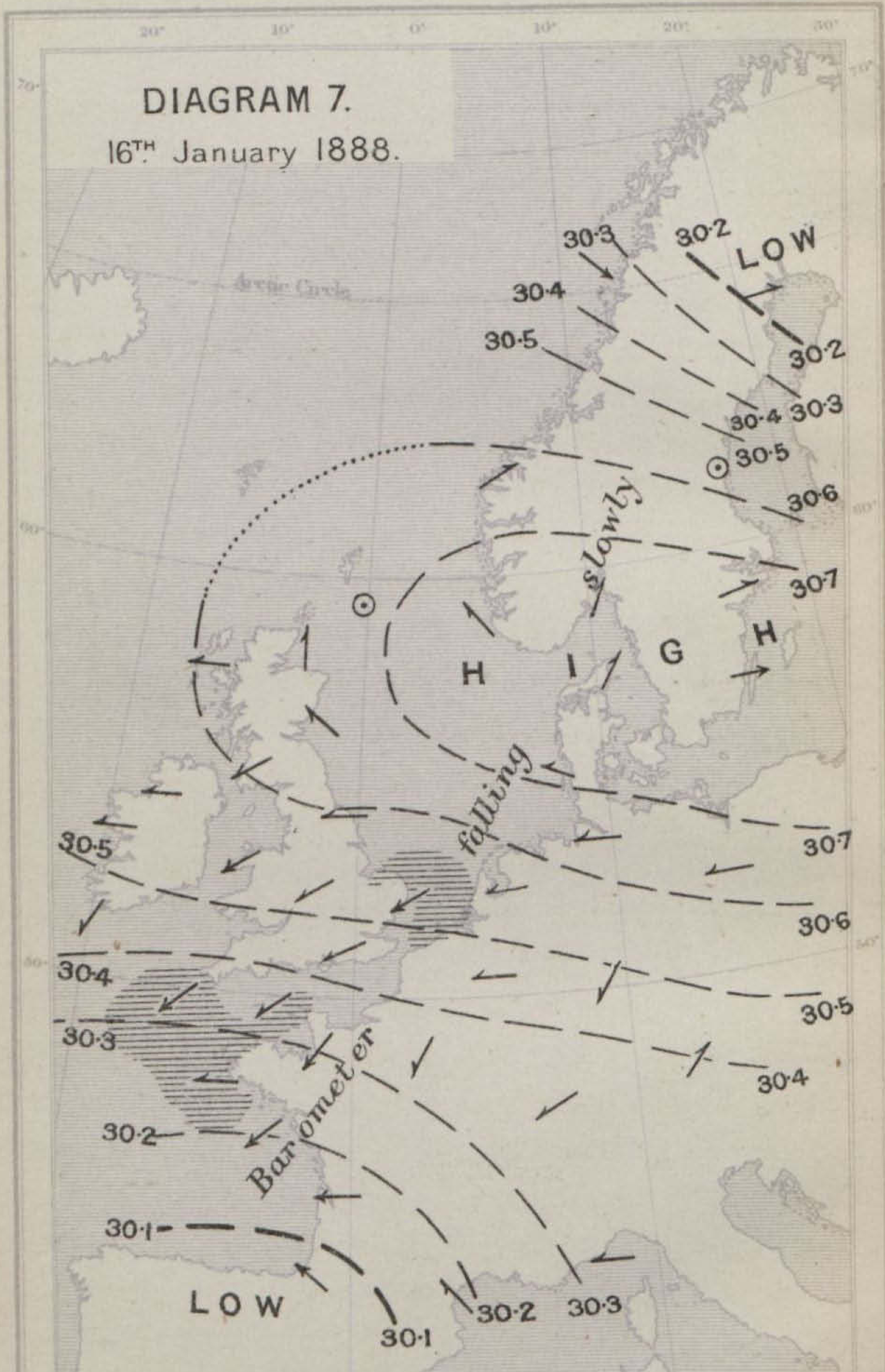


January 16, 1888. This was a case of a north-east wind blowing across our islands having its source in an area of very high barometer lying over the south of Norway and the Baltic. It will be seen that the wind blew *with* the hands of a watch round but out of the patch of high barometer. Near the centre of the area there was a west-south-west wind, but the temperature was down to 26° Fahr.

This diagram shows the disposition of pressure which prevails during the bitter north-easterly winds of the early months of the year. The air is supposed to descend over the area of high barometer, causing great cold and dryness. These areas of high barometer sometimes remain nearly stationary for days, accounting for the persistency of some of our east winds. As already remarked, there are two kinds of wind from each direction, their difference depending on whether they are blowing out of an area of high barometer, and so formed of descending air, or into an area of low barometer, and so formed of ascending air. An easterly wind blowing into an area of low barometer is shown on Diagram 8; when considering it, the difference between the two will be remarked on.

