AUSTRALASIAN ANTARCTIC EXPEDITION
1911-14

UNDER THE LEADERSHIP OF SIR DOUGLAS MAWSON, O.B.E., D.Sc., B.E., F.R.S.

SCIENTIFIC REPORTS

SERIES B

VOL. VII

METEOROLOGY.

DAILY WEATHER CHARTS.

EXTENDING FROM AUSTRALIA AND NEW ZEALAND TO THE ANTARCTIC CONTINENT.

BY

EDWARD KIDSON, O.B.E. (MIL.), D.Sc., F. Inst. P., F.R.S.N.Z.

WITH FOUR TEXT FIGURES AND THREE HUNDRED AND SIXTY-FIVE CHARTS.

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DAILY WEATHER CHARTS.

(2nd February, 1912, to 31st January, 1913.)

PART I.

DESCRIPTION AND DISCUSSION.

INTRODUCTION.

THE period from February, 1912, to January, 1913, is unique in the annals of the Meteorology of Antarctica, and indeed of the Southern Hemisphere, in that throughout much the greater part of it continuous observations were being made at three distinct and widely separated bases in one quadrant of the Antarctic Continent. In addition, a station was maintained on Macquarie Island. There was thus provided the best opportunity that has hitherto occurred of correlating the weather in the Antarctic with that in temperate regions, and of studying the general circulation of the Southern Hemisphere. The writer, having been invited by Sir Douglas Mawson to discuss the meteorology of his expedition, decided, therefore, to attempt to draw weather charts for the Australia - New Zealand quadrant of the Southern Hemisphere for the period concerned. It proved impossible to obtain daily observations for tropical stations north of Australia and New Caledonia except for Apia in Samoa and Niue in the Cook Islands Group. The charts finally, therefore, had to be restricted to the area shown in the reproductions which follow. The value of the series was very much increased by the fact that during the preceding year simultaneous observations had been made at three stations in the Ross Sea region, namely, Framheim, Cape Evans, and Cape Adare. These observations, together with those of sledging parties, enabled Dr. G. C. Simpson (now Sir George Simpson, K.C.B., F.R.S.) to describe in some detail the weather processes in that region. Simpson's work appears in the three volumes on the Meteorology of the British Antarctic Expedition, 1910–13. It will be referred to frequently in what follows. Framheim was Captain Roald Amundsen's headquarters, while Cape Evans and Cape Adare were the bases of Captain R. F. Scott's last expedition. In the year with which we are concerned, in addition to Cape Evans, there were occupied in Antarctica Sir Douglas Mawson's Main Base at Cape Denison, Adélie Land, and that of his western party in Queen Mary Land. The Macquarie Island station, also, was established by Sir Douglas Mawson. Data for Macquarie Island and Adélie Land have been published in the Scientific Reports of the Australasian Antarctic Expedition, 1911–14, Series B, Meteorology, Volumes III and IV respectively. Volume V which will contain the observations at Queen Mary Land and those made on the expedition's vessel, the S.Y. *Aurora* had not appeared at time of writing but access has been had to the manuscript. In addition, the writer has had at his disposal the meteorological log of the *Aurora* and the original barograms and thermograms of Sir Douglas Mawson's stations.

The New Zealand weather reports were obtained from manuscript in the Meteorological Office, Wellington.

For Australia, the Commonwealth Meteorologist, Mr. W. S. Watt, loaned the original daily weather reports from the Central Weather Bureau, Melbourne, the only complete record available. This was a very great kindness. Complete sets of barograms for Melbourne and Perth with all the necessary corrections were also supplied. The writer wishes to express his most sincere gratitude for this and other assistance received from the Commonwealth Meteorologist.

The Australian charts contained, especially in the later stages, a number of reports received by wireless telegraph from ships at sea. This type of reporting was then in its early days and the times of observation frequently differed considerably from the standard. In a few cases, also, there was some uncertainty about the report. Besides the data for Cape Evans, the publications of the British Antarctic Expedition contain the log of the *Terra Nova* and extracts were made from this as well as from the *Aurora's* log. Unfortunately, by the time enquiries were made for them, the logs of the Union Steamship Company's vessels crossing the Tasman Sea had been destroyed so that no additional information was obtainable for that area. Nor was it possible to secure from the British authorities any further records from home-going ships. Data from the oceans are thus very meagre. Such as are available are, nevertheless, very important.

The Australian observations were made at 8 a.m. (00.00 G.M.T.) in Western Australia, and at 9 a.m. Eastern Australian Time (23.00 G.M.T.) in the rest of the country. For the Antarctic stations, the expeditions' vessels, and for Macquarie Island, the nearest observations to this latter time are plotted. The New Zealand observations are made at 9 a.m. (21.30 G.M.T.).

The plotting of the observations is in accordance with present international convention. The amount of cloud is indicated by the extent to which the station circles are blacked in. The reports gave five degrees of cloudiness, namely, clear, quarter-clouded, half-clouded, three-quarter-clouded, and overcast. Wind directions are shown by arrows flying with the wind and the force on the Beaufort Scale by the number of feathers, a short feather representing one unit and a long feather, two. Pressures were all recorded in inches and expressed to the nearest hundredth. The pressure is entered to the right of the station circle, the inch figures being omitted. On the few occasions when past weather is given, this is indicated below the pressure. Temperature in degrees Fahrenheit is plotted to the left of the station circle and present weather just below it. Present and past weather are both denoted by the appropriate international symbols. It not being possible to use more than one colour, rainfall, where plotted, is given in hundredths of an inch and enclosed in brackets. Isobars are plotted for each tenth of an inch from 29·8 inches upwards, and for the even tenths at lower pressures. This generally gives a convenient spacing. It is, unfortunately, not possible to reproduce all the data that appear on the original charts, but it is hoped that that given will prove sufficient to indicate the grounds for the analysis.

The following table (Table I) gives the co-ordinates of stations specially mentioned in the discussion :—

TABLE I.

Station.	Lat.	Long.
	° ′	° ′
Framheim	78 38 S	163 37 W
Cape Evans	77 39 S	166 12 E
Cape Adare	71 18 S	170 09 E
Adélie Land	67 00 S	142 40 E
Queen Mary Land	66 18 S	94 58 E
Macquarie Island	54 30 S	158 57 E
Chatham Island	43 57 S	176 29 W
Wellington	41 16 S	174 46 E
Melbourne	37 49 S	144 58 E
Perth	31 57 S	115 51 E
Norfolk Island	28 58 S	168 03 E

THE ANALYSIS OF THE CHARTS.

The charts have been analysed, to the best of the writer's ability, by frontal methods. Fronts are indicated according to the usual conventions, a cold front by a series of peaks, a warm front by sectors of circles, and an occlusion by a combination of the two symbols.

There has been no attempt to make the analysis conform very strictly with kinematic laws, partly because there is insufficient data to permit the application of rigid tests, and partly because of the amount of labour involved. The first thing to be noted about Southern Hemisphere weather charts is the comparatively regular eastward progression of anticyclones. Next, analysis shows that there is a similar eastward movement of fronts, which are normally long-lived. The fronts are inclined to the meridian in a north-west to south-east direction. To facilitate the following by the reader of the day-to-day changes and the analyses, the various anticyclones and fronts have been identified by letters, the former by capitals and the latter by small letters. Thus the first new anticyclone to appear from the west in each month is marked "A," the second "B," and so on. Similarly the first, fresh principal front (as distinguished from a secondary) is labelled *a*, the second *b*, and so on. On these principal fronts waves develop and in addition to moving eastward with the front travel along it in the poleward direction. The waves are numbered for identification in order of their appearance on the chart. Thus the first wave appearing on front *a* is called a_1, the second a_2, etc. Secondary fronts are given the same identifying letter as the preceding main front but are distinguished from them by dashes. b^{iv} thus means the fourth secondary to develop behind *b*. Waves may develop on secondary fronts and they are then numbered in the usual way. Occasionally a new principal front develops on the chart between two others. To distinguish this it is given a letter as a suffix. Thus C_a represents a front which has newly developed behind *c*. Sometimes, too, an anticyclone appears to divide, each portion then continues to be given the same letter but the second is distinguished by a dash. Other conventions adopted should be clear from the charts themselves.

When a cyclone is referred to in the discussion it will generally mean a depression round the centre of which there are closed isobars and a complete wind circulation, earlier stages in development will be referred to as waves. The majority of waves never develop into fully fledged cyclones. In the latter it is likely that the circulation extends throughout the troposphere.

In making the analysis of the charts, in addition to the data shown, various printed tables (usually of hourly values) of pressure, wind and temperature at Macquarie Island and the three Antarctic stations were studied together with the original barograms from Adélie Land, Queen Mary Land, Macquarie Island, Melbourne and Perth, and the thermograms from Adélie Land, Queen Mary Land and Macquarie Island. The weather diaries at the various bases and the logs of the *Aurora* and *Terra Nova* were consulted equally carefully. The journal kept at Macquarie Island was a particularly good one and great use was made of it. The temperature record from this station, also, is most interesting and instructive. A copy of it has, therefore, been traced and is reproduced on the charts, each week's record appearing on that corresponding to the first day.

Finally, for each month there has been prepared a diagram showing a complete record, where available, of the pressure variations throughout the month at the principal stations. In these diagrams the time scale is that for the 150° E. meridian and points on the curves falling on a vertical line are synchronous. The distance between the horizontal rulings represents a pressure of one inch of mercury. The times of passage of the various fronts shown in the analysis to have passed the stations are marked on the curves by the corresponding letters. When both the cold front and the occlusion of a wave passes the station, the letter is made to point to each of them. The occlusion will usually correspond with the lowest pressure. Two fronts occasionally merge over a part of their lengths. The index letters of both fronts are then bracketed over the point of passage on the barogram. Sometimes, of course, a pressure minimum will be caused by a depression which passes near the station without the associated fronts actually crossing it. Except in a very few cases the analysis is, however, intended to account for all the weather changes recorded. The stations for which barograms are given are, from the bottom upwards, Cape Evans, Adélie Land, Macquarie Island, Melbourne, Perth, and Queen Mary Land. The Cape Evans curve is derived from the published hourly values. For Adélie Land the original barograms also were consulted. The Queen Mary Land curve was derived solely from the uncorrected barograph record. It does not indicate the true pressure, being approximately 0·4 inch too low. The remaining curves were copied from the original barograms, applying the appropriate corrections.

The cold surface of the Antarctic Continent is continually removing air from the general circulation. This lies over it as a cold layer of varying thickness which flows outward to the periphery of the continent under the influence of gravity, giving the well-known katabatic winds. These latter are most strongly developed at Adélie Land where, except for a few short intervals in summer, they blow continuously and generally with the force of a strong gale. The cold air accumulates especially along the coast of the continent where it appears to raise the air pressure by about 0·2 inch above what is observed over the open sea, far from the shore, in corresponding latitudes (for example, over the Ross Sea). It is responsible for a prevalence of easterly winds along the Antarctic coastline and its effect extends, on the average, for about 200 miles from the coast. Pressure systems, fronts, waves, cyclones, etc., move, to a large extent, over and independently of the cold layer. Fluctuations in the katabatic flow are, of course, produced and some reference will be made to these later. In drawing the charts, some allowance has at times been made for the pressure field produced by the cold air but this has not been done consistently. Generally, indeed, the effect of the layer has been neglected. The same is true with regard to the effect of the altitude of the Antarctic Continent. The actual pressure field must, therefore, be much more complex than as shown and the analysis is rather schematic. One could not hope, with the scanty data available, to give anything approaching a detailed representation of the weather changes in the Antarctic. It is believed, however, that the major features are accounted for.

The plotting of the weather reports on the original charts was done in the Meteorological Office, Wellington. The writer is indebted to the New Zealand Government and particularly to Dr. E. Marsden, Secretary to the Department of Scientific and Industrial Research for this and other assistance. The analysis and discussion were carried out in the writer's own time. The copying of the Charts for publication was made possible by means of funds provided, at the instance of Sir Douglas Mawson, by the Australian Commonwealth Government. No professional draftsmen were available and the work was done by several members of the Meteorological Office Staff out of office hours.

The Anticyclones.

The regular procession of anticyclones from west to east has attracted attention ever since daily weather charts were first drawn for the Australian region. A similar procession is to be seen across South America and less clearly over South Africa, which lies northward of the average track of the centres. There is no doubt that the whole of the Southern Hemisphere is encircled in this way. The movements of the anticyclones have been discussed previously by the writer in "Some Periods in Australian Weather," Bulletin No. 17 of the Commonwealth Bureau of Meteorology, Melbourne. Individual anticyclones may differ greatly from the average as regards both the latitude of their centres at any time or the speed of their eastward progression. In the mean for any considerable number, however, the average conditions are usually approached closely. Though there are exceptions, the anticyclones are generally long-lived. The latitude of the tracks followed has an average annual variation of nearly 6° for the whole area from Western Australia to New Zealand, the centres being furthest north in September and furthest south in February. The mean latitude for each month as derived from the Australian daily weather charts for upwards of 30 years is shown in Table II for each even ten degrees of longitude from 120° E. to 170°E. The means for the whole range of longitudes and for the year also are given. The corresponding figures for the period covered by the present series of charts, February, 1912, to January, 1913, were redetermined from the charts. They agreed sufficiently closely with the previous estimates. In Table II are shown only the means for the whole range of longitudes. These illustrate the closeness with which a single year's figures tend to approach the average. Mean latitudes were, however, unusually high in 1912.

TABLE II.—MOVEMENTS OF ANTICYCLONES.

	Meridian E.	Month.												Year.
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	
		Mean Latitude (°S.).												
Average	120°	35·3	35·9	35·5	33·8	31·9	30·1	29·9	30·4	31·0	32·7	34·3	34·9	33·0
	130	36·1	36·6	35·8	34·1	31·7	29·5	29·8	30·3	31·3	33·0	34·7	35·6	33·2
	140	38·2	38·9	37·9	35·7	34·2	31·9	31·6	32·2	33·1	34·2	36·2	37·3	35·1
	150	38·6	39·5	38·7	36·2	34·9	33·6	33·4	33·1	32·8	34·3	35·7	37·5	35·7
	160	37·1	38·3	38·0	36·4	35·2	34·8	34·8	33·3	31·9	32·7	33·7	35·8	35·2
	170	36·3	38·5	38·4	37·2	36·7	35·8	35·9	34·5	32·8	32·7	33·4	35·3	35·6
	Mean	36·9	38·0	37·4	35·6	34·1	32·6	32·6	32·3	32·2	32·9	34·7	36·1	34·6
1912	,,	...	39·3	37·8	37·6	33·6	35·1	35·1	33·5	30·3	32·4	35·5	36·0	} 35·3
1913	,,	36·3	...	...	...	...	...	...	...	...	...	...	...	
		Mean Velocity, Degrees per Day.												
Average	,,	8·6	8·5	8·5	7·6	6·6	6·7	7·0	7·8	8·1	9·0	9·1	9·1	7·9
1912 (a)	,,	...	11·1	7·2	7·8	7·9	9·1	9·3	9·5	11·4	8·5	9·5	11·3	} 9·3
1913	,,	9·1	...	...	...	...	...	...	...	...	...	...	...	
1912 (b)	,,	...	9·2	10·0	5·8	7·7	7·4	9·0	8·3	9·7	11·2	8·1	9·0	} 8·8
1913	,,	10·0	...	...	...	...	...	...	...	...	...	...	...	
		Number Passing.												
1912	...	...	6	5–6	5	5	5	6	5	5	8	5–7	5–6	} 66–70
1913	...	6	...	...	...	...	...	...	...	...	...	...	...	

The anticyclones tend to follow the southern coastline of Australia in both winter and summer. In summer the continent is hot; pressure is relatively low over it; and the anticyclone centres tend to keep south of it. In winter, the anticyclones have their furthest northward tracks over the central and western portions of southern Australia, but further eastward the mean latitude increases because the intense, extensive and long-lived anticyclones which occasionally form over the continent with their centres over Tasmania occur more frequently in winter than in summer. There were several of these in July, 1912. Table III gives the departures from the average annual latitude of the means for the two periods May to July and November to January, when the land surface is colder and warmer, respectively, than the ocean. In the first period the anticyclones are furthest north of the average latitude on the 130° E. meridian while on the 170° E. meridian, over the ocean, their mean latitude is south of that for the whole year. In the second period, when the land is warmer than the ocean, conditions are reversed. The figures for 1912–1913 show the same effect.

TABLE III.—DEPARTURES OF LATITUDE OF ANTICYCLONE TRACKS FROM ANNUAL AVERAGE.

	Period.	Meridian.					
		120°.	130°.	140°.	150°.	160°.	170°.
		°	°	°	°	°	°
Average ...	V–VII	— 2·4	— 2·9	— 2·5	— 1·7	— 0·3	+ 0·5
	XI–I	+ 1·8	+ 2·2	+ 2·1	+ 1·6	+ 0·3	— 0·6
1912–13... ...	V–VII	— 1·4	— 1·1	— 0·3	+ 1·2	+ 1·3	+ 0·2
	XI–I.	+ 2·9	+ 2·9	+ 2·3	+ 2·2	0·0	— 0·6

The extent of the annual swing of the anticyclone tracks, especially in the eastern part, gives some measure of the intensity of the monsoonal conditions over Australia. The year dealt with is seen to be a rather normal one in this respect. 1911, 1913, and especially 1914, were years of small annual variation and little storm activity. All were dry years, the drought of 1914 in Australia being most severe.

In addition to the latitude data, Table II gives the mean eastward velocity of anticyclones in degrees of longitude per day for each month, first the average figures from the paper already cited and next those for 1912–1913, as determined by two different methods. These measurements, and also those of the frequency of passage of anticyclones and the distance between their centres which will be referred to later, are less simple than might appear. In the first place it is not always easy to decide what to call an anticyclone. Then, individual anticyclones may disappear, appear freshly, divide, or junction. One's judgment has frequently to be exercised and there is room for a certain amount of difference of opinion. The figures for the average velocity, in Table II, while giving a fair idea of the annual variation, are almost certainly somewhat too small. This is due principally to the scanty data in some of the early years when, especially owing to the absence of charts on Sundays and holidays, it was not always possible to be sure of the identification of anticyclones on successive charts. It was subsequently realized that especially when an extensive anticyclone of the type already mentioned was centred over Tasmania the passage of a fresh one into, or out of, the region was sometimes missed. The velocities obtained in the eastern Australian region, especially in winter, were, therefore, too low. The method used in the early work was the same as method (b) of 1912–1913. This was to record the number of days on which an anticyclone centre appeared in each 10° range of longitude during the period considered, then divide this by 10 and the number of anticyclones. The result may be slightly in error if, for example, there is in the mean a tendency for pressure to be high in the extreme eastern and western meridians, in which case the anticyclones would appear to move too quickly on to and too slowly off the area. Too low a velocity would then be obtained. Any error from this source should, however, be small. Method (a) used for 1912–1913 was to determine the velocity over portions of the tracks where the movement appeared fairly regular. This method gave the higher values in most months. Method (b) is probably somewhat the more reliable. The mean velocity in 1912–1913 was certainly above normal.

The last row in Table II shows the number of anticyclones appearing in each month. Again there is some uncertainty, reasons for which may be gathered from the charts. More anticyclones passed during the year than usual. This is in accord with the high velocity observed.

Another quantity measured was the distance between anticyclone centres. Here, again, there is frequently room for a difference of opinion. If two anticyclones are present on a chart they will usually be near the edges and it is, therefore, often difficult to fix the positions of the centres. When they are very far apart, it is not possible for two centres to appear on the same chart. Thus no measurement of the distance between them is possible. The average distance determined may thus be somewhat too low. Furthermore, the pressure changes produced by the anticyclones are, to a large extent, superimposed on large scale local variations of pressure. Thus if, for example, there is a semi-permanent area of high pressure in the eastern Tasman Sea, as indeed is frequently the case, anticyclone centres will have an apparent attraction for that position, while they will be found relatively seldom over an area where the pressure tends to be low. The mean distance determined, 44°·5 of longitude, is, however, probably fairly accurate. Sixty-six anticyclones in the year and a mean velocity of 8°·8 per day would give an average distance between centres of 48°·4, assuming the anticyclones to be permanent, while if the number were 70 the distance would be reduced to 45°·8.

It is of interest to know the frequency of occurrence of various intervals of time between the passage of one anticyclone and the next. In the previous paper it was found that the most frequent interval, measured to the nearest whole day, was 5; the mean interval was 6·4 days; and all but 10 per cent. fell between 3 and 11 days. In 1912–1913, the mean interval was 5·4 days and the range from 1·5 to 14 days.

Not only do the moving anticyclones seem to be superimposed on semi-permanent local variations but they also seem to move to a large extent independently of surface weather conditions. Thus on occasion, even when there is a deep cyclone over the Tasman Sea, an anticyclone may approach from the west, disappear temporarily, and then after the appropriate interval re-appear to the east of the cyclone. While the region of the cyclone is being passed there will be some rise of pressure, especially to the south. There is no very good example of this effect, however, on the 1912–1913 charts. Again, an anticyclone, particularly when it has become of feeble intensity, may be divided, generally by a front (12–14, VI, B; 30 VIII—4 IX, E; 29 X—2 XI, G), but in this case one of the resulting pair almost always appears to be absorbed, ultimately, in the preceding or following anticyclone (6–7, II, A′ and B; 19–23, X, E′ and F; 29 X—2 XI, G′ and H). Or, without any division, a weak anticyclone may appear to merge in its predecessor or follower (22–24, VIII, C and D; 28 XI—1 XII, D and E; 24–25, XII, D and C). In this latter case it is, however, probable that the combined anticyclone subsequently divides or a new one appears at about the normal distance from the others (1–4, XII, E′). At times an anticyclone appears to become stationary for a protracted interval but there are indications that even in these cases a pressure wave frequently moves onward and that if the charts were more extensive in longitude this would again appear further eastward as an anticyclone. There is, then, a strong suggestion that the moving anticyclones originate as some periodic function of the upper atmosphere, or of the atmosphere as whole, which is continually tending to produce them at intervals of about 45° of longitude. It has been found that there is a correlation between the surface pressure changes accompanying their passage and the amount of ozone in the atmosphere (Dobson, Kimbal and Kidson, "Observations of the Amount of Ozone in the Earth's Atmosphere, etc." Proc. Roy. Soc. A., Vol. 129, 1930).

In the preceding paragraph the charts showing the effect described are indicated in parentheses. First come the days of the month, then the month in Roman numerals, and finally, the letter indicating the particular system concerned. Thus the first reference is to anticyclone B on the charts of the 12th–14th June, 1912. This method will be used again later.

THE FRONTS.

The discussion of the meteorological results of the various Antarctic expeditions has led numbers of meteorologists, chiefly of the Northern Hemisphere, to study the general circulation of the atmosphere in that region. Amongst the most important works on this subject which have appeared so far, is that by Simpson, already referred to. This was based principally on a consideration of the synchronous observations at Framheim, Cape Evans and Cape Adare, in the Ross Sea region, though Simpson considered all the data available. Simpson's most important conclusion may be gathered from the following quotations from his discussion.

1. p. 245.

"*Cape Evans and Framheim.*—At these stations the evidence is almost conclusive that the barometer changes are not due to travelling cyclones and anticyclones but to real waves of pressure which travel outwards from the Antarctic Continent.

"*Gauss Station.*—According to Meinardus the barometer changes at this station are due entirely to travelling cyclones. Evidence has been brought forward to show that this is impossible and reasons have been given for believing that at this station, also, pressure waves are mainly responsible for the barometer changes.

"*Cape Adare.*—The evidence indicates very clearly that at Cape Adare the main barometer changes are due to pressure waves while secondary changes are occasionally due to travelling cyclones and anticyclones."

2. p. 217.

"There can, therefore, be little doubt that we have to do with waves of pressure travelling outwards from the centre of the Antarctic Continent along directions parallel to a line joining Cape Adare and Framheim."

3. p. 218.

"We have now found that it is difficult to see any close relationship between the winds at Cape Evans and the actual pressure waves, as would be the case if the pressure waves were due to the passage of high and low pressure systems which are maintained by the winds circulating round them——"

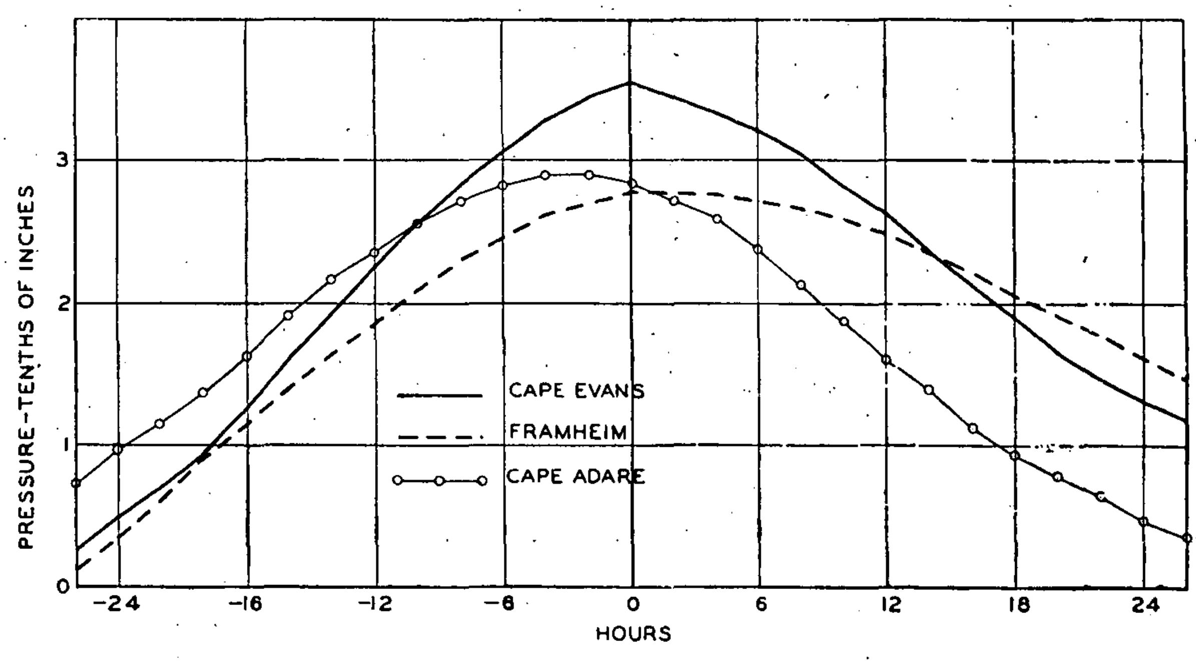
4. p. 246.

"From these results we are led to recognize long and deep pressure waves radiating out from the Antarctic Continent and extending over the Southern Ocean to some unknown distance from the Continent, traces of which can still be seen in the pressure curves for Kerguelen."

Simpson found indications that the centre from which his waves radiated was not at the Pole but in approximately 80° S. and 120° W.

The writer, in the discussion of the Meteorology of the British Antarctic Expedition, 1907–1909, p. 111, after briefly describing the pressure waves produced in the Australia-New Zealand region by the moving anticyclones and intervening low-pressure troughs and their southward extensions, states that "while agreeing in the main with Simpson's description of the actual processes I do not think it necessary to introduce a new type of pressure wave to provide the prime mover in the weather changes in the Ross Sea."

Simpson's views have been widely accepted, notably by some German meteorologists. Quite recently in the Quarterly Journal of the Royal Meteorological Society, Vol. LXI, October, 1935, after consideration of the additional data provided by the Adélie Land and Macquarie Island observations, F. Loewe accepts Simpson's views and rejects the writer's.



PRESSURE MAXIMA

FIG. 1.

Simpson traced the movements of pressure maxima and minima and found that they occurred earliest on the Antarctic Plateau to the south of Cape Evans, next at Framheim, next at Cape Evans, and finally at Cape Adare. According to his determinations they passed Cape Evans, on the average, about 9 hours later than Framheim, and Cape Adare after a similar interval. The barograms of these three stations show, in general, a close similarity, and the maxima and minima appearing, for example, on the Cape Evans curve are nearly always easily traceable on the others. In order to bring out the interrelations of these pressure variations at the three stations, the writer has prepared Figs. 1 and 2. The data are derived from the tabulations of hourly or two-hourly values of pressure for the period from April to December, 1911. First of all, 48 maxima and 48 minima were noted in the Cape Evans data. These included all those marked by Simpson in the plates of Volume II of his discussion with a few additional ones. All reasonably well-marked instances were included. Fig. 1 shows, in the continuous curve, the mean variation of pressure for the 48 maxima at Cape Evans, during the period from 26 hours before to 26 hours after the maximum. The values were determined for two-hourly intervals. There is a mean rise and fall of about 0·3 inch, the rise being steeper than the fall. The curve shown for Framheim was obtained by deriving the mean pressure values at times 9·1 hours in advance of the corresponding ones at Cape Evans. The precise figure 9·1 hours was determined by the times used in the pressure tabulations. Similarly the Cape Adare curve represents the means for times 10·7 hours later than those at Cape Evans. The pressure minima are similarly treated in Fig. 2. Owing to absence of record, two maxima and one minimum were missed at Framheim. It will be seen that the highest point on the Framheim curve for maxima falls at 0 hours, thus confirming Simpson's figure. That is, pressure maxima occur, on the average, 9 hours earlier at Framheim than at Cape Evans. The maximum at Framheim is flatter than at Cape Evans but that is to be expected since there is considerable variation of the time difference in different cases. In the same way it may be seen that the

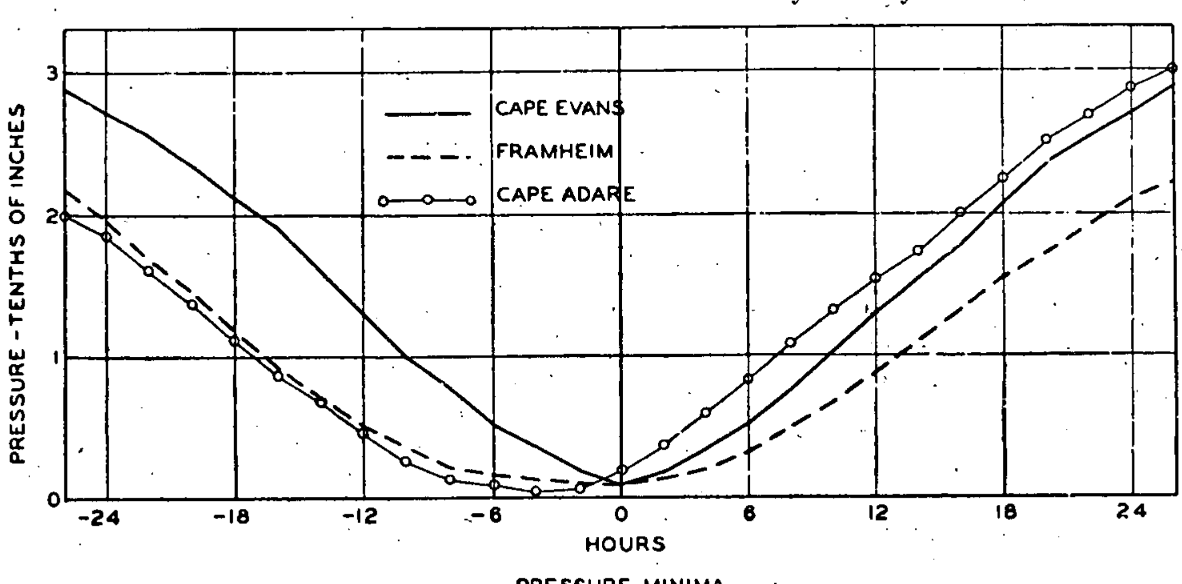


FIG. 2.

maximum on the Cape Adare curve is at -4 hours, though there is little difference between the -2 and -4 hour values. The maxima at Cape Adare, therefore, occur, on the average, about 7 hours later than at Cape Evans, again in fair agreement with Simpson's figure. At Cape Adare, the curve is more symmetrical than at the other stations. The remarkably close relationship between the pressure changes at the three stations is indicated by the close agreement in amplitude of the three curves, though this is in part due to the fact that the pressure variability is greater at Framheim and Cape Adare than at Cape Evans. The conditions are very similar for the minima, that on the Framheim curve in Fig. 2 occurs at 0 hours, and that on the one for Cape Adare at -4 hours, so that, again, Cape Evans is 9 hours behind Framheim and 7 ahead of Cape Adare. The total average variation about the minima is less than that about the maxima. This, again, is to be expected since the minima often are not simple and there is, consequently, a considerable amount of smoothing out. The same fact would account for the greater differences between the amplitudes.

Coming now to the 1912–1913 results, the relation between the pressure variations at Cape Evans, Adélie Land and Queen Mary Land can be seen in the figures giving barograms for each month. There is obvious correspondence between many of the changes at Cape Evans and Adélie Land. This is especially the case in June, August and September. It is clear, also, that, on the average, the changes at Adélie Land lag considerably behind those at Cape Evans. The resemblance between the Cape Evans and the Adélie Land curves is not nearly so close as was that between those for Cape Evans and Framheim and Cape Adare. Loewe, in the paper previously cited, gives 13½ hours as the mean lag of the Adélie Land variations behind those of Cape Evans. The amount of this lag is, however, very variable. Sometimes it amounts to practically nothing and there are even occasions when changes occur earlier at Adélie Land than at Cape Evans. It would be extremely difficult to account for all phases of the relationship between the two stations on the basis of Simpson's waves, even after allowing, as Simpson presumably would, for Adélie Land being affected to some extent also by cyclones moving from the west. Between Queen Mary Land and Cape Evans, except that there is occasionally a persistent tendency for high or low pressure which is partly synchronous at all three stations, the relationship is very slight. It will be shown later that it is not possible to account for the Queen Mary Land pressure variations as being due to waves which have passed Framheim, Cape Evans, Cape Adare, and Adélie Land at the intervals already indicated. The writer finds it still more difficult to imagine, as concluded by Loewe, that the waves which have reached Adélie Land 13½ hours after Cape Evans pass Macquarie Island only 7 hours later.

In the discussion of the Meteorology of Shackleton's 1907–1909 expedition the writer ascribes the day to day pressure changes in the Antarctic principally to the passage of pressure troughs and ridges which are continually moving in an easterly direction, and of a similar nature to those occurring in Australia and New Zealand and, indeed, also South America. The axes of these systems are inclined in a north-westerly direction. The analysis of the 1912–1913 charts is in conformity with this view. It is true that the gap between Australia and

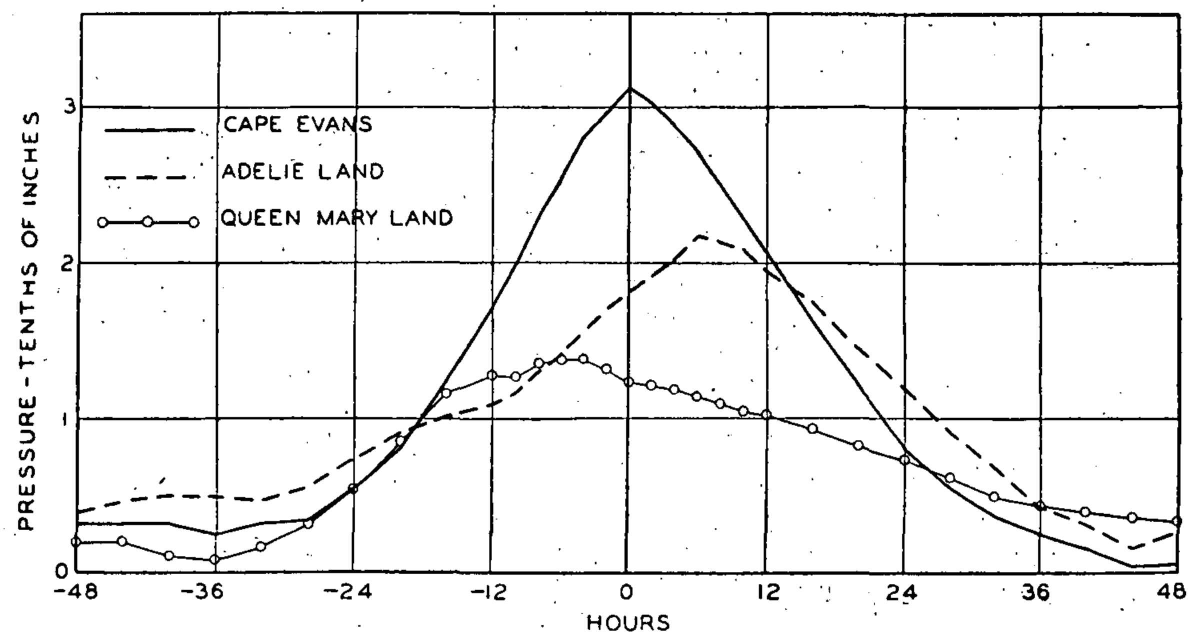
New Zealand and the Antarctic is very wide and Macquarie Island bridges it quite inadequately. On any particular day it would be possible with the data available to make an analysis which would differ widely from that shown but it is believed that the analyses are, in general, correct in their main features and that the evidence in favour of the type of analysis shown when all put together is overwhelming. There is a continuous procession eastward of fronts which are usually long-lived and which, in the great majority of cases, extend from Australia to the Antarctic. The times of passage of the fronts at each station are marked on the monthly barograms. These times were tabulated, and from them was determined the order in which various stations were normally passed by the fronts and the average time intervals occupied. The first passage of a front was taken. Thus if a cold front was followed by an occlusion, the time tabulated was that of the passage of the cold front. A similar practice was followed when a front, after having once passed a station, returned as a warm front and finally crossed it a third time, or if the station were crossed by two widely separated parts of the same front. Cases of the types just mentioned are, however, uncommon. The results are shown in the following table in which, on the basis of Figs. 1 and 2, Framheim and Cape Adare also have been interpolated 9 hours before and 7 hours after Cape Evans respectively, though these figures do not apply strictly to fronts. The table shows the average interval in hours after the passage of Queen Mary Land at which each station would be passed. Many fronts, of course, fail to pass all stations; what was actually measured was the interval between successive stations.

TABLE IV.—MEAN TRAVEL TIMES OF FRONTS.

Station.	Queen Mary Land.	Framheim.	Cape Evans.	Cape Adare.	Adélie Land.	Perth.	Macquarie Island.	Melbourne.	Wellington, N.Z.	Norfolk Island.
Hours	0	39	48	55	57	68	114	128	176	197

One hundred and eleven principal fronts were tabulated, secondaries being excluded. The means for the different seasons were fairly consistent and though there is, doubtless, some annual variation in velocity, results for one year are not sufficient to indicate its nature.

Next, there were prepared Figs. 3 and 4 in the same manner as Figs. 1 and 2. From the pressure tabulations for February to December, 1912, at Cape Evans 63 maxima and 59 minima were selected. The average variation from 48 hours before to 48 hours after these maxima and minima respectively, was then determined. The corresponding data were then found for Adélie Land, using again the tabulations of hourly values. The Adélie Land times were in every case advanced 9·5 hours. The same was then done for Queen Mary Land, the time in this case being advanced 48·3 hours. The Queen Mary Land data were obtained from the barograms. There are no March records available and one or two gaps occurred later, so that there were data corresponding to only 47 of the maxima and 45 of the minima at Cape Evans. The results are shown in



PRESSURE MAXIMA

FIG. 3.

the figures. For the maxima it is seen that the highest pressure at Adélie Land is 6 hours after the zero interval. In other words, the pressure maxima occur, on the average, 15½ hours later at Adélie Land than at Cape Evans, in fair agreement with Loewe's figure. The pressure range is a considerable fraction of that at Cape Evans as would be expected from the obvious resemblance of the barograms, but the fraction is smaller than in the cases of Framheim and Cape Adare. Fig. 3 shows, also, that pressure maxima occur, on the average, two days earlier at Queen Mary Land than at Cape Evans. It is clear, however, that in this case the correspondence is not close. It seems quite impossible to reconcile this figure with the idea that the pressure maxima are caused by pressure waves as described by Simpson. Fig. 4 confirms Fig. 3. The fact that the minimum on the Adélie Land curve does not occur at the zero hour but 8 hours later (17½ hours after Cape Evans) is due to the fact that a considerable number of cyclones passed this station and the lowest pressure occurred at the passage of the occlusion not the cold front. Cape Evans is not nearly so much affected by cyclones. The data for Queen Mary Land are not sufficiently numerous to ensure that the curves are very close to the normal ones. The right-hand side of the minimum curve, for example, is considerably higher than the left.

Table IV shows that the fronts are, on the average, inclined at a large angle to the meridian. In the Ross Sea region, indeed, they must lie almost east and west. But with the data at present available it is not possible to judge of the precise significance of the pressure changes about the Ross Sea. To the west and, beyond the Great Ice Barrier, to the south we have the great plateau of Antarctica. A very large area of this lies at an altitude of between 2 and 3 kilometres, while the Ross Sea and the Barrier are at or near sea level. To the

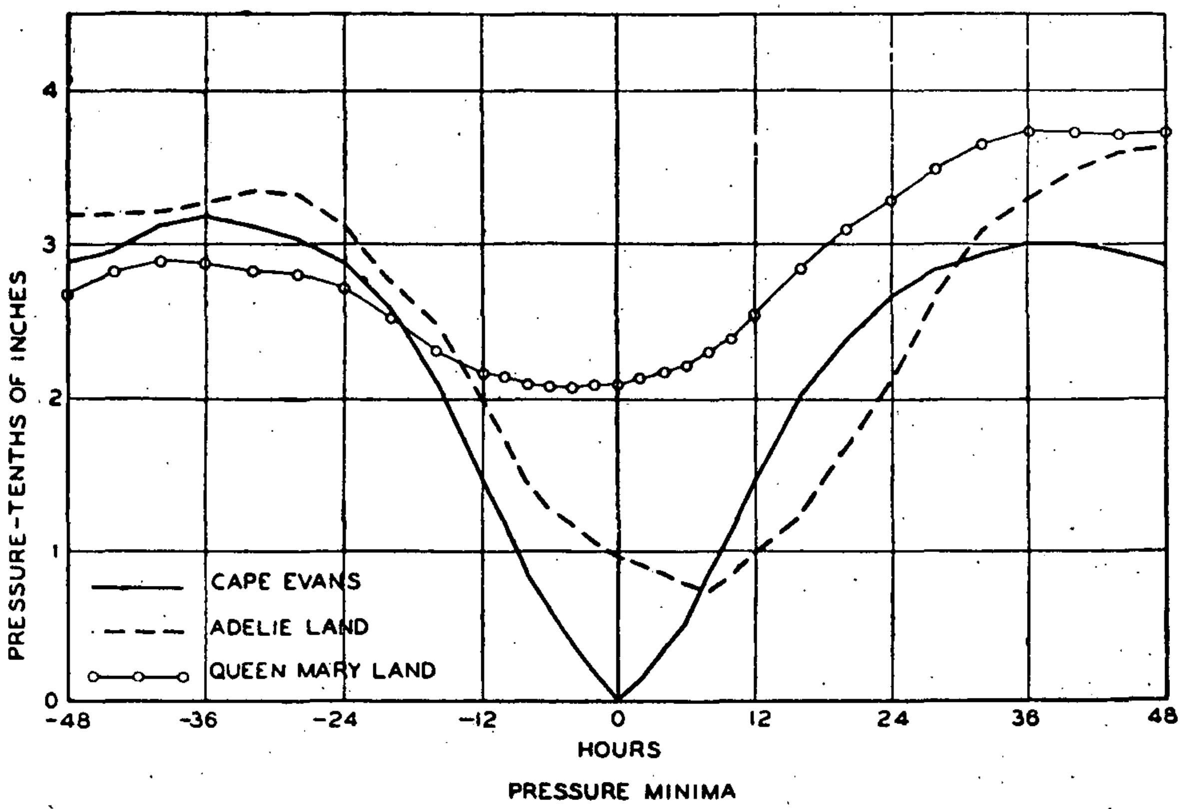


FIG. 4.

east there are, again, extensive areas of land but much of it, at least, appears to be at a lower level than that to the west and about the Pole. There are, therefore, bound to be many very pronounced orographical effects and perfect symmetry in the general circulation cannot be expected in the Antarctic. The great katabatic currents of cold air also are a complicating factor and the low-lying Barrier surface is probably to quite a considerable extent a sink for this cold air. Over the Southern Hemisphere as a whole, indeed, the symmetry, though much greater than in the Northern, is far from perfect. It is well known, for example, that mean temperatures in the Kerguelen region are about 10° F. lower than in corresponding latitudes about Macquarie Island. Then there is the great oscillation between the Australian and the South American areas, and so forth.

In spite of the departures from symmetry just mentioned, there can be little doubt that the same general type of circulation obtains in the temperate and antarctic portions of the other quadrants of the Southern Hemisphere as is indicated in the present charts. The régime in Australia and New Zealand is well known in its main features. It is certain that the same régime extends to Macquarie Island which, it must be remembered, is not in a very high latitude. All the evidence from ships points to its persisting to within comparatively short distances of the Antarctic Continent and even into the Ross Sea, the weather changes being due to systems moving from west to east. The present work extends that régime to the Continent itself.

Table IV is of considerable interest, especially to the forecaster. The figures are, of course, based on only one year but they are unlikely to differ seriously from the true average. They show how valuable a station at Macquarie Island would be to south-eastern Australia and particularly to New Zealand. The average time of travel of fronts from Perth in Western Australia to Wellington, New Zealand, is 4½ days. The time between Queen Mary Land and Adélie Land ranged from 21 to 105 hours, but of 67 measurements 41 were between 40 and 70 hours. Between Adélie Land and Macquarie Island the range was from —4 to 149 hours while of 95 cases, 58 fell between 30 and 50 hours. From Perth to Melbourne the range was from 25 to 99 hours with 73 out of 94 between 30 and 70 hours. From Melbourne to Wellington the corresponding figures were —20 to 106 with 55 out of 93 between 40 and 70 hours. Thus, a front may occasionally pass Wellington before it does Melbourne. There were indications of 87 of the principal fronts passing Norfolk Island. This is a surprisingly large proportion, even if allowance be made for weak and indefinite fronts and a degree of uncertainty in some cases. The times from Wellington to Norfolk Island ranged from about —15 to 105 hours with 62 falling between 1 and 30 hours. From Cape Evans to Adélie Land the times were from —24 to 47 hours with 60 out of 88 between 1 and 30 hours. The figures for the interval between the passage of Adélie Land and Perth are interesting in view of the great distance between them. The measurements in this case ranged from —70 to 87 hours with 63 out of 93 between —10 and 30. The consistency of this figure argues in favour of the analyses made.

The velocity of the fronts between Queen Mary Land and Adélie Land which are in approximately the same latitude is 20° per day. In Latitude 30° the velocity from the present series of charts was 10°·1 and in Latitude 40°, 12°·2. These may be compared with Meinardus' values of 12°·2 of longitude per day for depressions and 12°·4 for high pressure systems in Latitudes 40° S. and 50° S., in the years 1902 and 1903. Unfortunately the writer has only a very brief summary of Meinardus' results at his disposal.* Lockyer found for the mean velocity of pressure waves or anticyclonic systems over the oceans 9°·4 and over the continents 11°·6 (Southern Hemisphere Air Circulation, 1910). Whether Lockyer's figures would apply to fronts or to high pressure ridges, the velocities of which would not be quite the same, it is difficult to tell. The velocity of cyclones, also, is a somewhat indefinite quantity. Most cyclones move with the fronts and also along them. A deep cyclone, however, may cease to move along the front and may lag behind it. Its movement is certainly slower than that of the average front. In many cases in the past when the tracks of cyclones were being drawn on the basis of daily charts, it has probably not been realized that one cyclone has filled up and another appeared at no great distance from the location of the previous one. The drawing of tracks of cyclones in the Southern Hemisphere, except in the tropics, would seem to be a rather profitless occupation since they are not confined to any particular zones.

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* Copies of Meinardus' papers have kindly been furnished by him since the above was written.

The eastward velocities of the fronts given above in degrees correspond to relative velocities of 0·94, 1·00 and 0·84 at 30° S. 40° S. and about the Antarctic Circle respectively, which are more nearly equal than might have been expected. They are probably roughly proportional to the air velocities in the lower two or three kilometres in those latitudes. The maximum velocity occurs, probably, to the south of 40° S.

It is clear from the above figures that the fronts move faster than the anticyclones, also that they cannot revolve round the Pole with a constant shape like the spokes of a wheel. The northern portions are generally lagging behind the southern. In consequence of this effect fronts, as can be seen from the charts, frequently take on an approximately west-east orientation. This situation usually ends in an eastern portion of the front making a surge northward so that the normal inclination to the meridian is restored. The western portion of the front then usually dies out. When fronts become oriented in a west to east direction, the temperature contrast between the cold and warm air masses can seldom be large and it tends to disappear. Usually too, the cold air has a tendency to subside, thus accentuating this process. The movement of the waves along the front is slower and the occlusions trail to the southwards, almost at right-angles to the front (26–27, VI, g_1, g_2; 29, VI, *i*; 1–2, III, j_4, j_5; 17–19, III, d_4; 19–20, IV, d_3, d_4). Again, when a front encounters an anticyclone it may disappear, as such, in its northern portion to extend northwards again after the anticyclone has been passed (2–6, V, *i*; 16–18, V, *b*; 1–4, VI, *i*; 6–9, VI, *b*; 27–30, XII *h*). On other occasions the northern portion lags behind in the low pressure trough as the anticyclone is approached, while the southern portion advances eastward and then northward into the next trough (29 II – 5 III, *k*; 21–25, XI, *d*; 26 XI – 4 XII, *e*). The normal inclination is thus again restored in the eastern portion. The original northern portion, left to the west of the anticyclone either dies out (16–19, V, *e*; 10–14, V, *b*), becomes absorbed in the field of the next front (2–7, IV, *j*), or itself extends southwards forming a new principal front (7–13, III, *b*; 1–6, VI, *j*; 21–26, VI, *g*; 30 VI–6 VII, *j*; 7–14, XI, *b*). Then, fronts may disappear altogether. A few fronts manage to cross the anticyclones with little distortion (26–30, IV, *h*; 9–14, VIII, *a*; 13–17, XII, *d*). It is not possible to say how fronts accommodate themselves in the Antarctic to the differences of velocity but the distance to which they penetrate into it varies. In any case, the tendency is for fronts to keep approximately the same orientation. The controlling factor here is presumably the presence of the moving anticyclones. The most favourable place for fronts to be maintained is in the troughs between them, which must be oriented in an approximately north to south direction. The difference between conditions in the two hemispheres in this respect is very important. Generally speaking, the more nearly north and south the orientation, the more pronounced will be the fronts. They are also, of course, most strongly developed when in low-pressure troughs, symmetrically placed between anticyclones. These conditions favour sharp temperature contrasts.

It still appears to be believed in many quarters that there is a continuous "polar front" encircling the Southern Hemisphere in high latitudes. The writer has always held the contrary view. The evidence of the daily weather charts is, in his opinion, definitely against it. Throughout a range of latitudes extending from far into the Antarctic frequently to within the tropics there is an alternation of poleward and equatoward winds which are continuous over very long distances. There is little chance for stagnation of cold air over the Antarctic at any time of year. The maintenance of a continuous front against the steep poleward pressure gradient is difficult to imagine. At no very great height above the surface, this gradient must continue right to the region of the Pole.

The most favourable region for a continuous front to develop would seem to be on the northward sides of the anticyclones, with the warm sectors and especially the occlusions of pressure waves extending southward into the troughs between them. But conditions are extremely unfavourable for the maintenance of fronts on the westward sides of the anticyclones where the warm fronts should appear according to this scheme. Actually, it is only on extremely rare occasions that the writer has observed a definite warm front in such a position although there are occasionally some manifestations in the upper air. These latter, however, could well be due to the remains of old fronts of the type already described, which have been cut off from their southern portions.

In contrast to the above, conditions are very favourable for the extension of fronts in a north-west to south-east direction and this development can be seen taking place repeatedly, for example, in secondary cold fronts.

The temperature of the ocean surface in the neighbourhood of the Antarctic Continent remains almost constant at that of the freezing point of salt water. In the summer the snow surface of the Continent itself is heated by the sun, and the poleward temperature gradient and, consequently, pressure gradient also, becomes much less than at other seasons. Fronts, therefore, are generally poorly developed and storm activity is relatively slight. This effect was very marked in the year dealt with.

The time of circulation of the air round an anticyclone is of the order of 10 days. This would mean, roughly, that air starting as a northerly current west of western Australia would have completed its circuit and be returning as a northerly current when it reached Wellington. There would, of course, be wide variations from this. It will be clear from what has been said above that the air within the field of an anticyclone will usually be of complex origin. It will seldom remain the same during a whole rotation. Conditions will differ greatly, in this respect, at different levels. Nevertheless, the figure quoted above does give a useful idea regarding the nature of the circulation in the latitudes concerned. There have been occasions when it has been possible to identify warm air over New Zealand with what had been a cold outbreak over south-eastern Australia a few days previously from the smoke from bush fires which it has contained. Hitherto, however, there has been little work done on the trajectories of air particles in this region.

CYCLONES.

The normal course is for depressions to develop as waves on the fronts, beginning in low latitudes and travelling to higher along them. The occlusion when formed lags behind, trailing out towards the north-west. Most frequently the wave continues on, retaining this form but becoming more extensive and with lower pressure as it moves into the higher temperate latitudes. After passing the Antarctic Circle it gradually dies out. In addition, waves may occasionally originate, especially on new or secondary fronts, or die out or be regenerated and so on, in almost any latitude.

Some of the waves become very deep, their circulation presumably extending throughout the troposphere. Their movements then cease to follow those of the warm air so nearly, the centre of low pressure, usually at the tip of the occlusion, having a wide range of possible movement. It may even have a slight northward component but probably never, outside the tropics, a westward. Such waves though they may justly be called cyclones very seldom have a complete wind circulation in the region from Latitude 40° S. to near the Antarctic Continent, or if easterlies do occur south of the centre they are seldom strong. This is owing to the steep poleward pressure gradient associated with the prevailing westerly winds. When the vicinity of the Antarctic coast is reached, and in still higher latitudes it is possible that cyclones with a more symmetrical pressure and wind field occur more frequently but here there are so many complicating factors and the data are so scanty that little is known. Owing to the nearness of the Pole and the presence of the cold and uniform ice surface, old cyclones tend to fill up and new ones form only rarely. For cyclones of the type described appearing in temperate latitudes see 3–4, V, i_3; 15–17, V, d_3; 3–8, VII, a_3; 8–12, VII, c_3; 2–4, I, i_4; 11–15, I, c_4; and in the Antarctic 24–28, III, h_1; 5–7, IV, b_1; 17–20, V, e_2; 21–23, V, g_1; 22–24, V, g_2; 23–27, V, h_1; 22–23, VI, h_1; 6–9, VII, c_1; 12–13, X, d_1; 18–21, X, e_1; and so on. That cyclones do occur in very high latitudes over the Antarctic is proved by the experience of Shackleton on the 6th to 8th November, 1908, and of Scott and Amundsen on the 26th to 28th November and the 3rd to 6th December, 1911. On the two occasions last mentioned there was ample evidence of the Ross Barrier being invaded by strong flows of warm air from the north and north-east. There was also evidence of the weather changes moving from west to east.

To the north of Latitude 40° S. and especially of 35° S., cyclones with a complete circulation do occur. Here they are on the northern side of the anticyclones and surface winds commonly have an easterly component. These cyclones seldom form over the Continent of Australia but are very well known on the coast of New South Wales where they are responsible for some very stormy weather. The rain associated with them is usually heavy and very widespread. The extent in longitude of the region frequented by cyclones of this type is not known but they certainly occur far to the east of New Zealand. Very possibly they appear, in autumn and winter, in almost any longitude. In the Australia-New Zealand area they are most frequent from May to July and rare in November and December. A slight secondary maximum of frequence occurs in summer.

Many of the summer storms are, however, of rather a different type from the winter ones. Some originate as true tropical cyclones and at this season there are all gradations between the tropical cyclone and the winter type. The winter cyclones are, however, generally more extensive than the summer ones, and move throughout in higher latitudes. The average number affecting either the New Zealand region or the east coast of Australia per annum is between 6 and 7. There are no very good examples in the year in question but the following are of the type referred to : 17–21, III, c_6 ; 6–9, V, ib_1 ; 9–12, V, a_4 ; 14–19, V, c_2. A number of more outstanding cases occurring in other years have been described in papers produced from the New Zealand Meteorological Office (The Flood Rains of 11th March, 1924, in Hawke's Bay, by E. Kidson, *N.Z. Jour. of Sci. and Tech.*; Vol. XII, No. 1, 1930; The Analysis of Weather Charts, by E. Kidson, the *Australian Geographer*, Vol. II, No. 5; Frontal Methods of Weather Analysis, etc., by E. Kidson and J. Holmboe, Meteorological Office, Wellington, 1935).

Tropical cyclones occur on the tropical coasts of Australia and eastwards across the Southwest Pacific to the Cook Islands but are rare thence eastwards. They are confined, practically, to the summer half year and are most frequent from January to March, during which months there is little variation in frequency. They seldom move far inland into the Australian Continent and if they do so soon fill up. They are consequently more numerous and more violent on the east and west coasts than over the land. In the writer's opinion they originate in much the same way as those in temperate latitudes through the interaction of warm and moist tropical air and cooler and drier air from the south. The warm air usually comes from across the Equator in the north-west monsoon. It is a deeply ingrained belief that tropical cyclones normally move on parabolic courses, moving westward in the early stages and gradually changing course through south to south-east. But a fully developed cyclone is carried along in the general currents prevailing in the air masses in which it finds itself. Not infrequently the movement is from the east at first, and in this case, it is natural to expect that the air current which carries it will ultimately turn gradually through south-west and south to south-east, passing round an anticyclone to higher latitudes. The cyclone, if it lives long enough, will go through the same process. This is the kind of track usually drawn on charts indicating the prevalence and movement of tropical cyclones, as typical for all parts of the Australia-Southwest Pacific region. There is a strong tendency to do the same for individual cyclones, the early westward movement being assumed often when there is no evidence for it. Actually, cyclones may follow practically any course. The writer's experience is that to the east of Australia, at any rate, a westward component of translation is very rare, the motion usually being towards some direction between south and east with east-south-east the most frequent. It is probable that similar tracks are much more frequent on the north-west coast of Australia than is generally realized. Confusion has often arisen owing to the fact that after one depression has occurred in a particular area a second and possibly others, frequently develop further westward either on the same front or on a fresh one. This is what is believed to have happened in the case of the

Western Australian cyclone of the latter end of March which will be referred to later. On the other hand, a few cyclones do appear to have skirted the whole northern and north-western coast of Australia from east to west.

The cyclone of the 17th to 21st March, which originated to the north of New Caledonia was probably typical of the tropical cyclones which occur to the east of Australia but data with regard to it are very meagre and, in the first stages almost entirely lacking. Several cyclones of considerable intensity occurred also in the area between the Solomon Islands and Brisbane between the 13th and 16th April.

A frontal zone is particularly liable to develop on a line extending from south of New Guinea to just south of the Cook Islands. Apart from fully-fledged tropical cyclones many depressions of lesser importance occur on fronts which develop in this zone. The zone does not have a continuous existence even in summer, but once formed usually persists for several weeks. The movement of the depressions usually follows the line mentioned fairly closely but the tracks of deep cyclones are less regular. An important fraction travel almost due south over the middle portion of their courses. The frontal zone is formed between air in the north-west monsoon which flows from the Indian region towards the Australian monsoonal depression. After crossing the Equator the current is deflected to the east and a portion of it, at times, spreads eastward to the distance mentioned above. To the east of Australia it meets a south-easterly current of colder air which is of southern origin and which also is flowing into the Australian monsoonal depression. The depressions in the zone follow the course of the warmer, tropical air from the west-north-west.

Of the tropical cyclones of the north-west coast of Western Australia we have two excellent examples in those of the 4th to 7th and 19th to 23rd March. The first was, relatively, of only moderate intensity but it caused severe gales and heavy rain, and at Wallal on the coast the pressure fell to 28·98 inches (981·4 mb). The second storm was one of the most severe experienced in the region. Much damage was done to buildings, etc., ashore, while at sea there were grave losses. The most disastrous of these that of the s.s. *Koombana*, with all her passengers and crew. At 23.30 hours on the 21st a pressure of 28·866 inches (977·5 mb.) was recorded at Cossack. The barometer then remained almost stationary and the wind practically calm until 02.00 hours on the next day. On the 21st there were hurricane winds from the east. Next day when the barometer began to rise, a strong westerly wind set in. The damage done 40 miles to the eastward, was more severe than at Cossack. The rainfall was very heavy, as much as 13 inches falling at one place and over 5 inches being recorded as far inland as 200 miles. In Bulletin No. 16 of the Commonwealth Bureau of Meteorology this cyclone is shown as originating east of Darwin in northern Australia on the 15th. Actually, a depression appears on each day's chart in a progressively more westward position from that date until the 19th when, according to the present analysis, the cyclone which subsequently passed Cossack is first shown. But it is not possible to state what the direction of movement of these low pressure centres was on each particular day and the westerly winds indicated on the north coast of Australia make it unlikely that the movement was to the westward. In the writer's opinion there was a series of regenerations of the original depression by successive invasions of cold air, each regeneration occurring further westward. There can be little doubt, however, that a condition favourable to cyclonic development was carried westward from day to day. Whether this was a saturation of the cold air by the rain falling through it around the centres of the depressions, some development at very high levels, or some other set of circumstances cannot be stated. We have yet much to learn regarding the structure and life history of tropical cyclones.

The disturbances which occurred on the Queensland coast between the 6th and 8th of April were very interesting and remarkable. It is stated in the volume of "Rainfall Observations in Queensland," published in 1916 by the Commonwealth Bureau of Meteorology, that a tropical disturbance was off the coast and caused strong winds, rough seas, and heavy rain between Cooktown and Bowen. It is further stated that a cyclonic storm occurred at Innisfail on the 6th. It commenced at 4 p.m., the wind increasing in volume, and lasted till 11 p.m., accompanied by torrents of rain and terrific lightning. A number of buildings were damaged and cane crops suffered. In Bulletin No. 16 of the Commonwealth Bureau of Meteorology, also, this storm is referred to as a cyclone. It is not clear, however, that it was a true tropical cyclone. No very low pressures are shown on the charts or mentioned in the account of the storm and it seems possible that the damage to buildings was due to a small tornado. The rainfall, nevertheless, was phenomenal. The amounts shown on the chart of the 8th are for the previous 48 hours.

Between the 13th and the 16th April, a steamer travelling from the Solomon Islands towards Sydney encountered what appeared to be a series of cyclones of considerable severity, the barometer being reported to have fallen to 29·10 inches at one stage. Conditions were favourable for the development of an active front in this region at that time but no data are available apart from the ship's account and this does not give positions.

In spite of the subsidence taking place in the sub-tropical high pressure belt, that the rainfall over the ocean to the east of Australia is not light is proved by observations at Lord Howe Island, Norfolk Island, in northern New Zealand, and at the Kermadec Islands. This is presumably due to the high rate of evaporation from the ocean surface. In Australia, except on the east coast, a very dry zone occurs.

In the ocean waters immediately surrounding the Antarctic Continent, as previously mentioned, the temperature is practically constant at that of the freezing point of salt water. The annual variation of the surface air temperature must, therefore, be slight. Even in the southern ocean, partly owing to the condition just mentioned, partly to the very high degree of cloudiness, and partly to the stormy oceanic conditions, the annual range, as illustrated by the data for Kerguelen and Macquarie Island, is small. Over the Antarctic, on the other hand, the variation is large. Some of this variation must be confined to very shallow layers but even in the upper air it must be considerable. Again, in low-temperate and sub-tropical latitudes there is a considerable annual variation. Thus in high latitudes one would expect strong temperature contrasts between northerly and southerly winds and consequently, stormy weather in winter and this is in accordance with experience. In middle and low temperate latitudes, however, one might expect the summer to be the stormiest season and the winter the least. Actually the winter has not the marked storminess in Australian and New Zealand waters that it has in the Northern Hemisphere. The average wind velocities, especially of westerly winds, are least in either autumn or winter. The stormiest period, however, again especially as regards westerly winds, is in spring and not summer. Furthermore, cyclonic storms, which though over a smaller area than westerly storms, produce some of our most severe weather are, as stated earlier, most numerous in sub-tropical and low-temperate latitudes from May to July. Except in the tropics, the period from January to March is the least stormy portion of the year.

Storm activity is obviously closely associated with the movements of the planetary wind systems, the tracks of the moving anticyclones, etc. Thus the tropical cyclones occur when the Southern Hemisphere is being invaded by the north-west monsoon. The winter cyclones referred to above are most frequent when the anticyclone tracks are moving northwards and westerly storms when they are moving southwards. But much more complete and precise data on all these questions and particularly regarding the structure of the upper air is wanted from the Southern Hemisphere before the general circulation can be thoroughly understood.

Air Masses.

At present, there is no recognized general classification of air masses in the Southern Hemisphere. The use of the adjective " maritime " in a hemisphere whose surface consists so largely of water would seem superfluous. Nor does there appear to be any air mass to which the application of the term " Antarctic " could be justified. Cold air is being continually produced over the Antarctic but it cannot be regarded as a reservoir of air with approximately uniform characteristics. In one longitude, air which is warm for the particular latitude will be flowing into the Antarctic while, not far away, cold air will be flowing out. There will be this alternation in numbers of parts of the periphery of the zone. The boundaries of the various outflows of cold air are not continuous nor is there any very definite latitude to which they normally reach. The northward excursions are to very varying distances. Through various processes the air which has started northward as cold air becomes diverted from its course, the outbreak or a portion of it is turned back southwards, often after a comparatively short interval, and soon becomes " warm air." Cold air which continues northwards is constantly receiving heat from the surface and by radiation and its temperature, moisture content, and often its structure is soon very different from what it was over the Antarctic. For example, even were air to move continuously with a northward component from the Antarctic to New Zealand, its state on arrival would be determined by conditions over the Southern Ocean and not those over the Antarctic. Similar remarks apply to warm air. This may originate in the tropics, or from once cold air which is returning southwards after a recent northward excursion, or it may come partially from each of these sources. Much of the returning air will have travelled round anticyclones but there are various other ways in which cold air may have its direction of movement changed. It will be clear from the charts that air masses in the temperate latitudes will usually be of composite origin. At present it would seem advisable to classify air only as either " cold " or " warm," the terms being used in relation either to the latitude in which the mass finds itself, or to an adjacent air mass.

The air which comes across the Equator in the north-west monsoon in the summer half year, having travelled for long distances over tropical waters must have rather definite and uniform characteristics and it should, perhaps, have a name allotted to it. In New Zealand, warm air which has come from Australia will be drier and of different structure from that which has come from the same latitudes to the north or north-east and when sufficient aerological data about it have been accumulated, it also should probably have a separate classification. Possibly, it will be necessary ultimately to introduce some other distinctions. But, generally speaking, the differences between air masses and the uniformity and persistence of their characteristics, is less marked in the Southern than in most parts of the Northern Hemisphere. The most important factor in regard to an air mass will be the distance which it has moved, from the north in the case of warm air and from the south in that of cold, during the preceding few days. The factor next in importance will be the processes that have been taking place in it, such as convergence or divergence, uplift or subsidence, etc. In temperate latitudes as far south as 45° S. in the Australian-New Zealand area, air mass characteristics are greatly influenced by the fact that this is the region of the high pressure belt. The curvature of the paths of both cold and warm air is predominately anticyclonic and subsidence is frequently taking place. Thus in the warm air, though there is usually considerable high cloud, low cloud, mist or fog, are often lacking. Visibility may be good. Similarly, in cold air, not very far in rear of a front there are frequently brilliantly clear skies and extraordinarily good visibility. When warm air does answer to the descriptions given in Europe of tropical air it is usually moving into an area of lower pressure, and marked convergence is evident. Generally these phenomena are associated with fairly well-developed cyclones. Cyclones, especially the large winter type are often accompanied in their forward halves by widespread and persistent fog. When cold air is moving over a long straight path either from the west in the higher latitudes or from the east in the sub-tropics it exhibits unstable characteristics with showers over very wide areas. As will be seen from the charts, this type of rain is common and frequently heavy on the Queensland coast.

Temperatures at Macquarie Island are not greatly affected by the presence of land and, therefore, afford unusually good means of determining the differences of surface temperature between air masses. Measurement is complicated even there, however, by the fact that the greatest contrasts are usually in the neighbourhood of fronts and at and near the front conditions are disturbed by the vertical movements taking place. The greatest differences occur, generally, about occlusions. It is with them that the contrast between the directions of movement of warm and cold air, or in this case, actually between returning and fresh cold air, is usually most marked. Occasionally, however, cold fronts bring a large fall of temperature. For the year dealt with, the average change of temperature with the passage of a principal front was about 4° F. The extreme difference between cold and warm masses averaged rather less than 6° F. The differences were greatest in winter, rather less in spring, still less in autumn, and least in summer. Total differences of as much as 10° F. were not very rare in the winter half year, the highest being 13° F. The greatest fall in a single step was about 10° F.

Weather at the Antarctic Stations.

The weather sequences at the Antarctic Stations are very much obscured by the prevailing katabatic winds, the cold surface air layer and the presence of thick drifting snow, mainly picked up from the surface, when the wind is strong.

Adélie Land.—At Adélie Land the southerly or south-south-easterly katabatic wind was blowing almost constantly, was nearly always strong, usually of gale force, and frequently of hurricane force for considerable periods. The stronger the wind the greater, in general, was the turbulence and the mixing of the lower layers of the atmosphere. The smaller, consequently, was the surface inversion and the higher the surface air temperature. This effect on the surface temperature was so large relatively to the changes due to the advent of different air masses that it is practically impossible to isolate the latter at any time. With the approach of a depression the blizzard almost always increased while at varying intervals, usually a few hours, after what according to the analysis was the time of advent overhead of the cold air there would be a decrease. The increase in the wind during the approach of a depression the writer believes to be due to the arrival of warmer air over the ocean to the north and also above the katabatic wind, over the land. The contrast between the radiation equilibrium temperature of the inland ice and the temperature of the free air is thereby increased. This would tend to cause an increase in the katabatic wind. The warm air, also, would be more stable so that the katabatic wind would probably be shallower. It is true that the warm air would have a component of motion from the north which would oppose the blizzard but apparently at Adélie Land this effect was entirely masked by that described above. The sea was practically always free of ice at Adélie Land so that the horizontal temperature gradient on the coast always tended to be steep. This might account largely for the phenomenal severity of the katabatic wind at this locality.

Conditions of the type described above prevailed at Cape Adare and Queen Mary Land. At Cape Evans there was a nearer approach to the normal.

The great strength of the blizzards and the density of the drift snow which usually accompanied them made weather observations, particularly of cloud structure, extremely difficult or impossible at Adélie Land just when they would have been most interesting. Furthermore, observers at that time looked for and recorded different features of cloud and weather phenomena from what they would nowadays. It is, therefore, not possible to get much idea of the structure of depressions. Simple fronts seem frequently to be accompanied by little or no cloud at Adélie Land. There were usually large areas of overcast sky associated with occluded wave depressions and there is little doubt that most of the snowfall, which must frequently have been very heavy, was connected with them. The orientation of the coast-line is favourable for the rapid uplift of warm air from the north and the production of much precipitation from it.

Queen Mary Land.—At Queen Mary Land, except when a depression was in the vicinity, winds were very light. Surface air temperatures were, therefore, very low and even a moderate wind produced a considerable rise. A blizzard would often cause an increase of 20° or 30° and the temperature would remain high until the wind dropped. Frequently the thermometer screen became filled with snow and the thermograph record useless just when fronts were passing. Snow was associated with most depressions and especially occluded waves.

The winds at Queen Mary Land did, however, show more variety and a closer relation to the weather than did those at Adélie Land. Occasionally, particularly if a cyclone were passing to the south, a light northerly wind preceded the advent of a front, more especially an occlusion, just when a northerly would be expected in the free air. On one or two other occasions when the cyclone centre was further south a westerly breeze blew at Queen Mary Land as one would expect under normal conditions. In numbers of cases the passage of a cold front was followed by a south-westerly breeze instead of the katabatic wind from the prevailing east-south-easterly direction. Usually, the strong winds soon dropped after the passage of a front and the advent of the cold air.

Cape Evans.—At Cape Evans northerly winds frequently set in as a front approached and were sometimes strong. Even when the northerly was unable to overcome the surface drift from the south-east there was almost always a marked reduction of the force of the latter. Northerlies were especially likely to occur between a cold front and an occlusion or when a cyclone centre was passing some distance to the south. On the other hand, after the passing of a cold front or occlusion the advent of the cold air was almost always accompanied by the setting in of a blizzard from an approximately east-south-easterly direction. In winter the south-easterly wind usually set in some time before the arrival of the barometer minimum but this effect was much less marked in summer.

The temperature régime at Cape Evans, also, was more normal, especially in summer. In the latter season, warm air masses brought with them higher surface temperatures and a fall followed the advent of a cold air mass. In the winter months conditions were much complicated by the fact that, as at the other stations, any increase of wind tended to raise the temperature through decreasing the surface inversion, while radiation caused low temperatures in calms or light winds. Nevertheless, it was still possible sometimes to trace the effects of warm and cold air masses.

Conditions at Cape Evans differed greatly from those at Adélie Land. As has been pointed out, the latter station was on the shore of a sea which was almost always free of ice; while to the south there was a gradual rise to the interior plateau. Cape Evans was on the western side and at the foot of the lofty Mt. Erebus while some distance away to the west, across McMurdo Sound, was the high and steep escarpment of South Victoria Land. To the south-east lay the expanse of the Great Ice Barrier. McMurdo Sound was frequently frozen over or covered largely by pack ice. The situation is unfavourable for the production of much precipitation in depressions approaching from the west or north-west and of the nature indicated by the analyses. Mt. Erebus would protect it from north-easterly winds. At high levels the prevailing wind is from a westerly quarter and any moisture in this would be removed by the western ranges. One would expect the greater part of the precipitation to be produced by the blizzards of cold air from the south or south-east. Both would be subject to convergence and uplift when passing through McMurdo Sound, while the south-easterlies would be forced to rise over the western ranges. Even from the southerly there is considerable protection by Mt. Discovery and the Bluff Peninsula to the south. Actually, the precipitation in McMurdo Sound, and especially on the western side is light and most of it does appear to come in south-easterly blizzards. At Cape Evans, in addition to the local drift off Mt. Erebus, there is a great source of cold air to the westward as well as to the south.

The records from *Macquarie Island* are extremely interesting but the régime there is typical of a station in high temperate latitudes. It is well shown by the pressure and temperature traces and the charts in the Volume, and by the tables and the excellent weather diary contained in Volume III. The climatology will be discussed in a later volume. Attention is drawn to various special features in the notes on the daily charts themselves. During outbreaks of cold air the temperature record at Macquarie Island showed rapid fluctuations due evidently to showers, especially showers of hail. Indeed it is possible almost always to tell from the temperature record when hail showers are occurring.

Notes on the Charts.

The February charts are interesting because the month was a fairly active one in Antarctica and the weather changes at this season, particularly in the Ross Sea area, are much less affected by the presence of the cold layer and the prevalence of katabatic winds than in the winter half year. There is, therefore, a much better check on the analyses. The same is to a large extent true of March also. During the middle and latter portions of February there were frequent and widespread rains in Northern Australia, accompanied in many cases by thunderstorms. The origin of these rains, which have been referred to elsewhere, is not entirely understood.

During March, in addition to the important tropical cyclones in Western Australia and the New Caledonia area, there was activity in the tropics during most of the month. Following the first of the cyclones in the north-west a cyclone of an uncommon type developed in central and southern Australia, apparently in the same air stream. Such developments may have an interesting bearing on the life history of tropical cyclones. Pressure was low in the Antarctic in March and the month was a rather stormy one. The voyage of the *Terra Nova* added to the value of the Charts.

April was not quite so interesting as March but certain features have already been mentioned. From the 23rd onwards until the 3rd May there was a good example of the south-westerly type of weather which, though not occurring very frequently, is one of the characteristic features of the New Zealand climate in autumn and winter. Following an invasion of warm air and an active frontal zone there is a wide outbreak of cold air from the south-west. In rear of the principal front numerous secondaries develop in the cold air. Anticyclone D became intense, extensive, and slow moving. The northern portions of fronts disappeared in it while, at the same time, conditions were disturbed and several cyclones developed in Antarctica.

In much of May the analysis of the charts was difficult, especially in the Australia-New Zealand region. On the 7th an entirely new front appeared to develop between New Caledonia and Norfolk Island and a cyclone to form on it. At the latter end of the month the *Aurora* was at sea.

The *Aurora* remained at sea in June. From the 2nd to the 6th and the 8th to the 11th there were pronounced invasions of cold air over New Zealand. These were probably associated genetically with the rains in eastern Australia which culminated by the 10th June in very serious flooding. On the 11th there was an interesting cold outbreak over Western Australia which extended eastward during the following days. A number of secondary fronts developed in it and it resembled the type of outbreak seen more completely in New Zealand of which an example in April was referred to above. Pressure was very low in the Antarctic in June and the pronounced nature of the pressure changes makes the analysis especially interesting and more certain than in most months.

At the beginning of July there were again rains in eastern Australia which were in many places heavy. These are undoubtedly due principally to instability or potential instability in moist air and its uplift on crossing the coast. In some cases at least, however, other factors, such as convergence, must be involved and a detailed investigation of the conditions under which they occur, including observations in the upper air would be of considerable interest. Cyclones a_3, c_3, and c'_2 were of rather unusual types. On the 24th to 25th there was heavy rain in New Zealand in high pressure on the northern side of an intense anticyclone. This was another interesting month.

In August, the analysis was again very difficult for a considerable time, but, later, changes became more pronounced. The pressure readings at Chatham Island were sometimes unreliable. This was so occasionally in other months also.

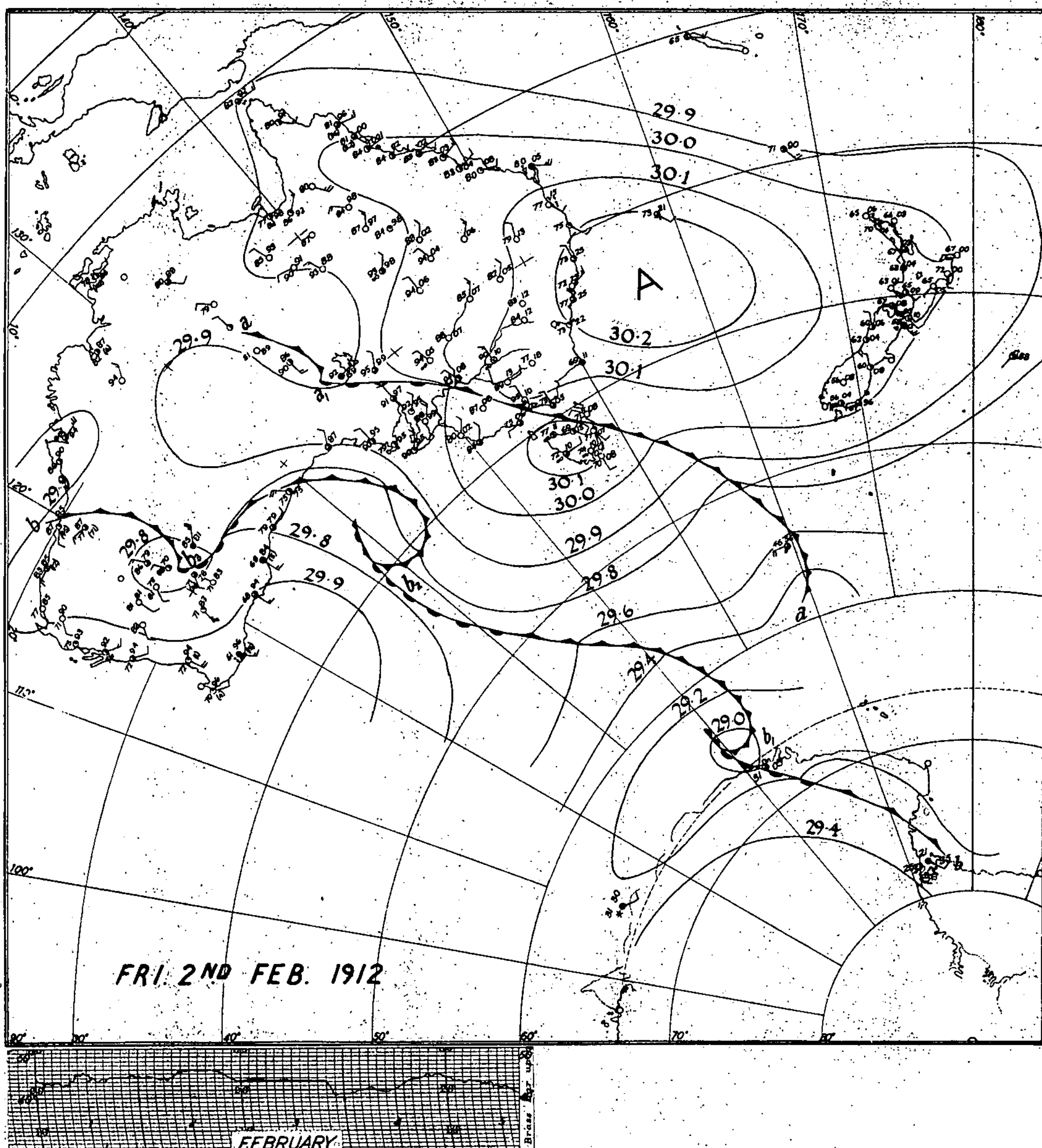
In September, pressure was very high in the Antarctic and activity relatively slight. At Macquarie Island and in New Zealand, on the other hand, pressure was low. From the 1st to the 4th a very intense anticyclone moved southwards to the Antarctic coast where it caused the highest pressure hitherto recorded. The contemporaneous weather changes in Australia were very interesting. During these periods of high pressure in the Antarctic the analysis there is difficult and very uncertain. From the 11th to the 18th September there was a remarkable development of westerly weather following a widespread invasion of warm air over eastern Australia. Conditions were stormy over southern Australia and New Zealand but not so at Macquarie Island, although pressure fell very low there. Pressure in the Antarctic was mainly high at this time. There were remarkably widespread rains in advance of fronts in New Zealand on the 12th and 20th. On the 29th pressure was exceptionally high at Cape Evans.

October is normally the month of lowest pressure in New Zealand and the quarter of the Antarctic with which we are concerned; conditions are stormy; and there is a prevalence of westerly weather. In 1912, however, pressure was rather high and conditions were generally quiet. Westerly weather, but not of a very pronounced type, was in evidence in the first part of the month and there was a disturbed period at Queen Mary Land.

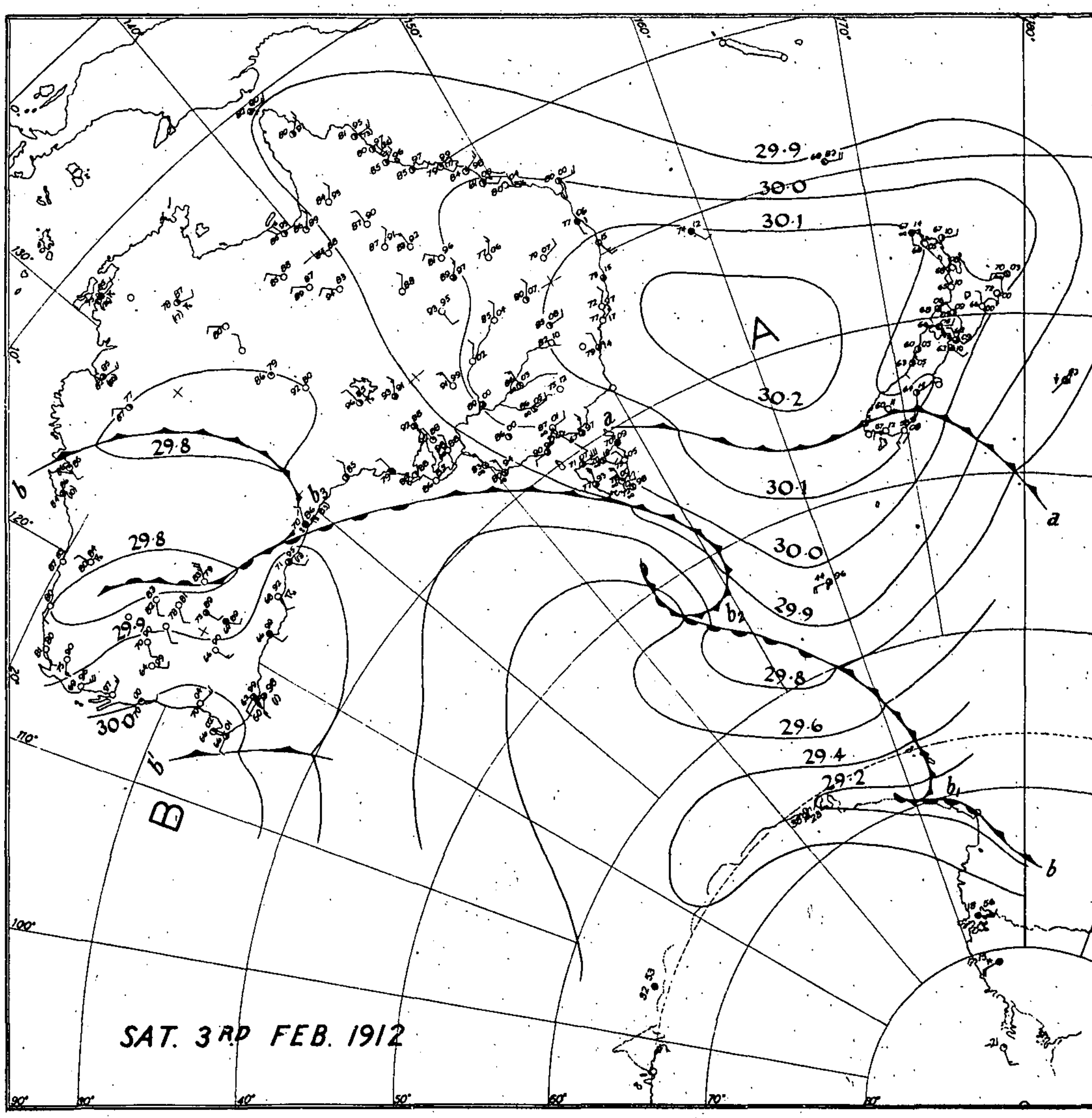
In November and December pressure was rather low in the Antarctic. On the 4th November the chart shows rain at almost all the New Zealand stations. The movement of anticyclone C from the 16th to 22nd is interesting and of a type which occurs frequently. On the 24th there were gale winds in Western Australia on the northern side of an anticyclone but the weather remained fine. The *Aurora* was at sea from the 14th November. During the early part of December some fronts seem to move faster than the pressure field would have indicated.

On January the 6th disturbed conditions and heavy rains occurred in central and western Australia. Easterly winds prevailed over Australia in the middle of the month combined with activity in the Tropics. The weather changes recorded on the *Aurora* and *Terra Nova* were very interesting and instructive, affording a check on the analysis. For a full account of them the published "logs" of the vessels must be consulted.

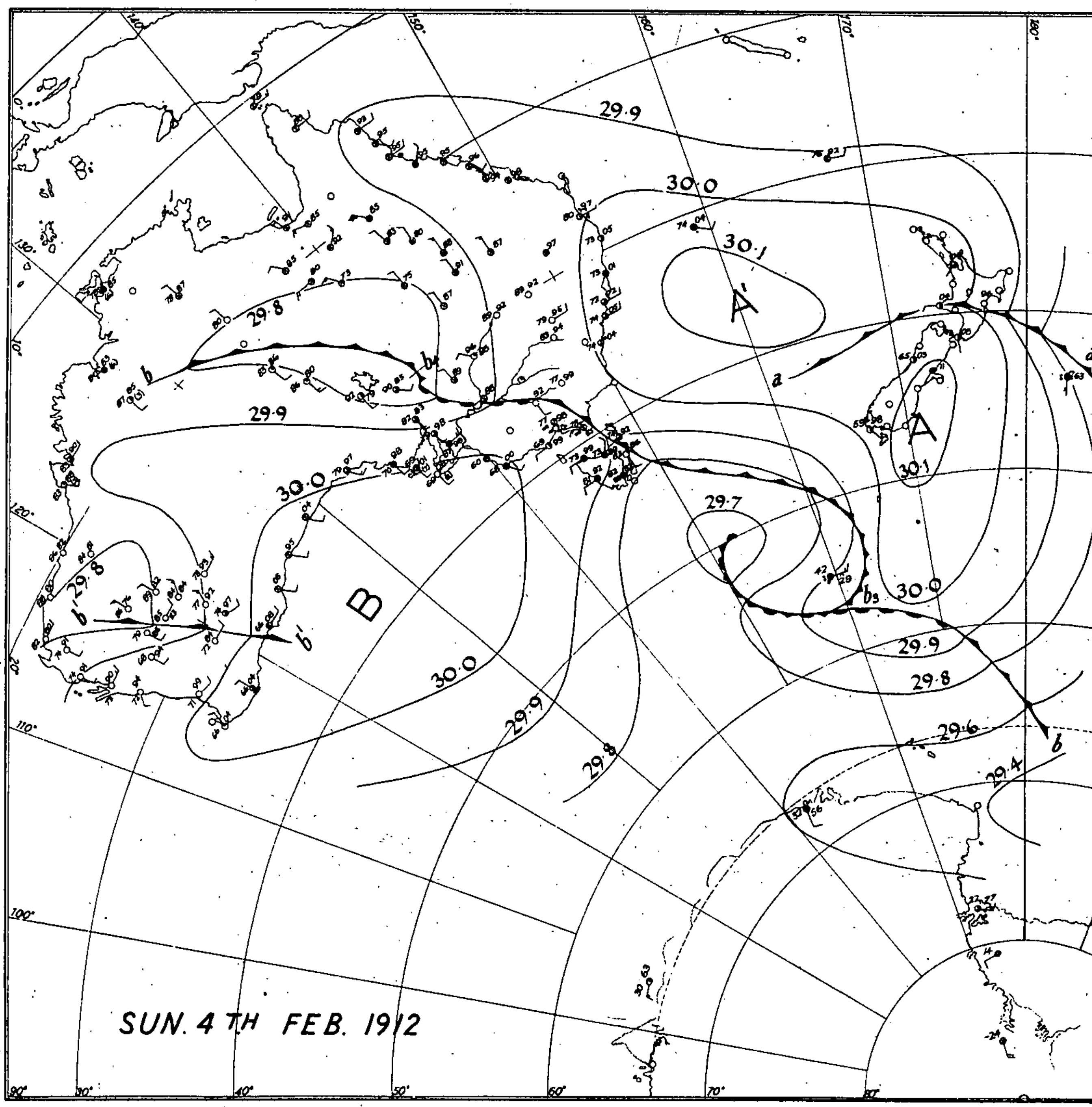
Sydney: Thomas Henry Tennant, Government Printer—1947.



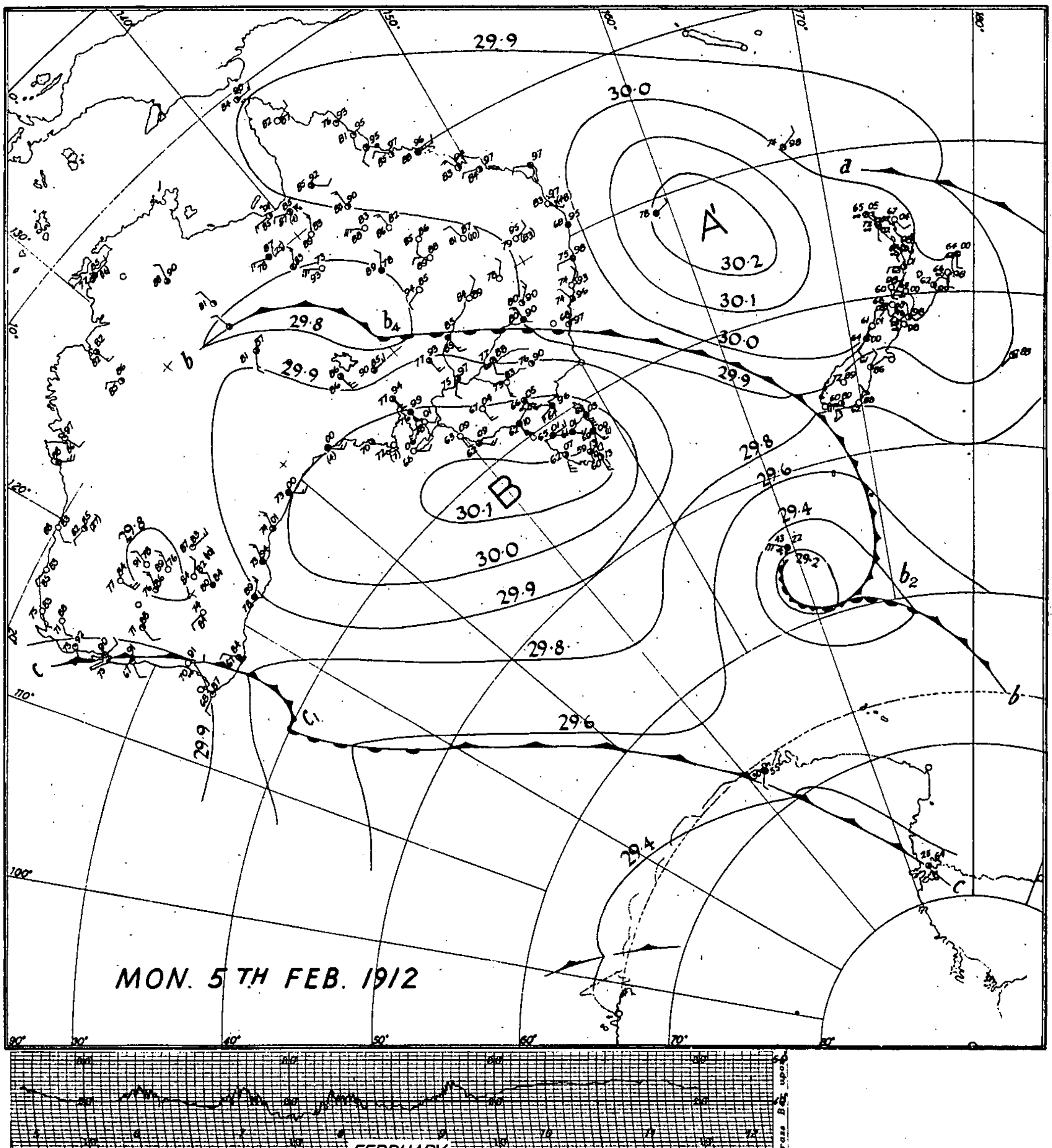
Front *a* is moving into anticyclone A and becoming weak. Temperatures are high in the central and eastern interior of Australia.



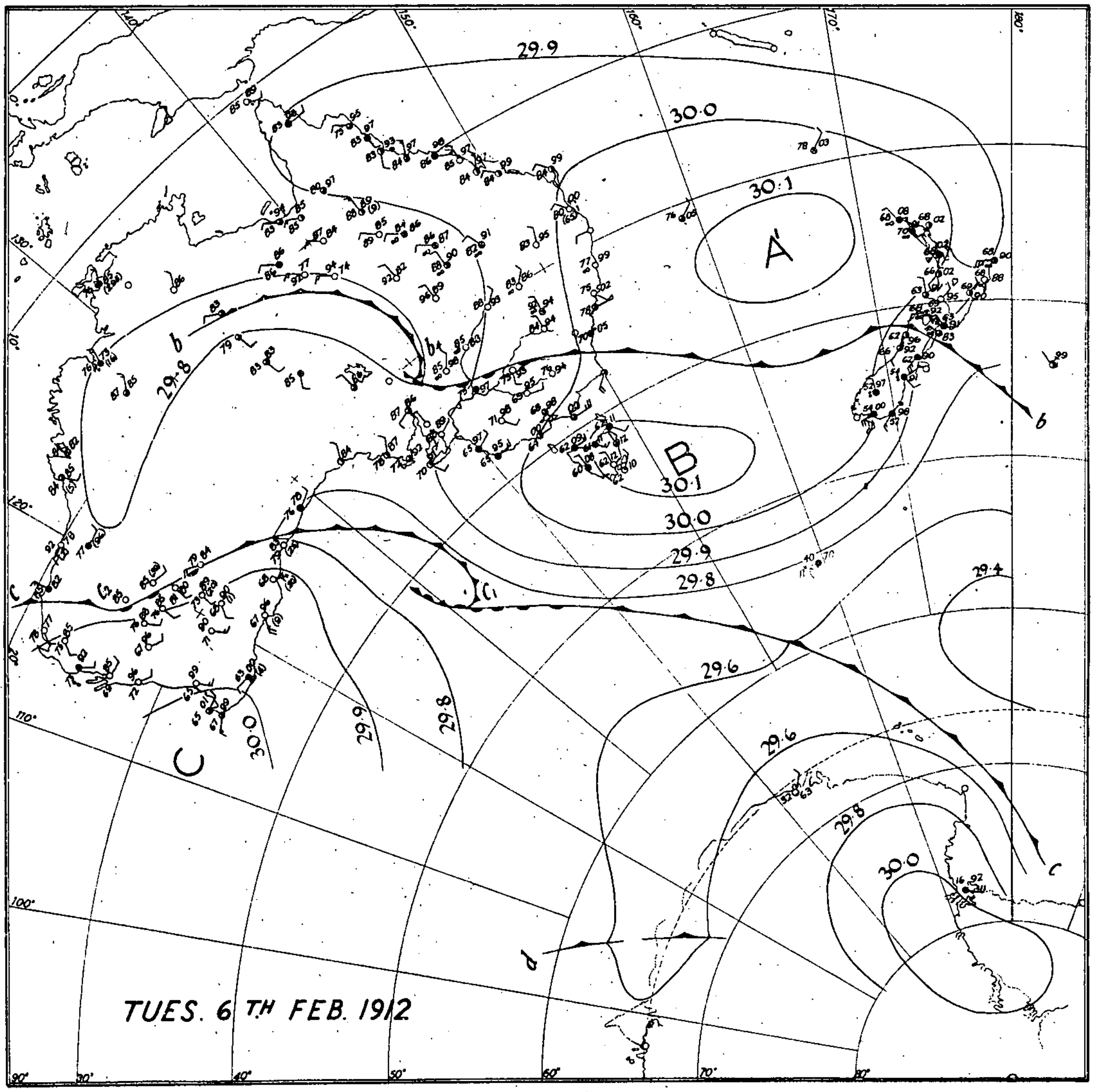
Frontolysis is proceeding on front *a*. Wave b_3 has a long occlusion.



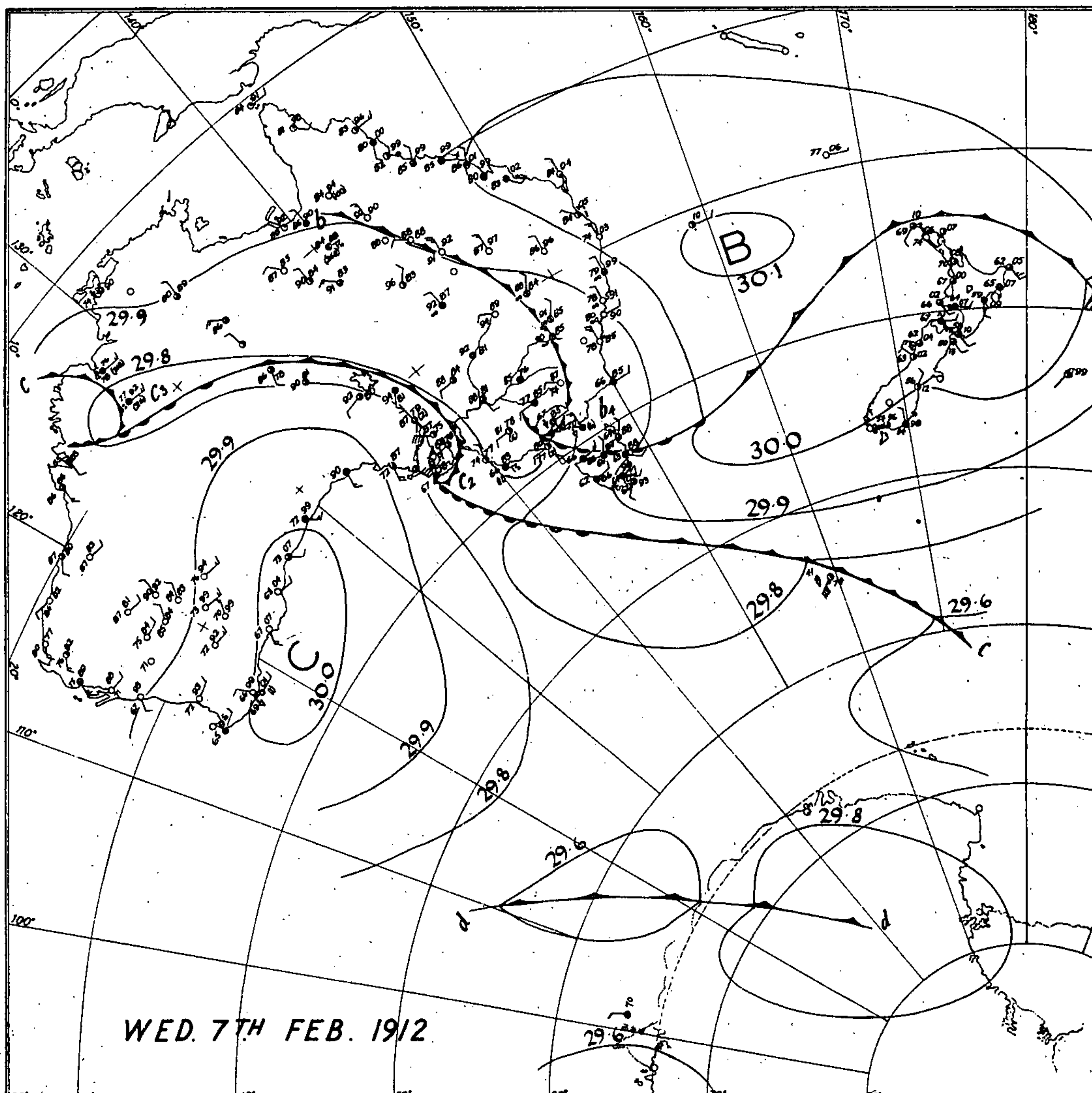
Front *a* now lies across anticyclone A. Wave b_3 has disappeared, the cold front probably having dissolved. Wave b_2 has developed a cyclonic centre at the tip of its occlusion.