Diagram 8 represents what was going on at 8 A.M., April 23, 1888. It shows the case of a north-easterly wind blowing across our country, due to an area of low barometric pressure south of the British Islands, round and *into* which the wind was blowing contrary to the hands of a watch. The result was that the thermometer was generally above 40° Fahr., and there was a good deal of rain at some places. A comparison of Diagrams 7 and 8 shows the difference between the two kinds of easterly wind; there being a difference in the temperature of 20° at some places. Of course, this was partially due to difference of seasons, though chiefly to the fact that in one case we were in the near neighbourhood of a high barometric pressure, whilst in the other we were nearer to a low one.

Diagram 8 also illustrates the importance of considering the general disposition of pressure when endeavouring to forecast. It will be noticed that the barometer was higher to the north than to the south of the area of low barometer; had it been higher to the south, which is the most frequent condition, the area of low pressure would have moved away along an easterly or north-easterly track, and north-westerly wind with improving weather could have been foretold for the English Channel. But as areas of low pressure generally move along a track which has the higher barometer to its right, this depression was

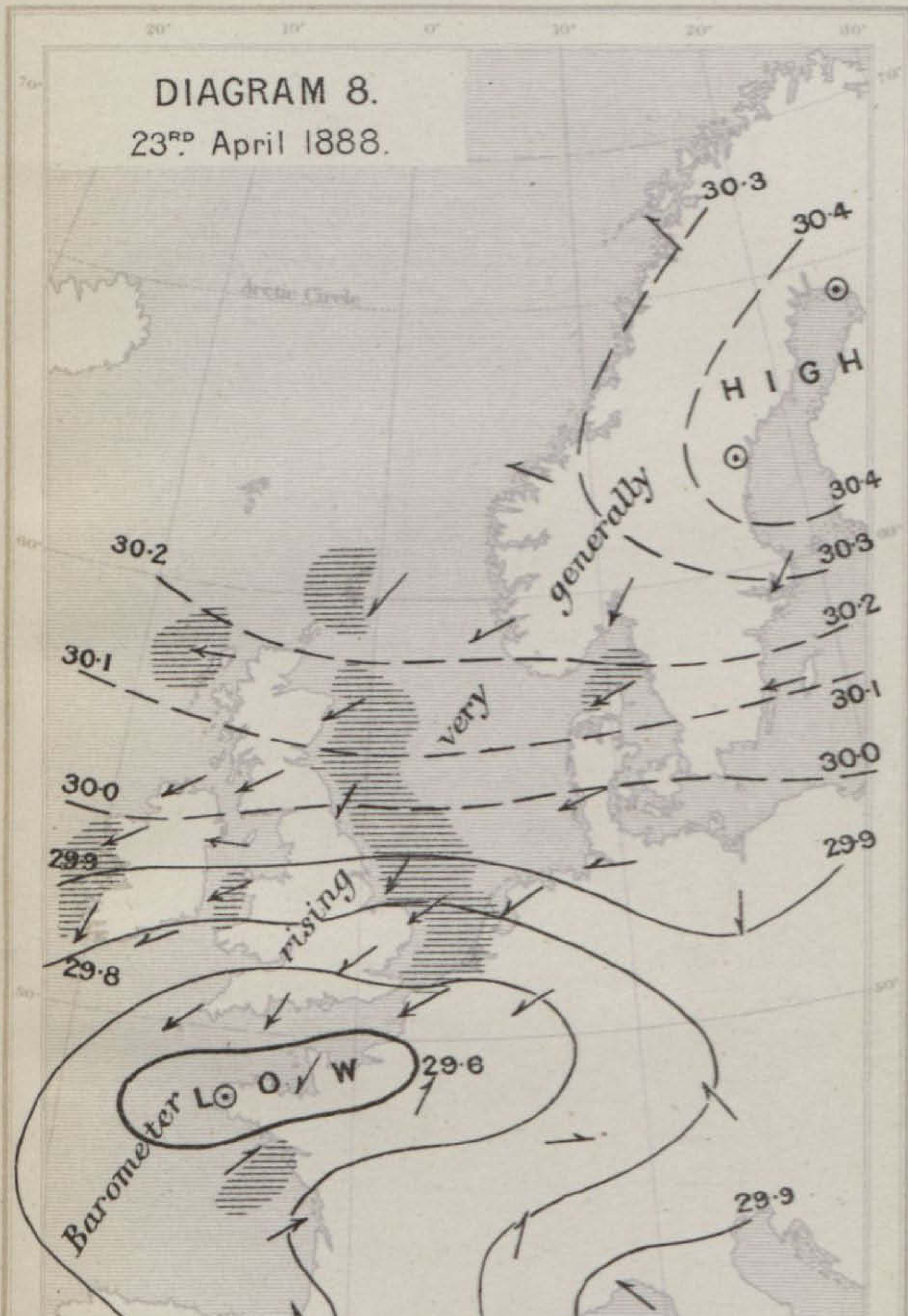


DIAGRAM 8.
23RD. April 1888.
HIGH
LOW
Barometer
rising
very
generally
30·4
30·3
30·2
30·1
30·0
29·9
29·8
29·7
29·6
Arctic Circle
0° Meridian of Greenwich
SCALE OF MILES

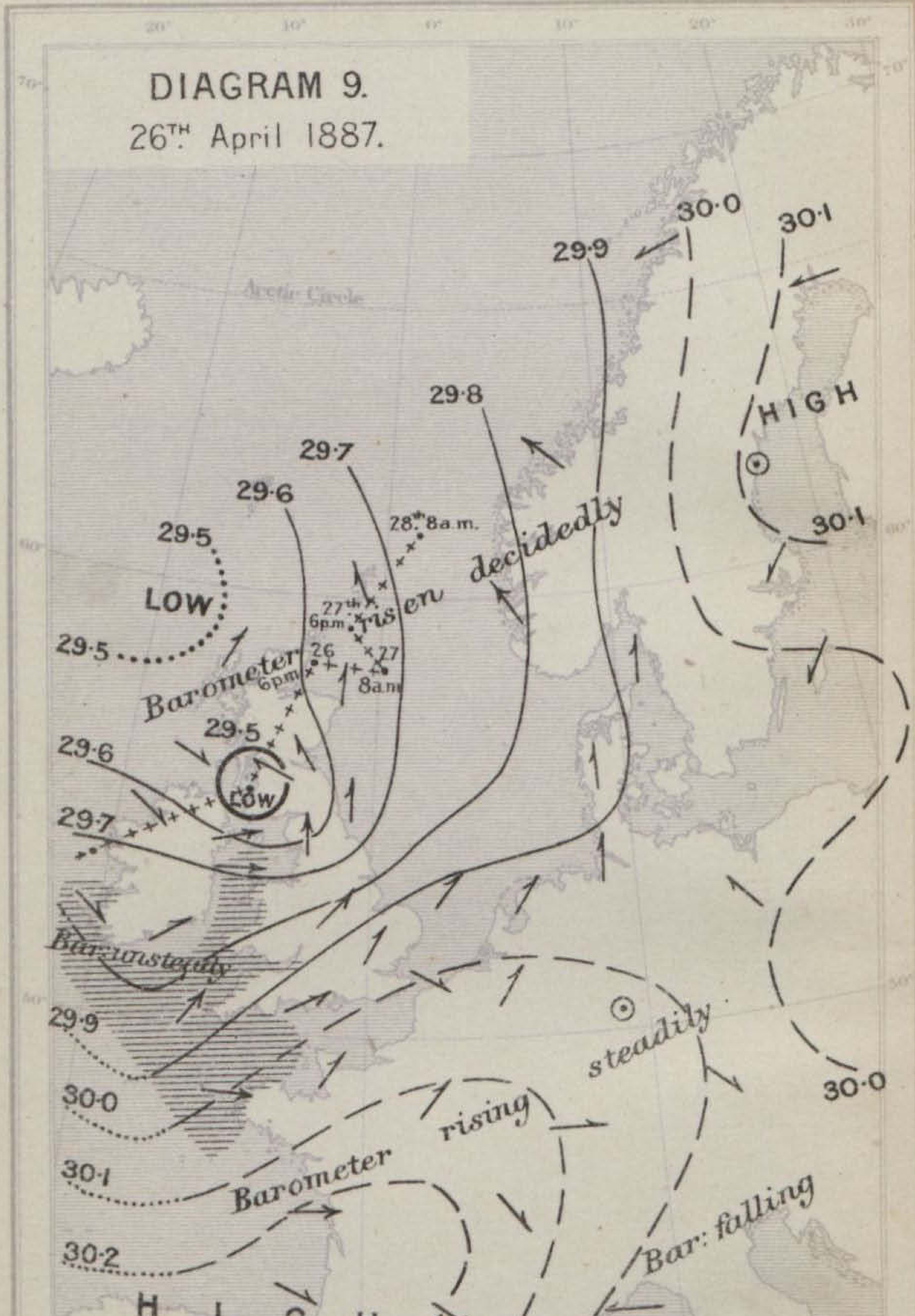


DIAGRAM 9.
26TH. April 1887.
Arctic Circle
LOW
29·5
29·6
29·7
29·8
29·9
30·0
30·1
30·2
HIGH
Barometer risen decidedly
28th 8a.m.
27th 6p.m.
26 6p.m.
27 8a.m.
Bar: unsteady
Barometer rising steadily
Bar: falling
H I G H
0° Meridian of Greenwich
SCALE OF MILES

more likely to move to the westward than to the eastward. It is, however, well known that depressions rarely do move to the westward, and that if they do their motion is generally very slow; so the Meteorological Office forecasted a continuance of the same wind and weather, which proved to be correct, for the depression remained over the Channel three days and then filled up. It will be seen by this case how valuable are 6 P.M. observations in helping to prepare the forecasts which appear in the next morning's papers, as they give ten hours' later information. For instance, had the 6 P.M. observations shown that the barometer was rising to the south and falling to the north of the depression, it would have been probable that the depression would have passed away to the north-eastward instead of not moving.

Diagram 9 represents what was going on at 8 A.M., April 26, 1887. Here we have the case of a centre of low barometric pressure between two areas of high barometer. In such a case it is not uncommon for several small low-pressure centres to form between the areas of high pressure, and to hang about or move slowly along irregular