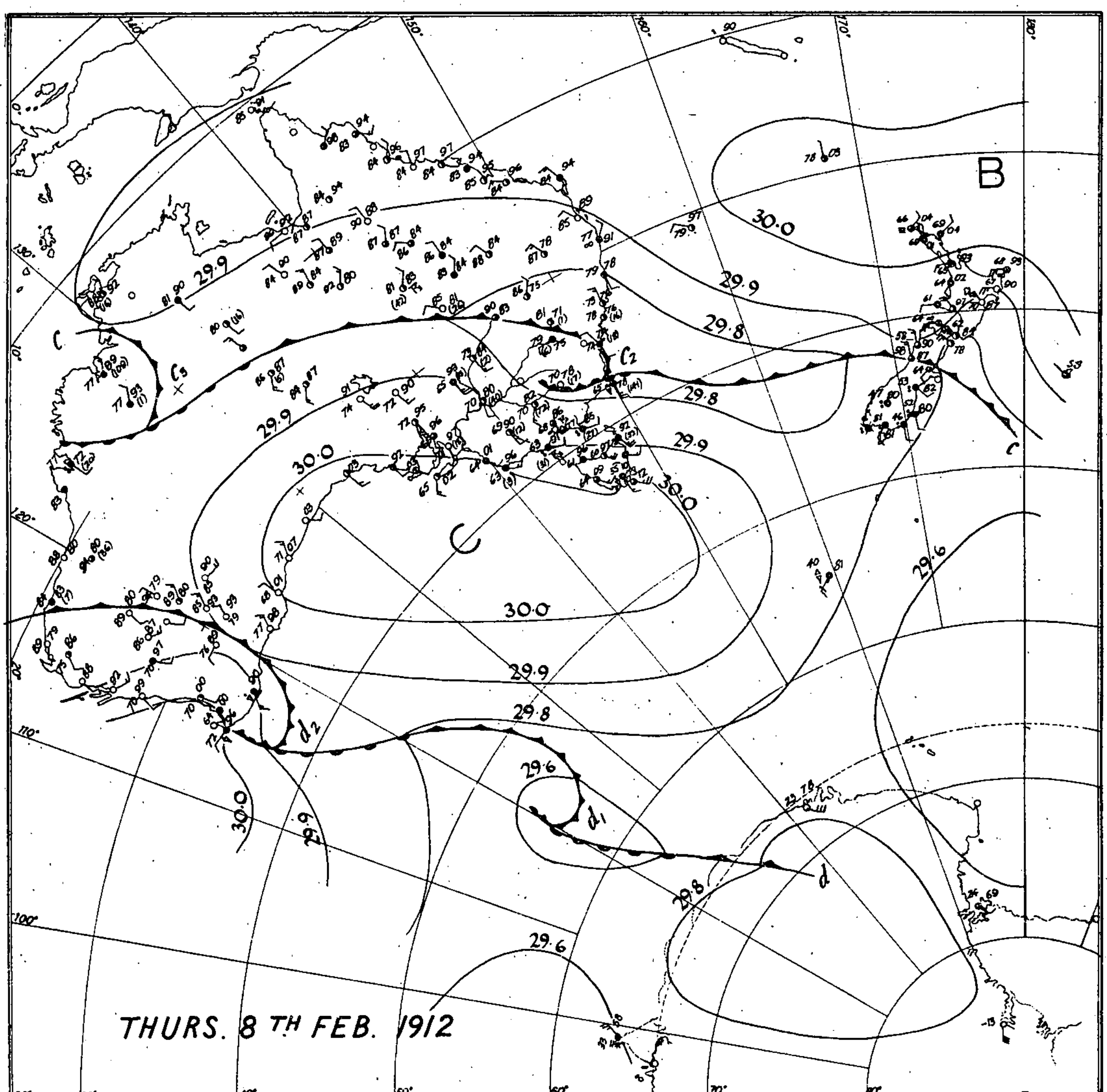
Anticyclone A is now definitely divided by front *a*. A considerable amount of rain has fallen in eastern Queensland, particularly the southern portion. The northern part of front *b* is becoming retarded.



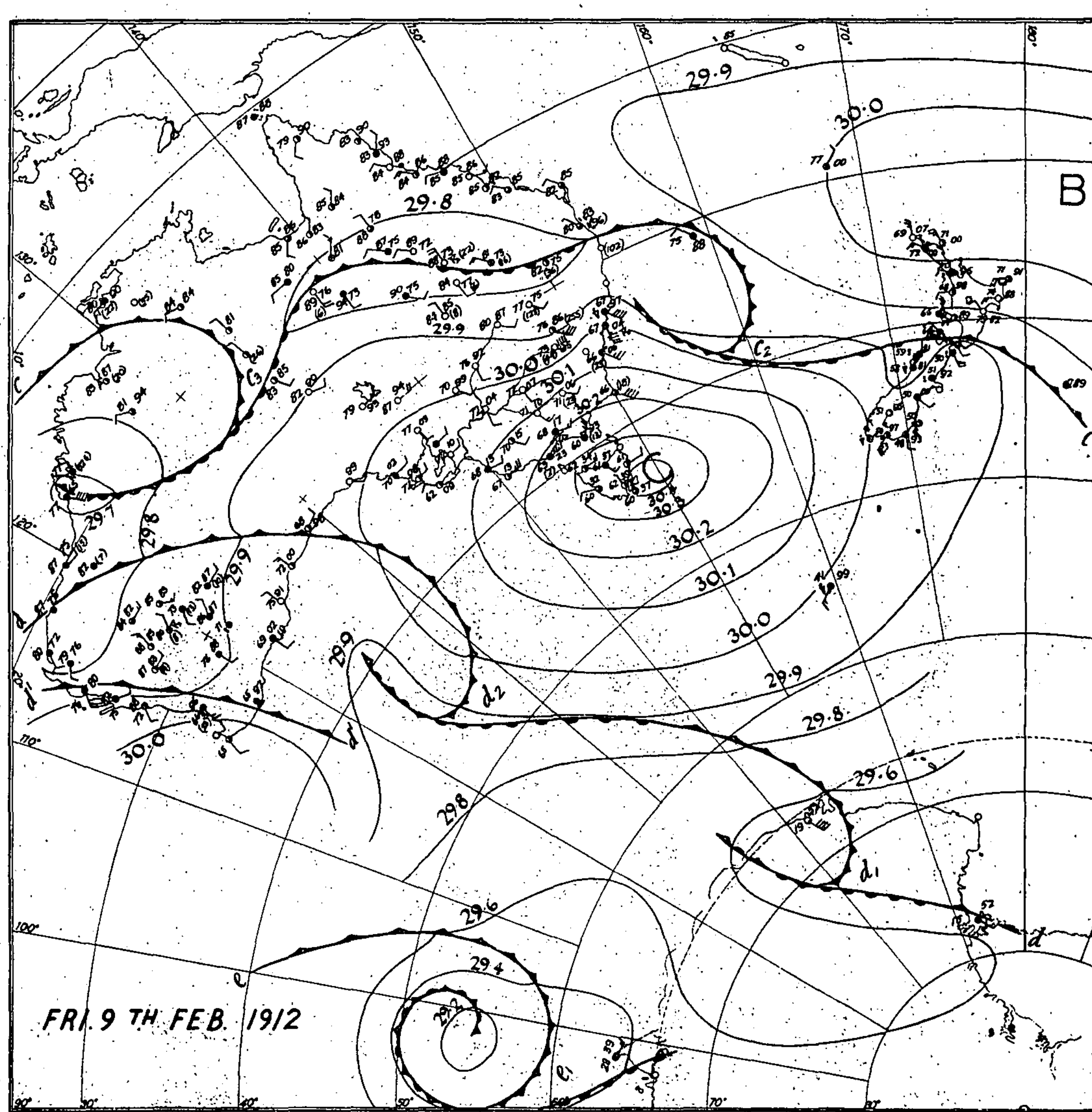
Front *b* is experiencing frontolysis in the anticyclonic region but frontogenesis in the northern portion, anticyclones A' and B are merging into one. It is still hot in Queensland where there have been further scattered rains. These rains are probably due to convergence.



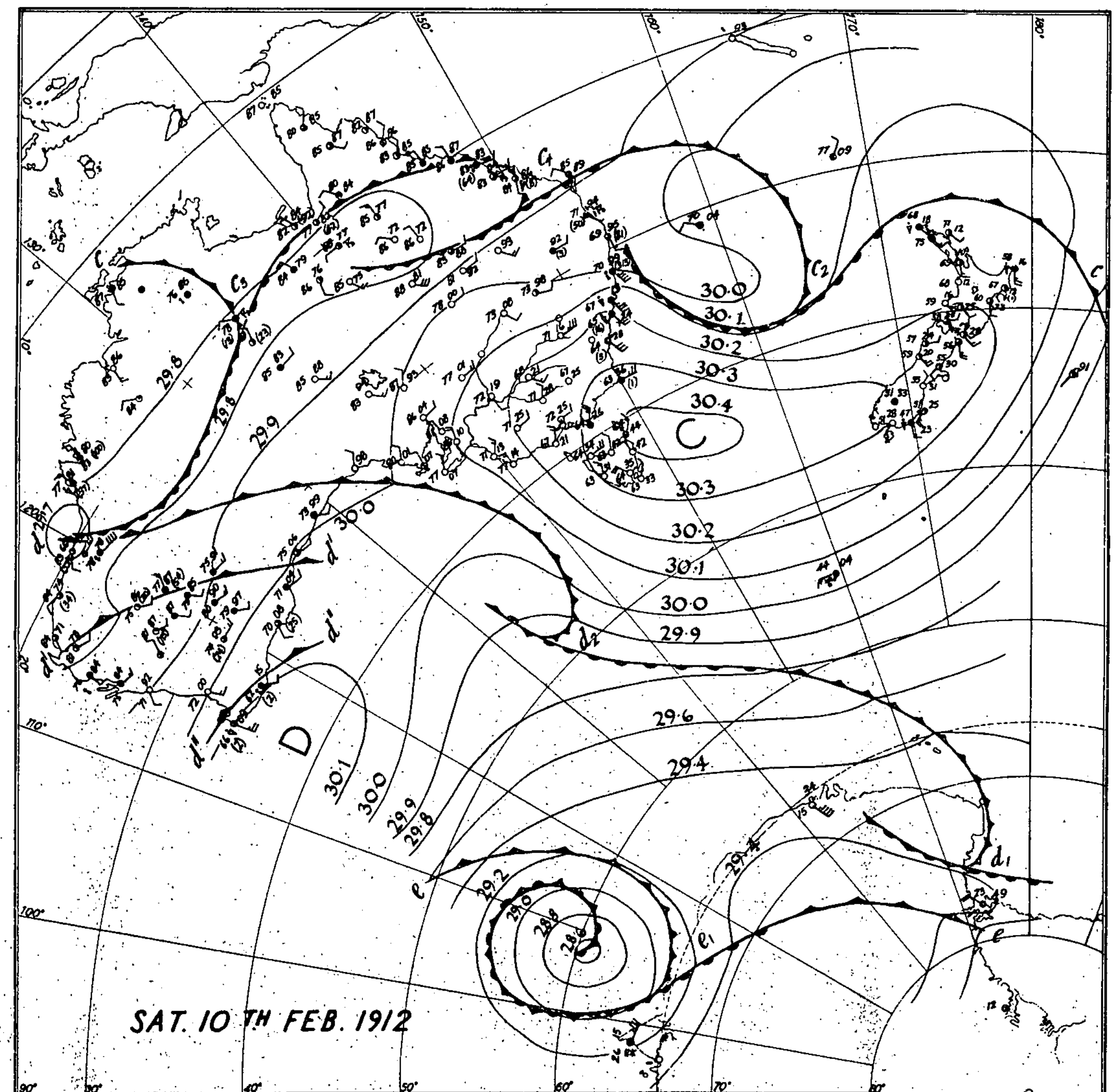
The eastern part of front *b* is now crossing anticyclone B. There has been cyclogenesis on its eastern part at wave b_4 but this is now beginning to merge into the wind system of *c*, especially the small cyclone c_2, which has a strong circulation. Rain has fallen about both cyclone centres. Fronts in Australia are active for the first time in the month.



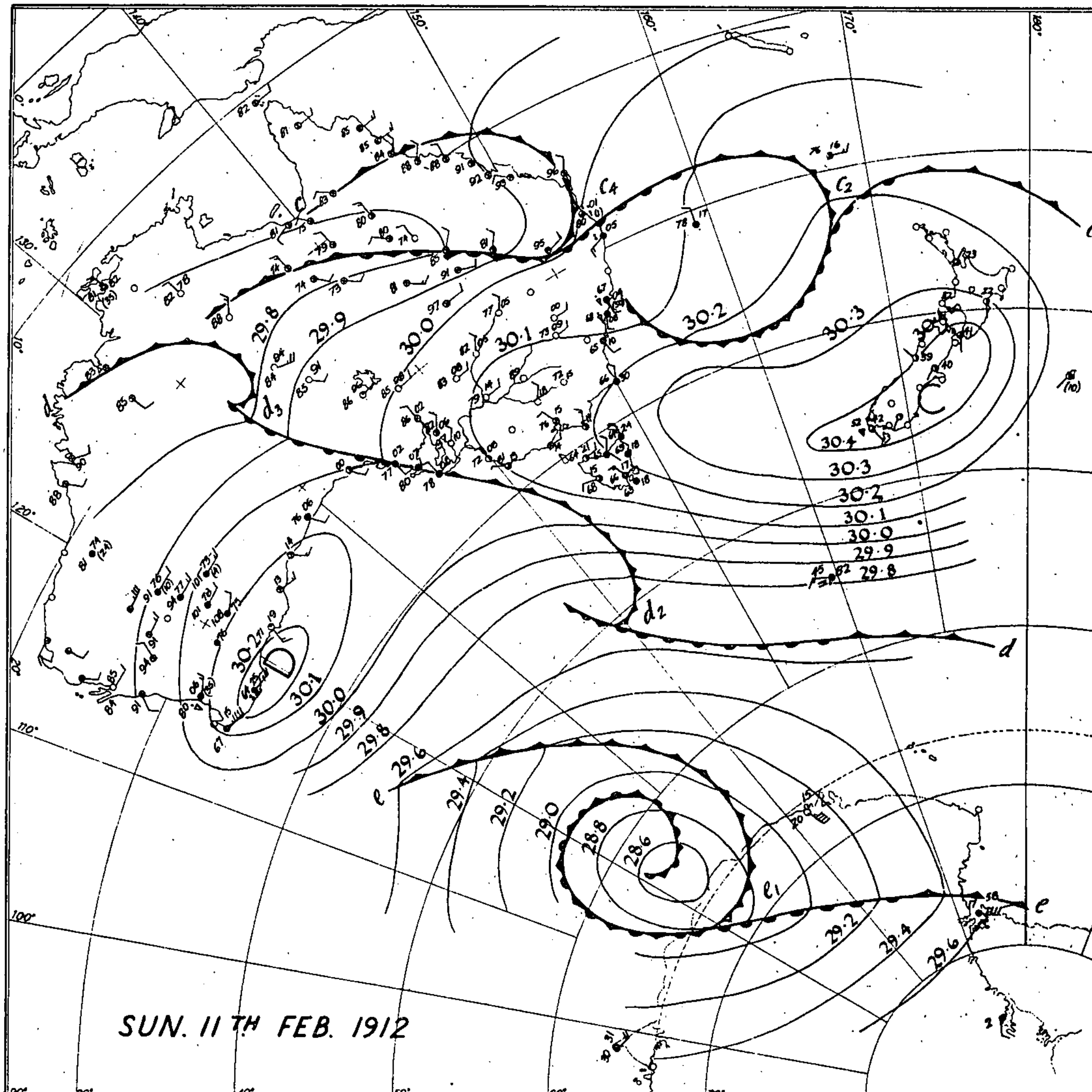
Front *b* is no longer traceable. There has been general rain in the south-east of Australia.



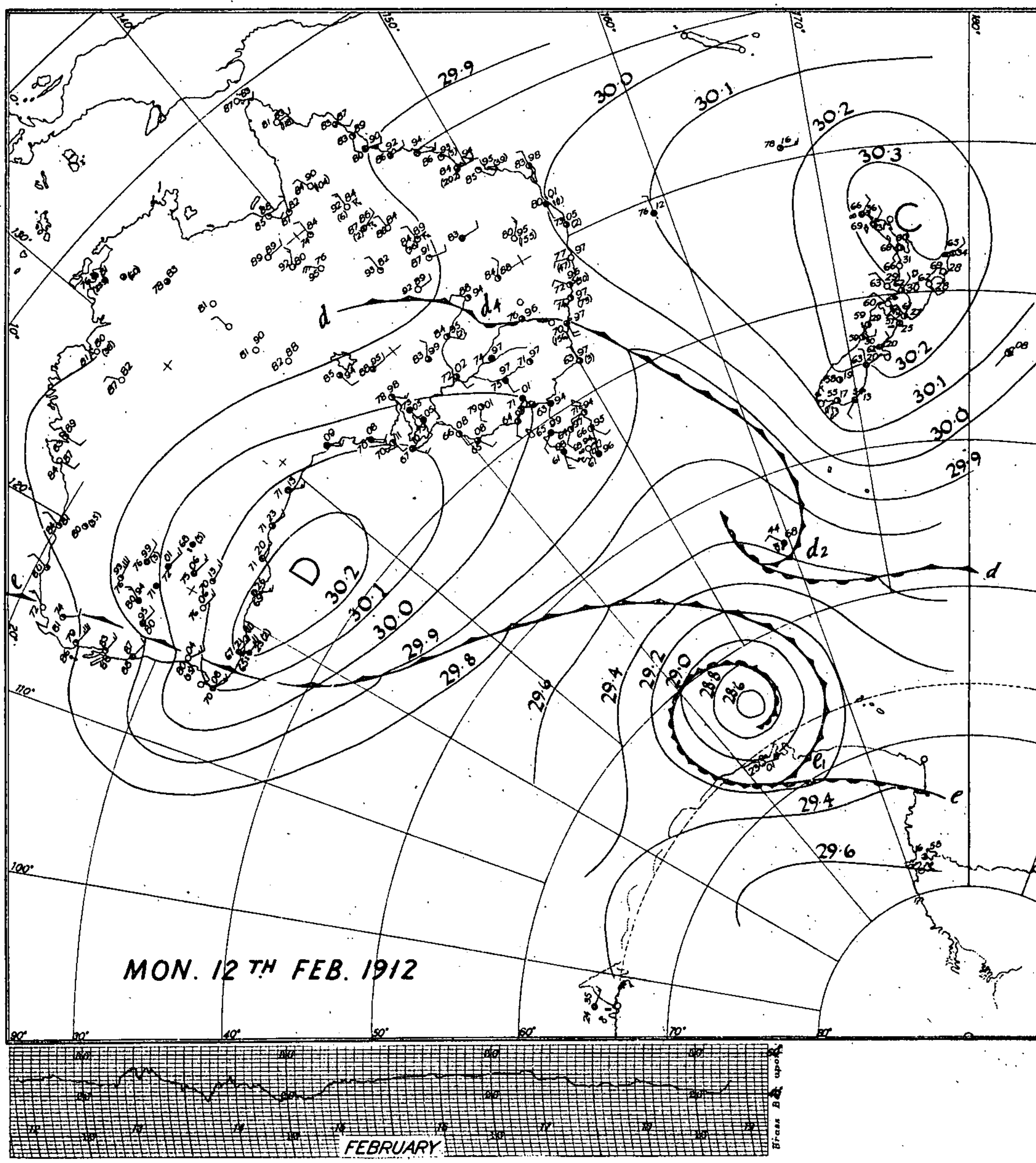
Anticyclone C has become intense and is centred south of the usual track. There is a well marked invasion of cold air over eastern Australia and frontogenesis in the north. A small cyclone has developed on the tip of the occlusion of wave c_3.



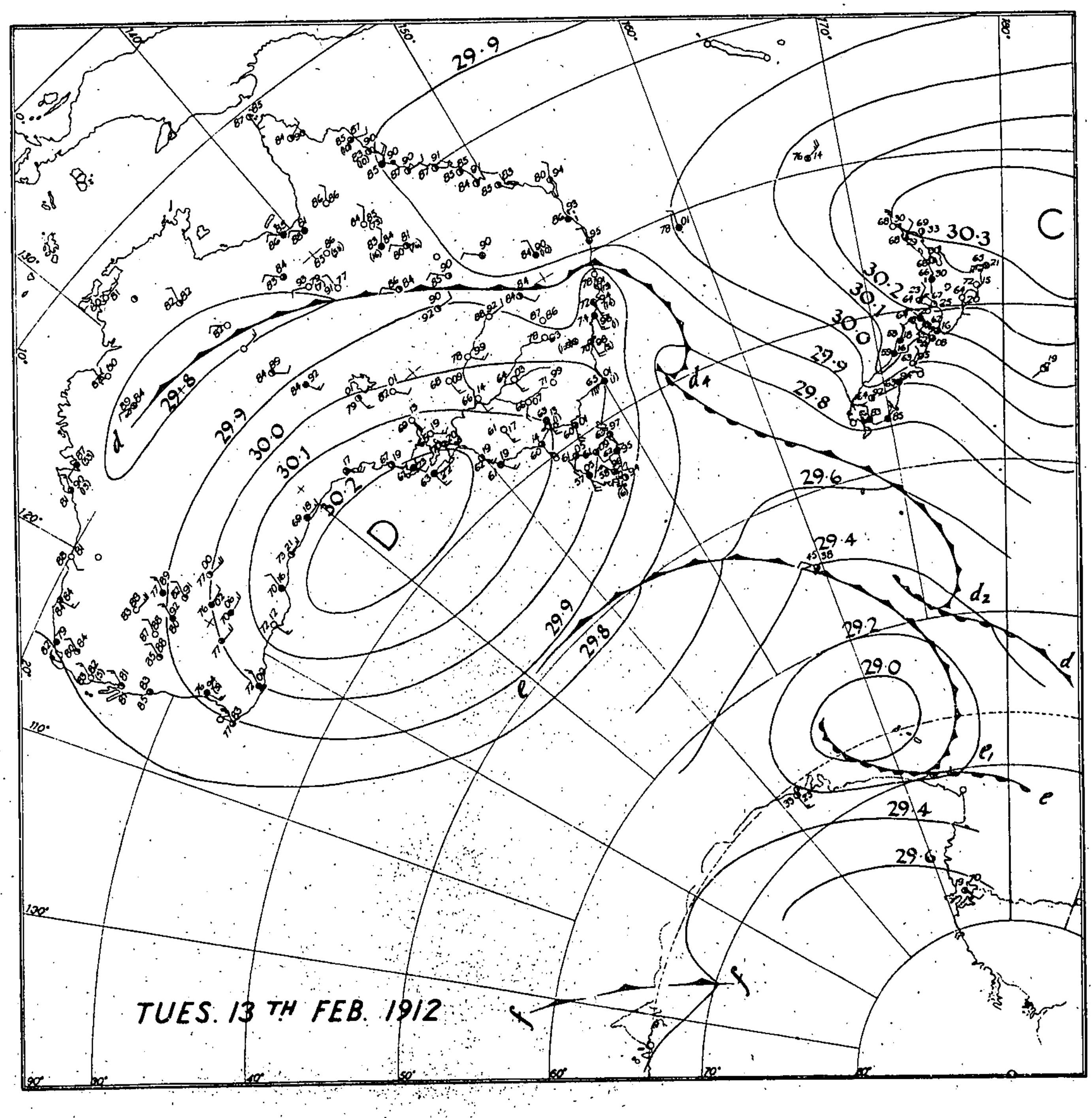
Frontal developments are still marked north of anticyclone C. A small cyclone is still centred in north-western Western Australia. There are indications of a cyclone having passed Queen Mary Land to the north.



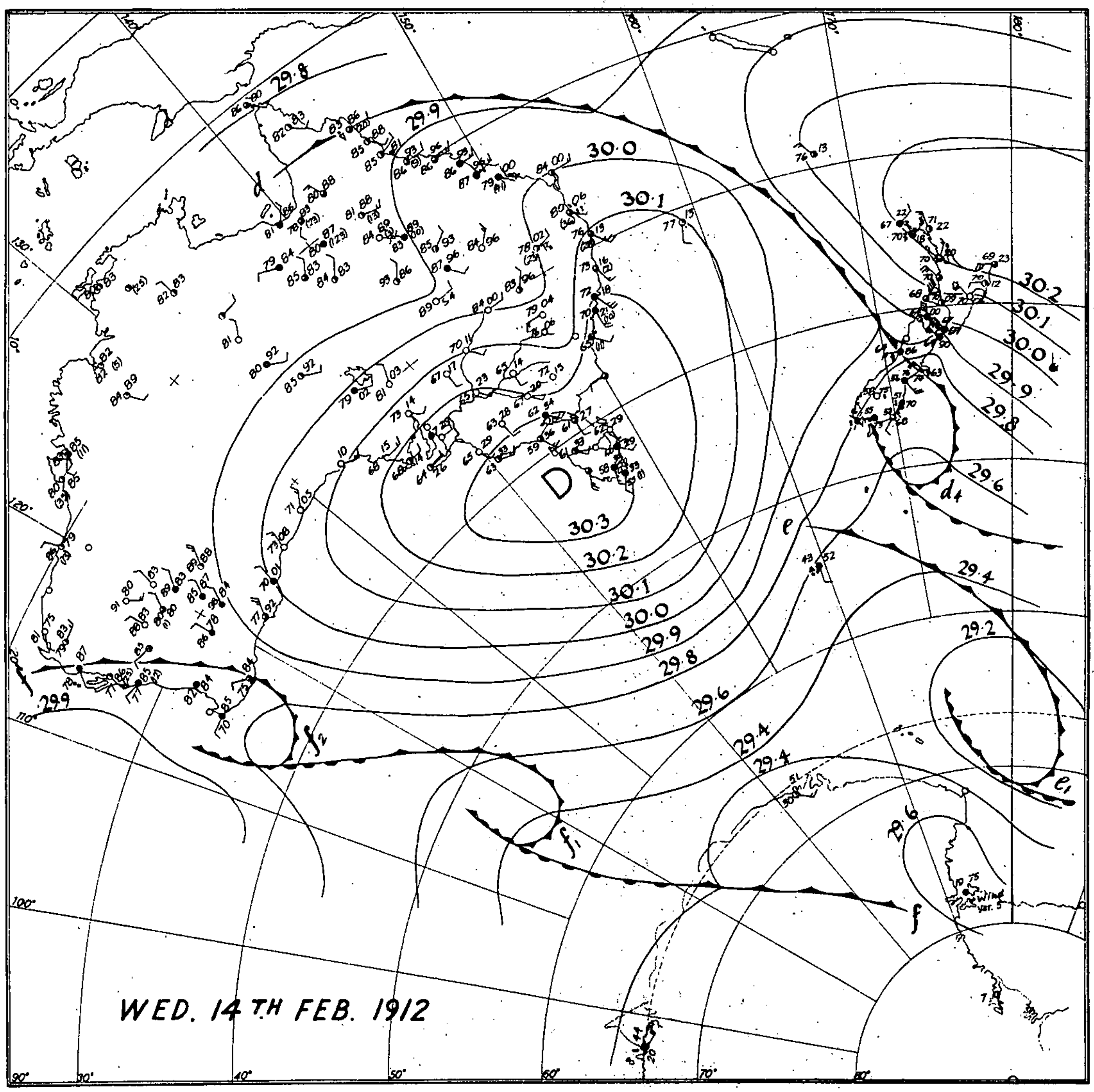
Front *e* is now becoming less marked. A considerable amount of rain has been associated with it.



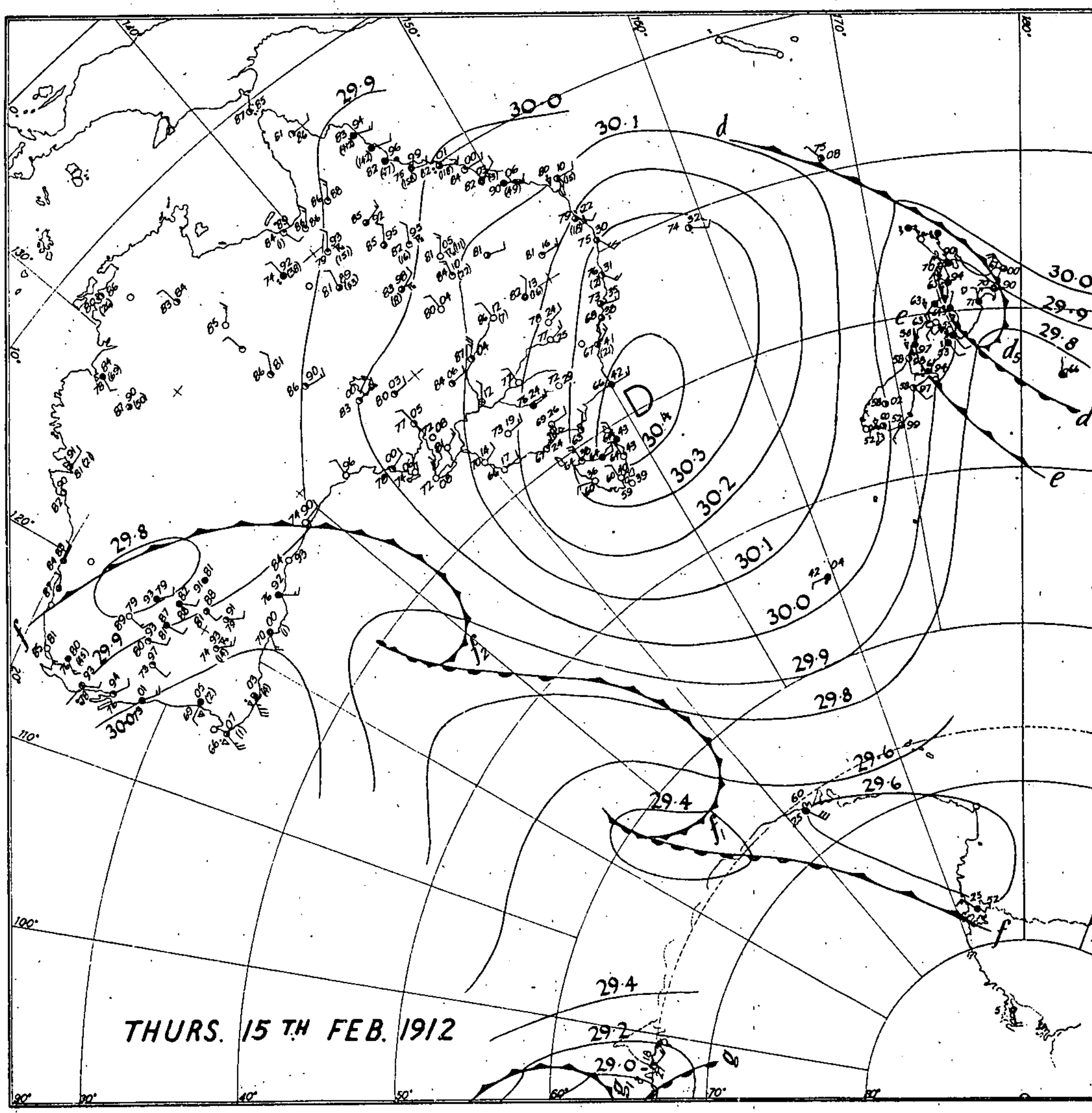
The Antarctic cyclone is now passing north of Adélie Land. There is great instability over Queensland as indicated by the heavy rains and thunderstorms. This is in air, originally cold, which has come round anticyclone C and is beginning to return.



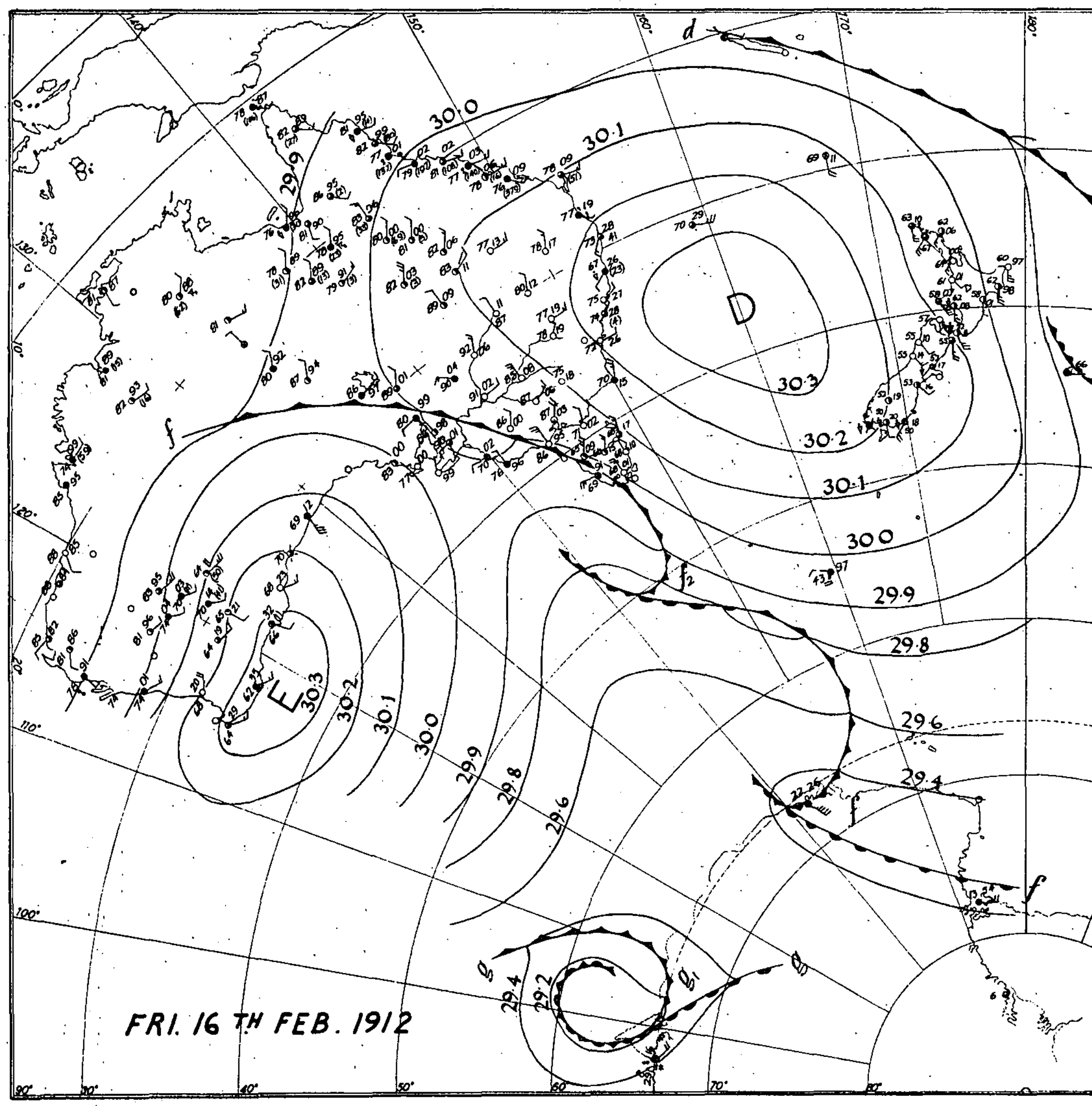
The northern portion of front *e* has been cut off by anticyclone D. Cyclone e_1 is passing eastward and probably filling up.



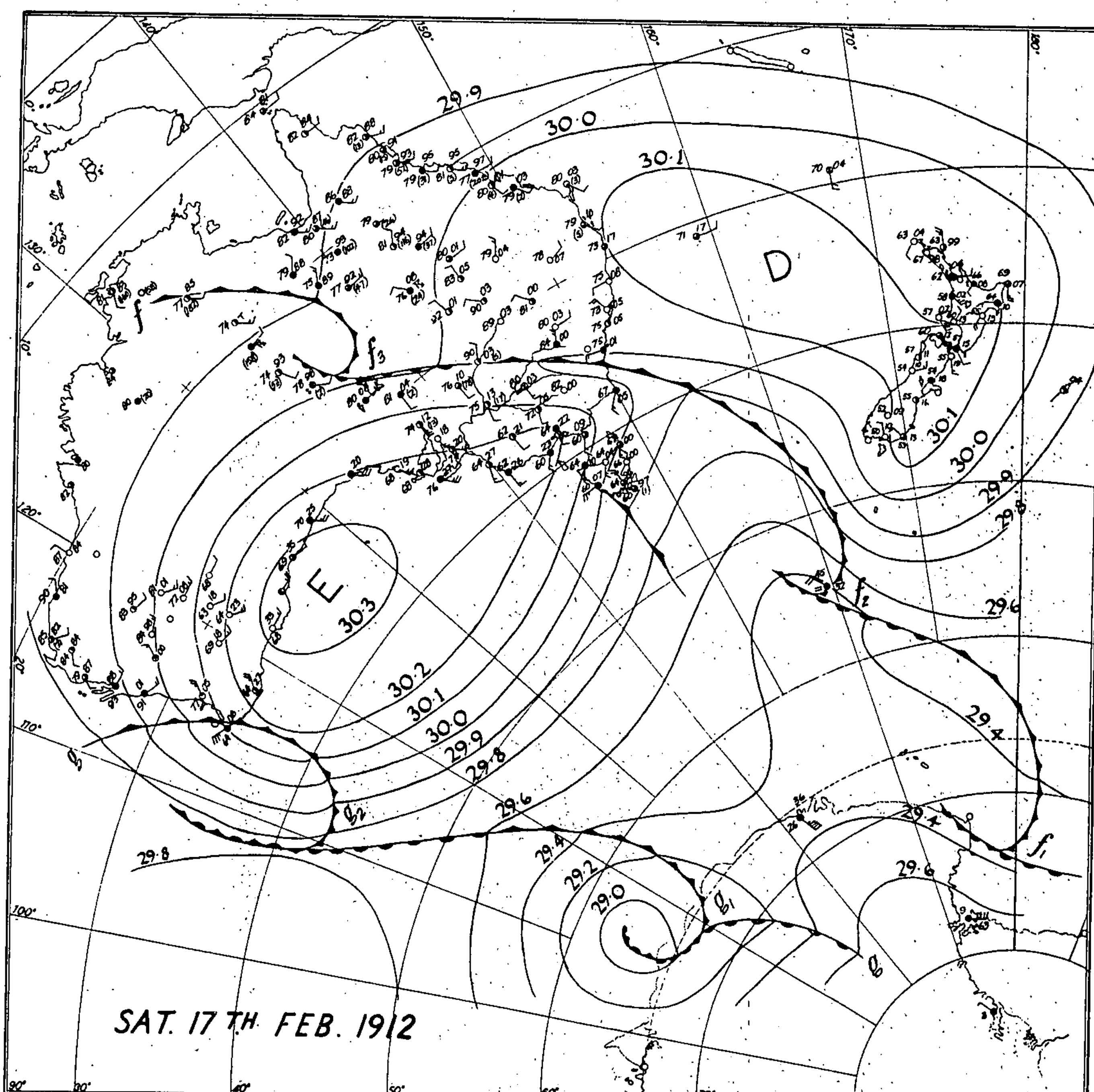
Anticyclone D is now well developed and centred rather far south. Cold air is being carried over Queensland, being heated rapidly, and becoming very unstable. Rain has fallen in Western Australia with the passage of front *f*.



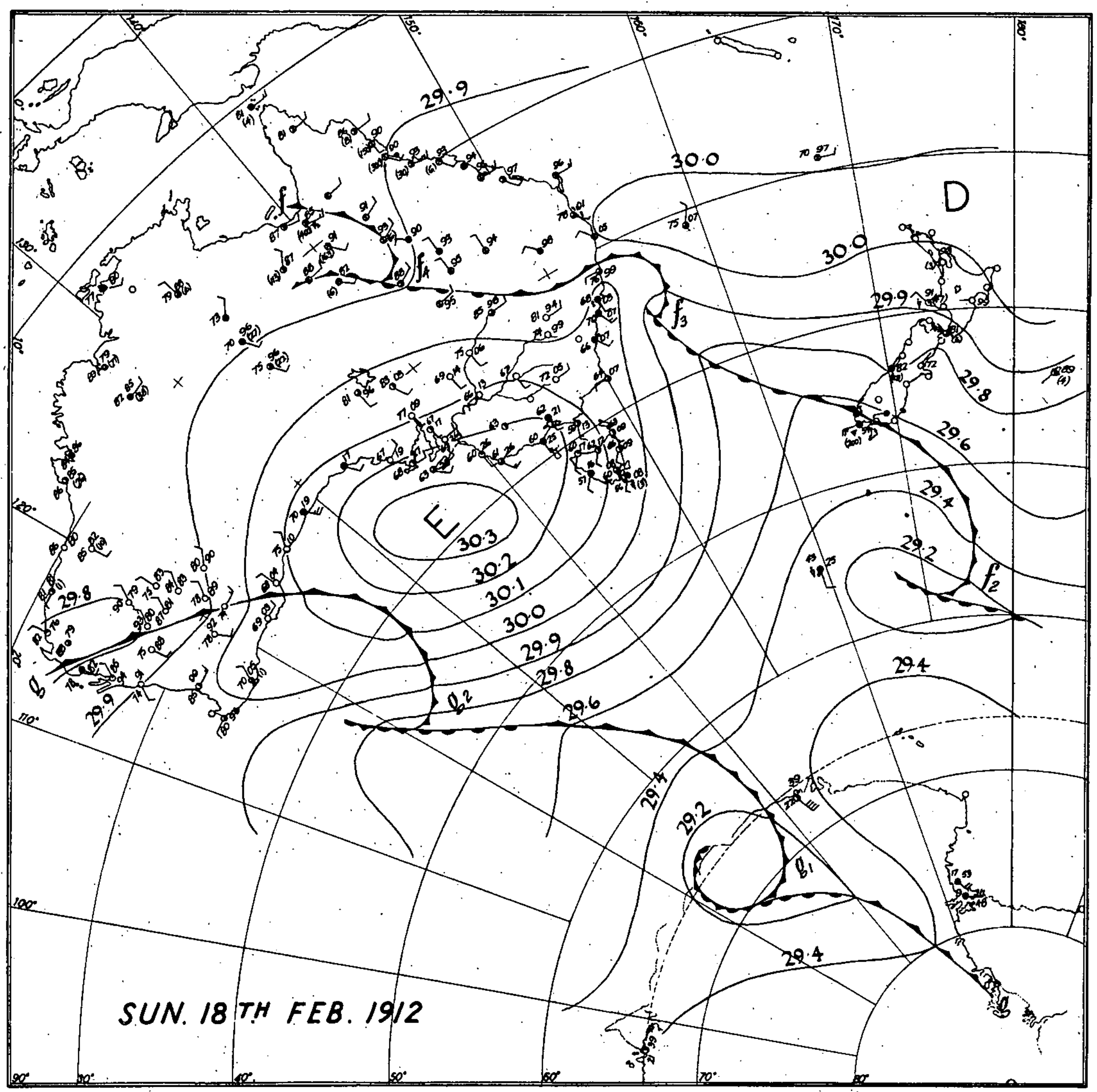
Unstable conditions with scattered thunderstorms and heavy rains persist in Queensland until the 17th. A new cyclone g_1 is approaching Queen Mary Land.



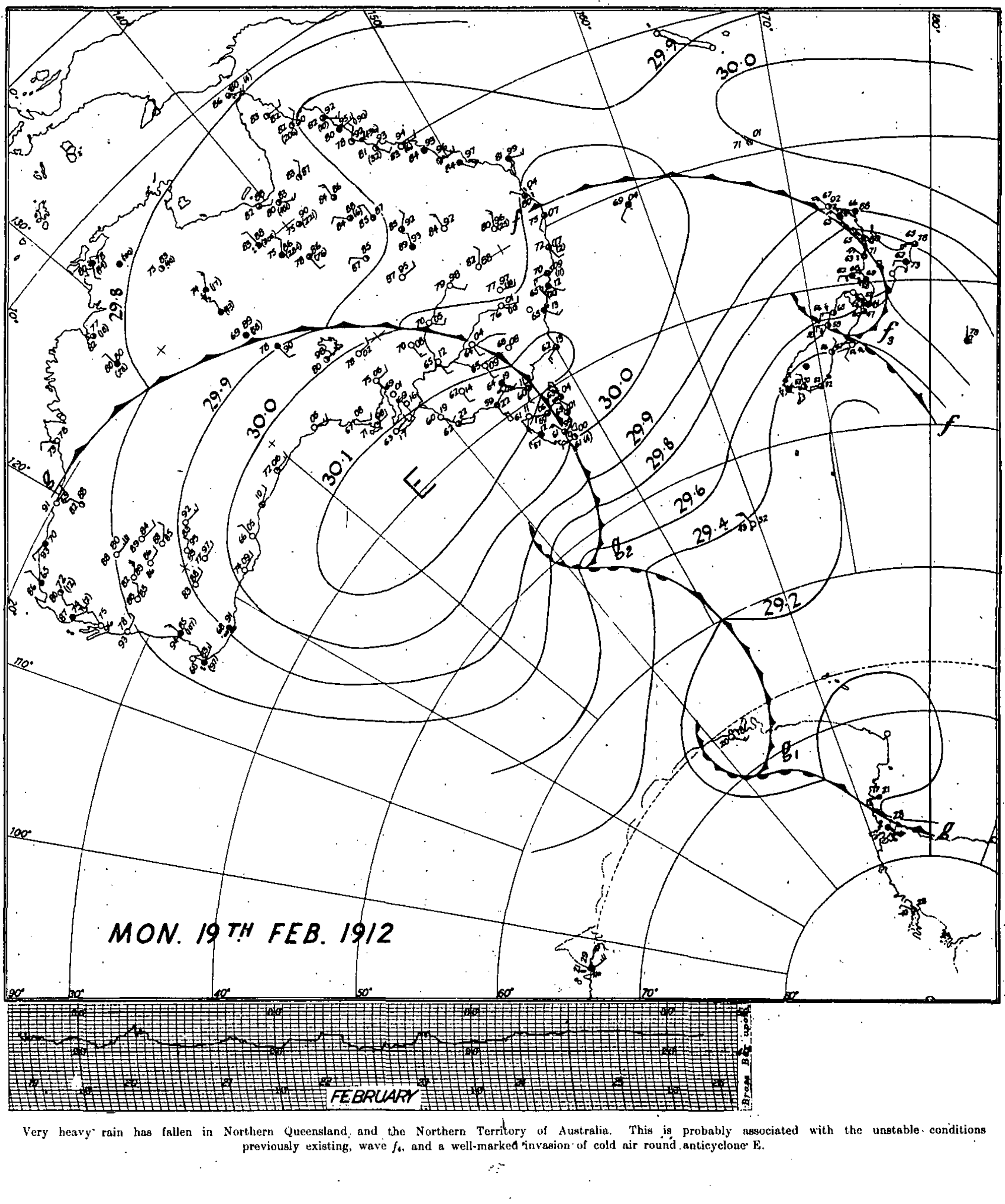
Nothing of note.



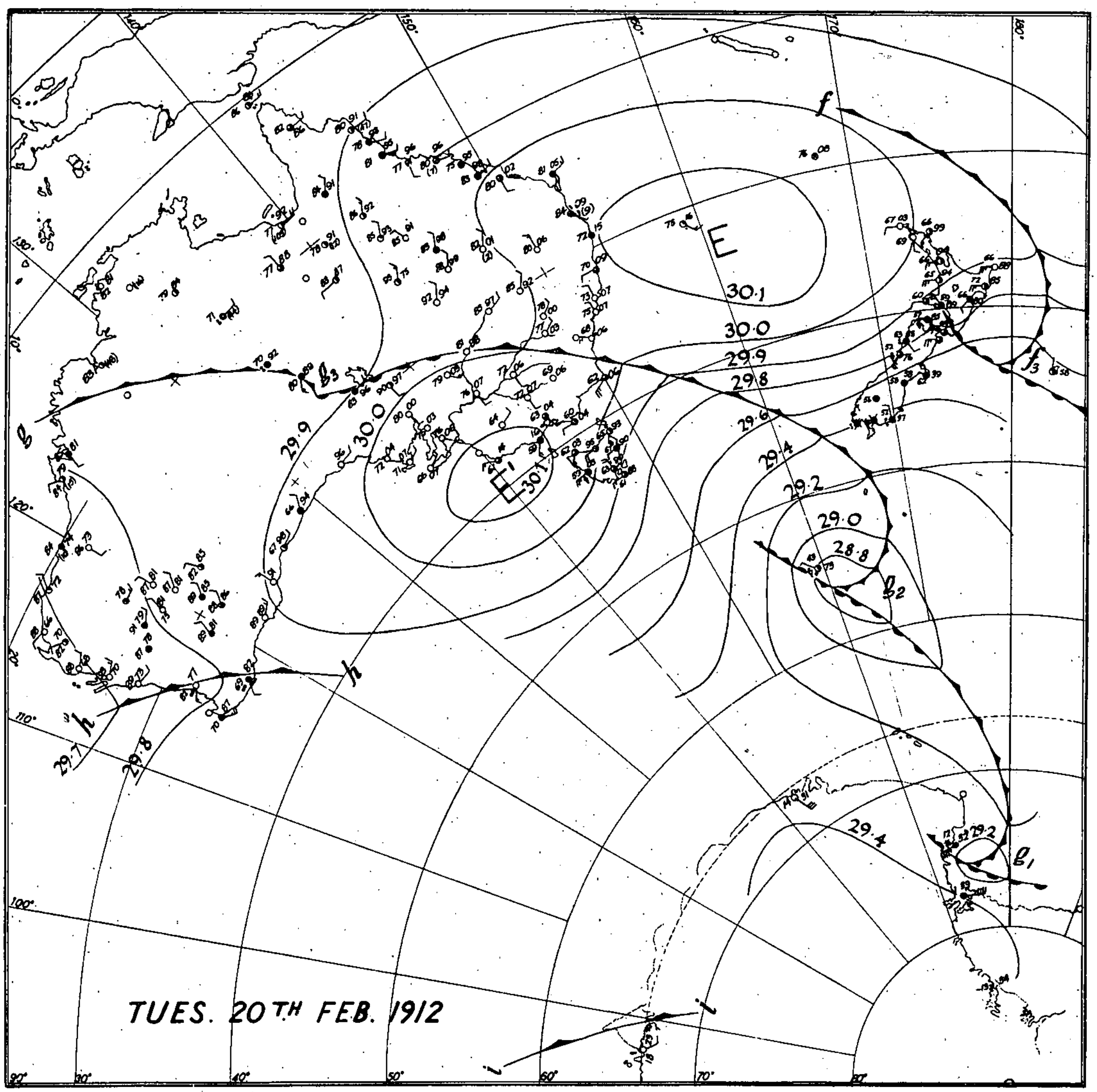
Nothing of note.



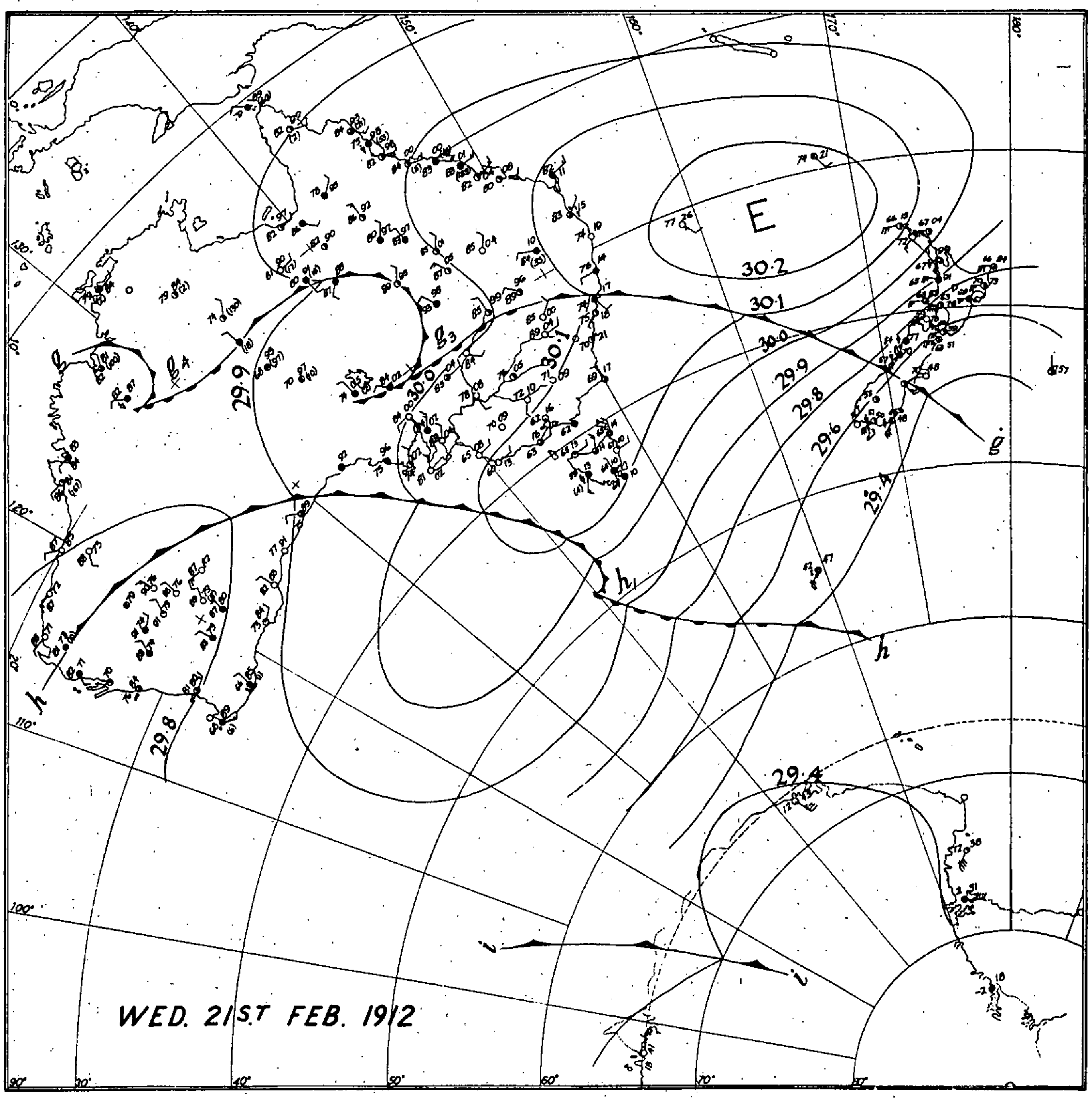
The reduction in the force of the katabatic wind at Adélie Land on this and the following day suggest that cyclone g_1 is passing to the southward of it, giving a gradient for northerly winds in the upper air.



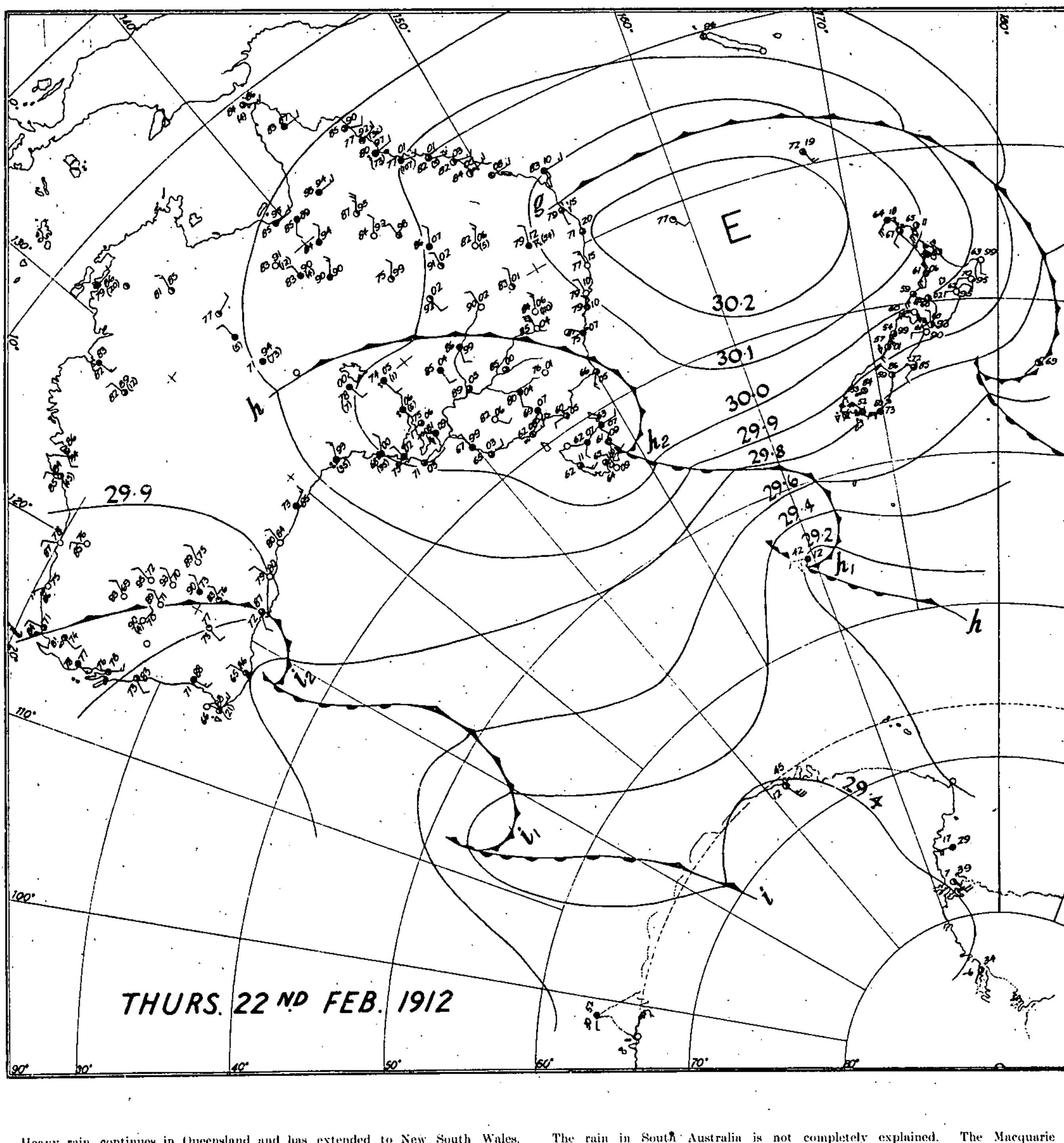
Very heavy rain has fallen in Northern Queensland and the Northern Territory of Australia. This is probably associated with the unstable conditions previously existing, wave f_4, and a well-marked invasion of cold air round anticyclone E.



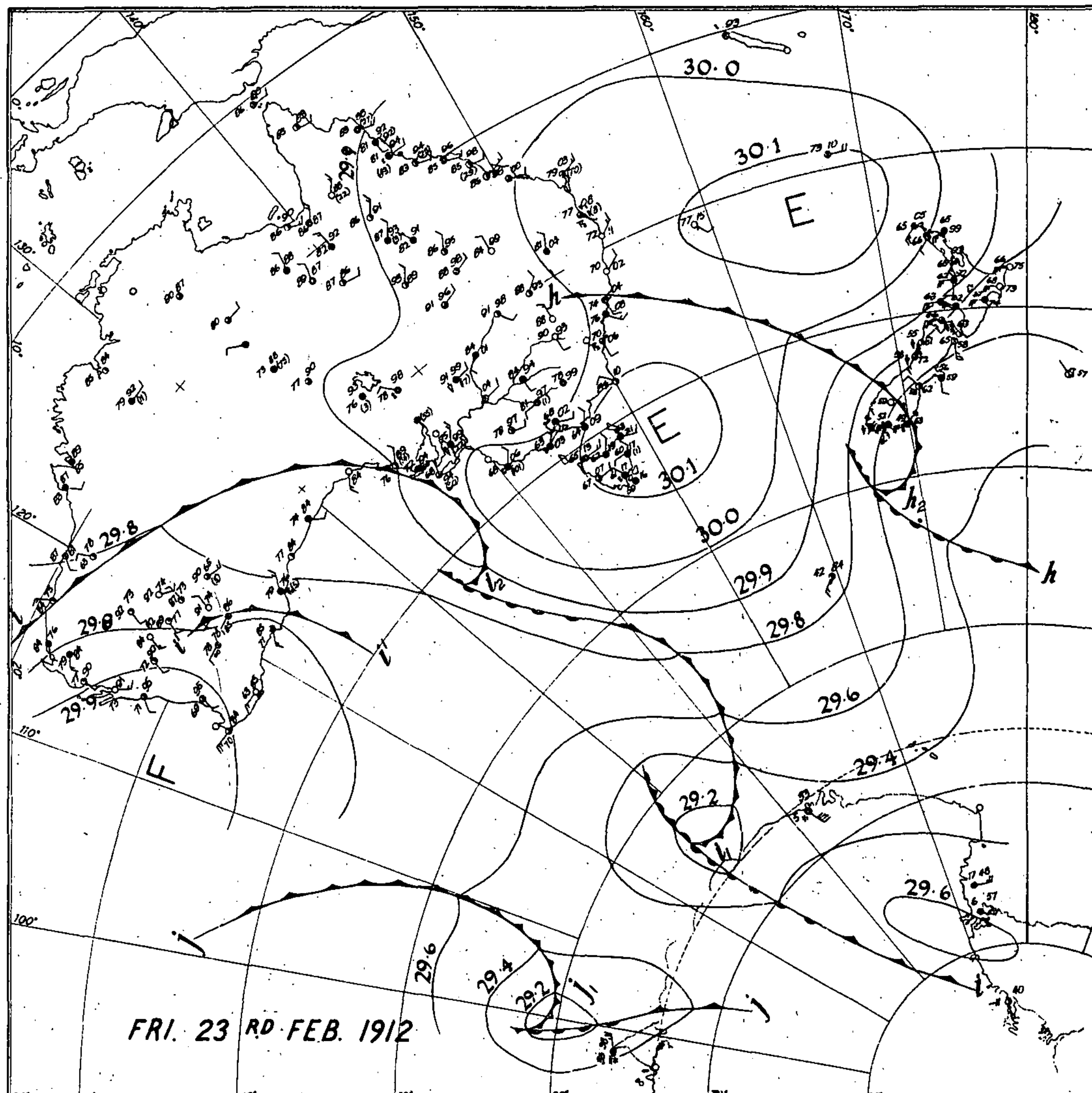
Cyclone g_1 has reached the Ross Sea where there are blizzards round the centre. Wave g_2 has developed into a deep cyclone near Macquarie Island. Front g lies across anticyclone E which it has divided.



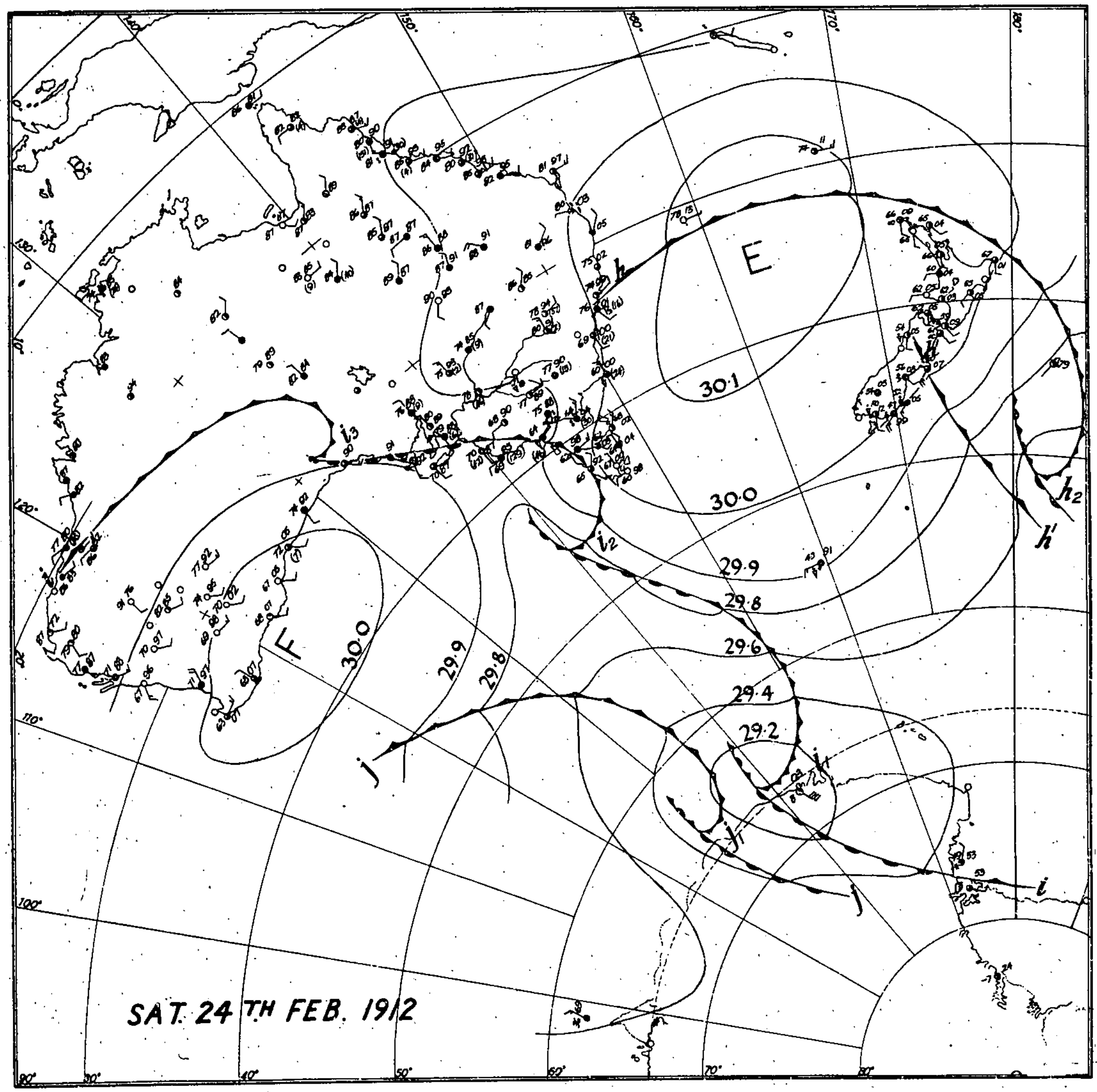
Scattered heavy rains have continued in Northern Australia. Front g, also, has become active there. These phenomena appear to be associated with invading moist air coming round the north side of anticyclone E.



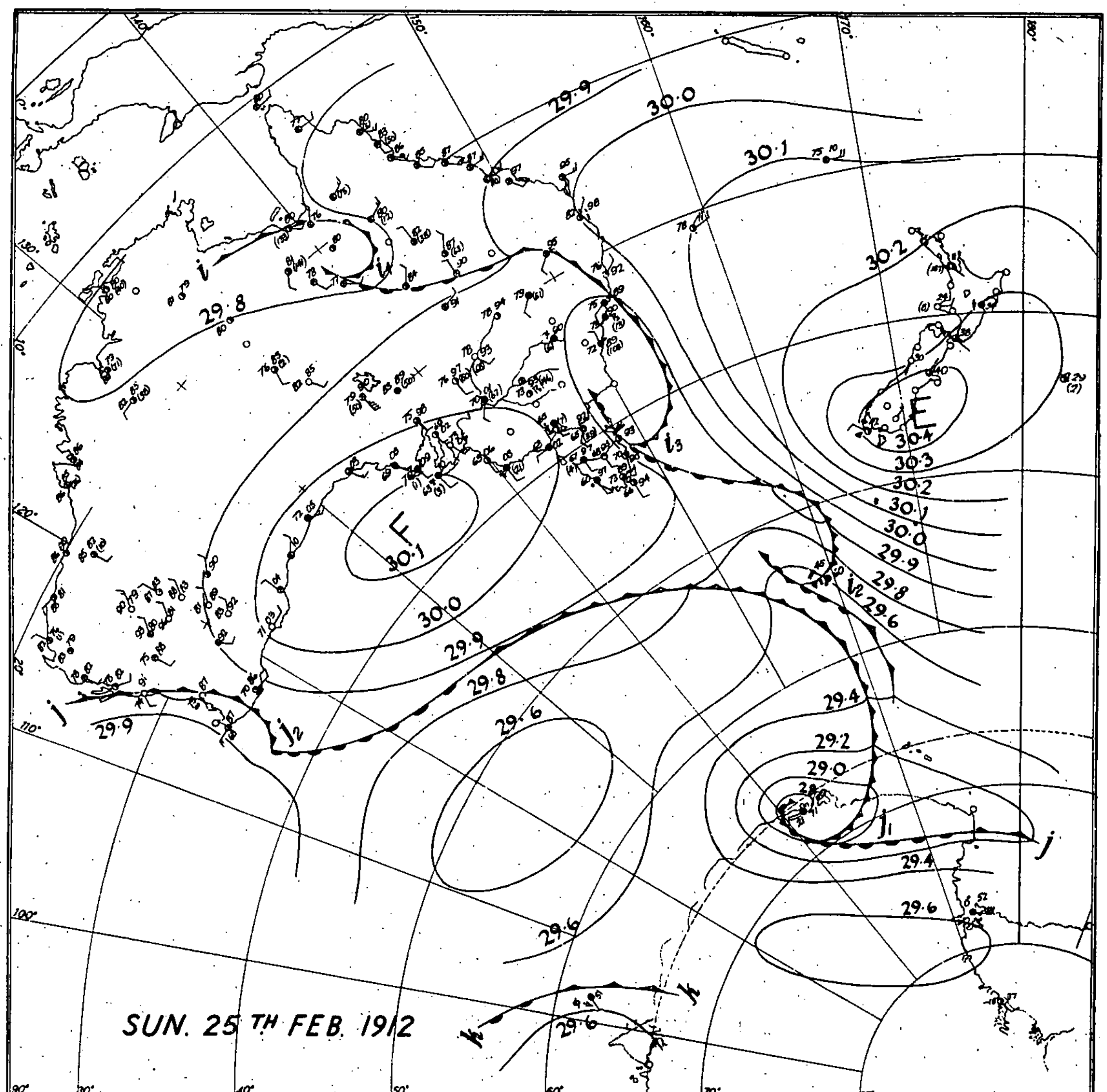
Heavy rain continues in Queensland and has extended to New South Wales. The rain in South Australia is not completely explained. The Macquarie Island thermogram shows a marked rise of temperature between the cold front and the occlusion of h_1 and a fall after the passage of the occlusion.



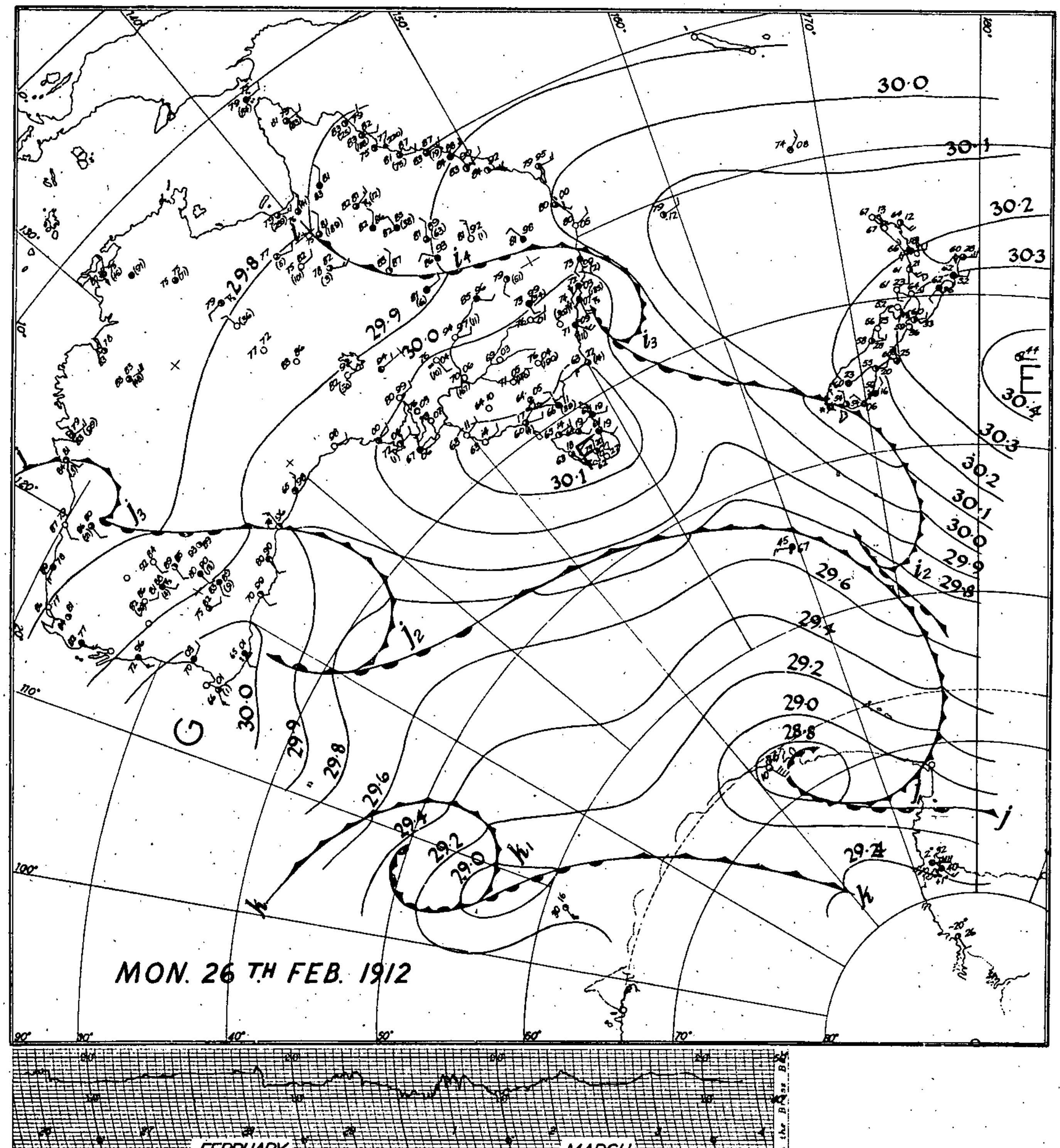
Anticyclone E is once more being crossed and divided by a front (*h*).



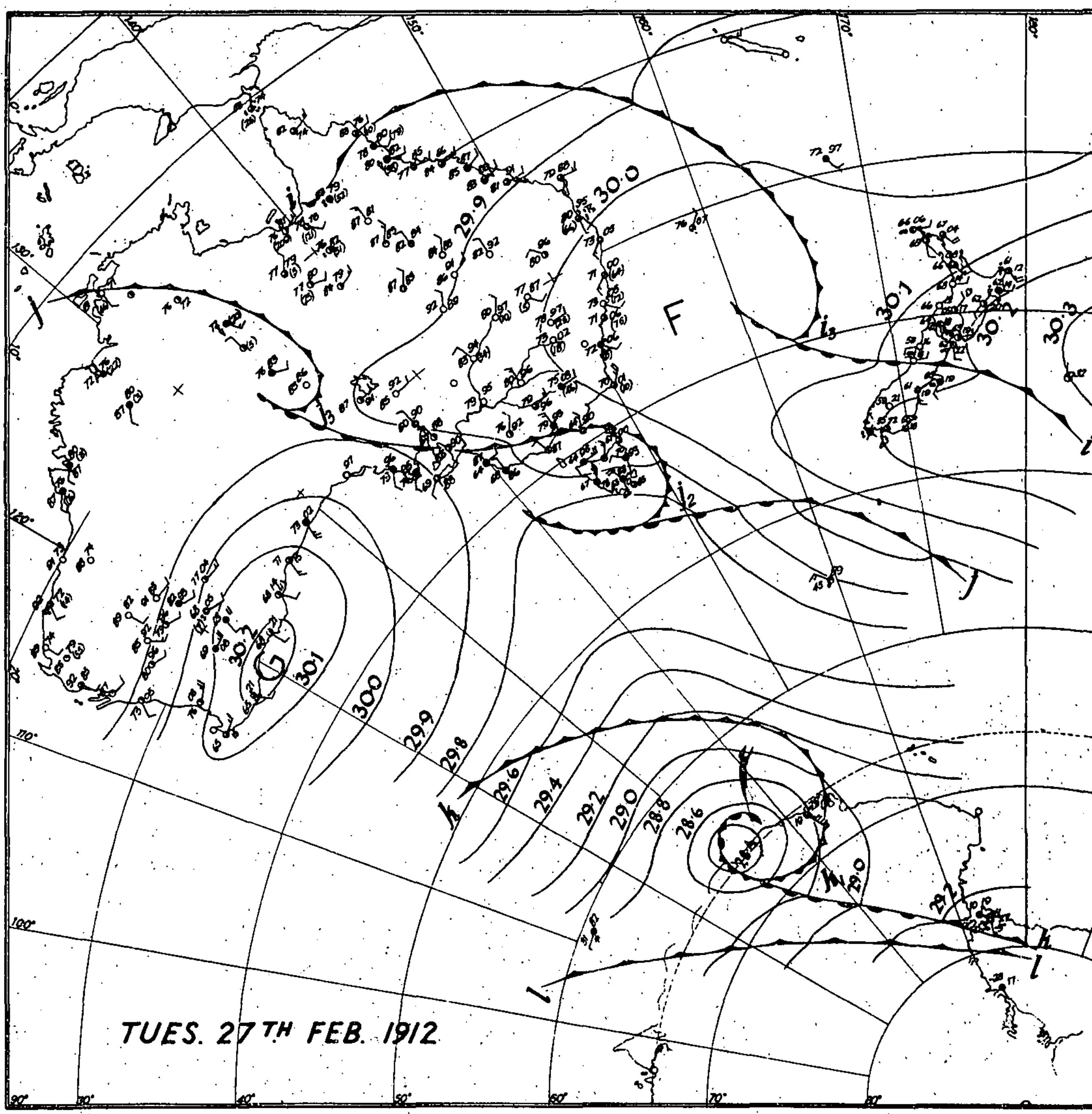
There is much rain still in eastern Australia. Note the winds in the Ross Sea.



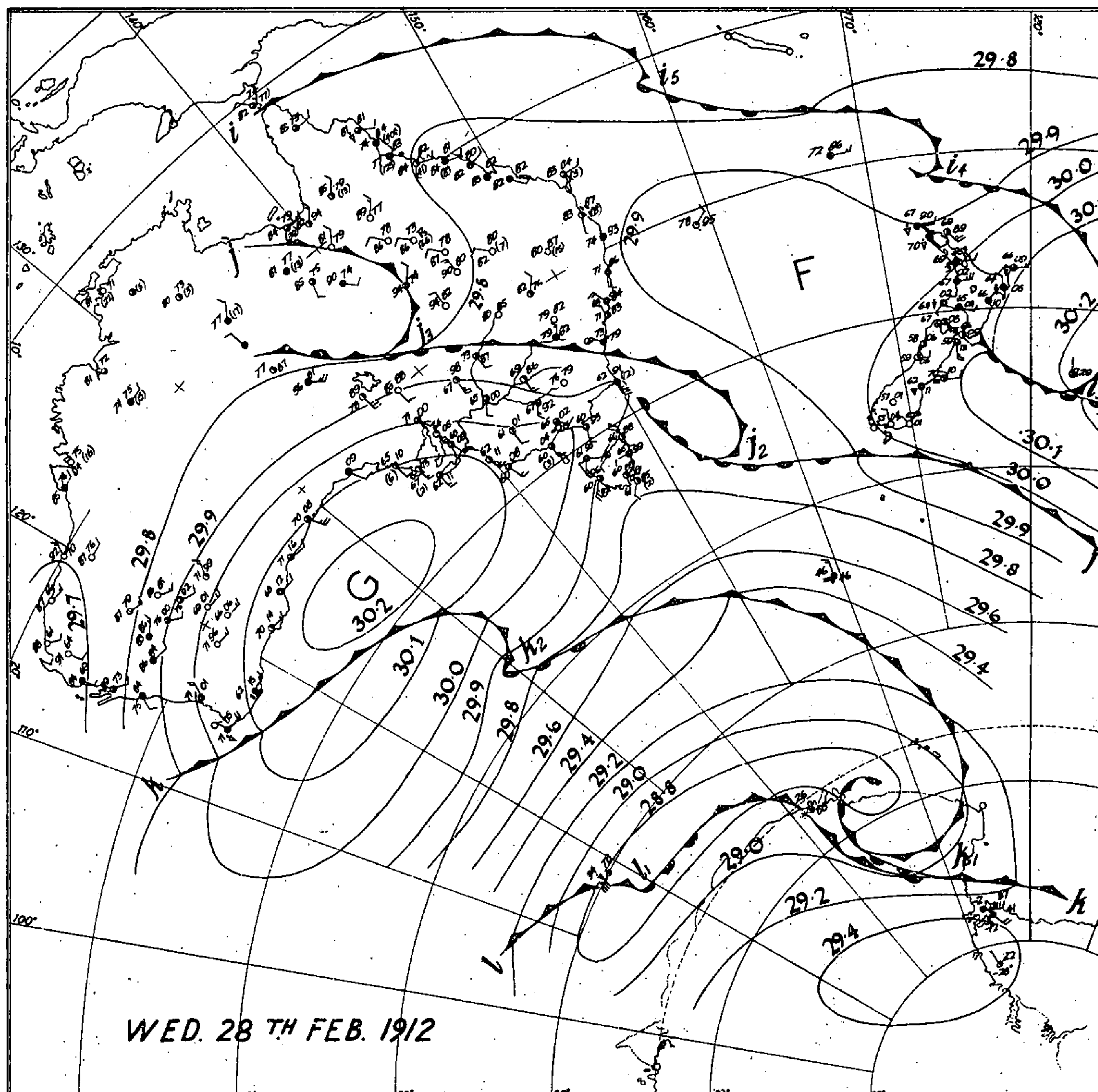
Wave j_1 has developed into a deep cyclone. Note the very light wind at Adélie Land where in the free air there is probably a strong gradient for northerly winds. Anticyclone E is unusually far south and has become intense.



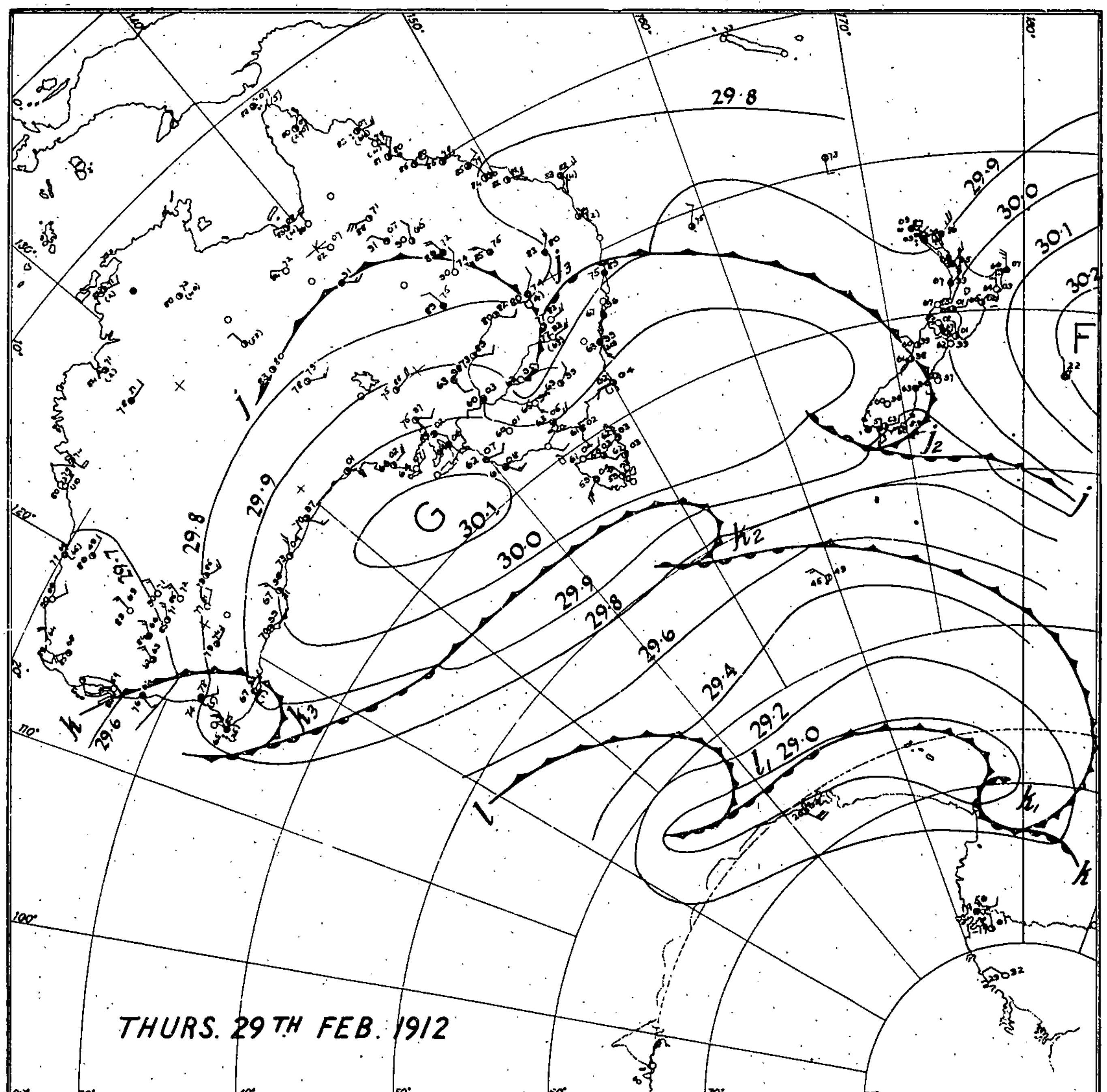
There is a blizzard at Cape Evans as the cyclone approaches. The katabatic wind is again blowing at Adélie Land. Widespread and often heavy rain has been reported in eastern Australia.



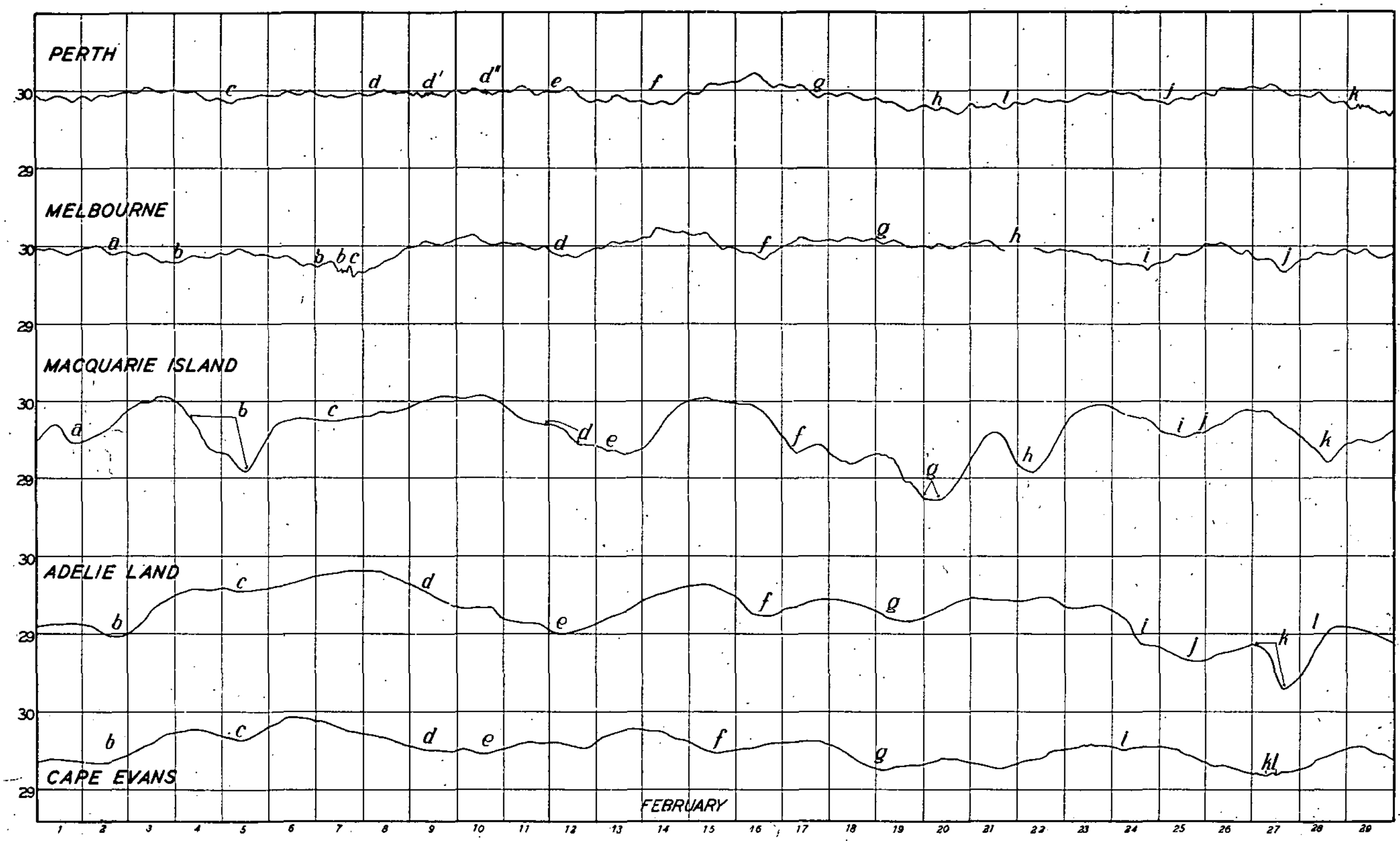
Another deep cyclone is approaching Adélie Land. Widespread rains are again recorded in eastern Australia. Conditions are disturbed over much of the Continent. Anticyclone F is beginning to merge into the high pressure area centred east of New Zealand.

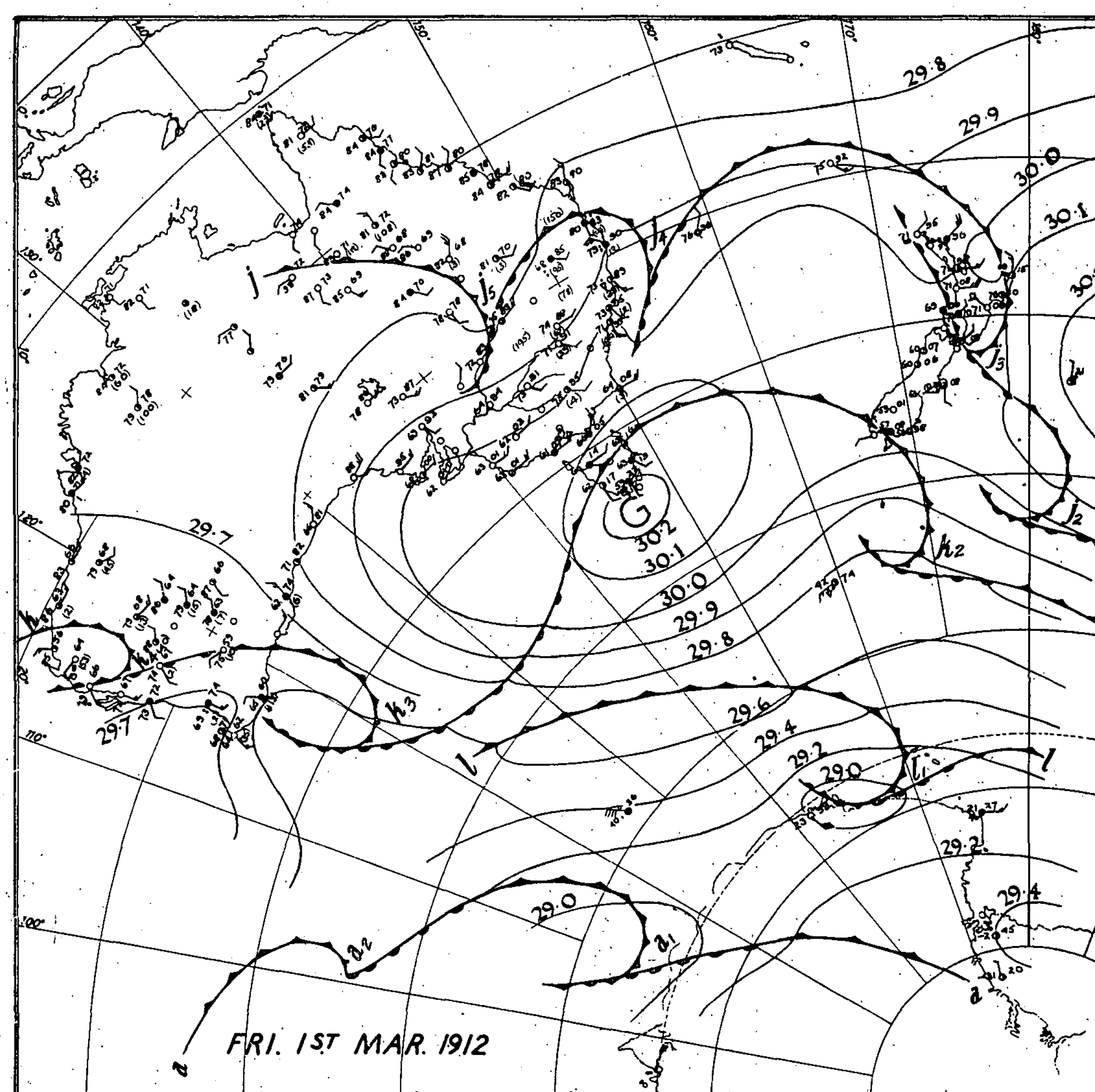


Note the calm and snow at Adélie Land. There must be a strong gradient for northerly winds in the free air. The passage of front h caused a sharp fall of temperature at Macquarie Island.

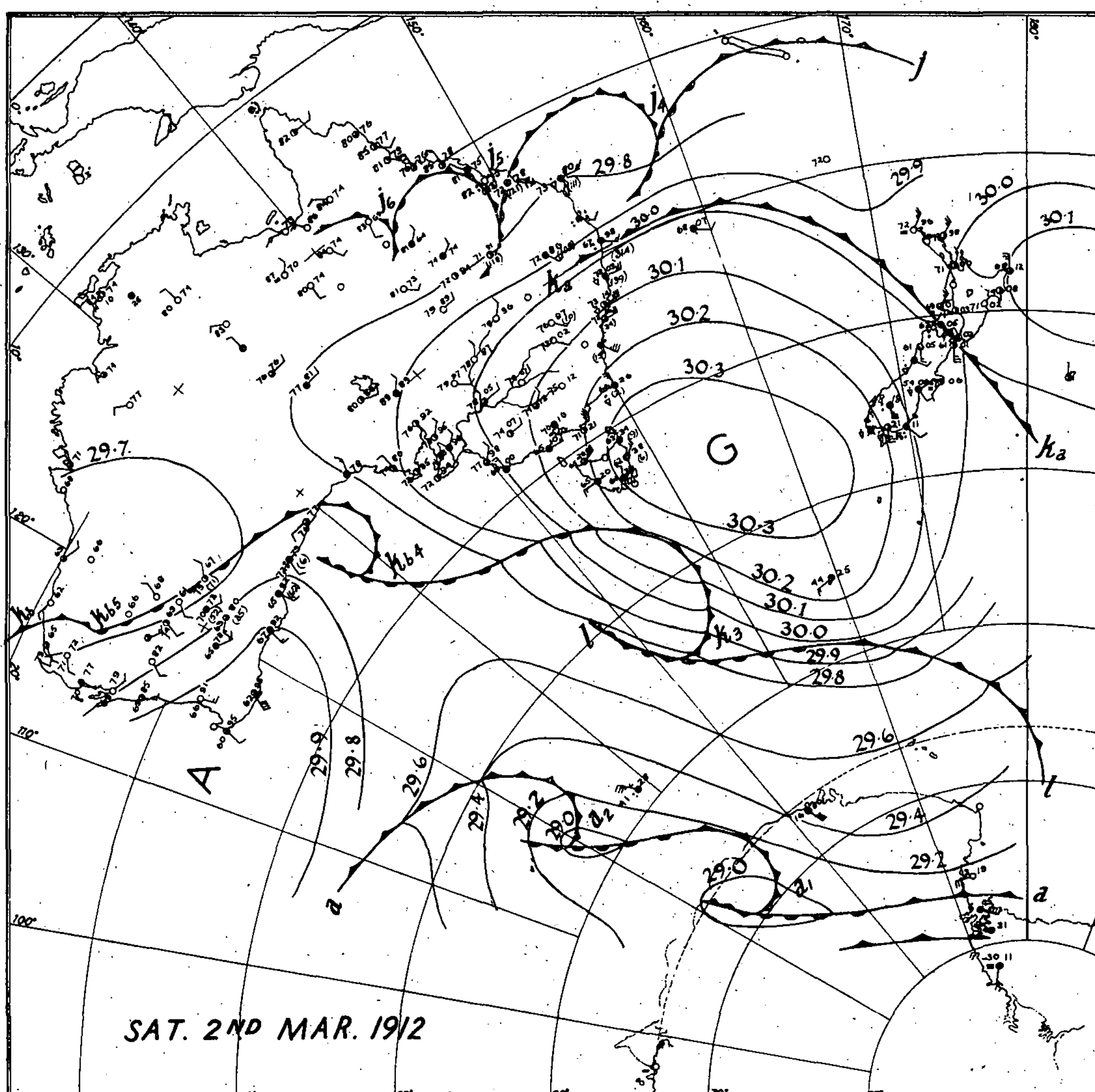


Fronts are taking a west to east orientation. There has been considerable warm front rain in eastern New South Wales, associated with wave j_3.

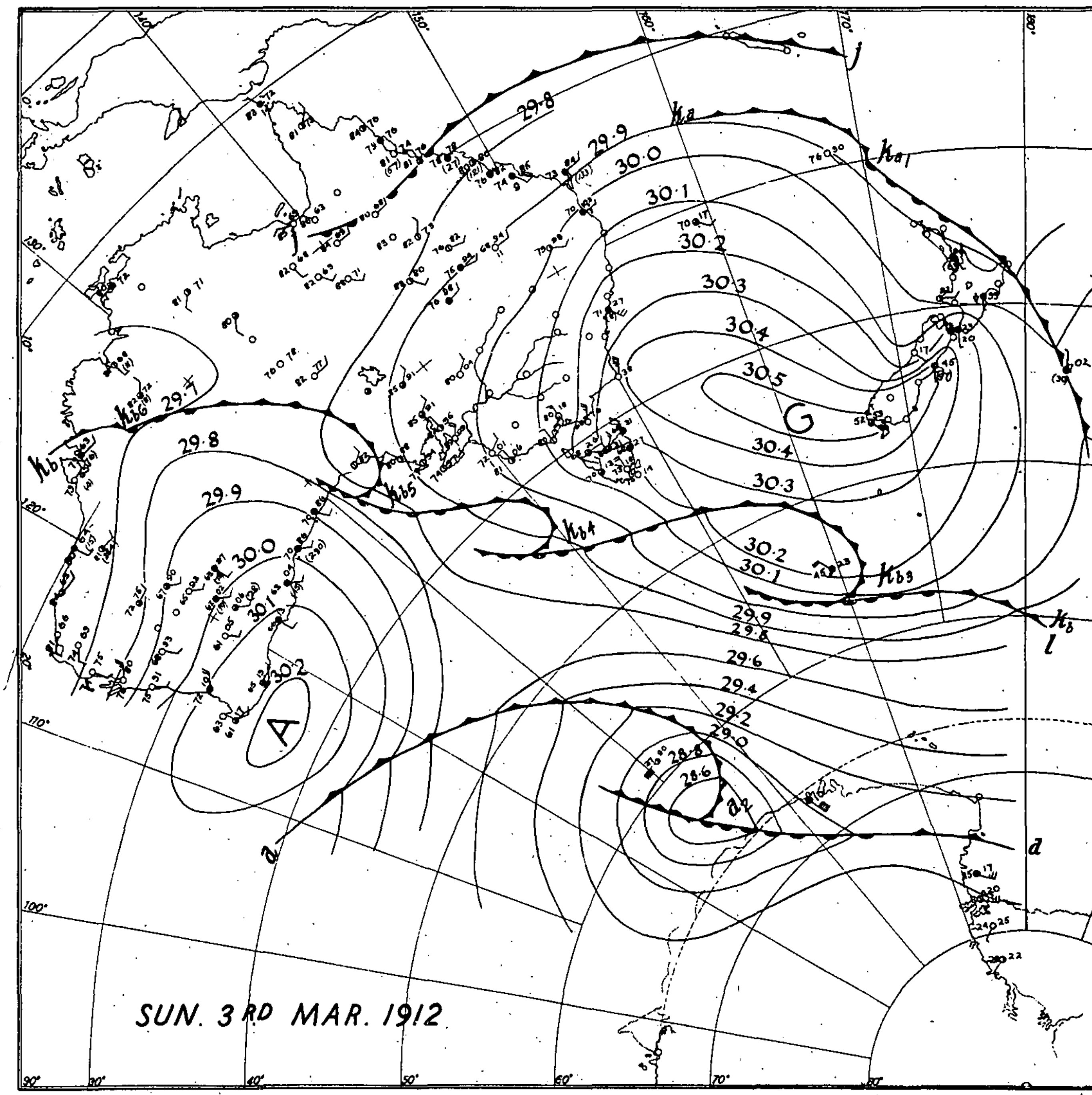

PERTH
MELBOURNE
MACQUARIE ISLAND
ADELIE LAND
CAPE EVANS
FEBRUARY



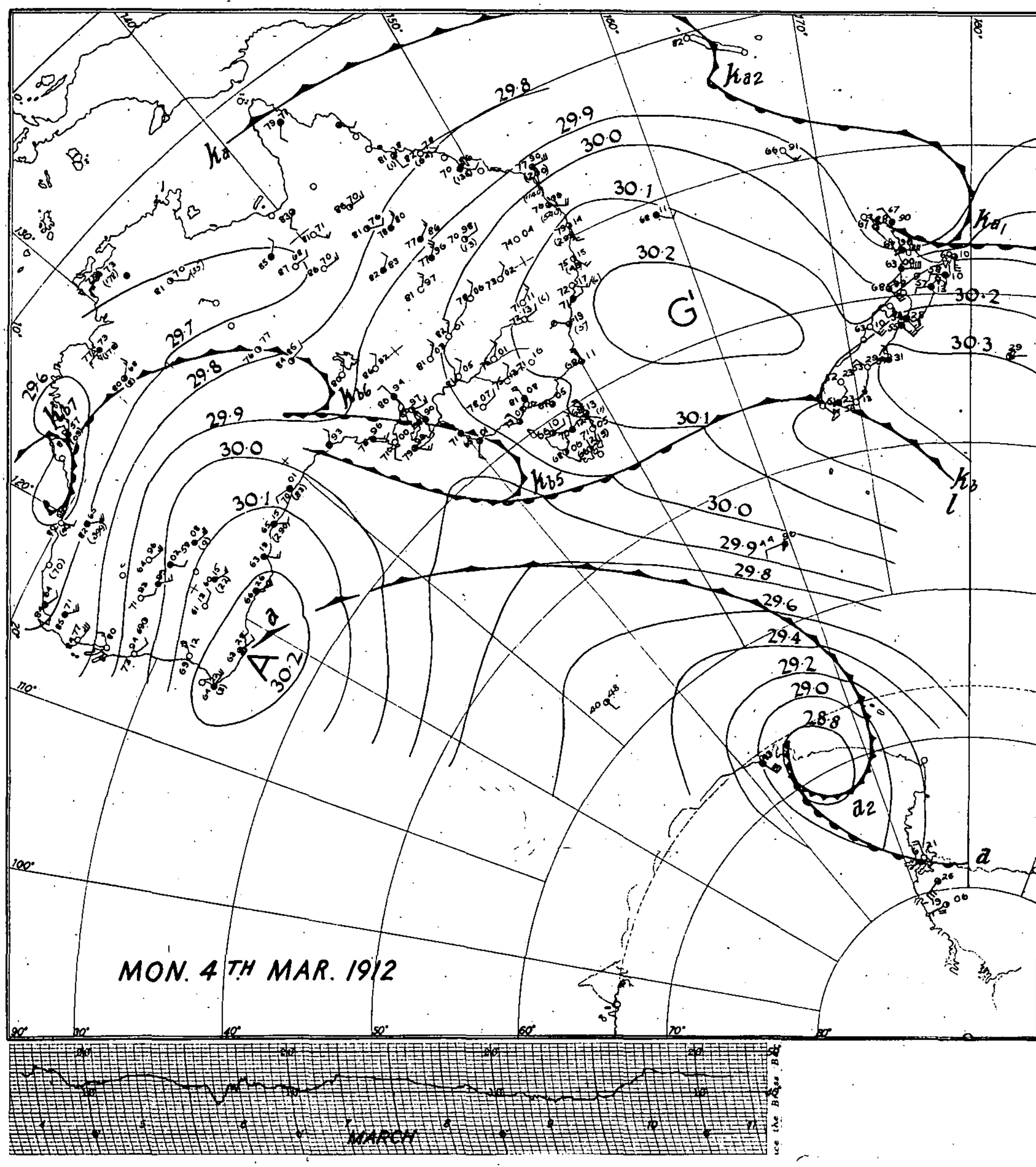
Front *k* is crossing anticyclone G. Note the shape of the waves on *j* which is moving northwards. There has been widespread rain in Western Australia, New South Wales and parts of Queensland, with many heavy falls.