tracks. The track of this depression is given for three consecutive days; it will be seen how irregular it was, and that it must have been quite impossible exactly to forecast its direction. It will be remembered that July of 1888 was very wet. That wet weather was related to several shallow depressions which hung between two areas of high barometer. At 8 A.M. of the 30th of that month there were two depressions over our islands and one over the Baltic.

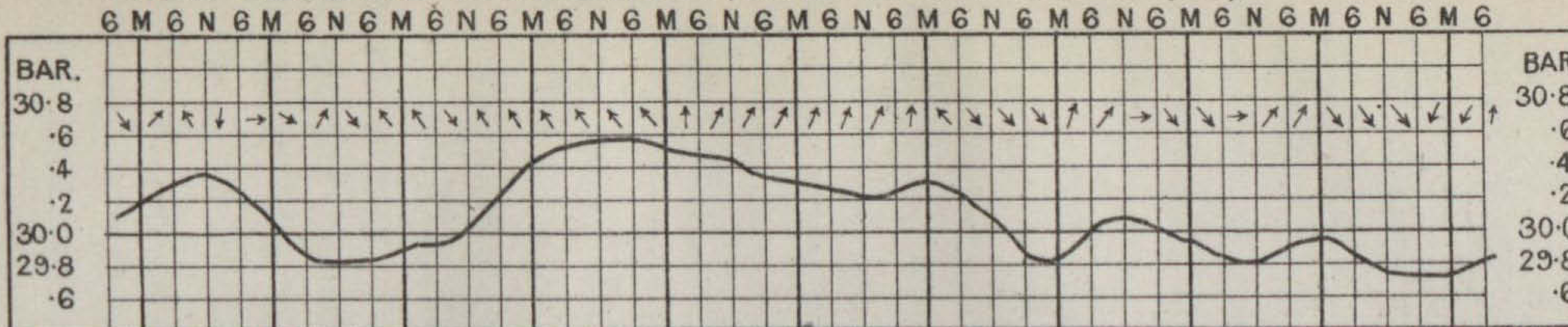
Diagram 10 is given as evidence of the fact that centres of low barometric pressure move in an easterly direction across the Atlantic; it represents the action of the barometer on board the Cunard steamer 'Algeria,' Captain W. Watson, F.R.Met.S., during one of her voyages to and from America, whilst the corresponding winds are shown by the lines of arrows, which fly with the wind.

The upper line is a curve of the 'Algeria's' barometer readings when she was steaming to the westward; the lower line is a similar curve when she was steaming to the eastward. The loops in the upper line show that she steamed through six or seven depressions as she went to the westward; the wind arrows above the line show that each of these depressions had the wind more or less southerly on its eastern side and more or less northwesterly on its western side,[1] so that she had

[1] This was much more clearly shown by the log, which gave twelve observations a day.