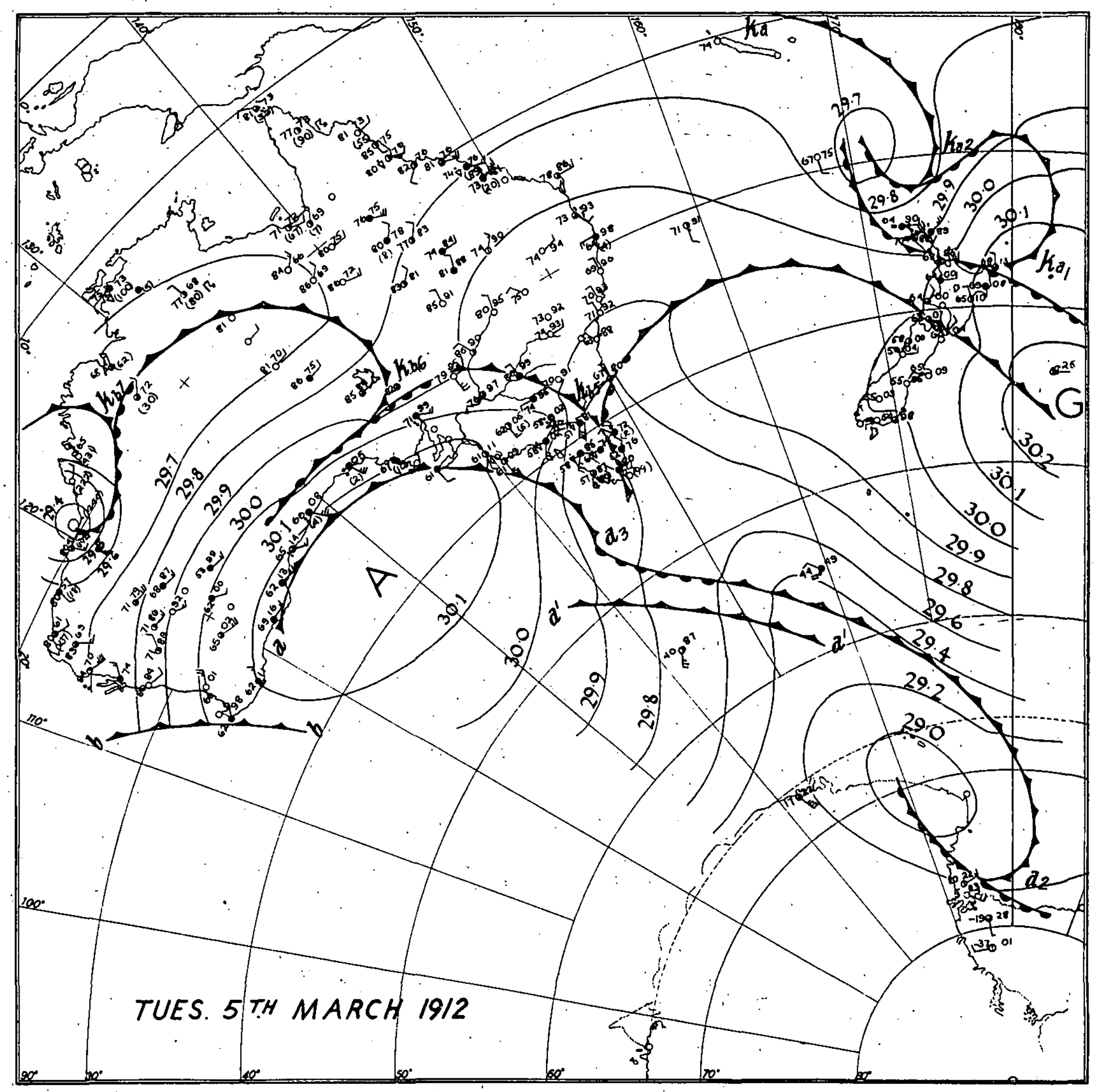
Front k has been broken by anticyclone G. The western part now called k_b has junctioned in the south with l. There has been further heavy rain in eastern Australia.



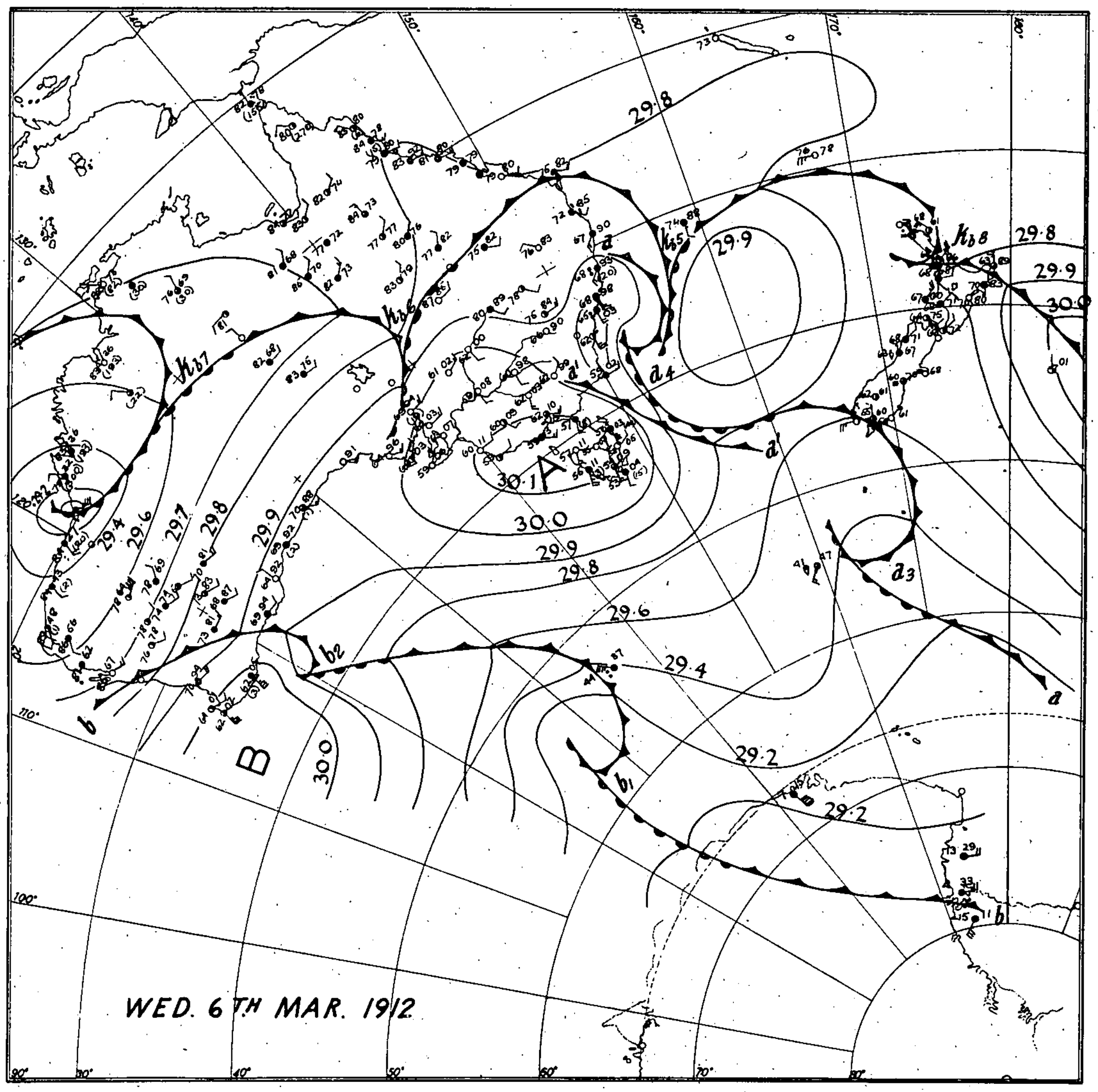
There are interesting evidences of the passage of front *a* in the Antarctic. Note the wind changes at the "Terra Nova," near McMurdo Sound, and the series of changes of pressure wind and temperature experienced by the "Aurora" north-west of Adélie Land.



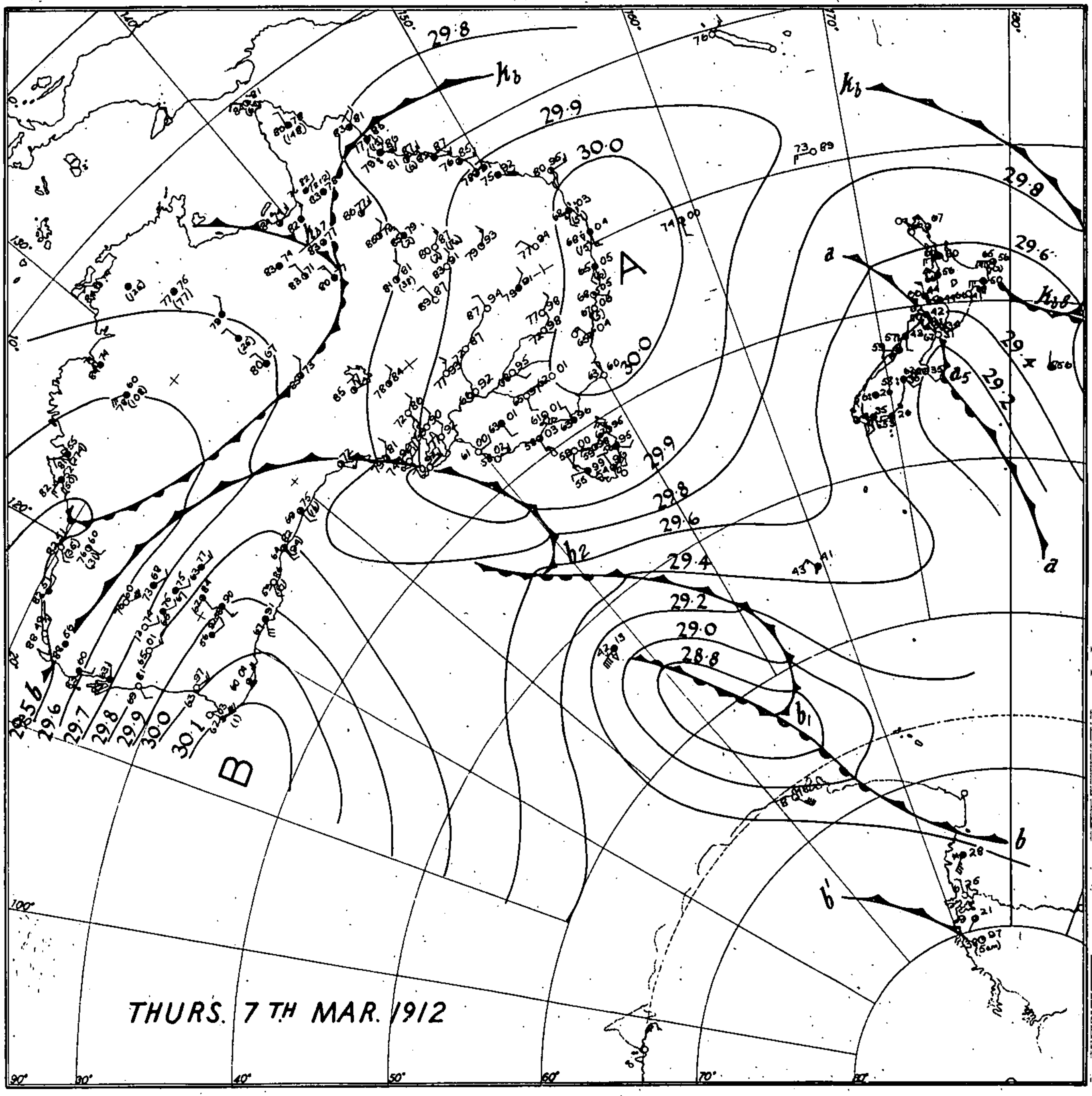
Note the evidence of the passage of a warm front at Cape Evans. Front *a* is passing anticyclone A. For some days there have been instability rains and rather low pressure in north-western Western Australia. Now a definite depression has formed, the last stage probably being the influx of cold air from around anticyclone A. There have been extremely heavy rains also on the south coast of Queensland.



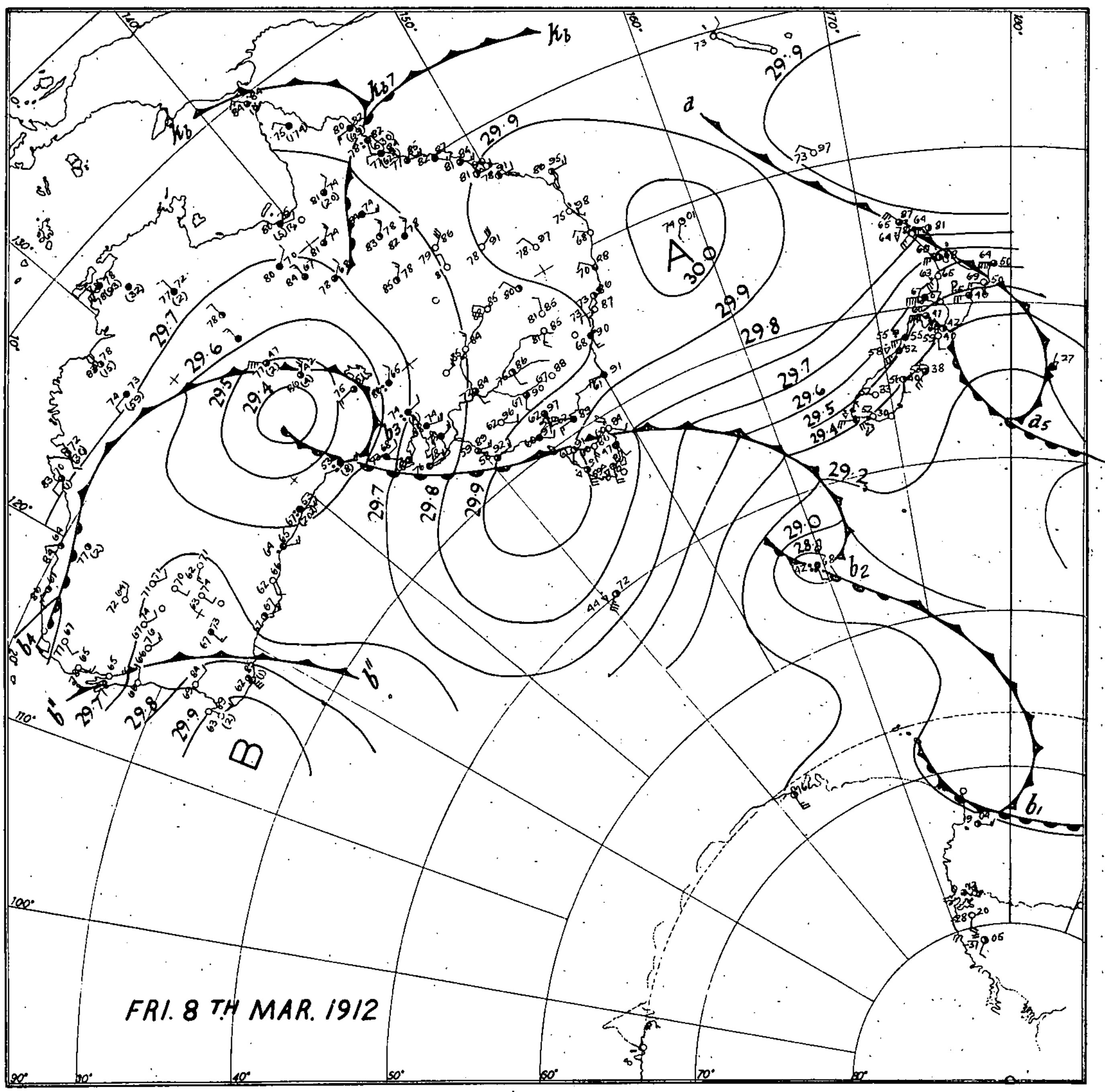
A typical example of a tropical cyclone of north-western Australia is now developing there. It is not a very deep one but is causing very heavy rain. Note also the cyclonic development over northern New Zealand.



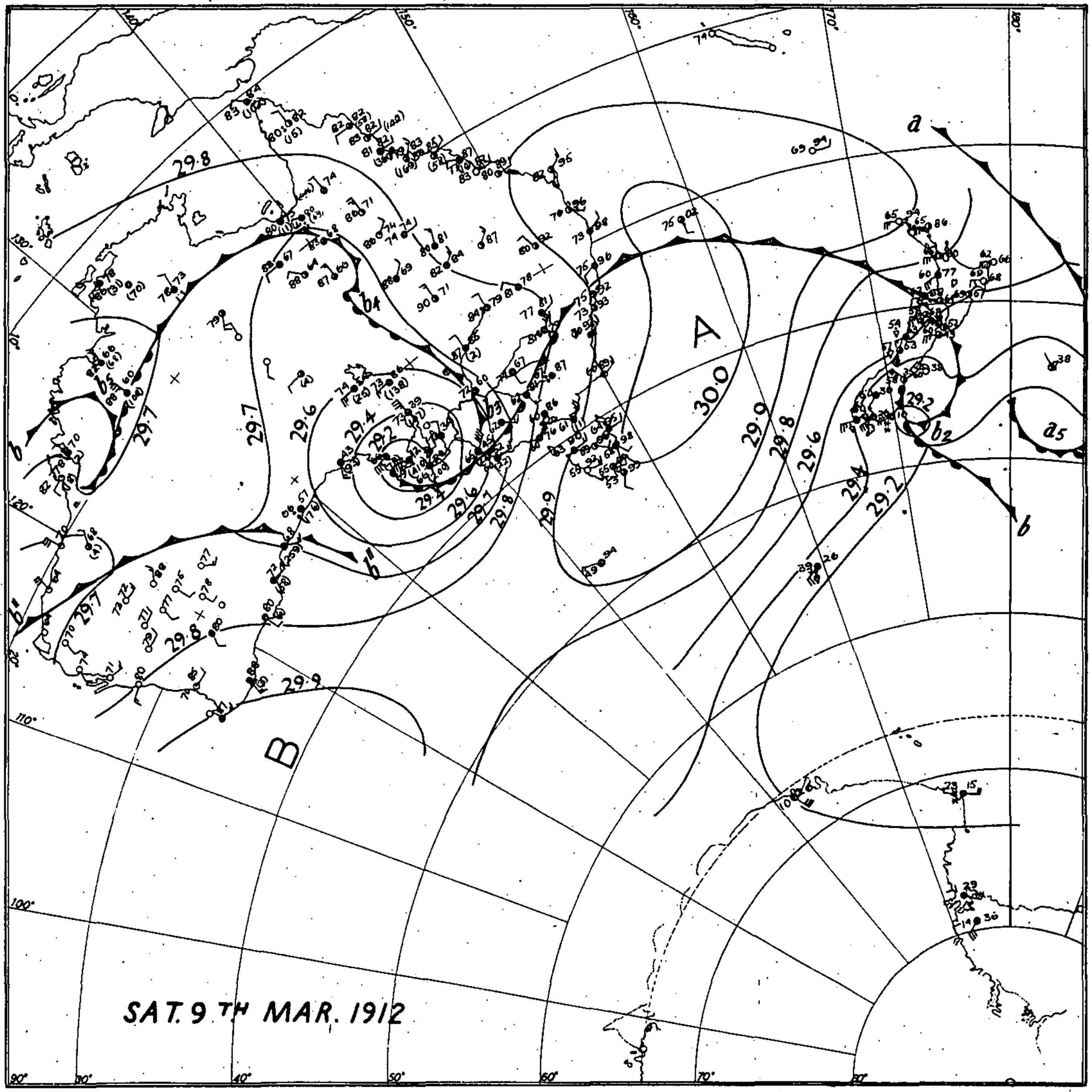
The north-western cyclone has intensified. A very marked fall of temperature is shown on the Macquarie Island thermogram with passage of the occlusion of wave a_3.



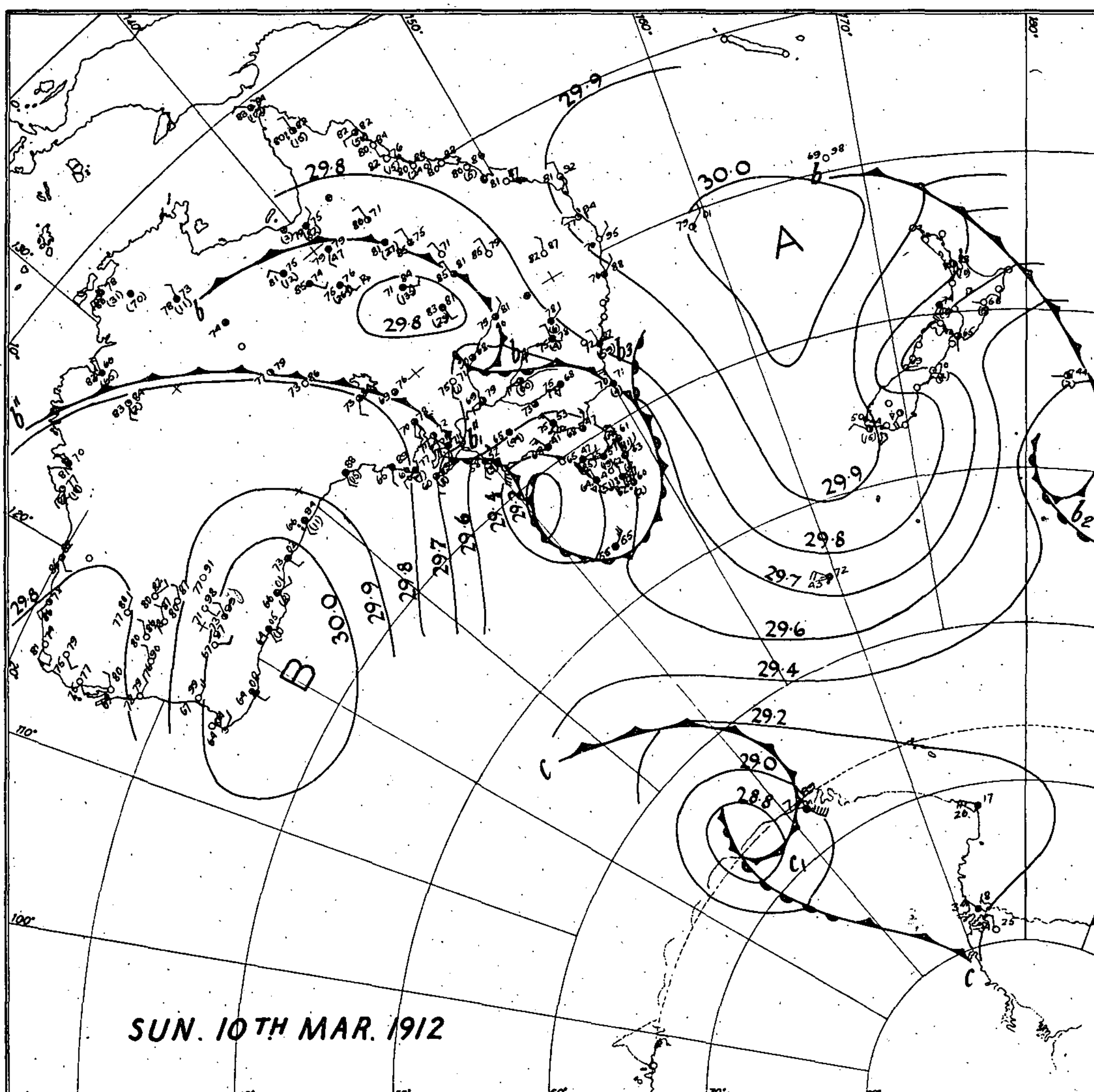
The north-western cyclone is now filling up.



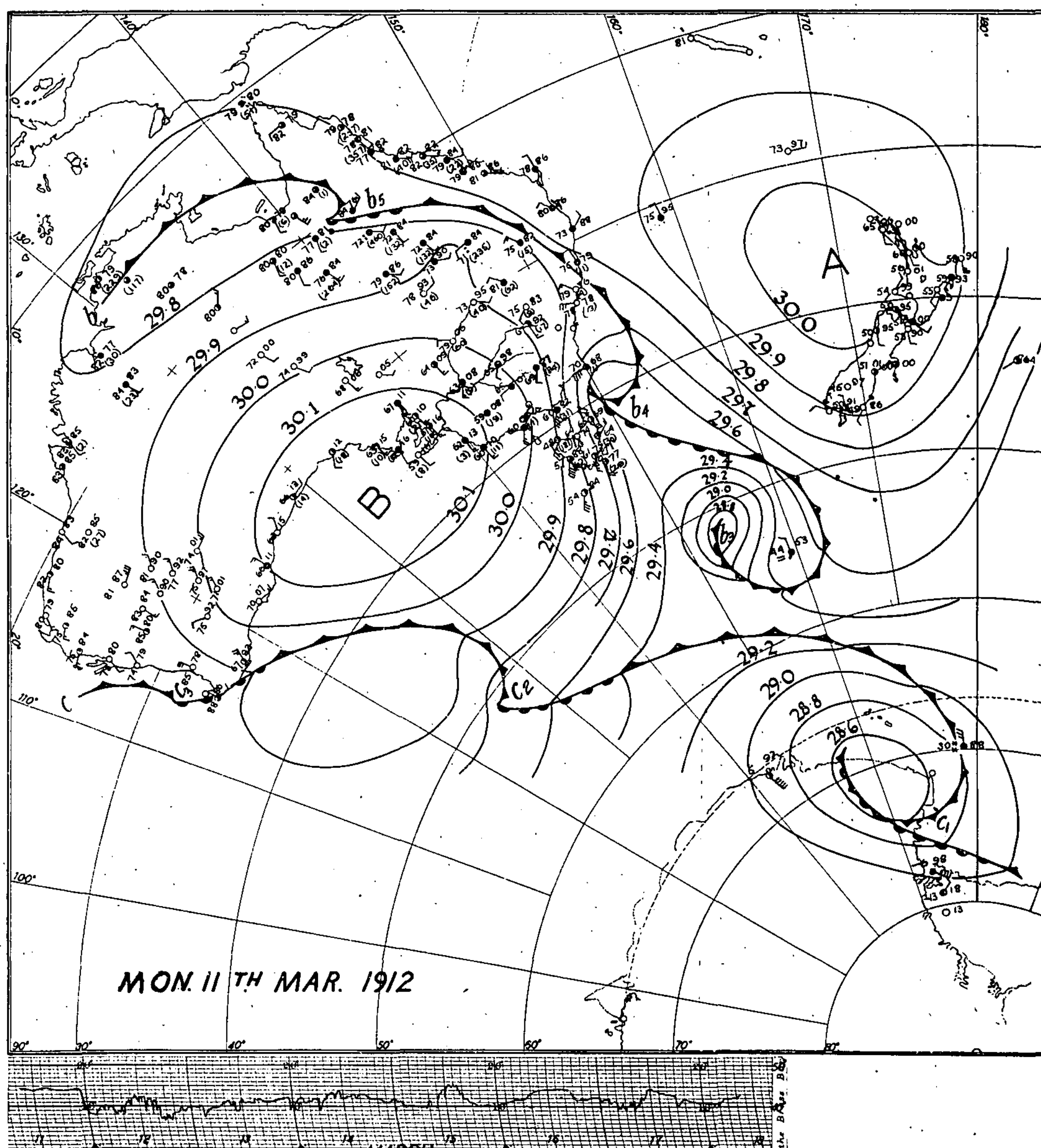
Note the strong westerly winds over New Zealand and the very low pressure at Macquarie Island. There is a very interesting development in south-central Australia. This is probably associated with the influx of cold air into the field of the tropical cyclone.



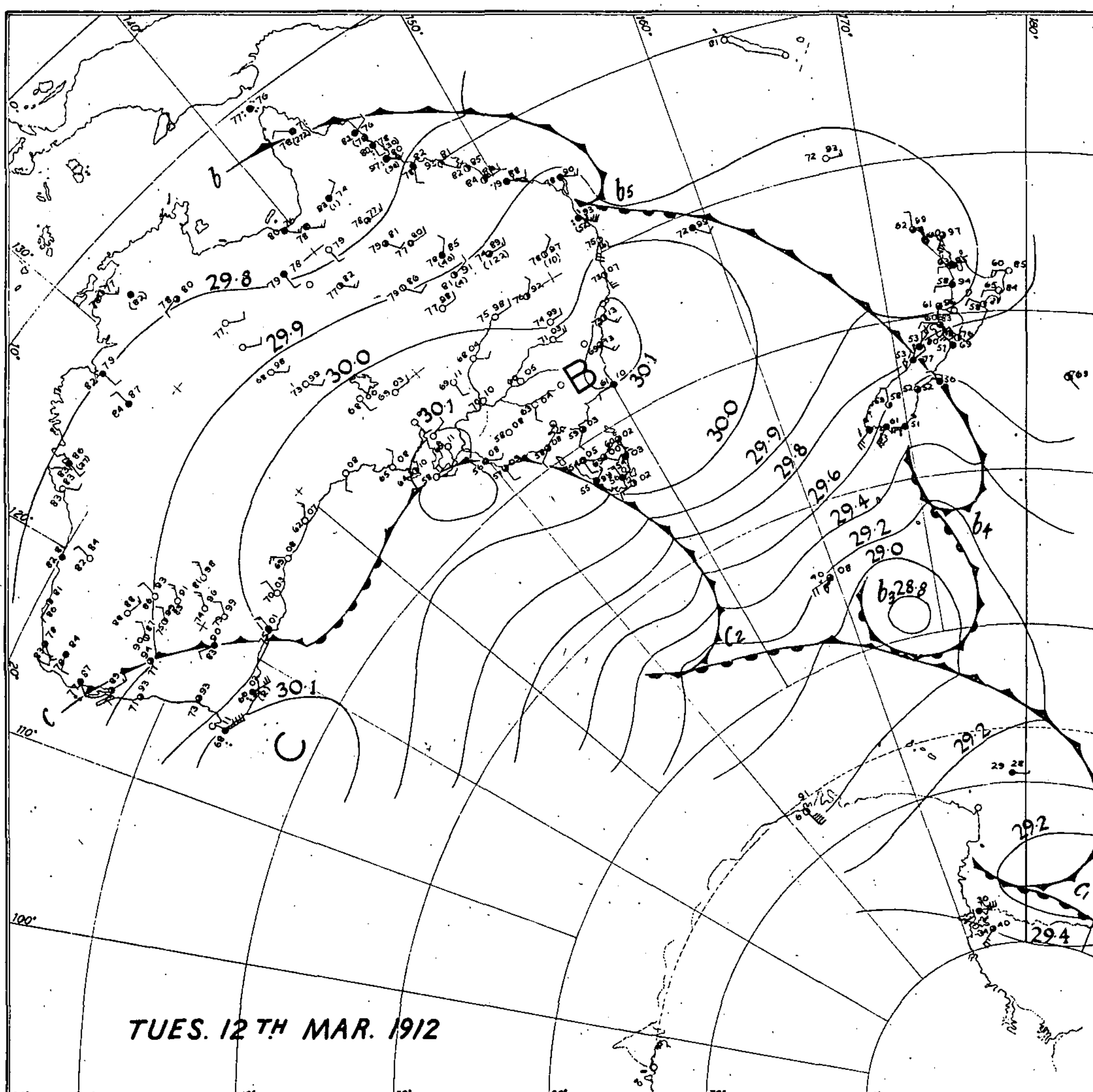
Wave b_3 has developed into an intense cyclone. A second cyclone is incipient in the north-west of Australia. The eastern part of front b is crossing Anticyclone A.



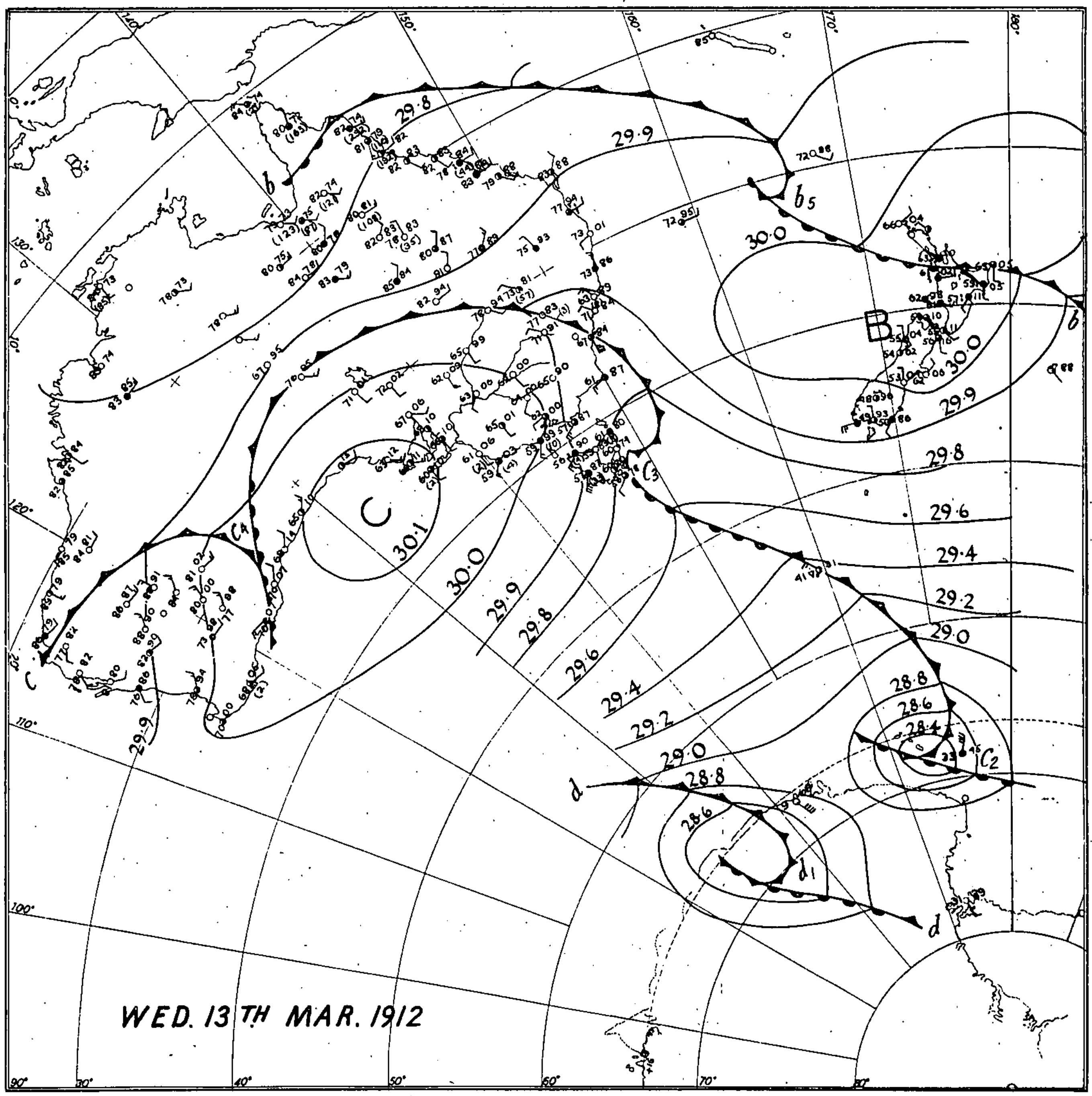
Front *b* is now separating into two parts. Note the northerly winds in the Ross Sea region. The second cyclone failed to develop in north-western Australia. There was much rain around cyclone b_3. There have been heavy falls and thunder also in western Queensland.



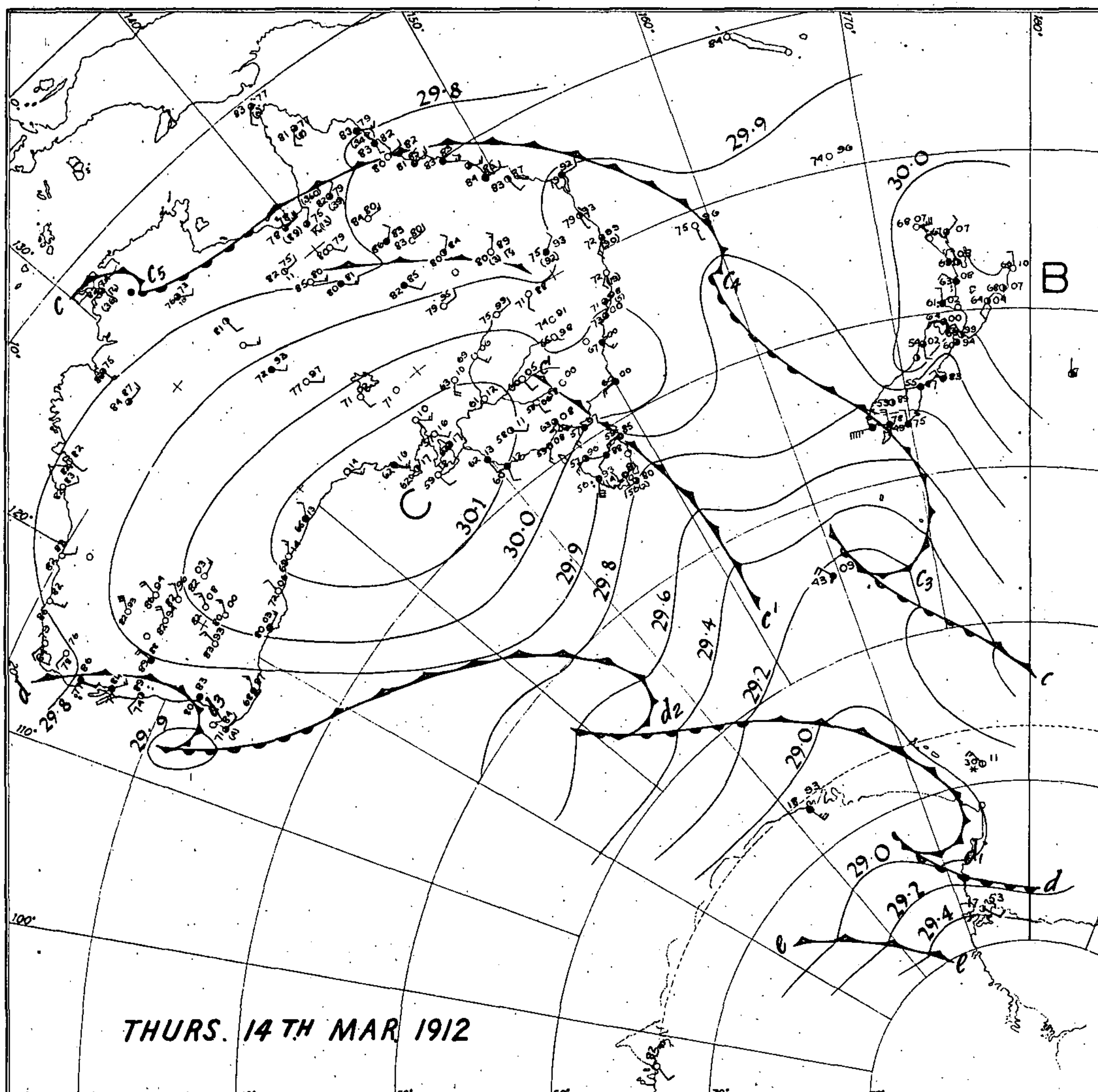
A deep cyclone has developed on the tip of the occlusion of b_3. The deepening is possibly due to a fresh supply of cold air behind front b^{II} which has merged in b_3.



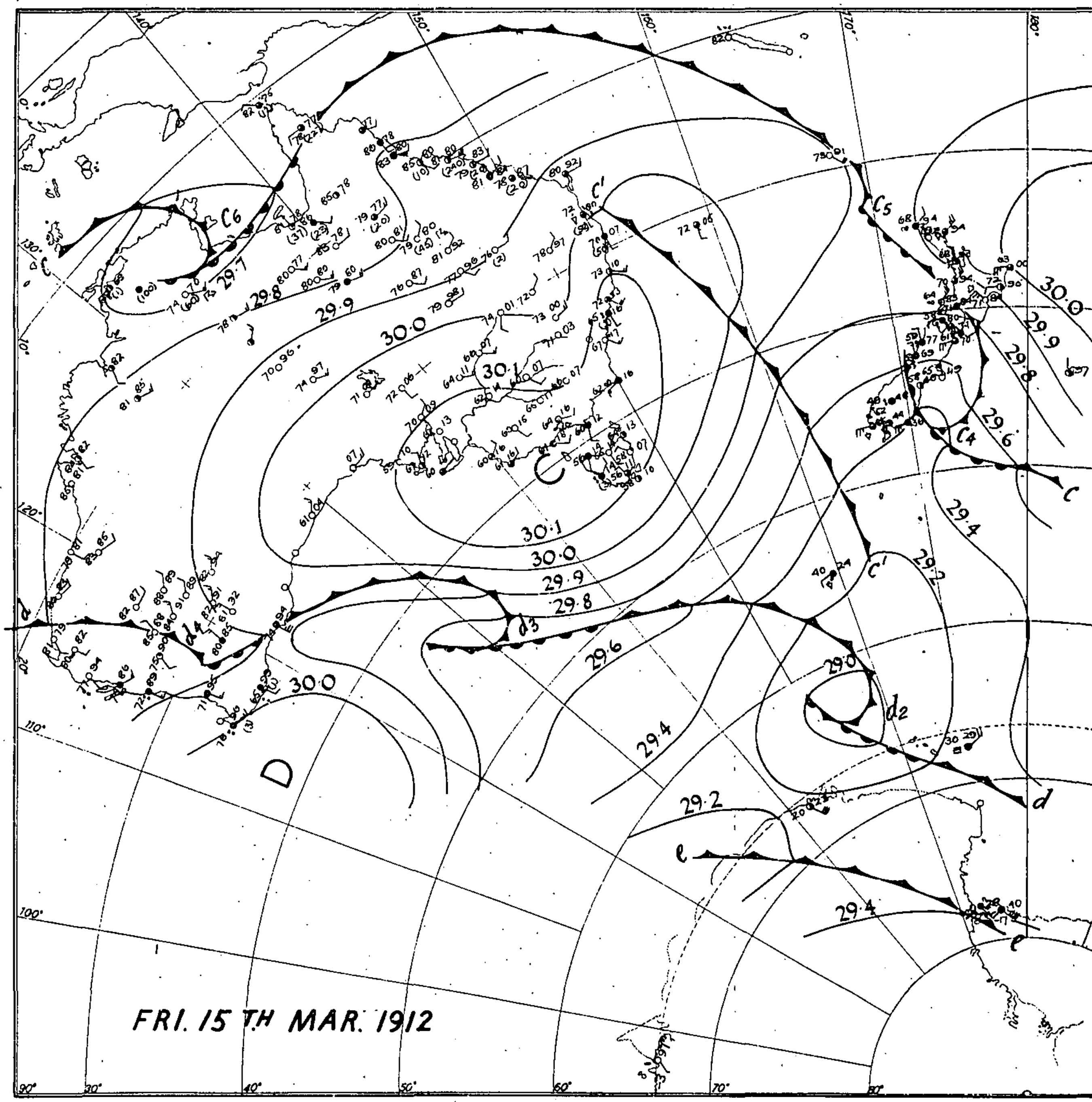
Note the series of changes, especially winds in the Ross Sea area with the passage of front c and cyclone c_1. The temperature falls very sharply again at Macquarie Island after the passage of cyclone b_3.



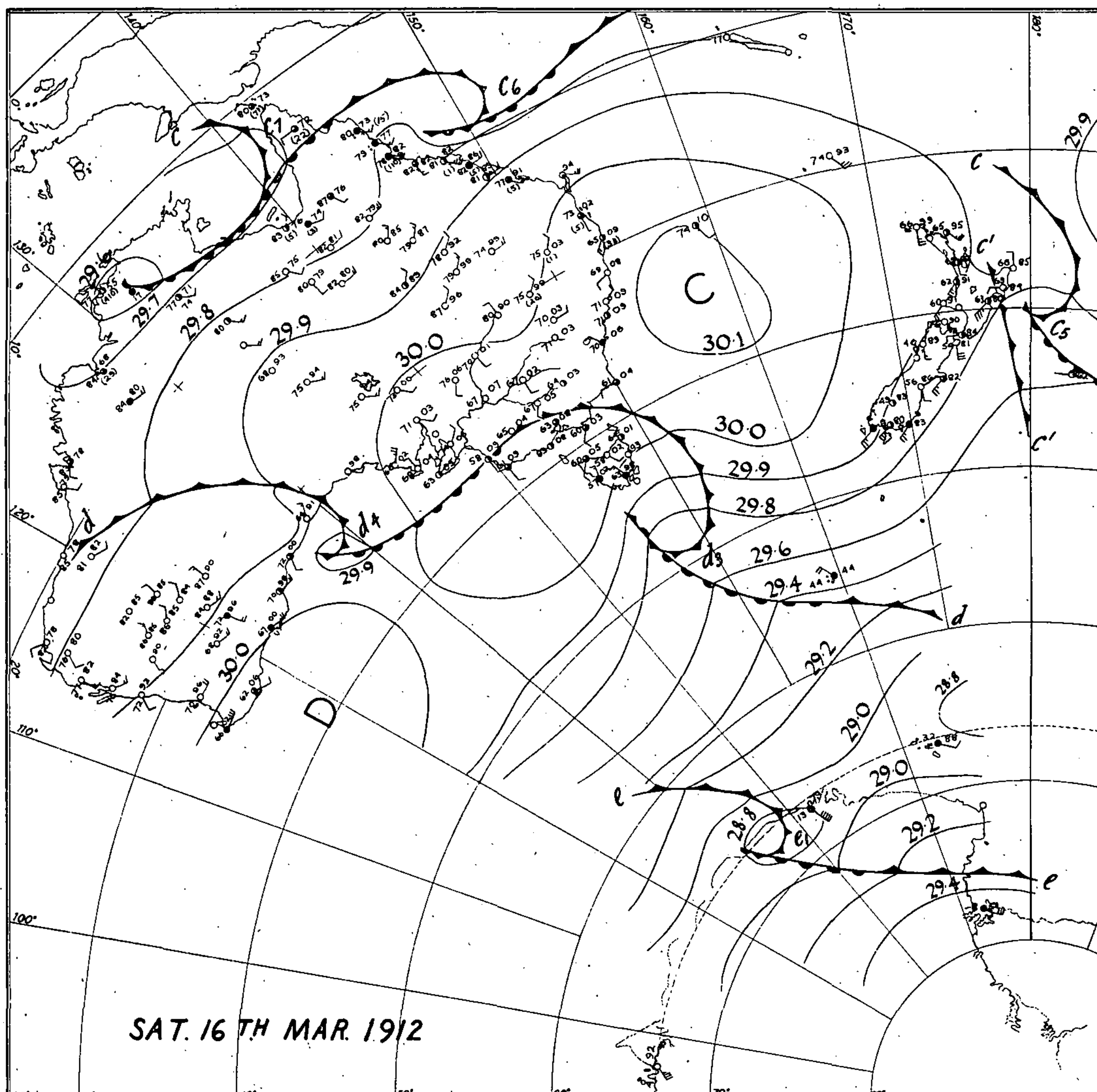
. Note cyclone c_2 which is passing the "Terra Nova." Much rain is still reported from northern Queensland.



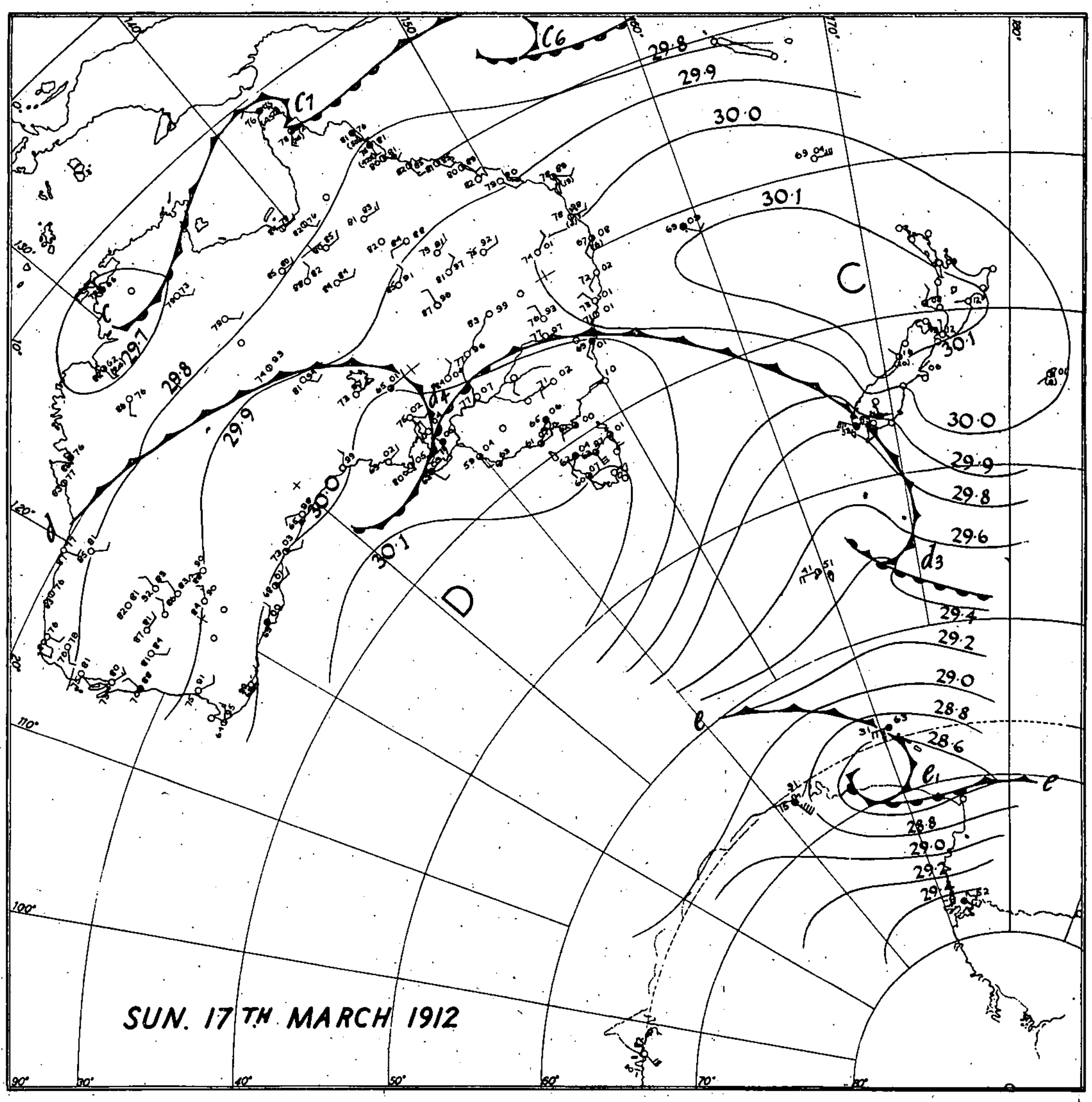
The series of wind changes recorded in the log of the "Terra Nova" during this period are very interesting. Heavy rains are again reported from northern Queensland.



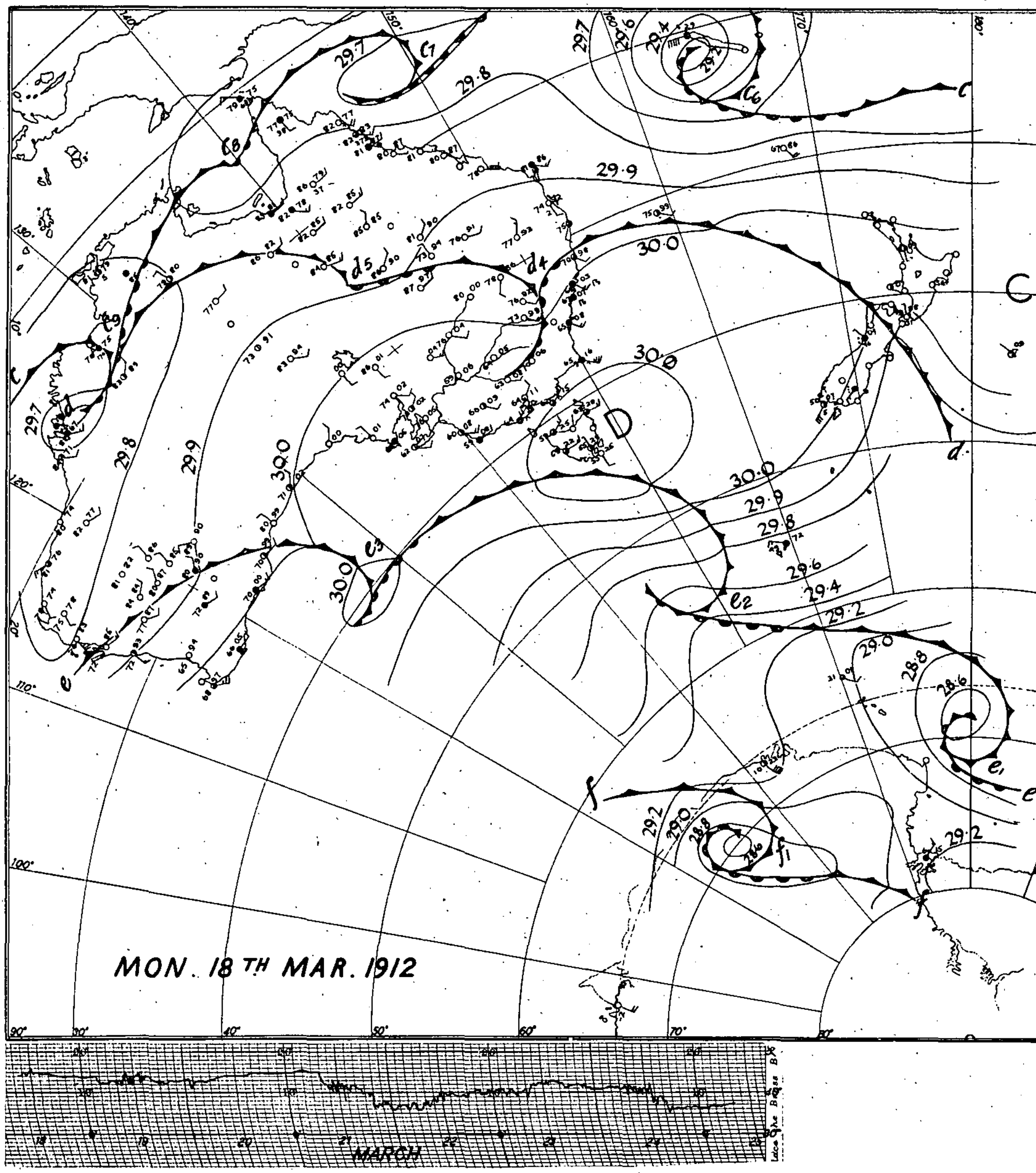
Note the commencement of a series of waves in the tropics on front *c*. There were many sudden falls of temperature at Macquarie Island during the preceding few days, due to hailstorms.



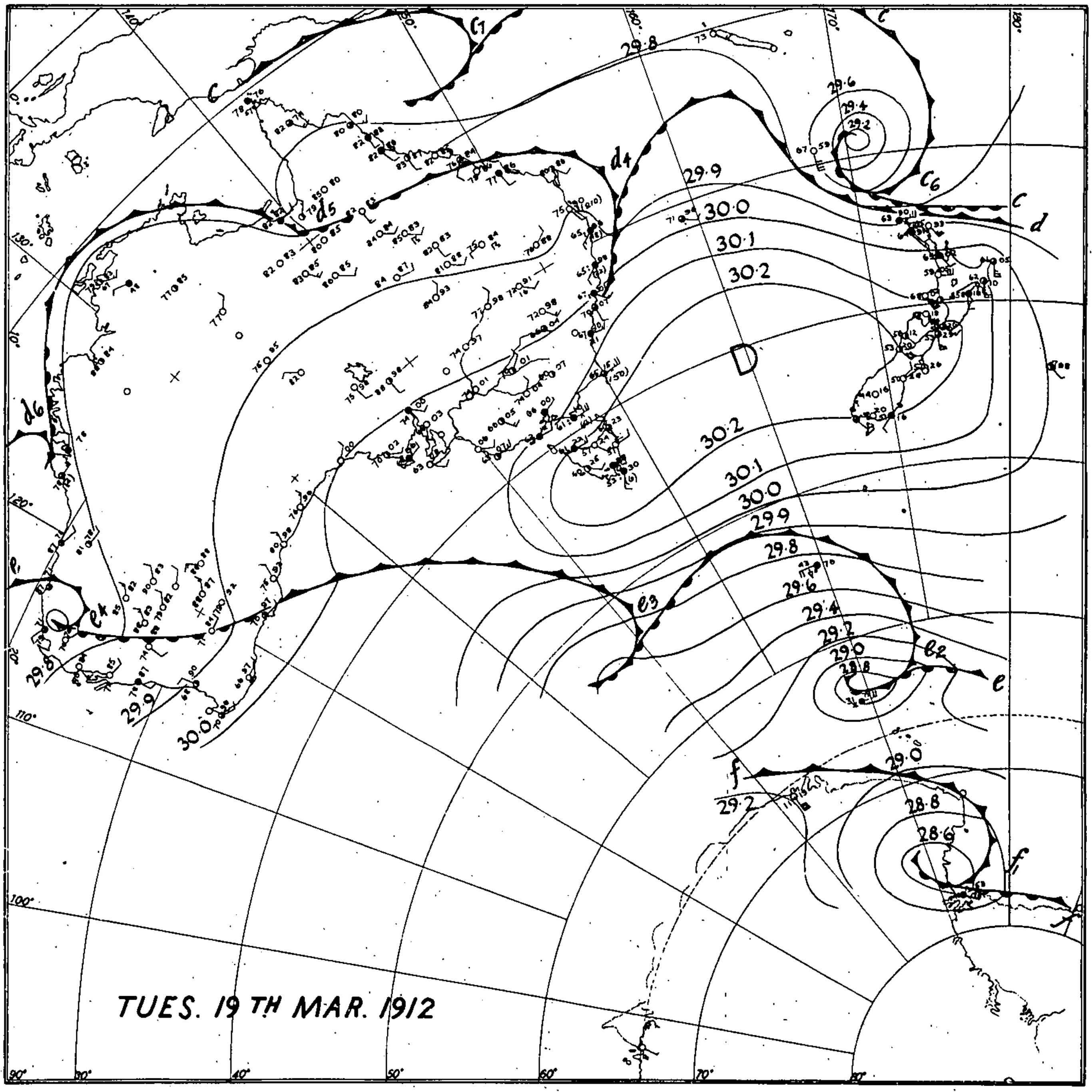
There is a small cyclone at Darwin at the tip of the occlusion of c_7.



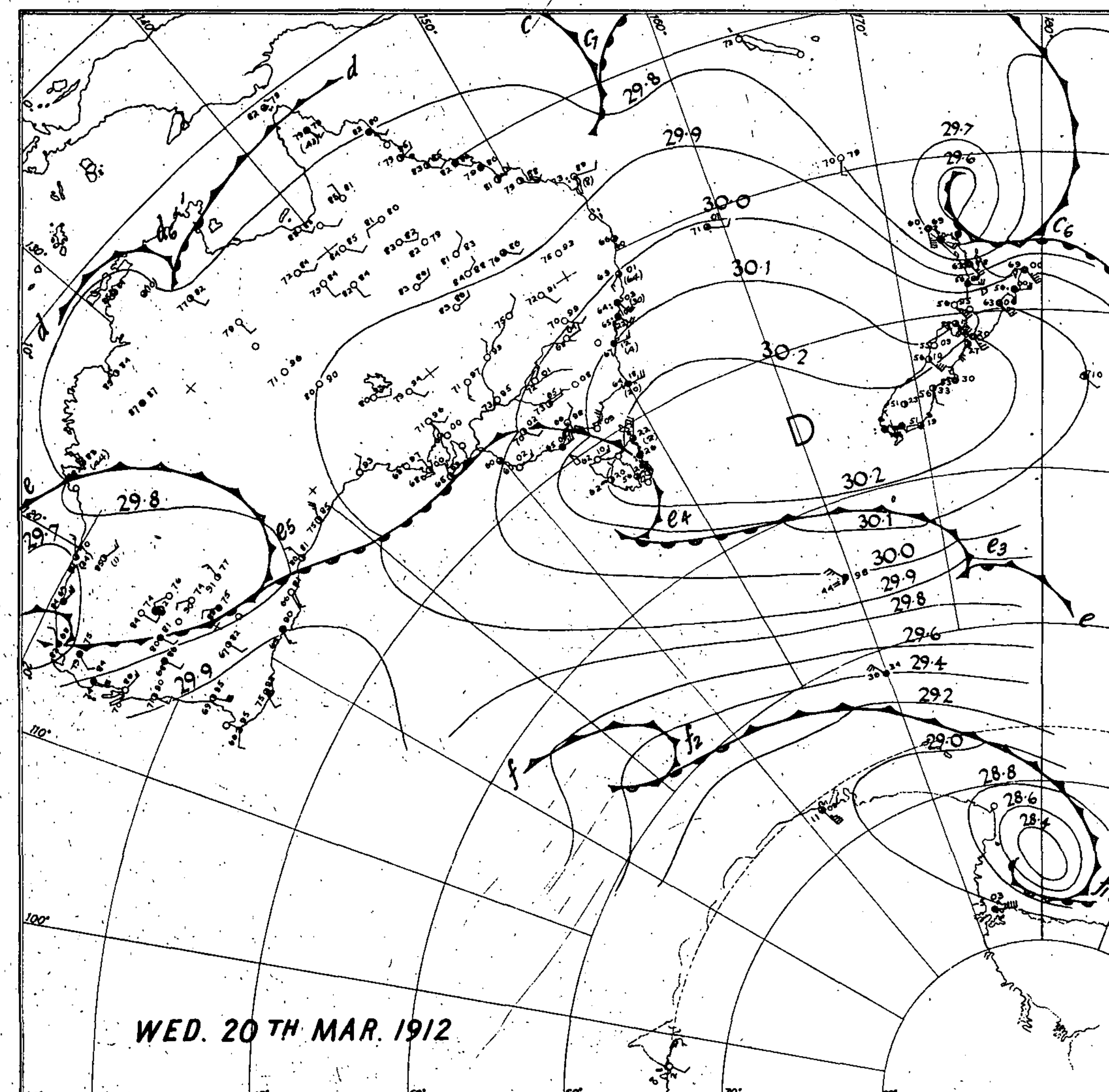
The passage of cyclone e_1 is well shown by the "Terra Nova" observations. Some very heavy rains are reported from the north coast of Queensland.



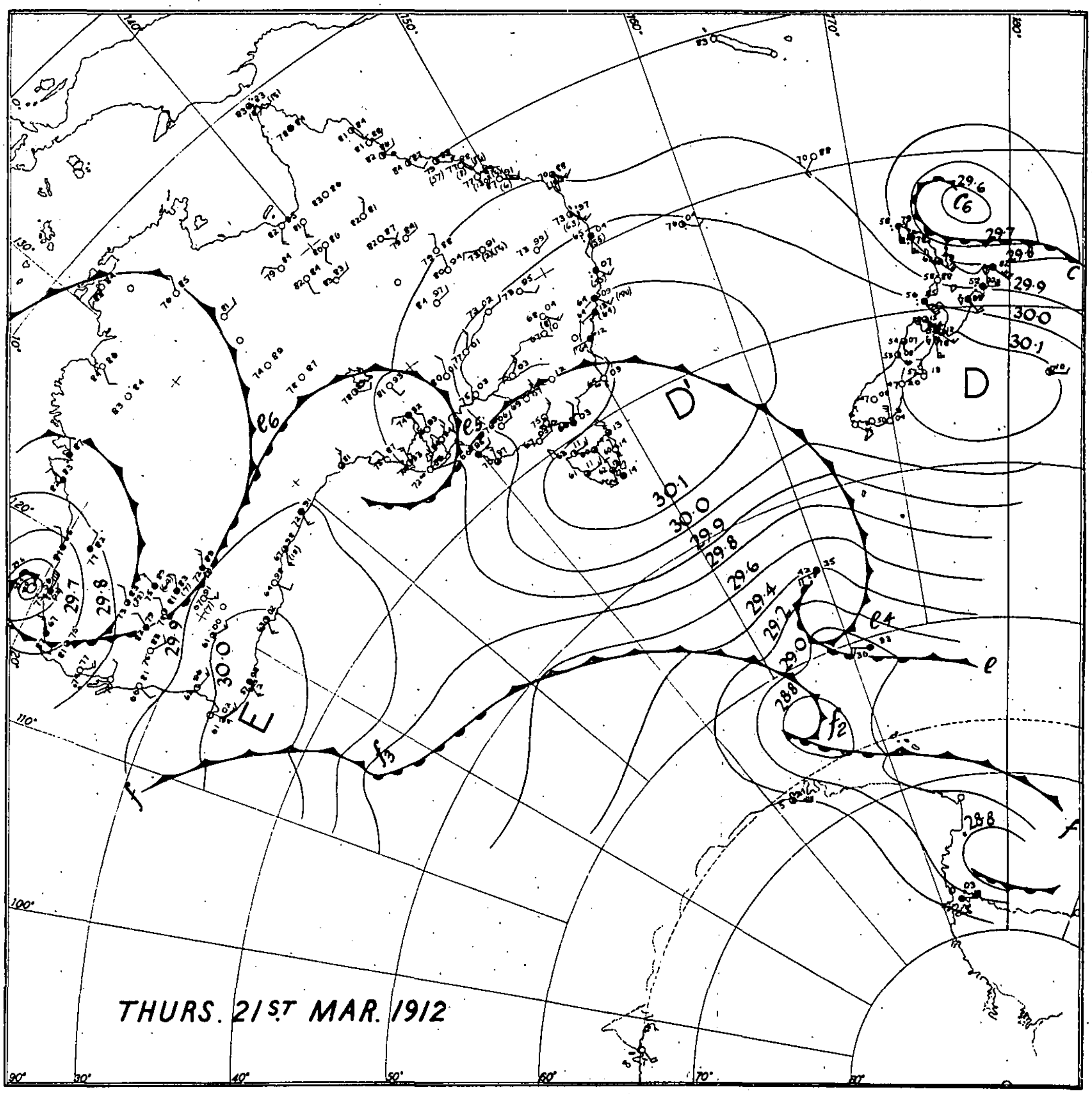
Activity still continues on front c in the tropics. A well-developed cyclone, c_6 is now centred near New Caledonia.



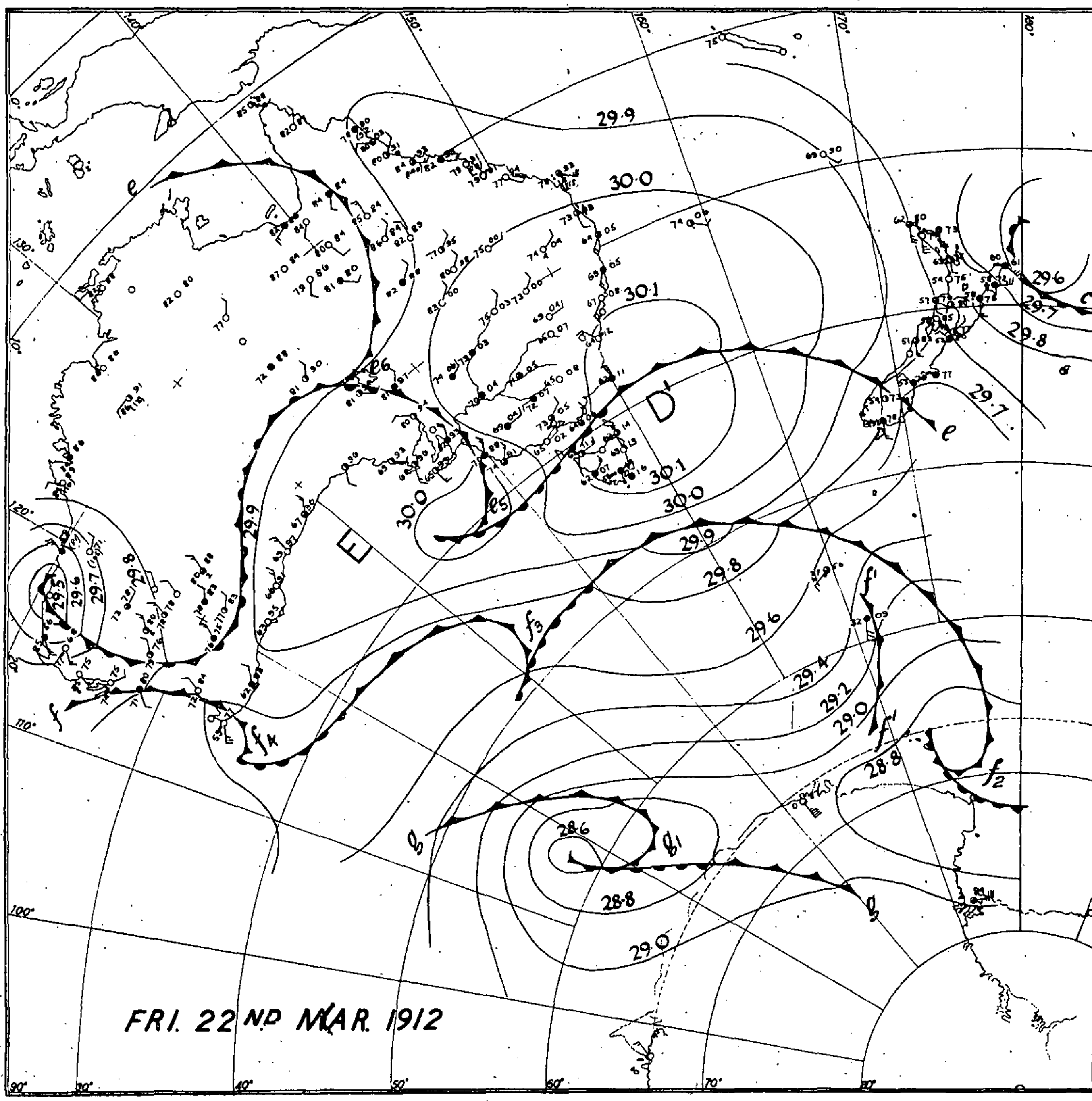
Cyclone c_6 is now approaching New Zealand. Another deep cyclone is passing the "Terra Nova."



Cyclone c_6 is moving more slowly and filling up. A cyclone is forming in north-western Western Australia, the centre being on the occlusion of e_5.

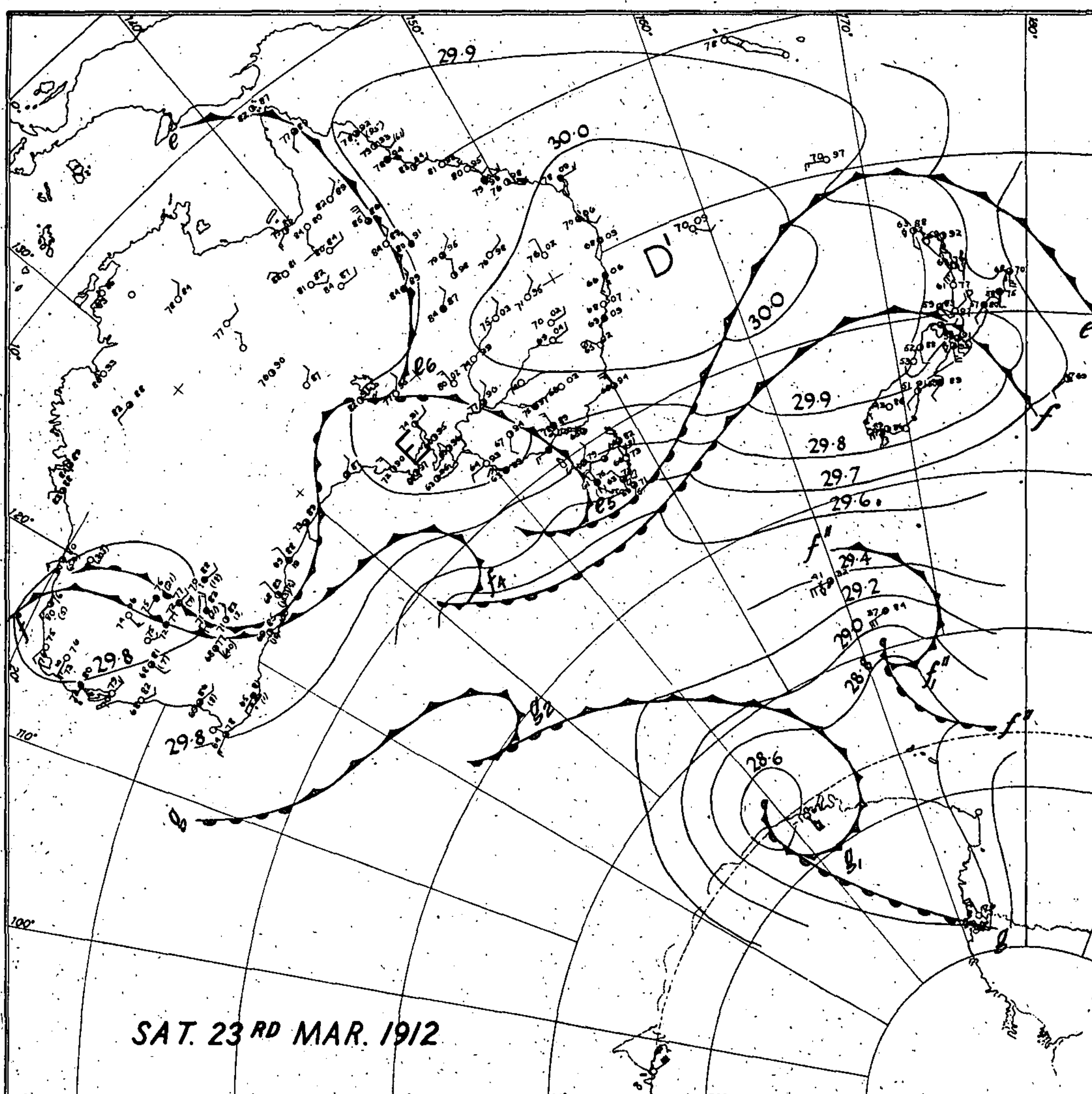


Cyclone c_6 has moved very little. The new cyclone in north-western Western Australia has become deep.

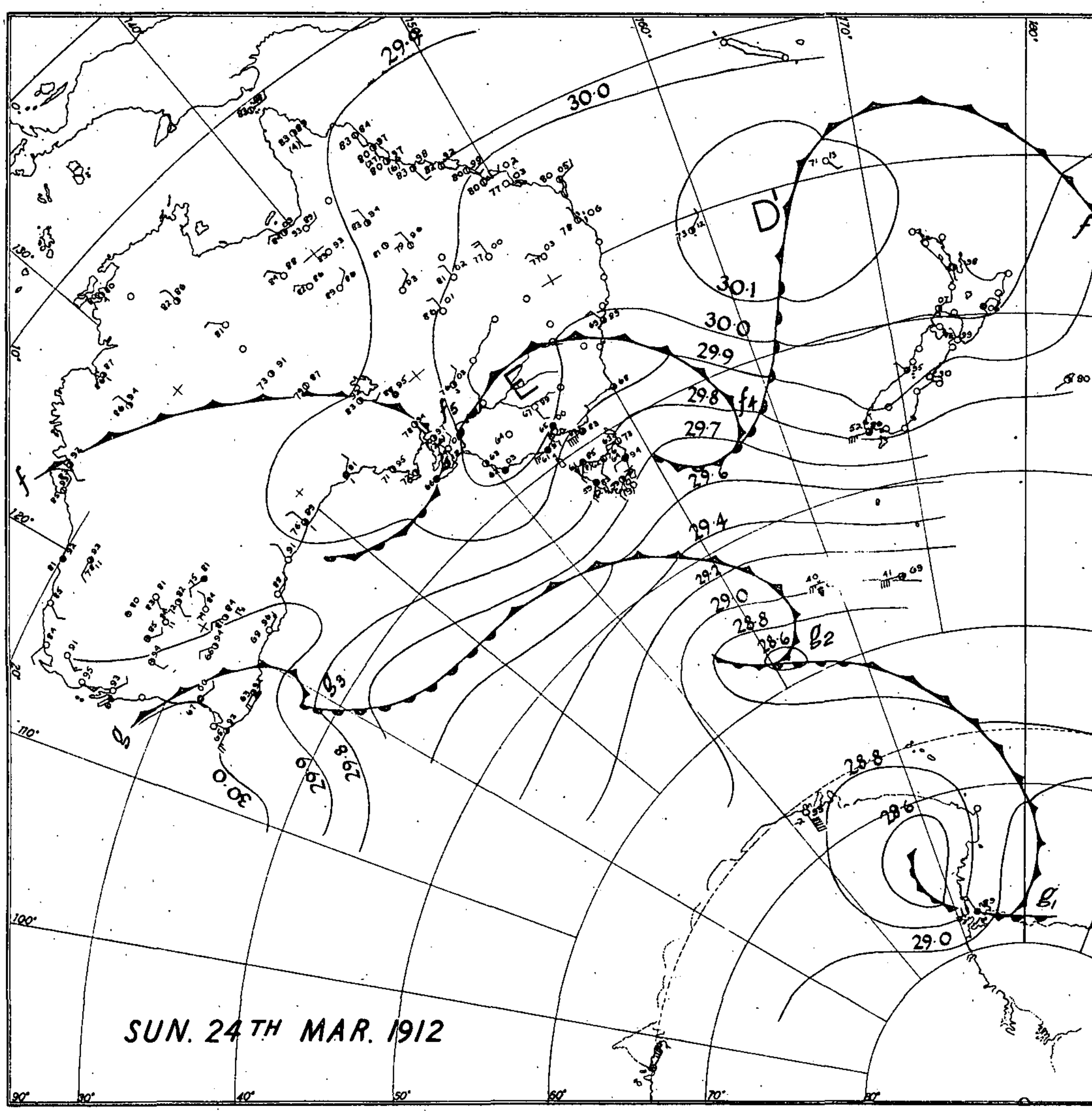


The cyclone in Western Australia has reached its maximum development. It was very severe. Rainfalls of from 9 to 13 inches were reported from near its centre. The pressure fell to 28·866 inches (977·5 mb). Great damage was done by it.

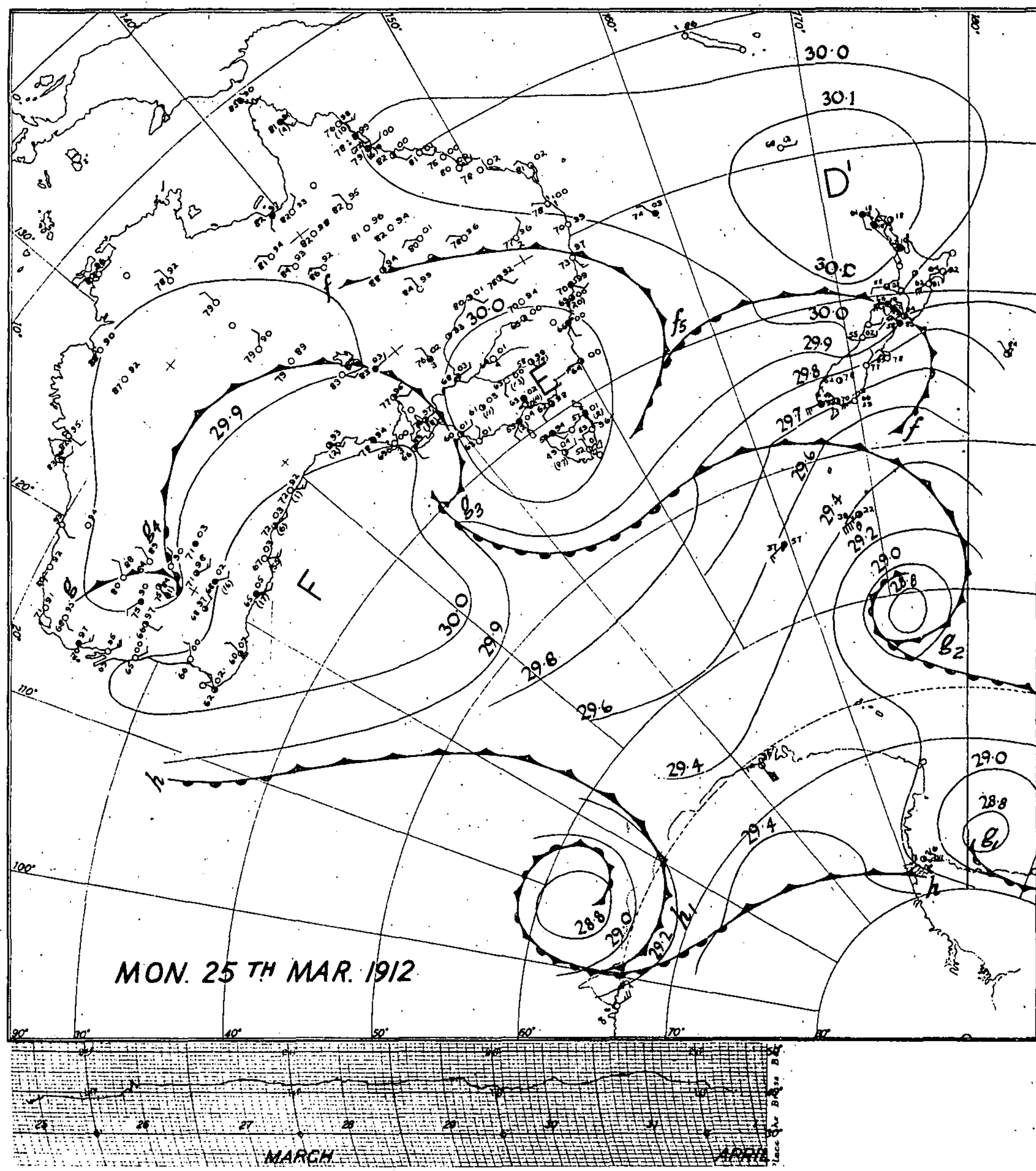
There were marked temperature changes at Macquarie Island with the passage of fronts *e* and *f*.



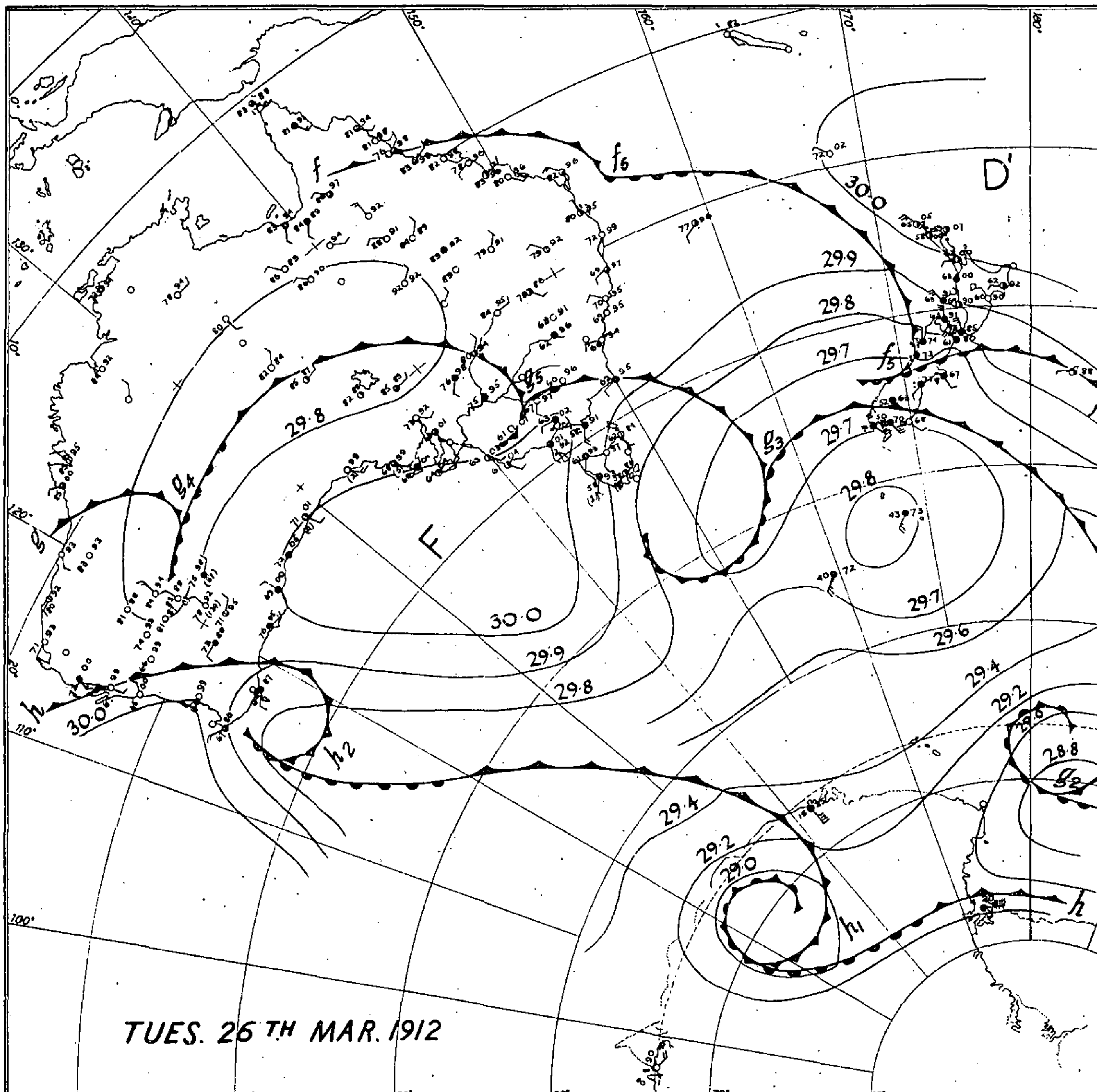
Anticyclones D' and E become merged. Front f has a west to east orientation. Note the northerly winds at Cape Evans and the movement of cyclone g_1.



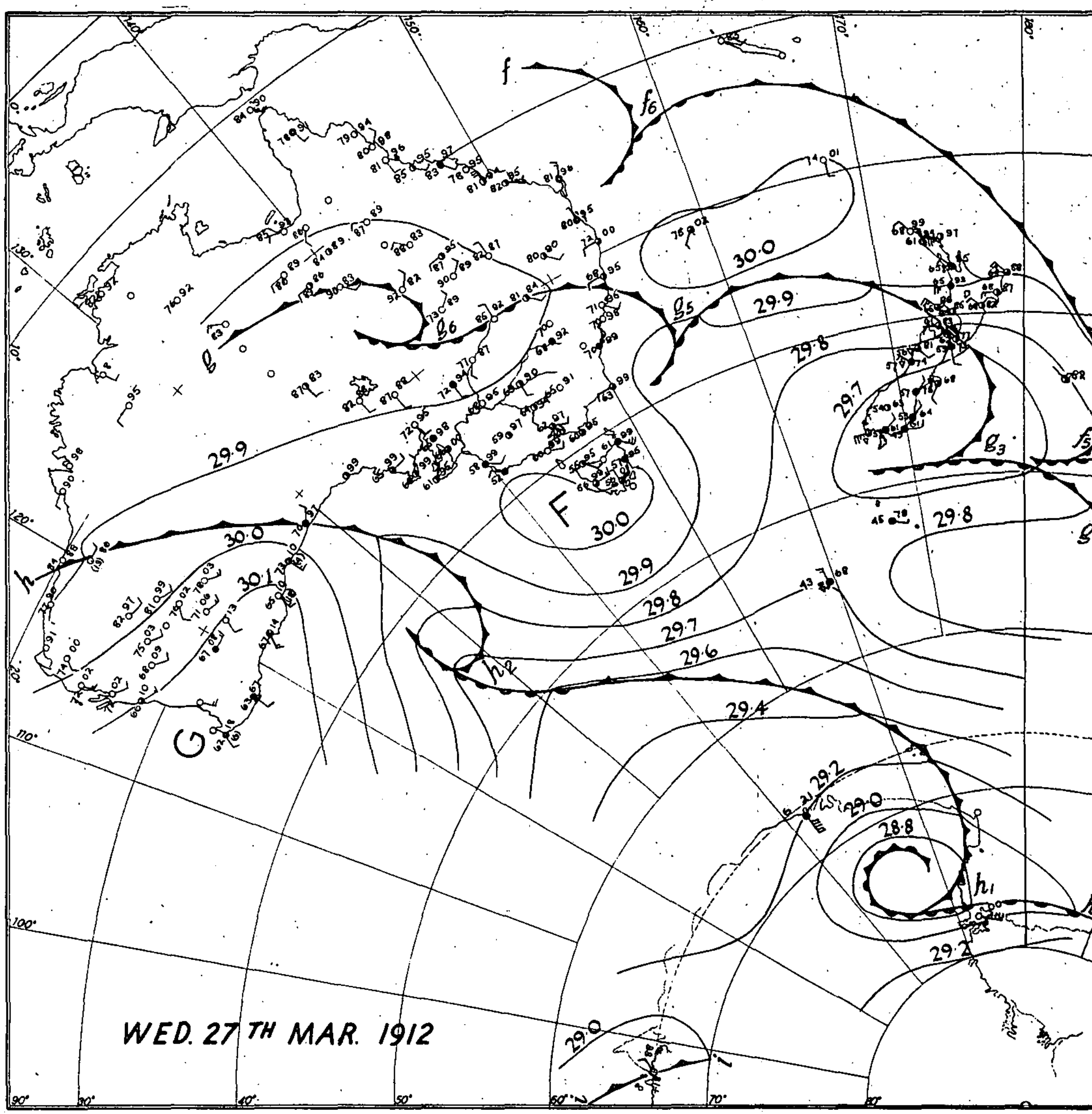
A' cyclone is evidently passing north of Queen Mary Land but no pressure readings are available. Wave g_2 causes marked temperature changes at Macquarie Island.



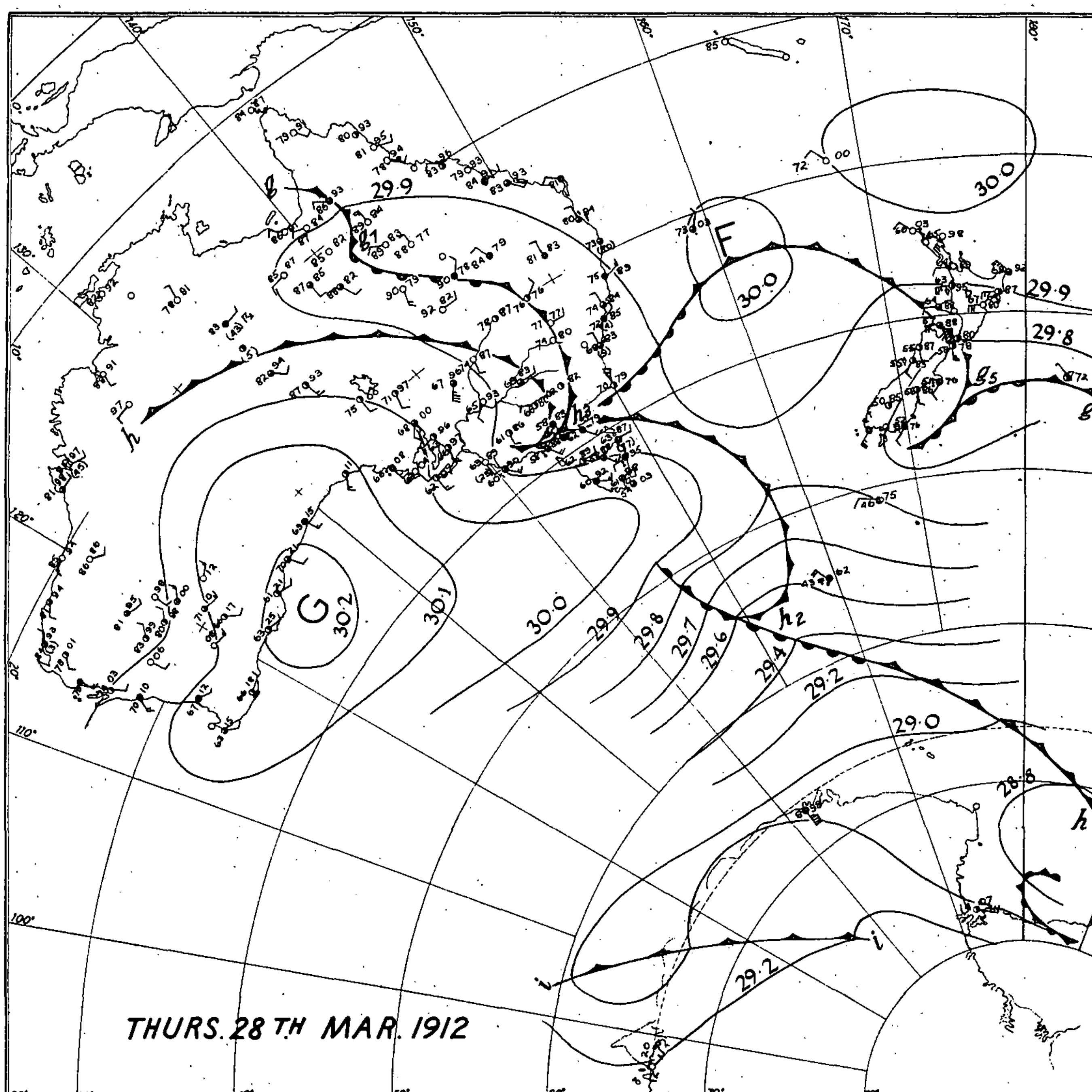
A blizzard follows the passage of cyclone g_1 at Cape Evans. There has been widespread rain over Victoria.



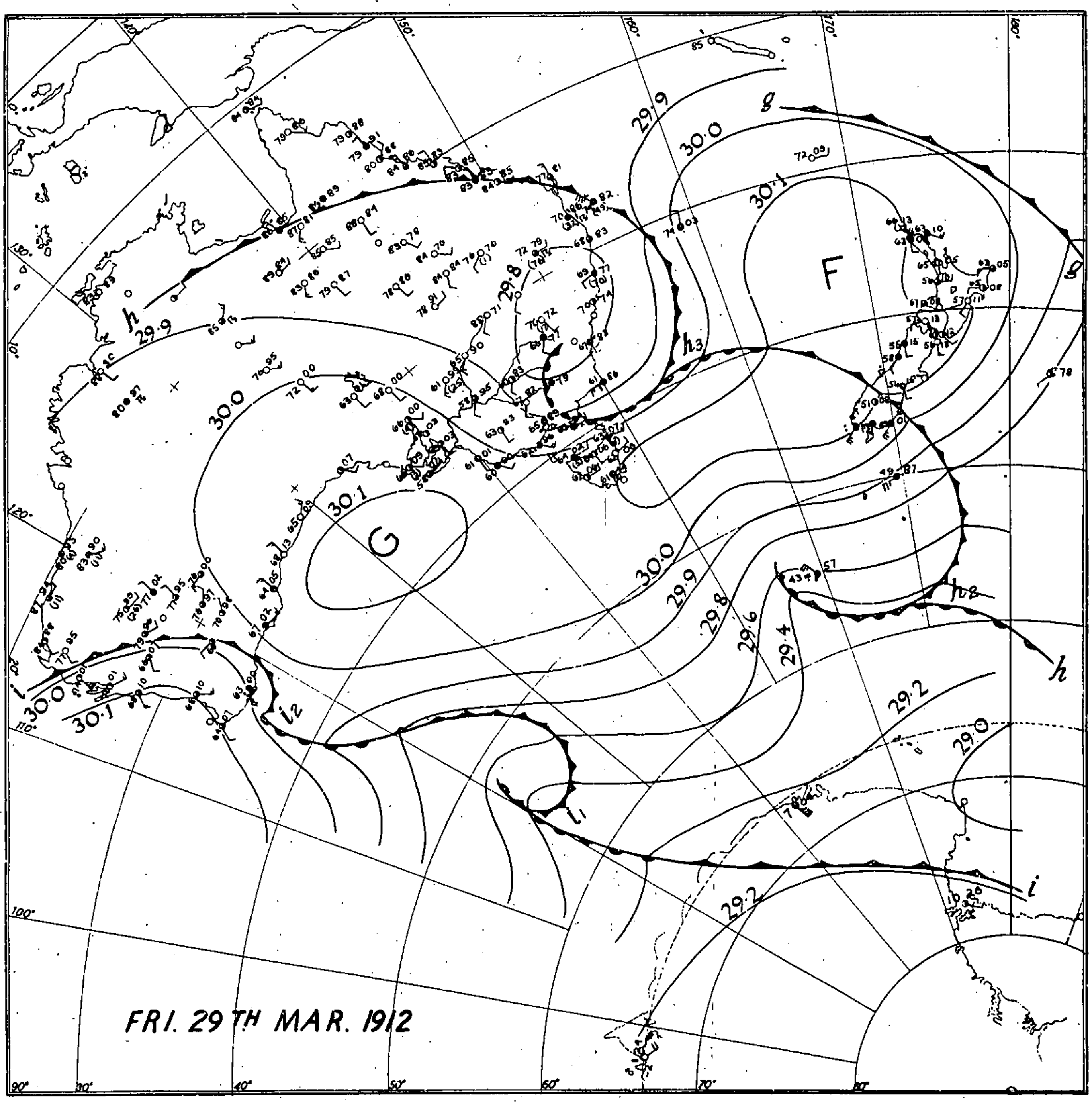
The blizzard at Cape Evans increases with the passage of front h. Rain is falling at a number of places in Victoria south of wave g_5.



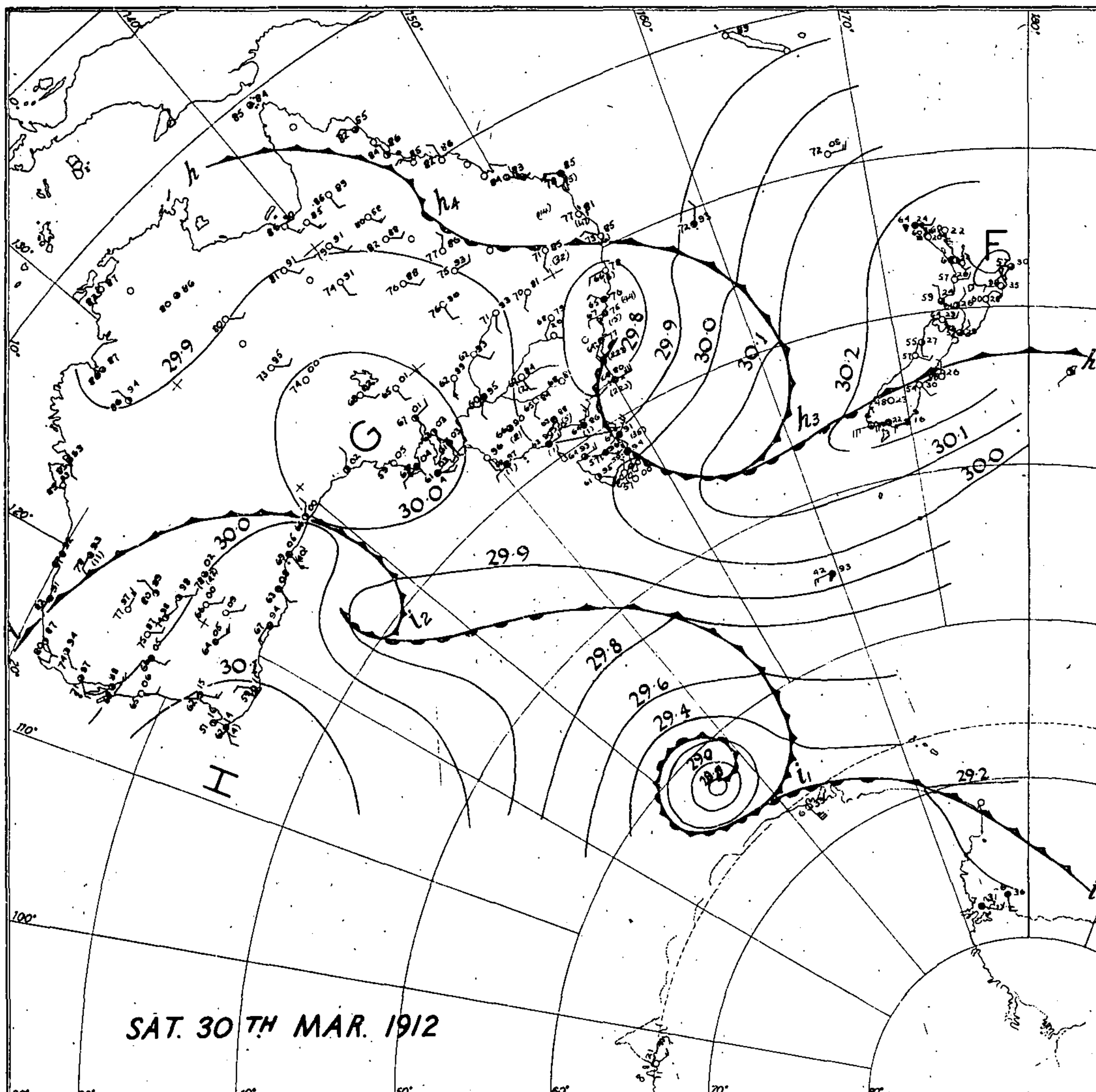
Front g, following f, also takes a more nearly west to east orientation than normal. The shape of the waves on it changes accordingly.