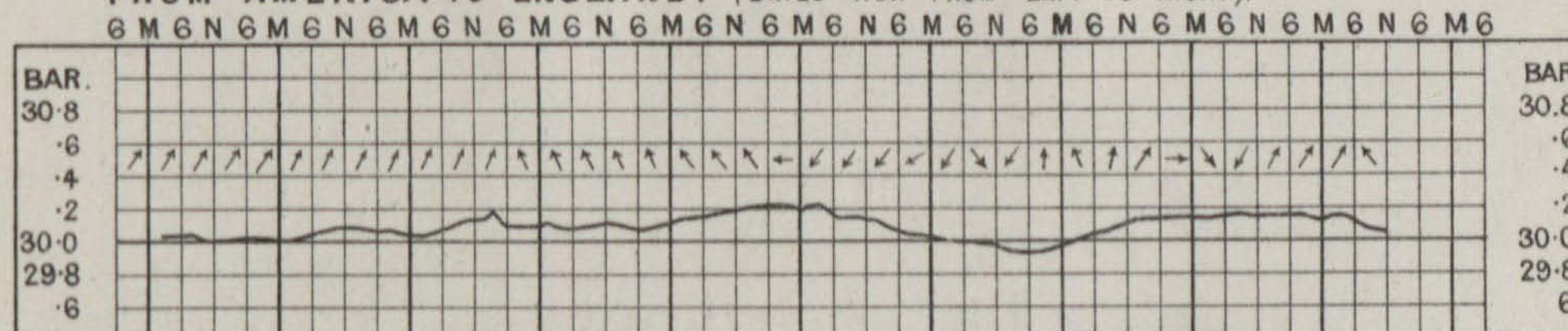
Diagram 10.

FROM ENGLAND TO AMERICA. (DATES RUN FROM RIGHT TO LEFT).



LATITUDE AND LONGITUDE AT NOON.	40°45′N. 69° 0′W.	41°43′N. 62°4′W.	42°50′N. 55°19′W.	48°50′N. 48°41′W.	46°22′N. 42°43′W.	48°4′N. 36°40′W.	49°46′N. 29°24′W.	50°50′N. 22°31′W.	51° 25′N. 15°10′W.	51° 51′N. 8°17′W.	LATITUDE AND LONGITUDE AT NOON.
DATE	27TH	26TH	25TH	24TH	23RD	22ND	21ST	20TH	19TH	18TH MAY.	1879.

FROM AMERICA TO ENGLAND. (DATES RUN FROM LEFT TO RIGHT).



LATITUDE AND LONGITUDE AT NOON.	40°37′N. 68° 51′W.	41°2′N. 61°31′W.	41° 50′N. 54°16′W.	43° 37′N. 47°8′W.	46°24′N. 40°12′W.	48°10′N. 32° 57′W.	49°37′N. 25°54′W.	51°2′N. 18°14′W.	51°29′N. 10°5′W.	53°29′N. 3° 5′W.	LATITUDE AND LONGITUDE AT NOON.
DATE	5TH JUNE	6TH	7TH	8TH	9TH	10TH	11TH	12TH	13TH	14TH	1879.

STANFORD'S GEOG. ESTABT

changeable wind and weather when going to America.

The lower line is seen to be comparatively straight, whilst the arrows show that the wind was more steady in direction than it was when steaming to the westward. This difference in the barometer curves of outward and homeward passages is so frequent on American voyages, that I could generally tell which way a steamer was going by the shape of her curve. The cause for the difference of shape in these curves is manifest; for if low-barometer centres generally move towards the east, a steamer going west will meet and pass through several, whilst a steamer steaming east may keep company with the weather system which she was experiencing when starting, so that she may have the barometer reading continue nearly the same, and similar wind and weather for a great part of her passage.

We have already alluded to the fact that there is generally a relatively low barometer to the southward of Iceland, and a higher barometer about the latitude of the Azores. This, taken together with the fact that low-pressure areas generally move along tracks having a high barometer to their right, accounts for the prevailing easterly tendency of these storm-tracks as they cross the Atlantic.

In Diagram 10, and similar records, we have then an independent proof that these depressions do generally cross the Atlantic, moving on easterly or north-easterly tracks, before they strike our coasts; whilst our daily weather charts abundantly show that their tracks are generally north-easterly to northerly over the land of North-western Europe.

In conclusion, it is hoped that the reader has obtained a clear idea of the valuable forecasting power which may be acquired by a single observer from a careful record and study of the barometer, wind (both its direction and force), and cirrus clouds. Also that he has obtained an insight into some of the facts on which forecasting in general is based.

LONDON: EDWARD STANFORD

26 & 27 COCKSPUR STREET, CHARING CROSS, S.W.