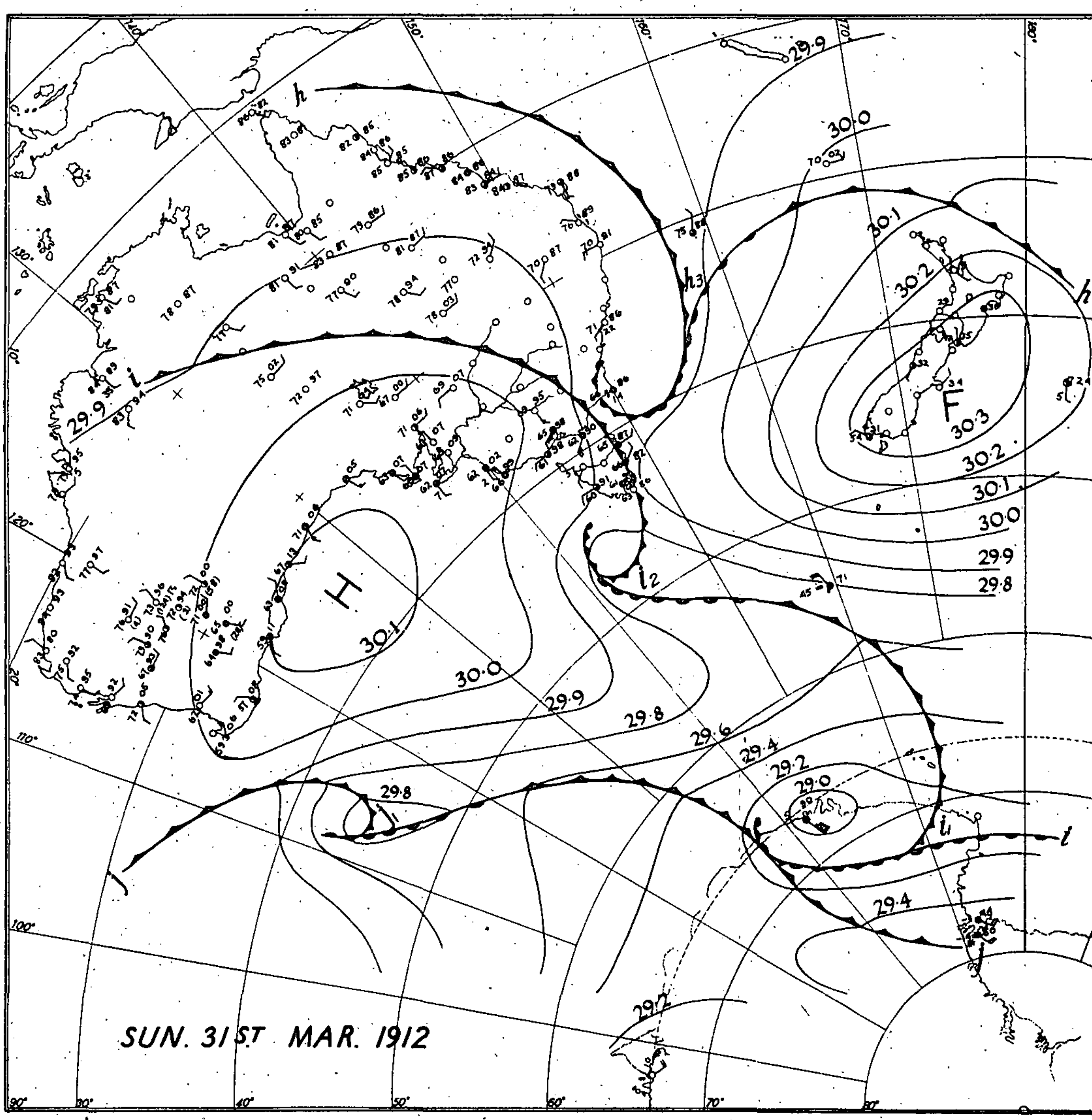
An active depression has formed where wave h_3 has moved up to g_6 and absorbed it. It is raining at many places in Victoria round the centre, especially south of the warm front and the occlusion.



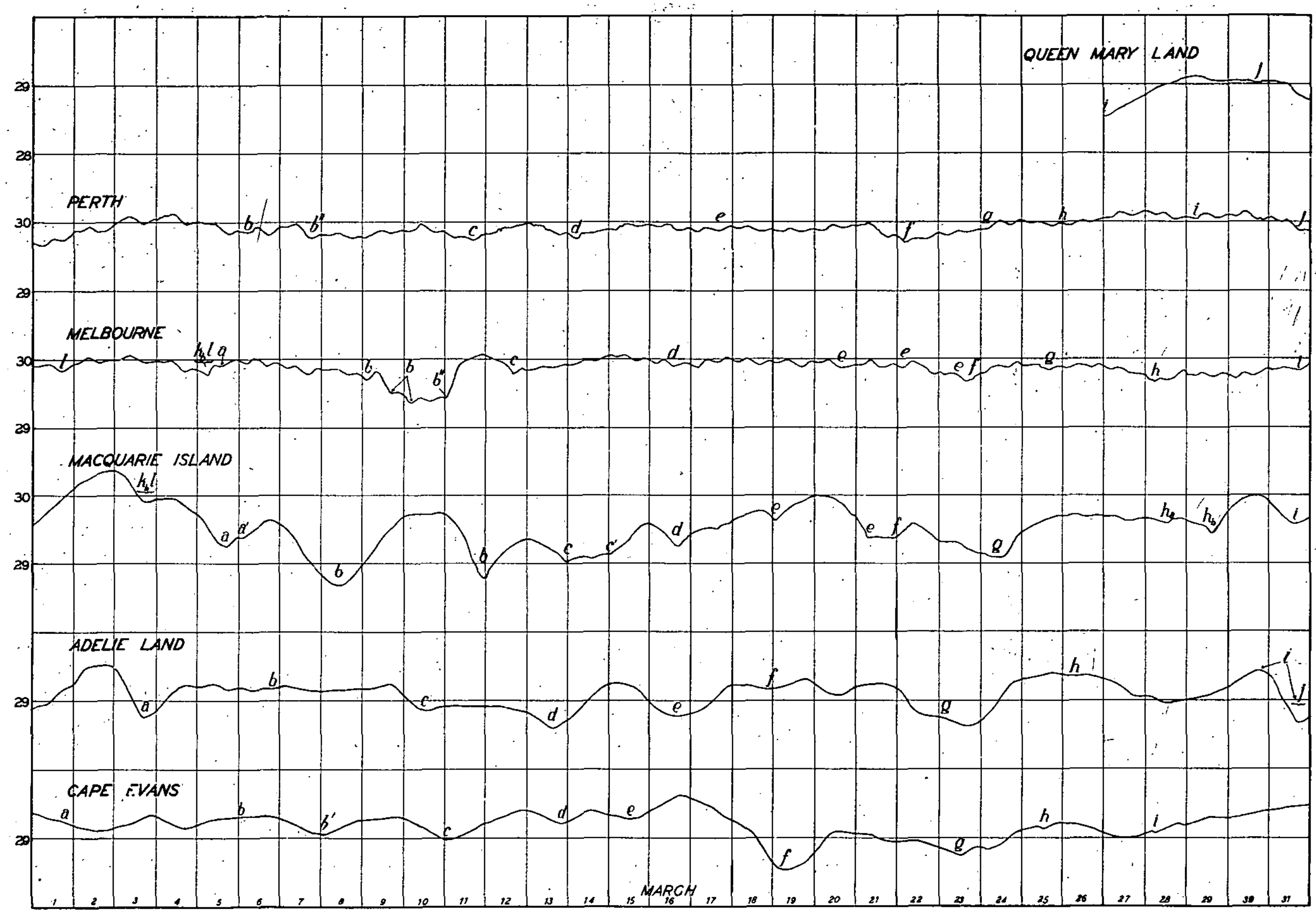
Wave h_3 though not a deep cyclone causes widespread and heavy rain, which it is not possible to show in detail, over south-eastern Australia.

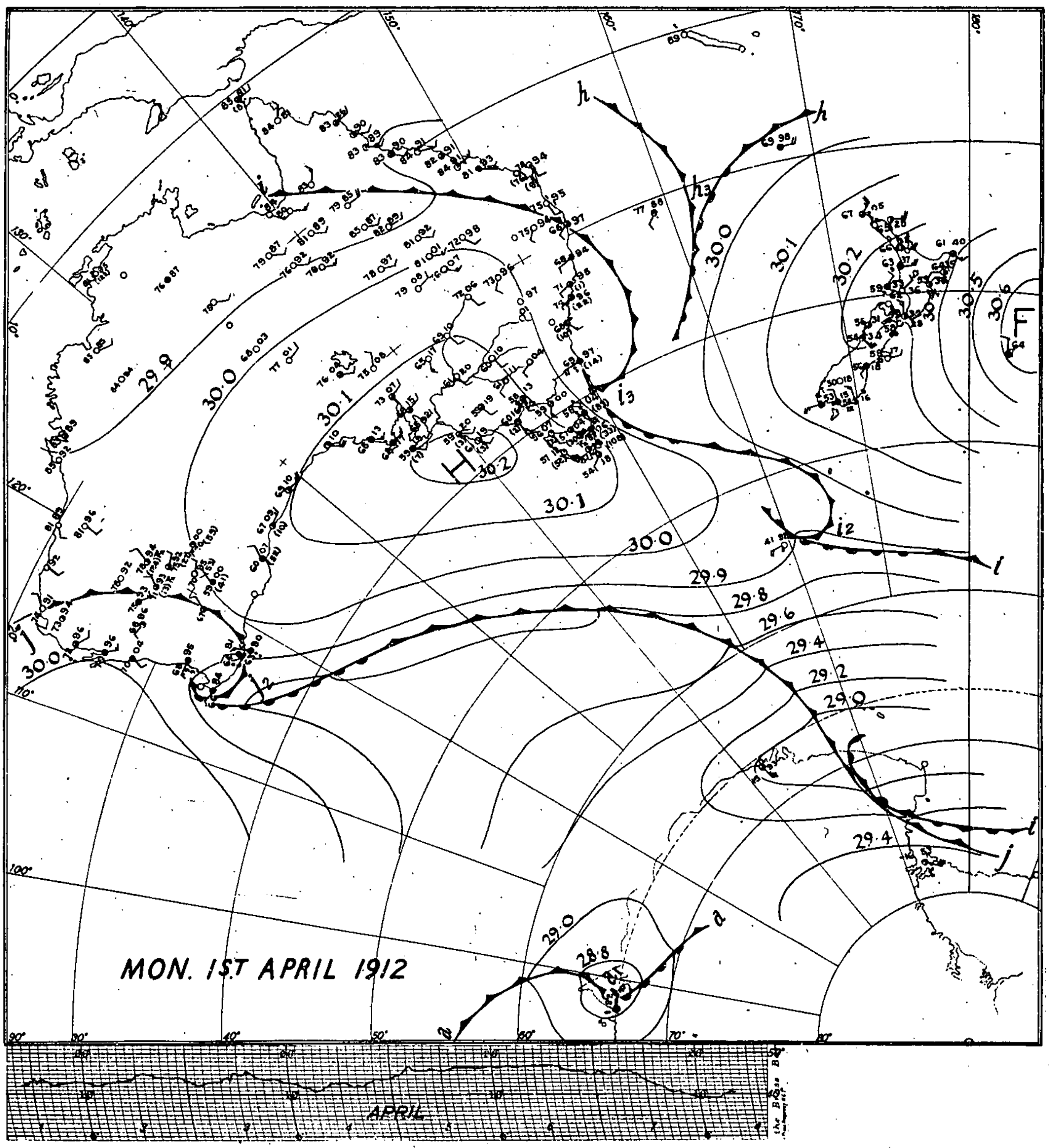


A deep cyclone passes Adélie Land during the day. Rain has been widespread over Victoria and eastern New South Wales.

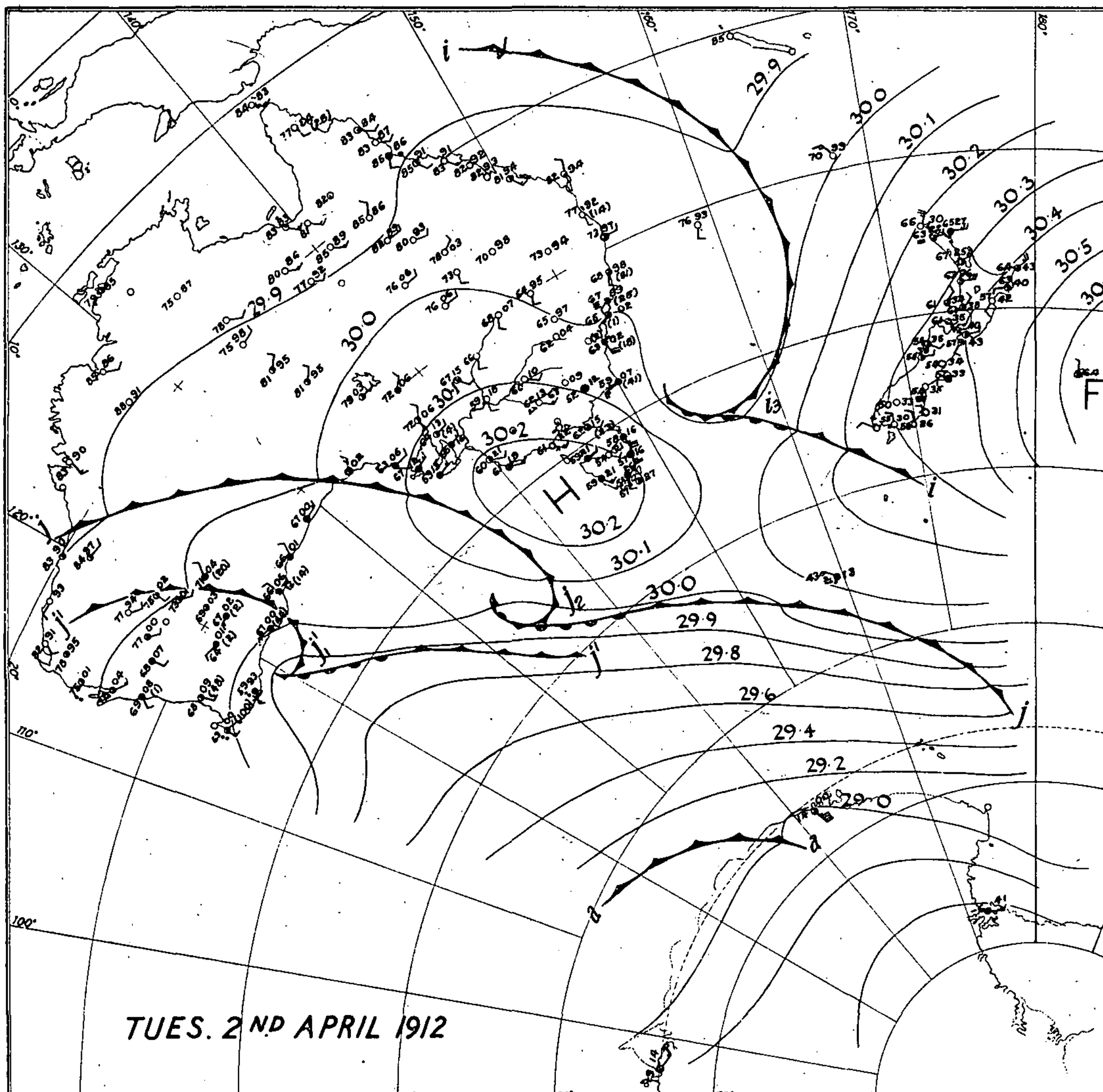


Anticyclone F has intensified over New Zealand. It has been crossed by front *h*. There have been some instability rains in the interior of Western Australia.

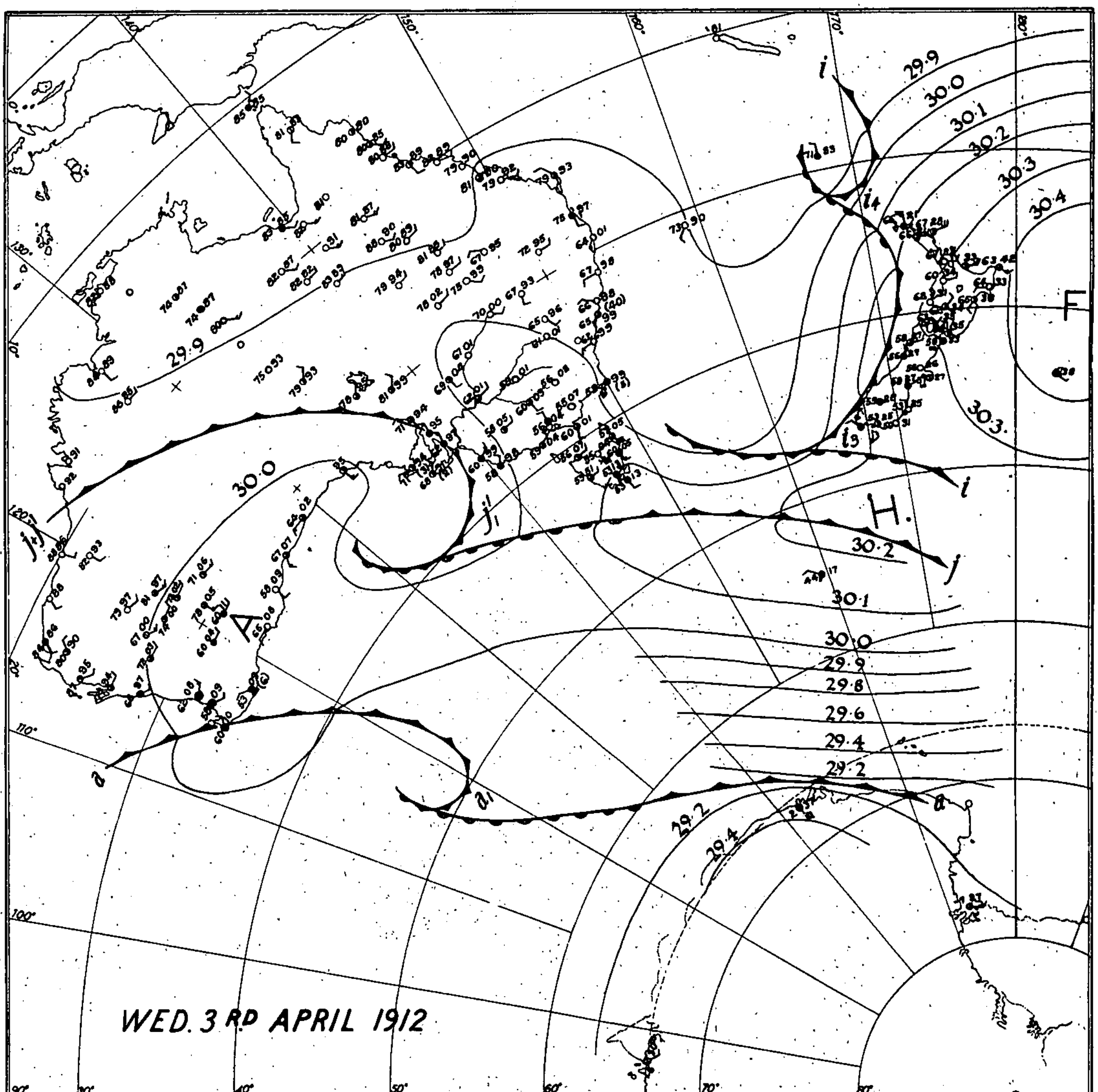

QUEEN MARY LAND
PERTH
MELBOURNE
MACQUARIE ISLAND
ADELIE LAND
CAPE EVANS
MARCH



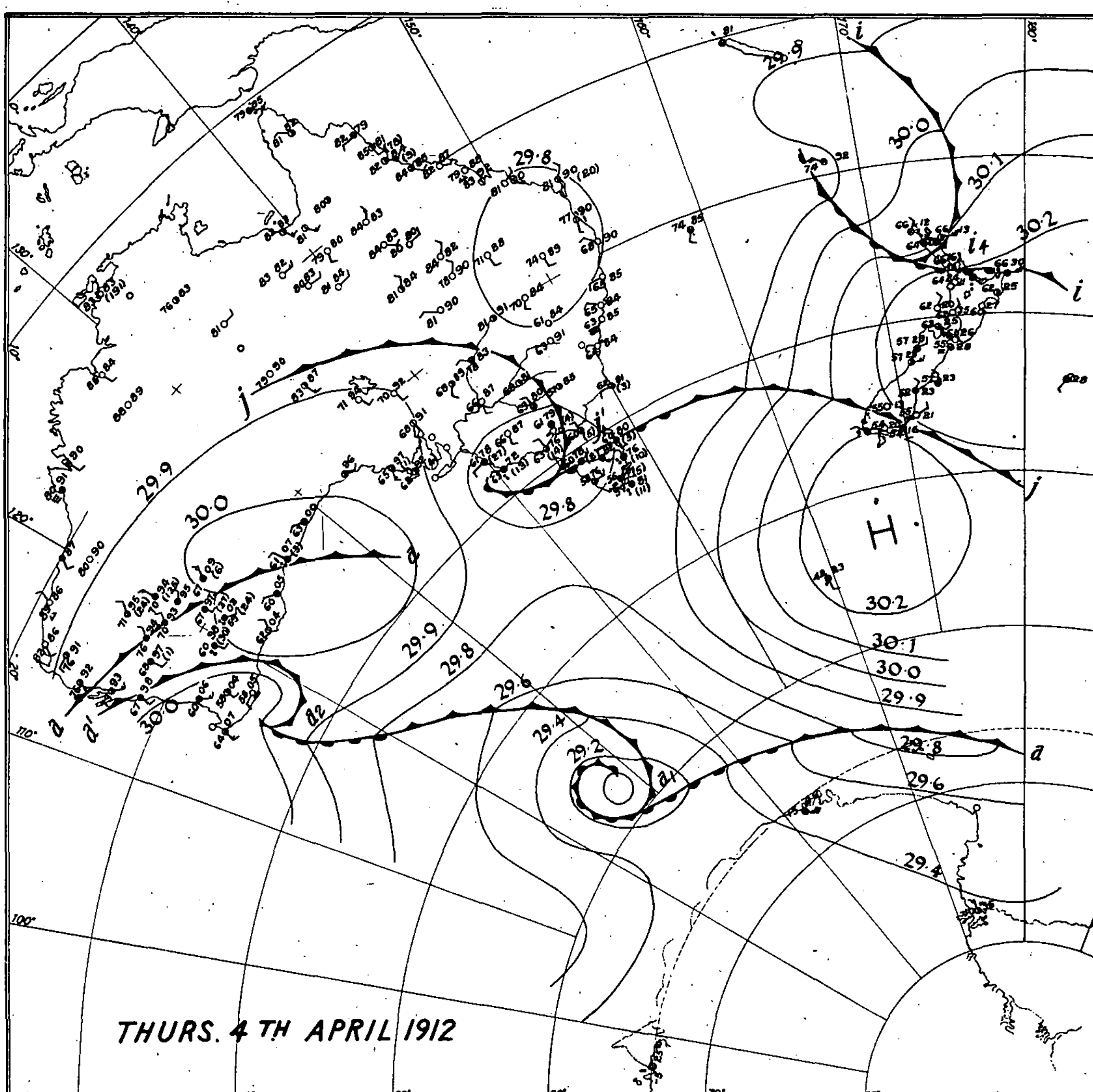
Anticyclone F has become very intense.



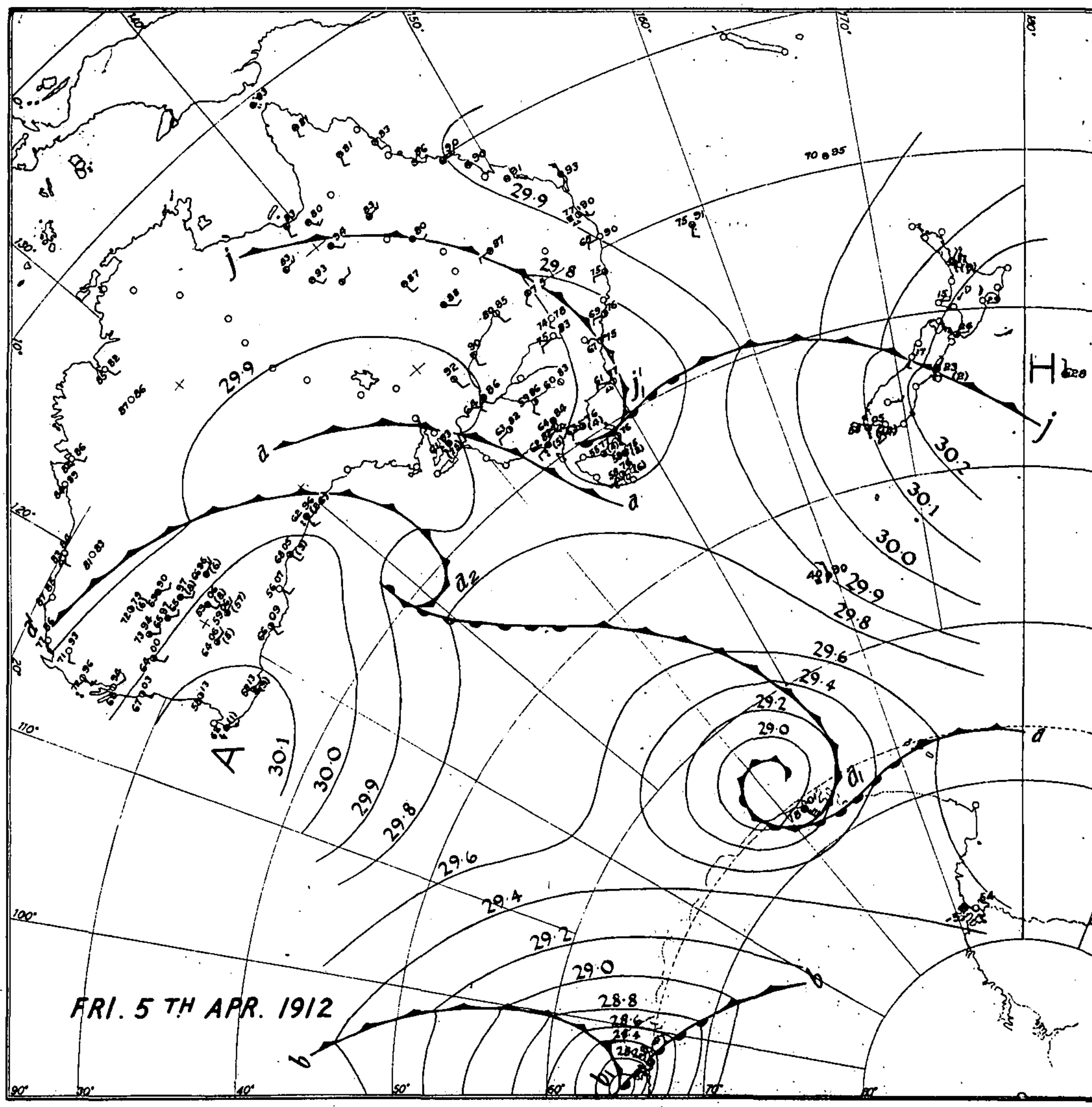
A wave appears to have developed on the secondary front j^1.



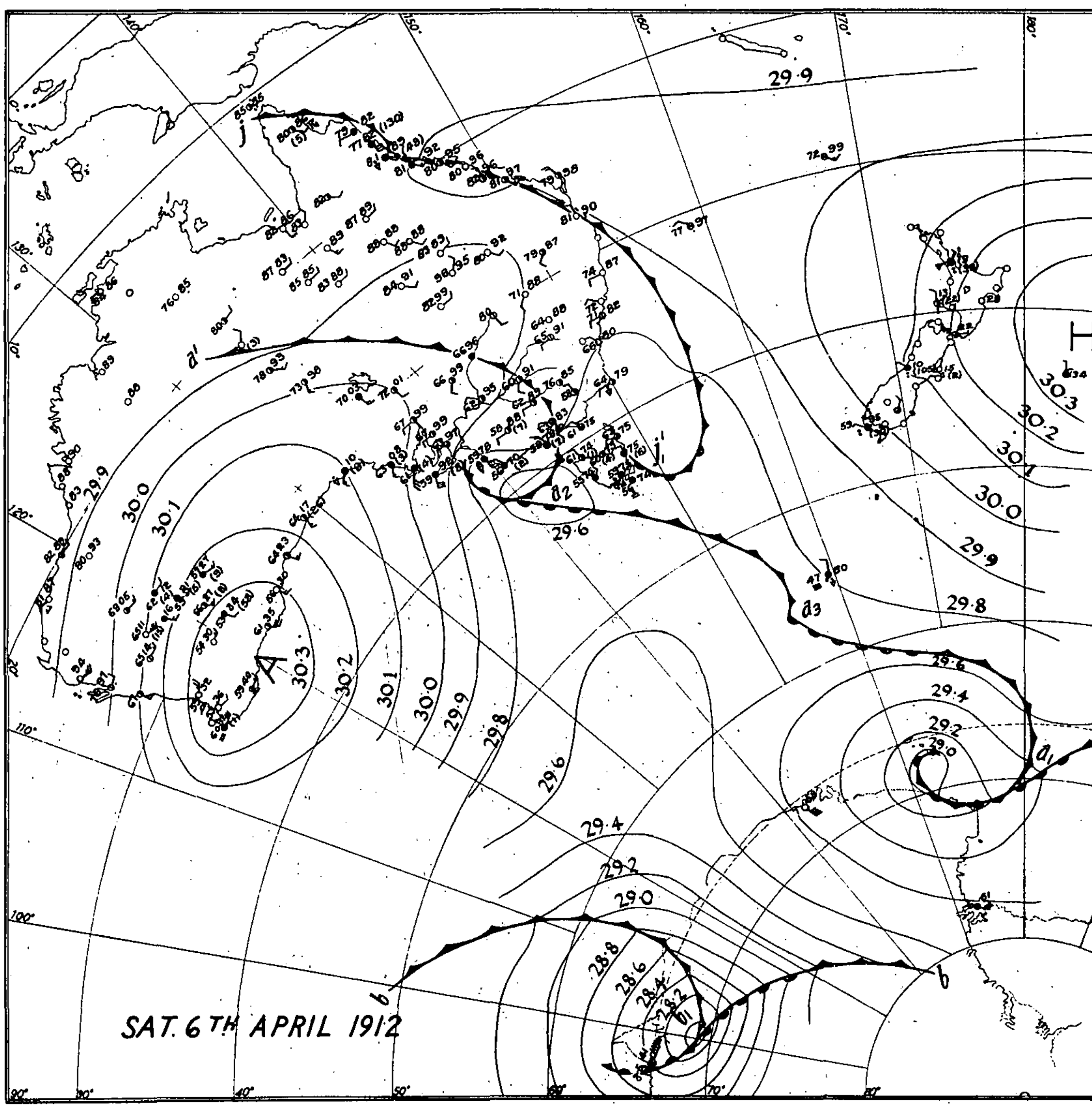
Front j^1 has become merged in j.



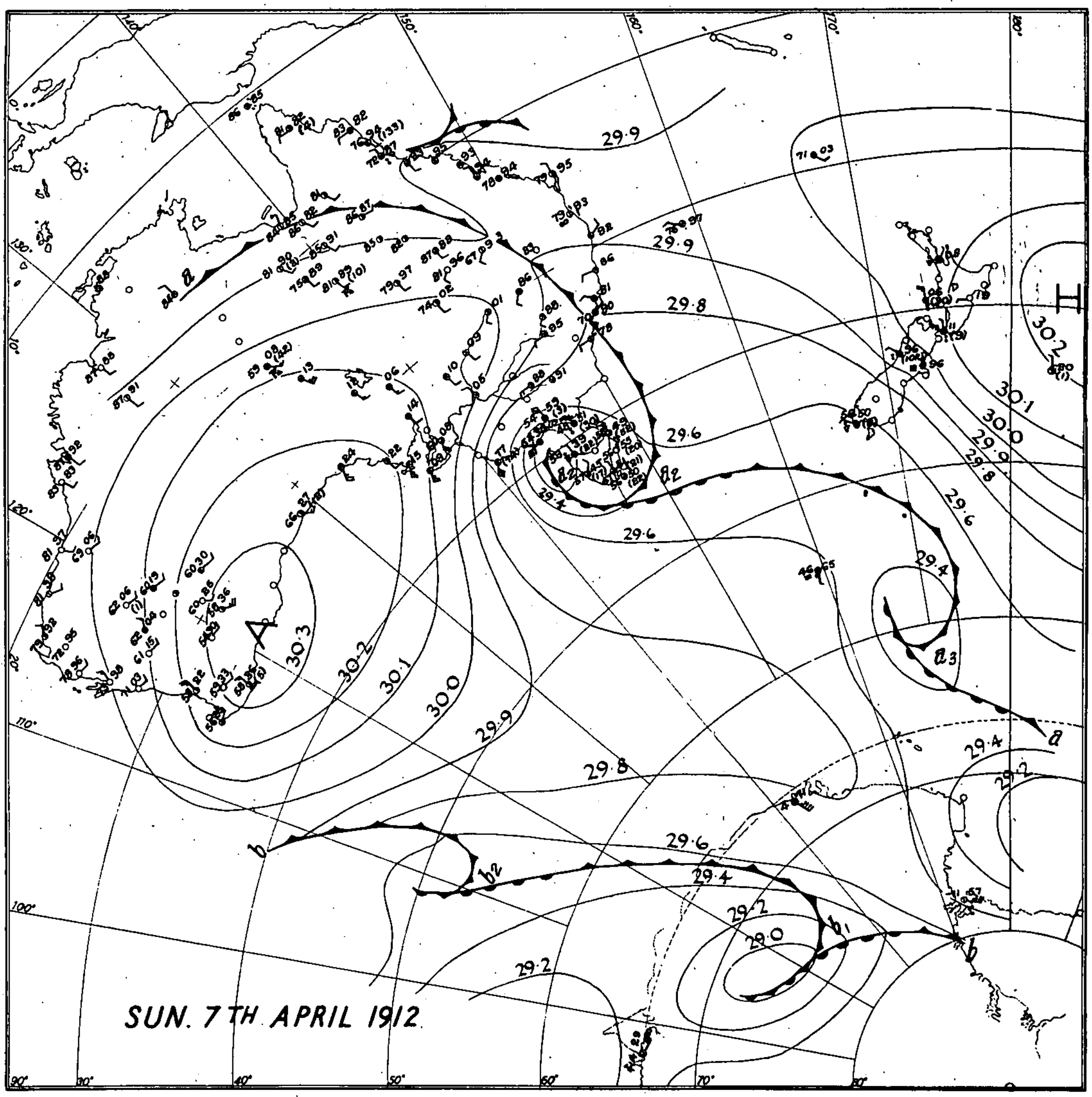
Wave j_1' has developed into a shallow cyclone and is passing through Bass Strait. Anticyclone H has moved on an unusual course; later it merges into the high pressure east of New Zealand.



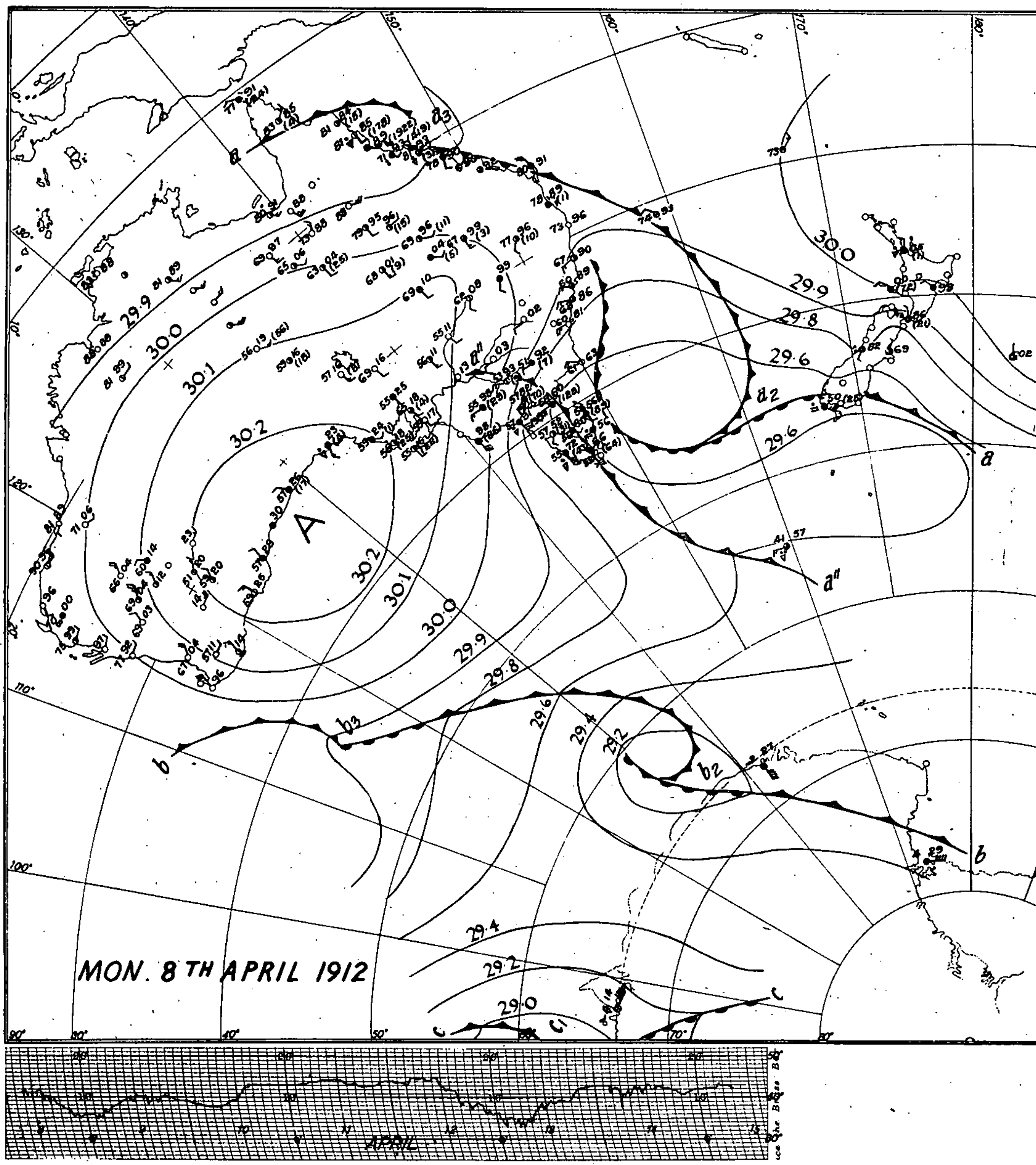
A cyclone is passing Adélie Land and a much deeper one approaching Queen Mary Land.



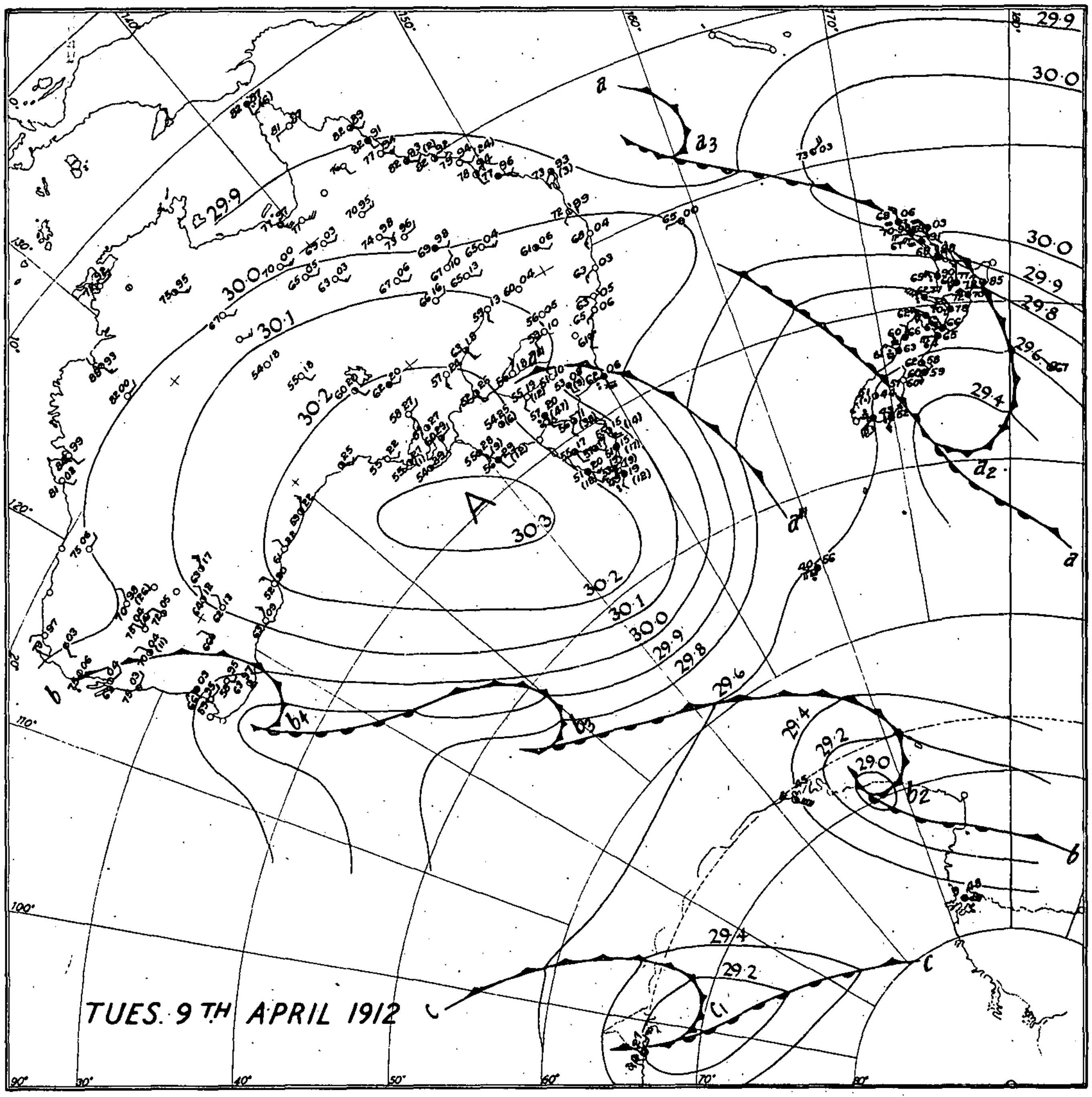
Pressure changes indicate that cyclone b_1 has passed Queen Mary Land.



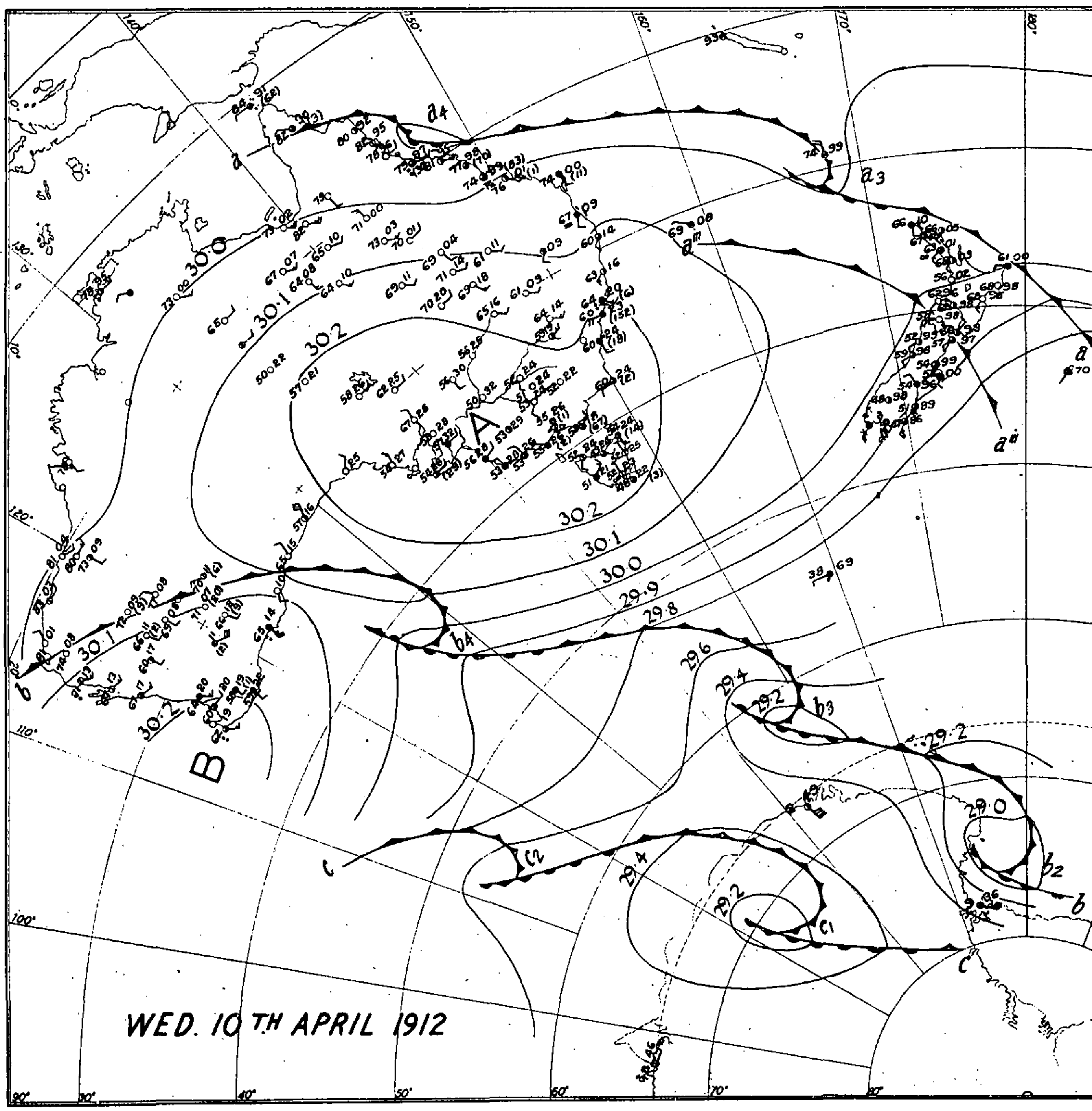
Wave a_2 has developed into a cyclone. This appears to be the culmination of a process in this area, where low pressure has prevailed for several days. Cyclone b_1 has probably filled up as it moved southward. Its cold front alone appears to have affected Cape Evans where a blizzard was blowing next day.



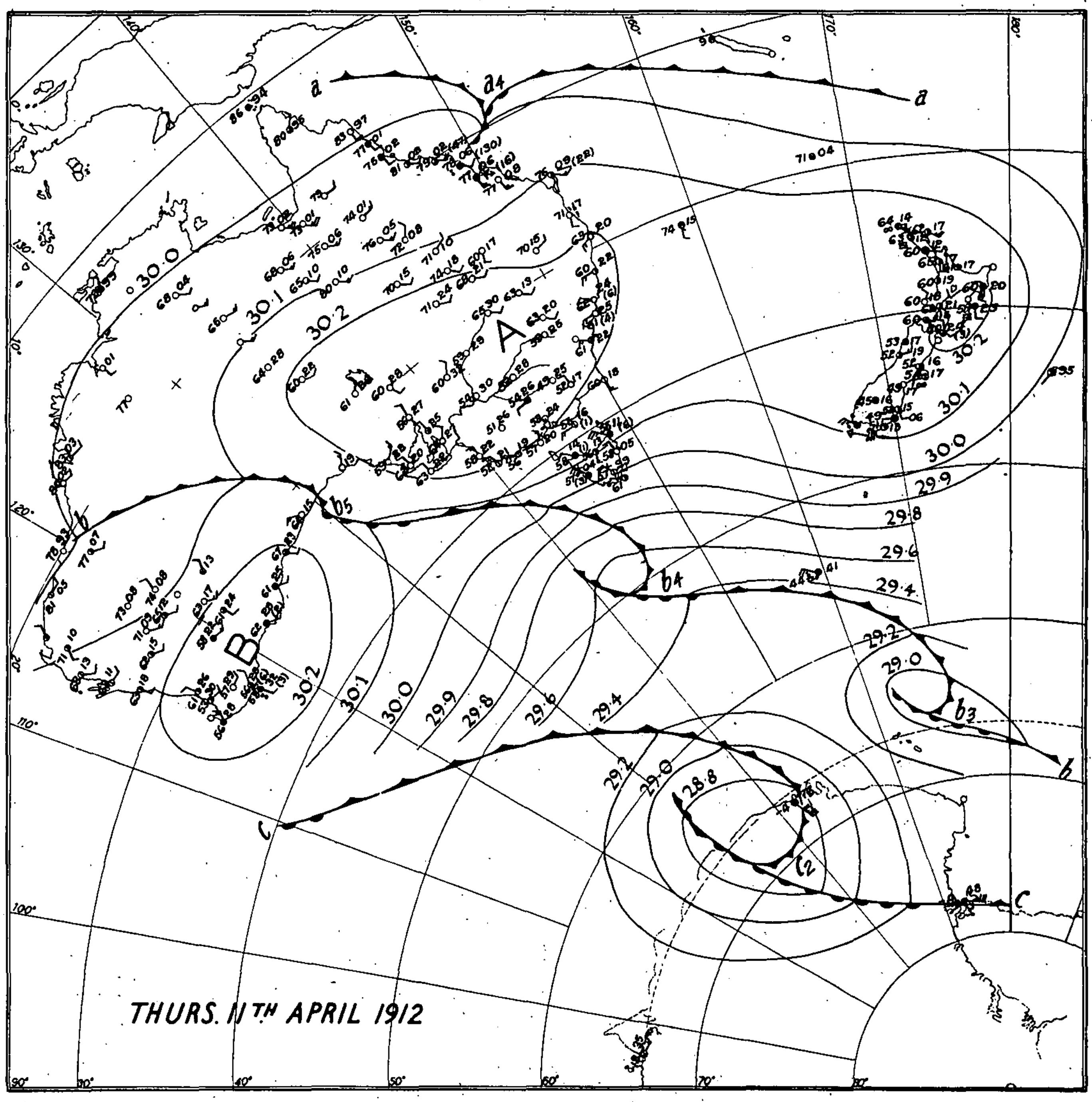
Cyclone a_2 has developed a long occlusion. A fresh cyclone is approaching Queen Mary Land. Note the extraordinarily heavy rainfalls on the Queensland coast associated with a small depression.



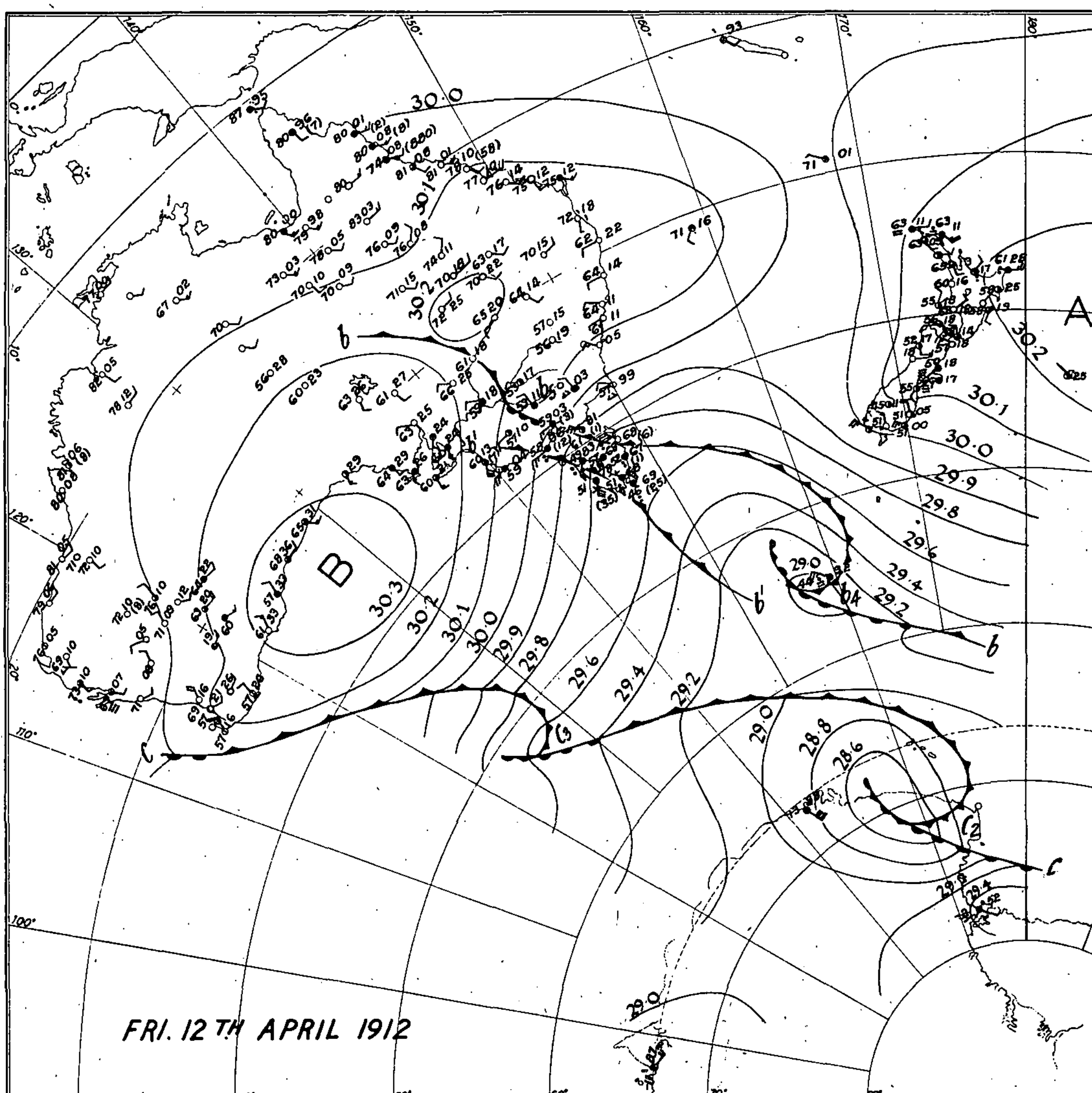
Cyclone c_1 has passed south of Queen Mary Land. There is very widespread rain over New Zealand.



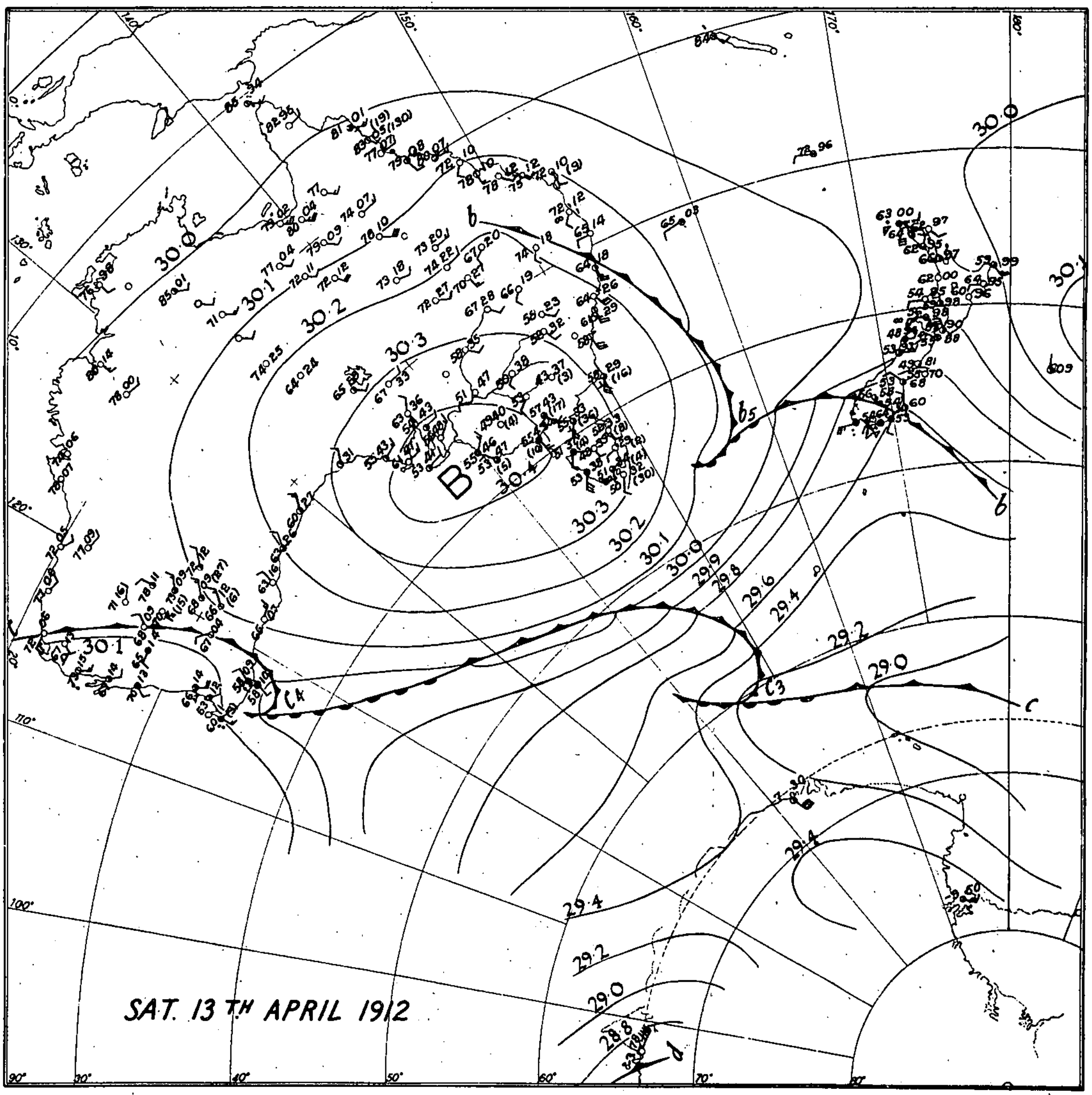
Wave b_2 has approached Cape Evans.



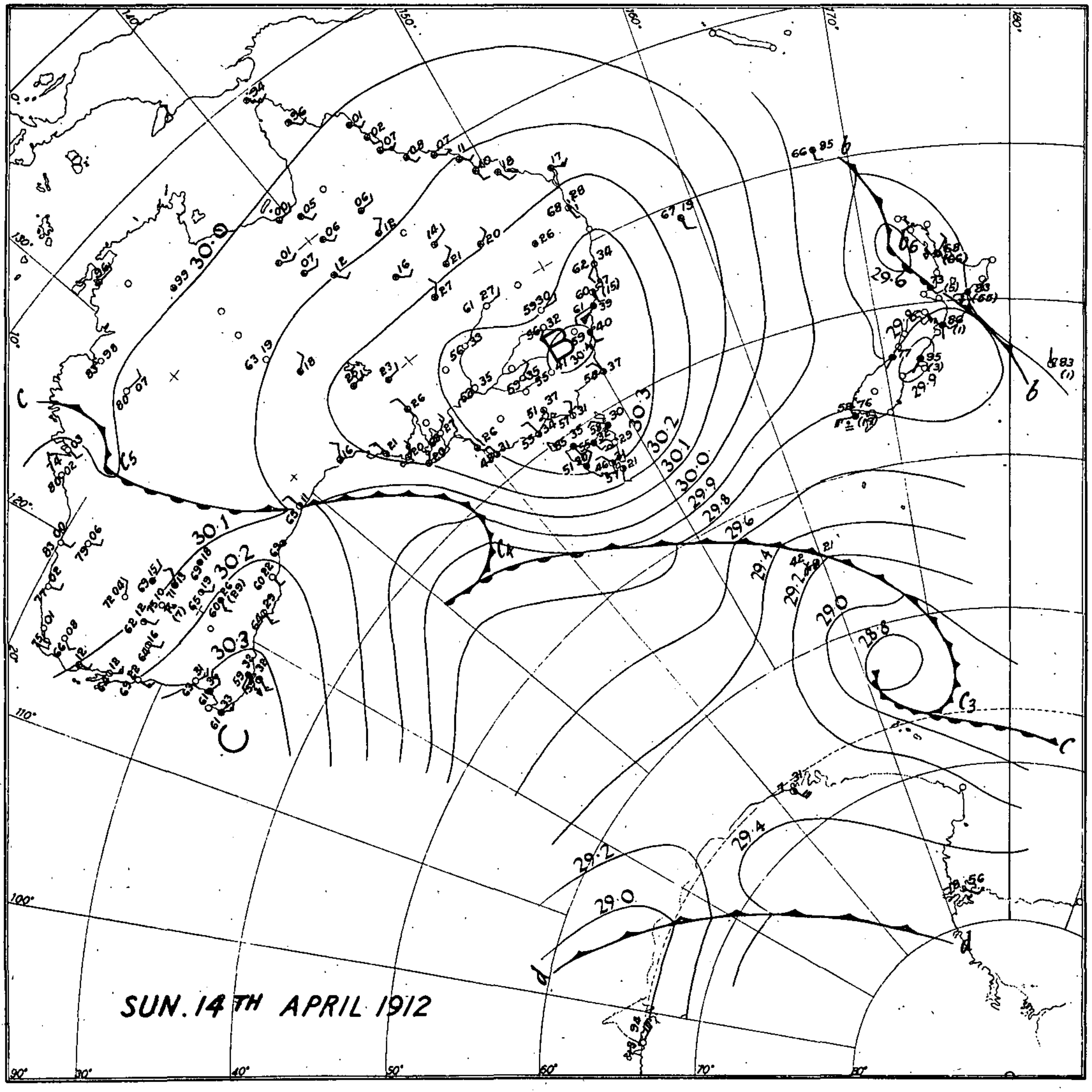
The temperature is high at Macquarie Island.



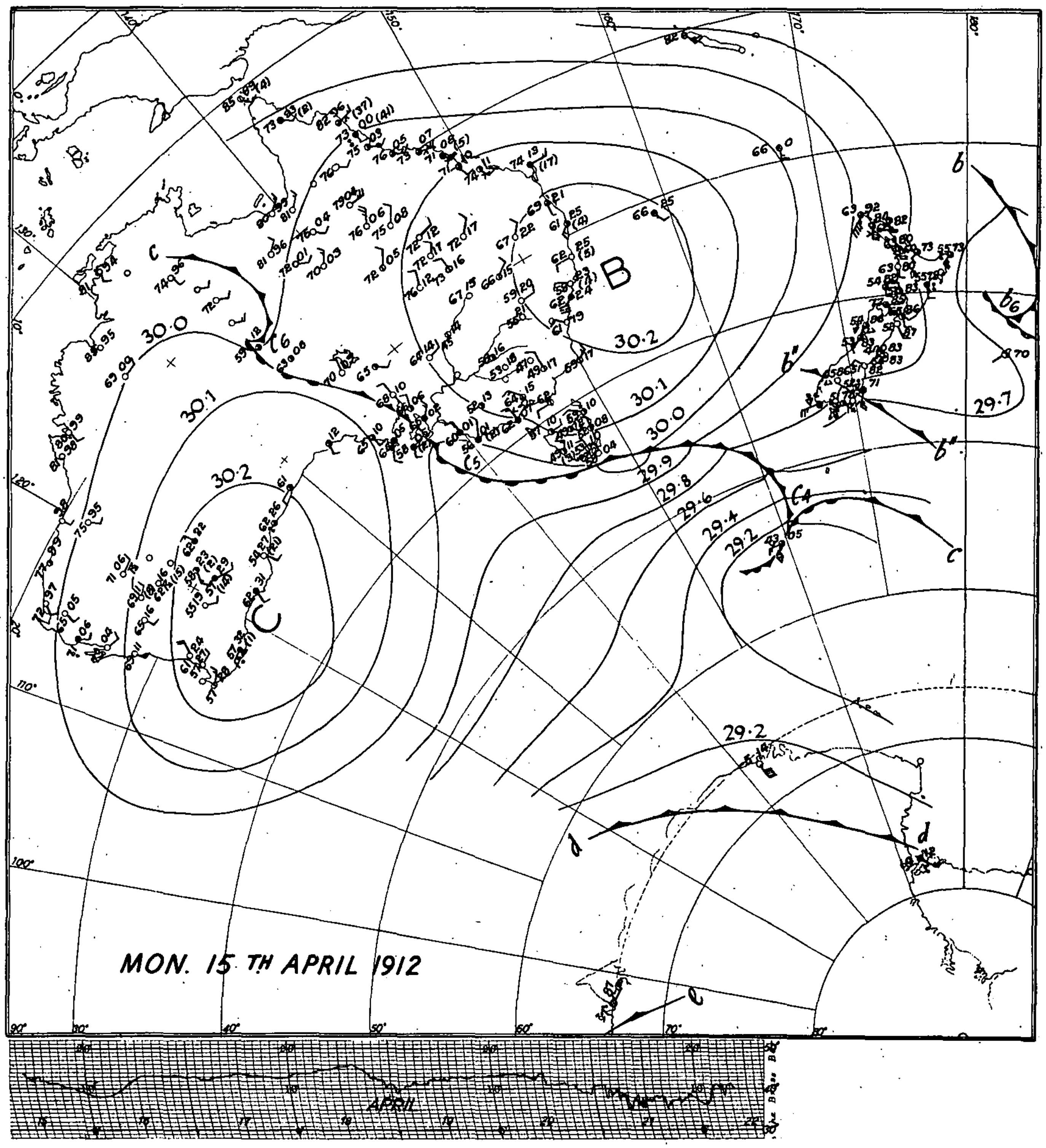
The temperature fell at Macquarie Island during the day as the fronts passed.



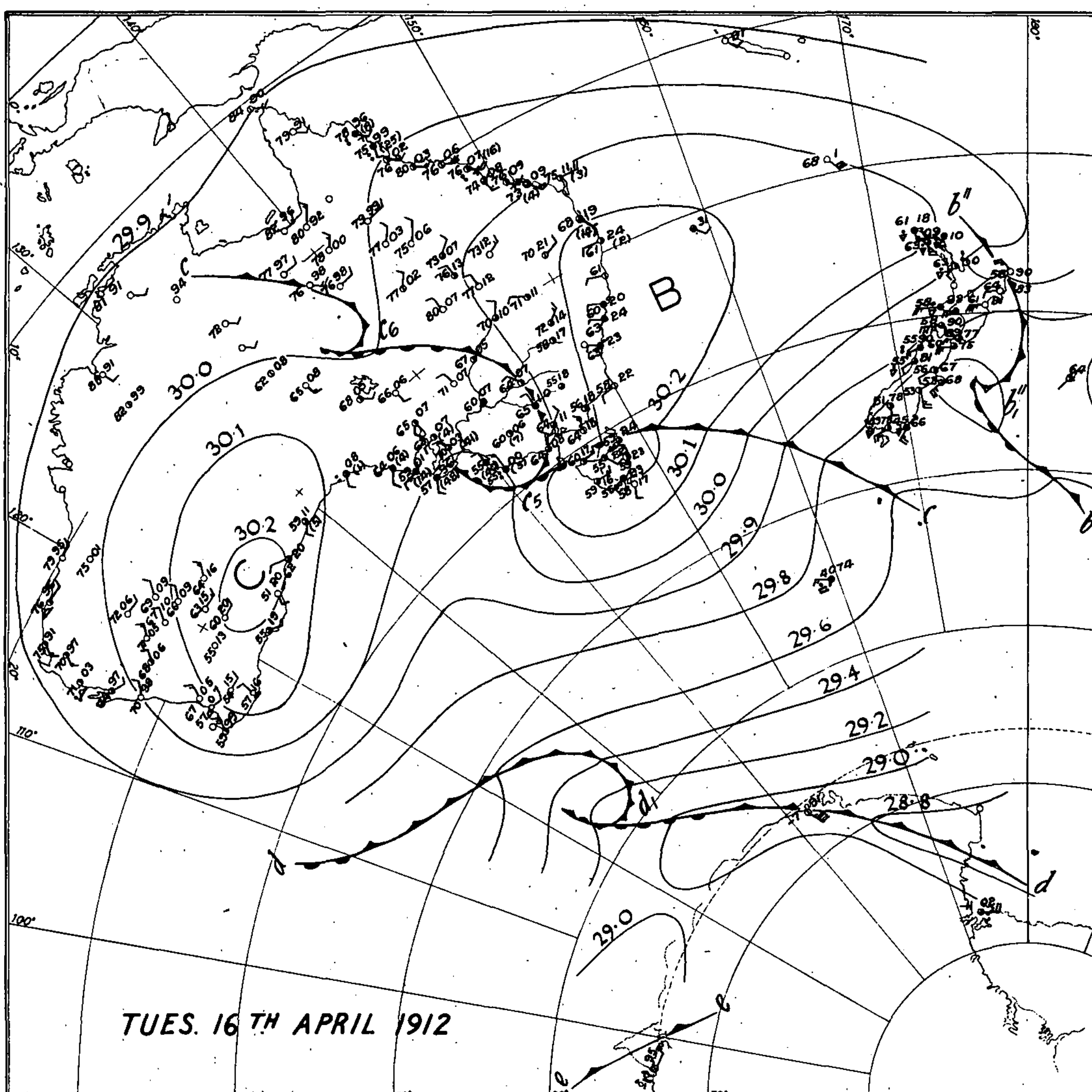
Anticyclone B is rather intense with an outbreak of cold air on its eastern side.



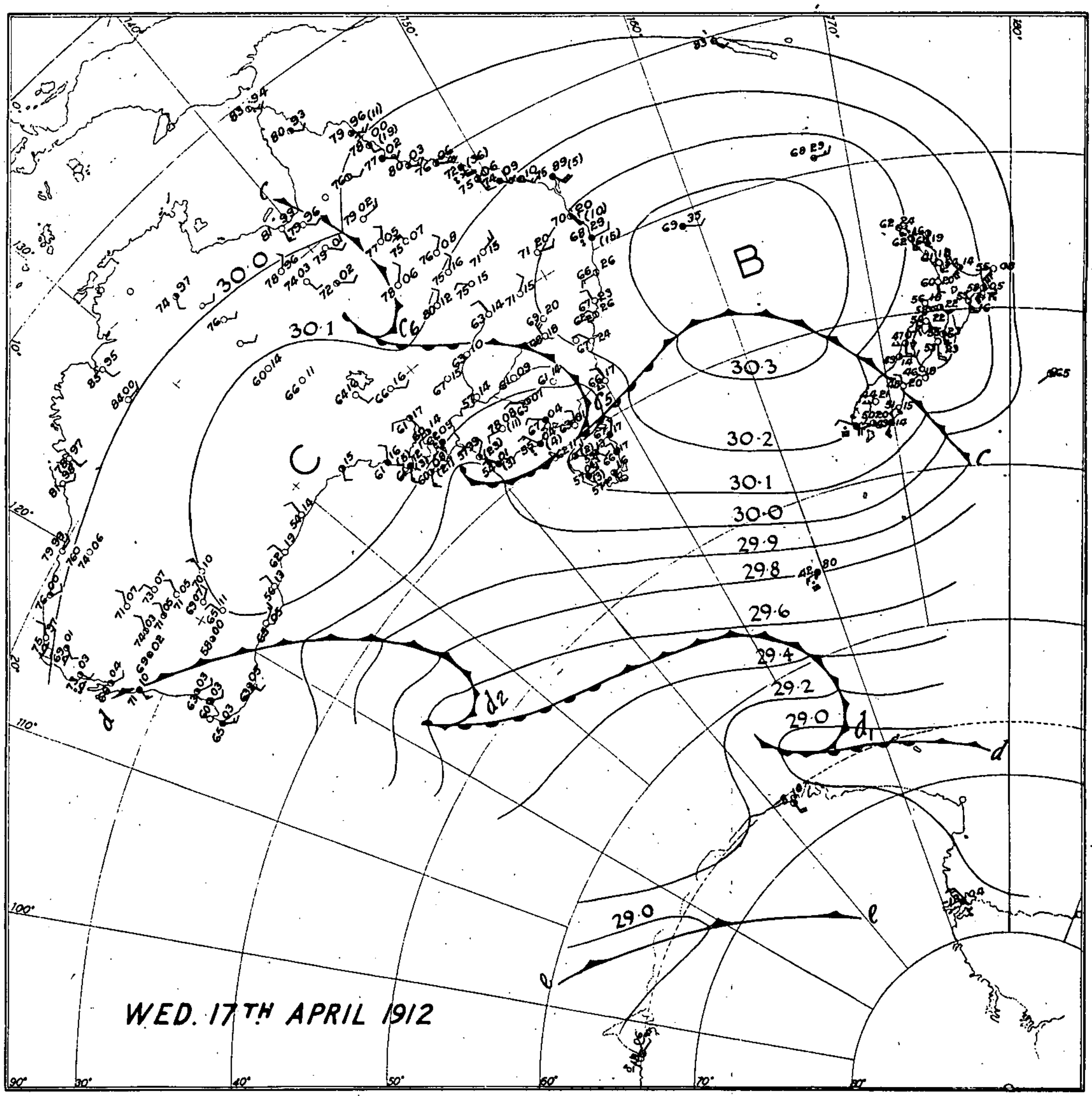
Anticyclone B is still intense. Front *b* has been moving fast. Possibly the northern portion as shown is no longer a true front, having been over-run in the upper air. The passage of front *c* was well marked on the Macquarie Island barogram.



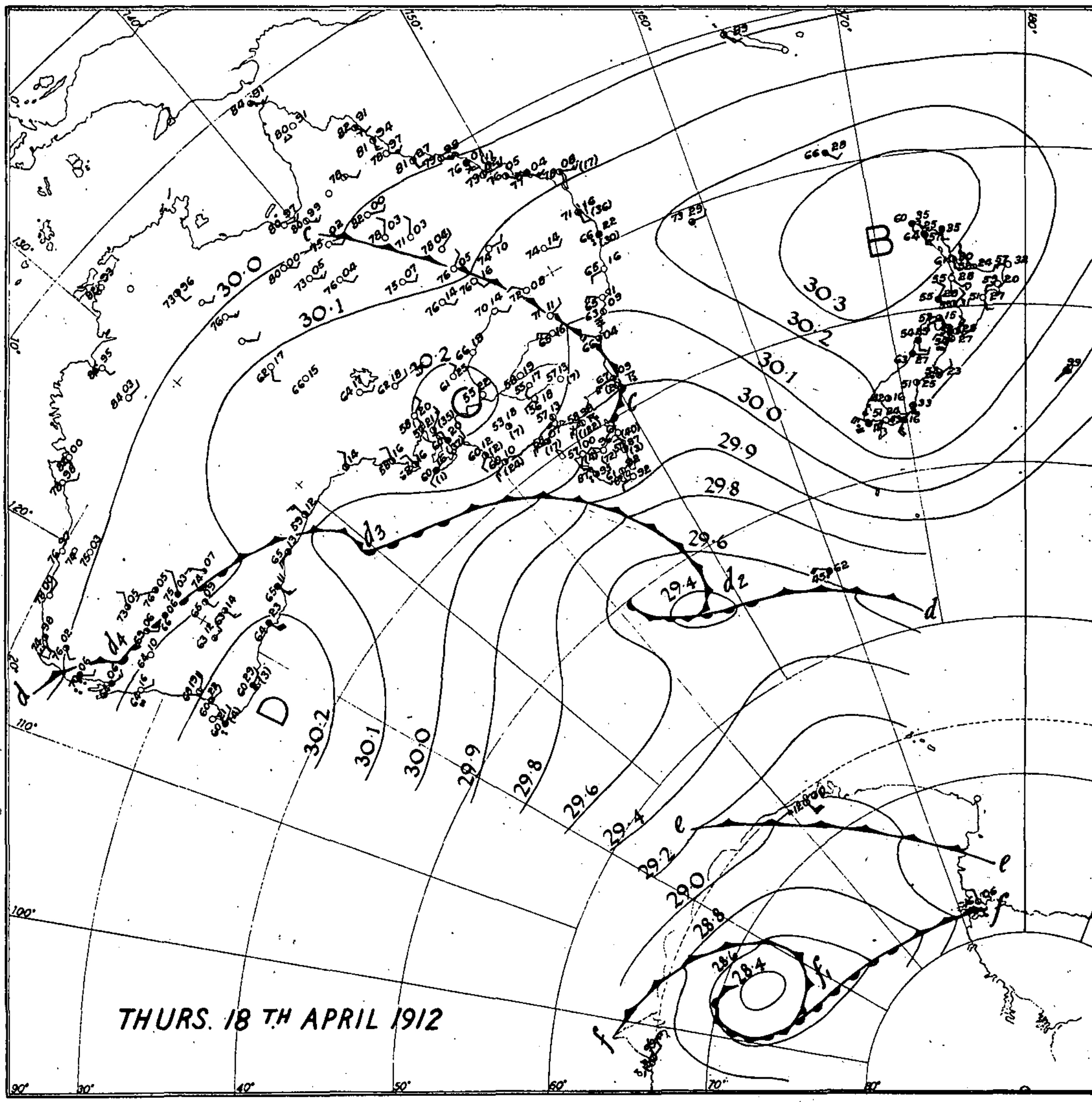
The temperature fell gradually at Macquarie Island but changes actually at the fronts were slight. The passage of the occlusion of c_4 is shown by a trough in the barogram.



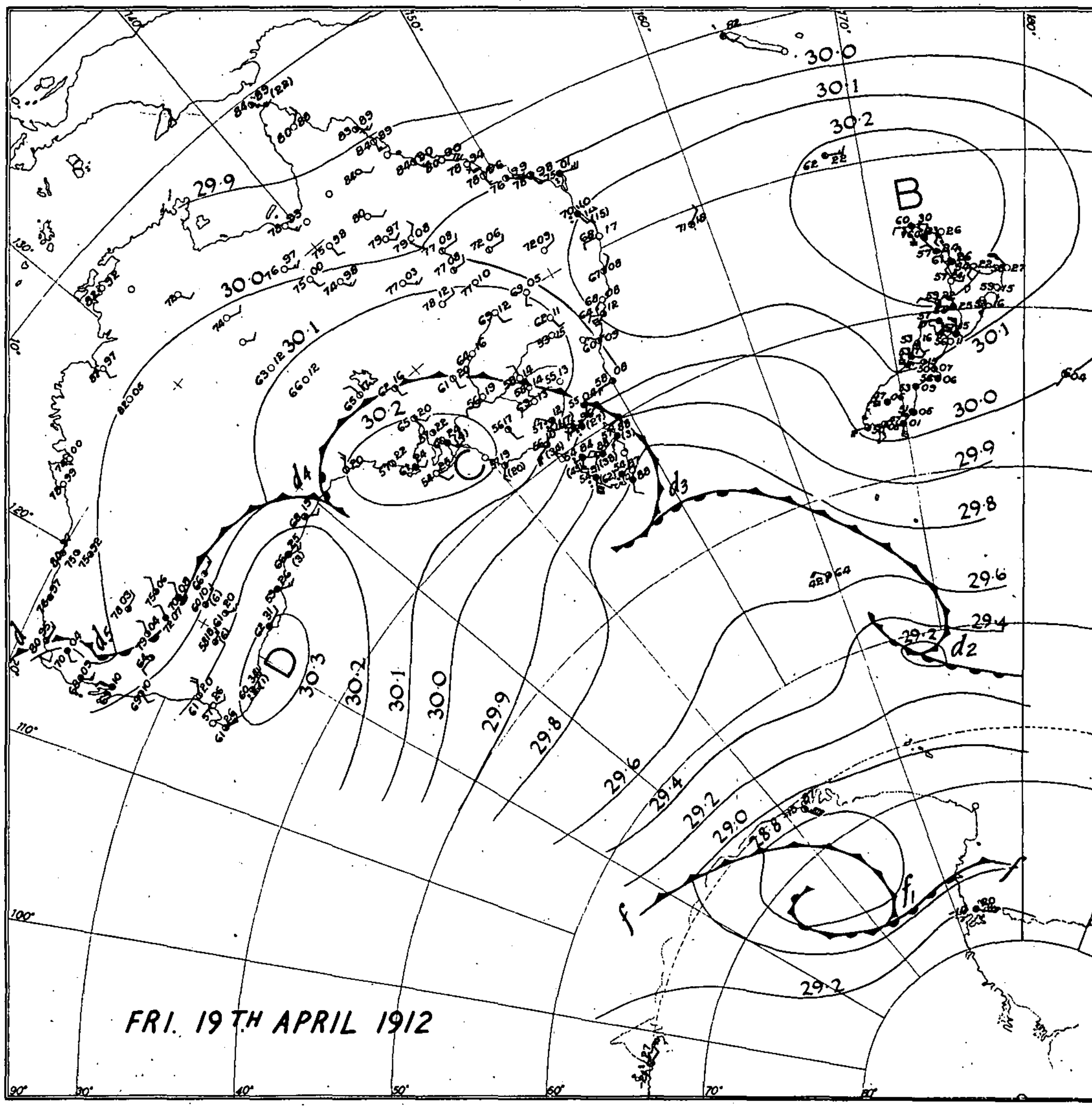
There are evidences that wave b_6 has deepened east of New Zealand, while a wave is developing also on the secondary front b''.



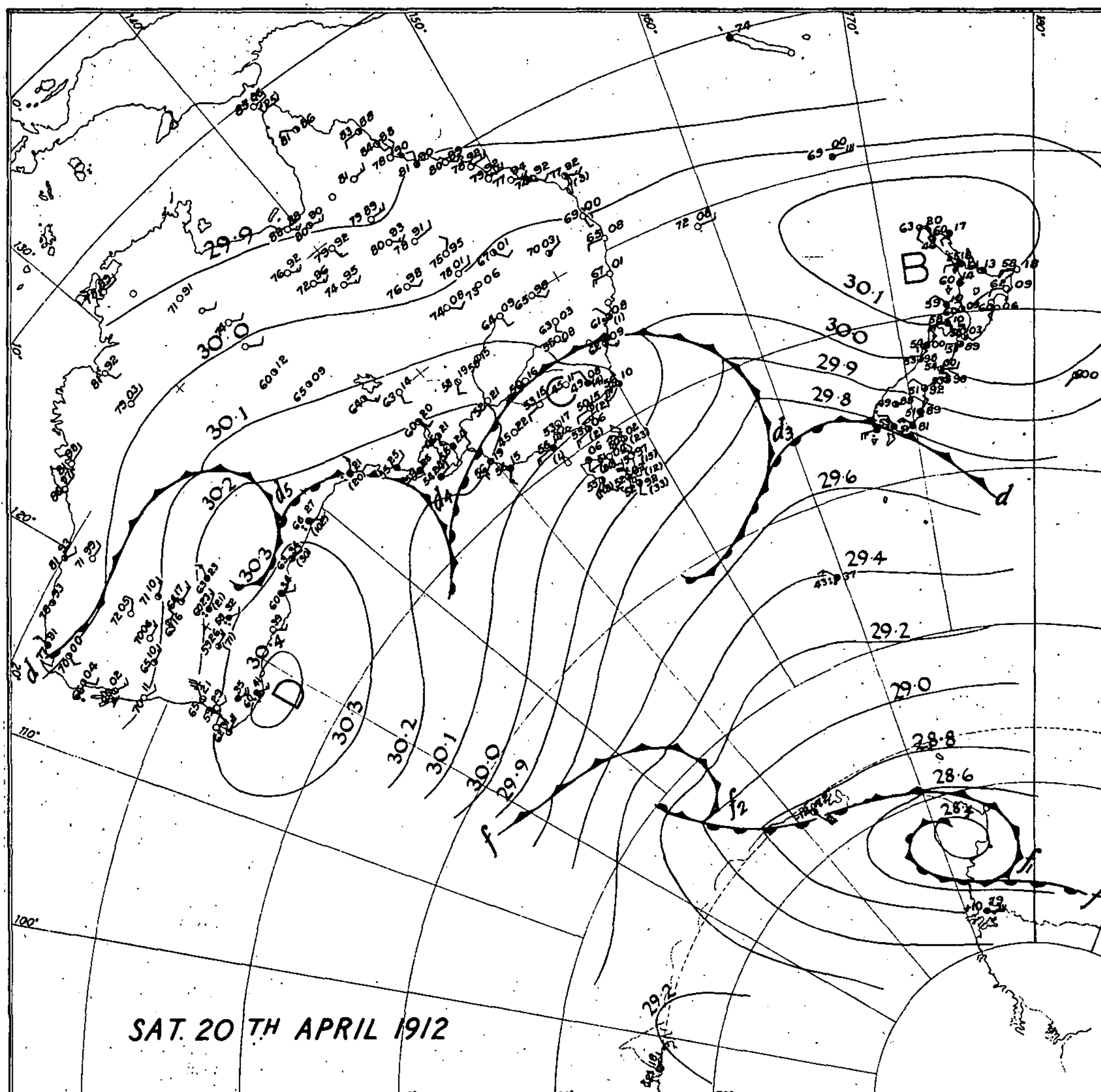
Front c is being carried northward over anticyclone B, while its more northern part is becoming stationary. The shape of wave c_5 and the advanced state of occlusion are consequences of this development.



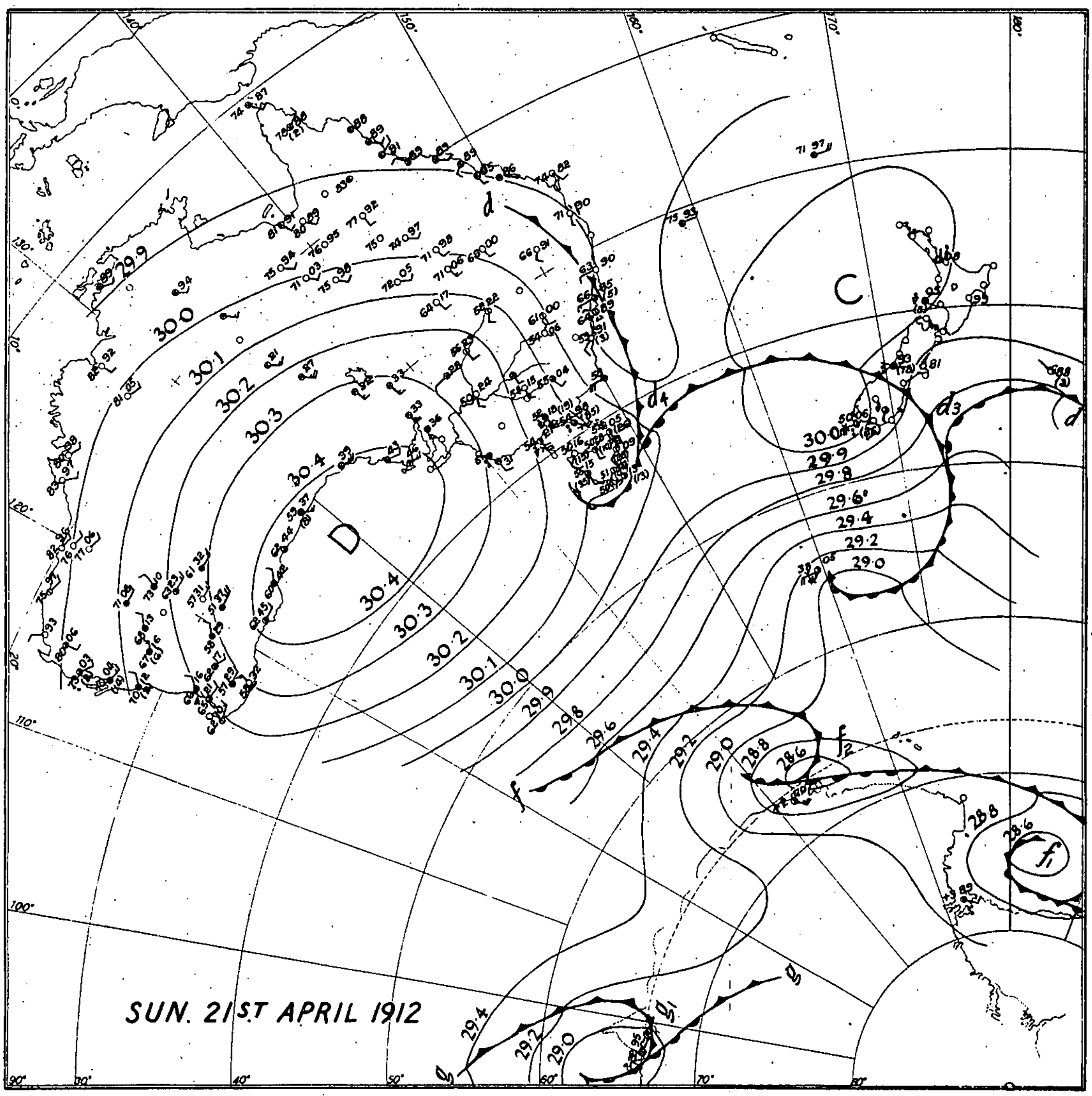
The western portion of front *c* has been separated from the remainder and is disappearing. Note the northerly wind at Cape Evans. The cyclone f_1 is drawn to account for wind and pressure changes during this and the next two days.



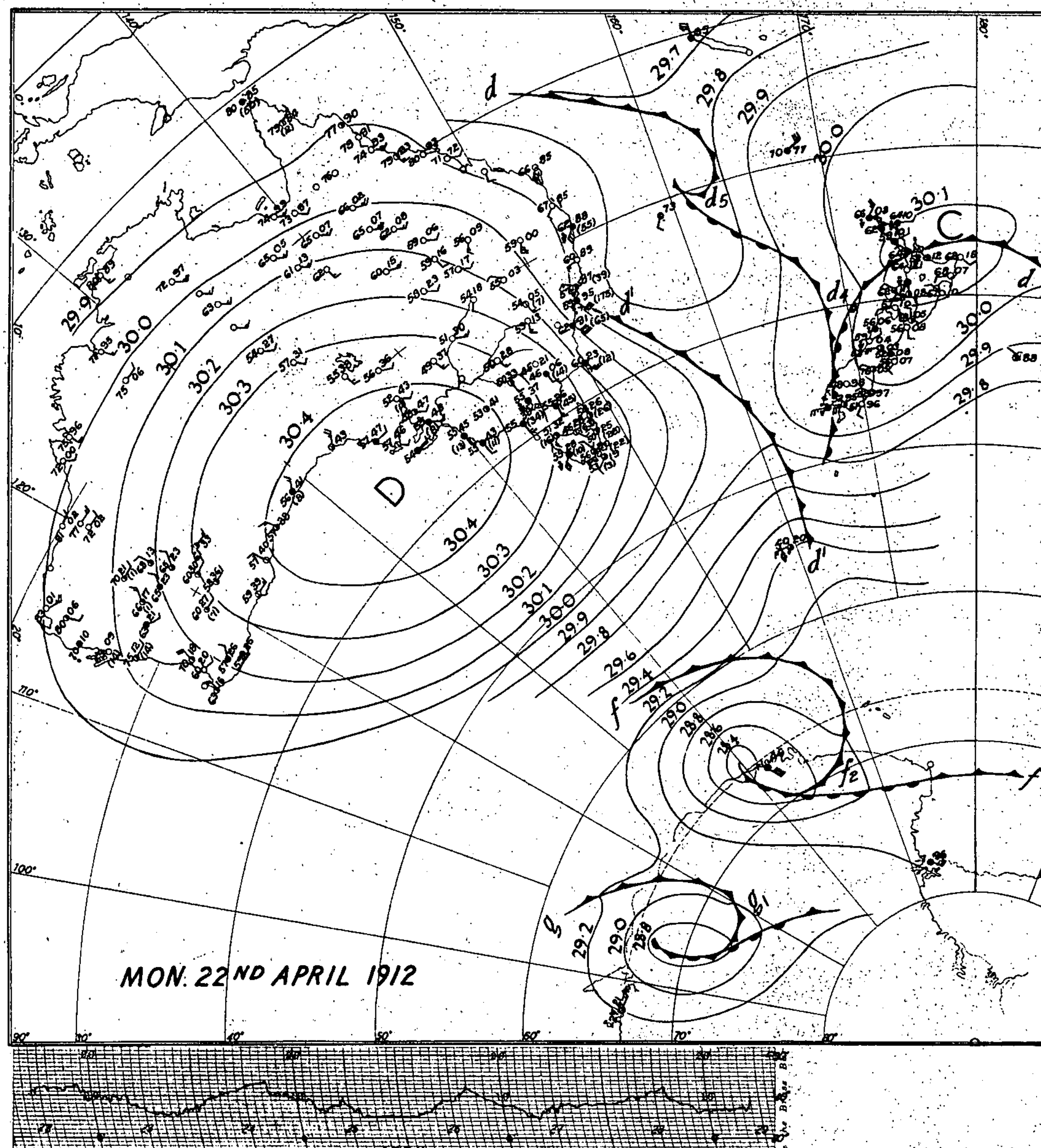
A blizzard is blowing at Cape Evans. Easterly winds prevail over northern Australia and front *d* is taking an east to west orientation.



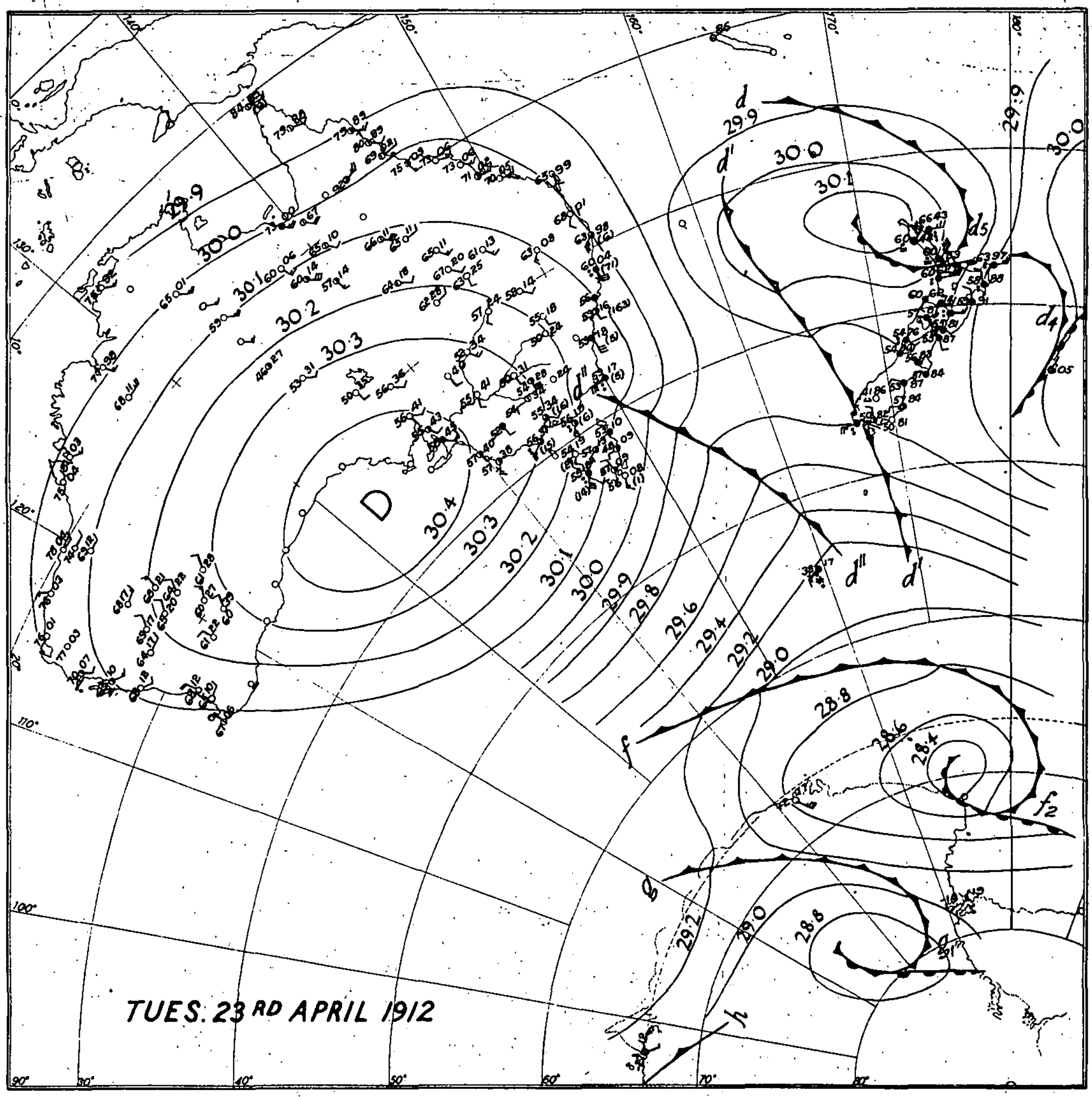
Little activity is shown by any of the fronts. The position is rather one of stagnation and analysis is difficult.



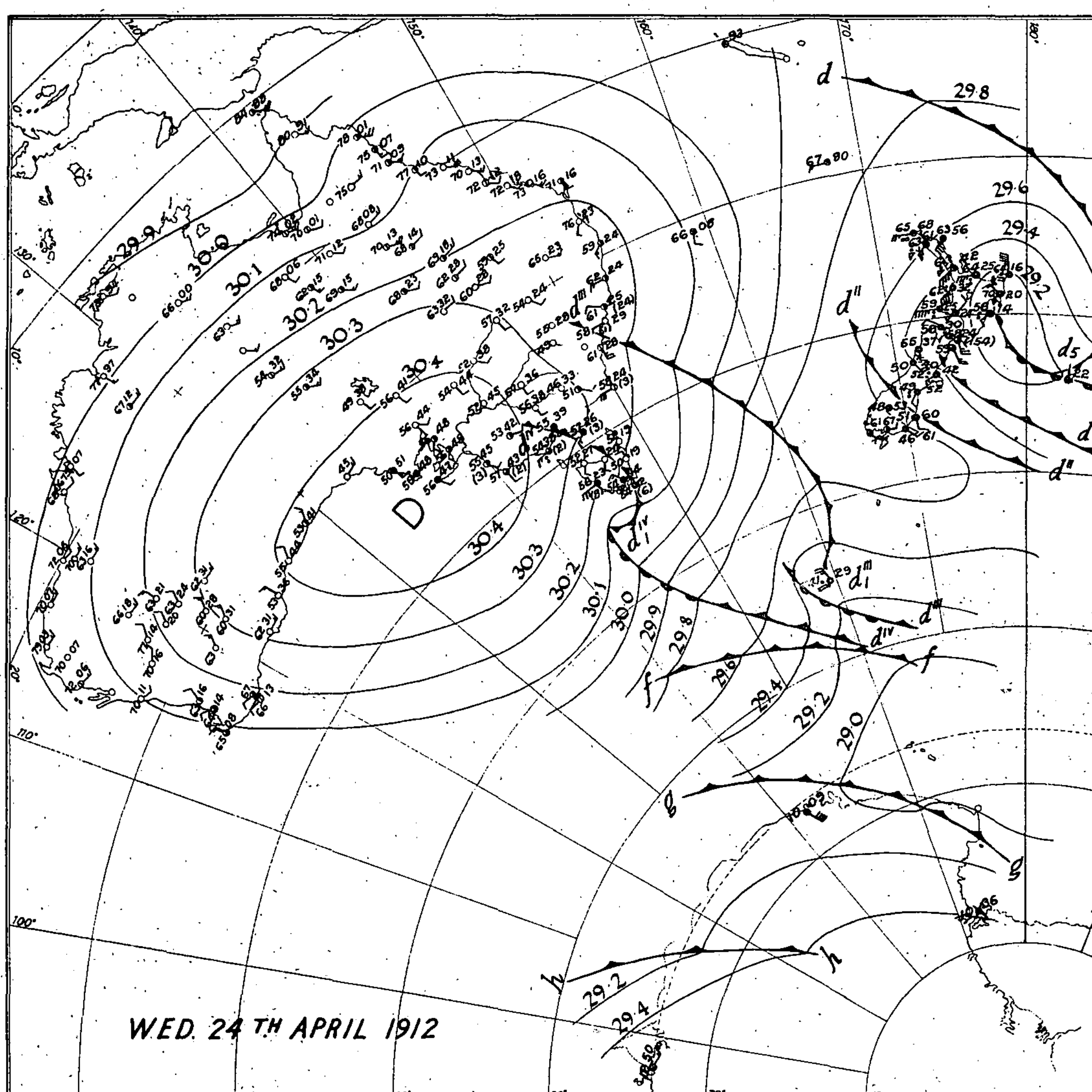
Anticyclone D has suddenly become intense and extensive and much of front *d* has dissipated. Note the series of pressure, temperature, and wind changes at Macquarie Island and the pressure and wind changes at Adélie Land.



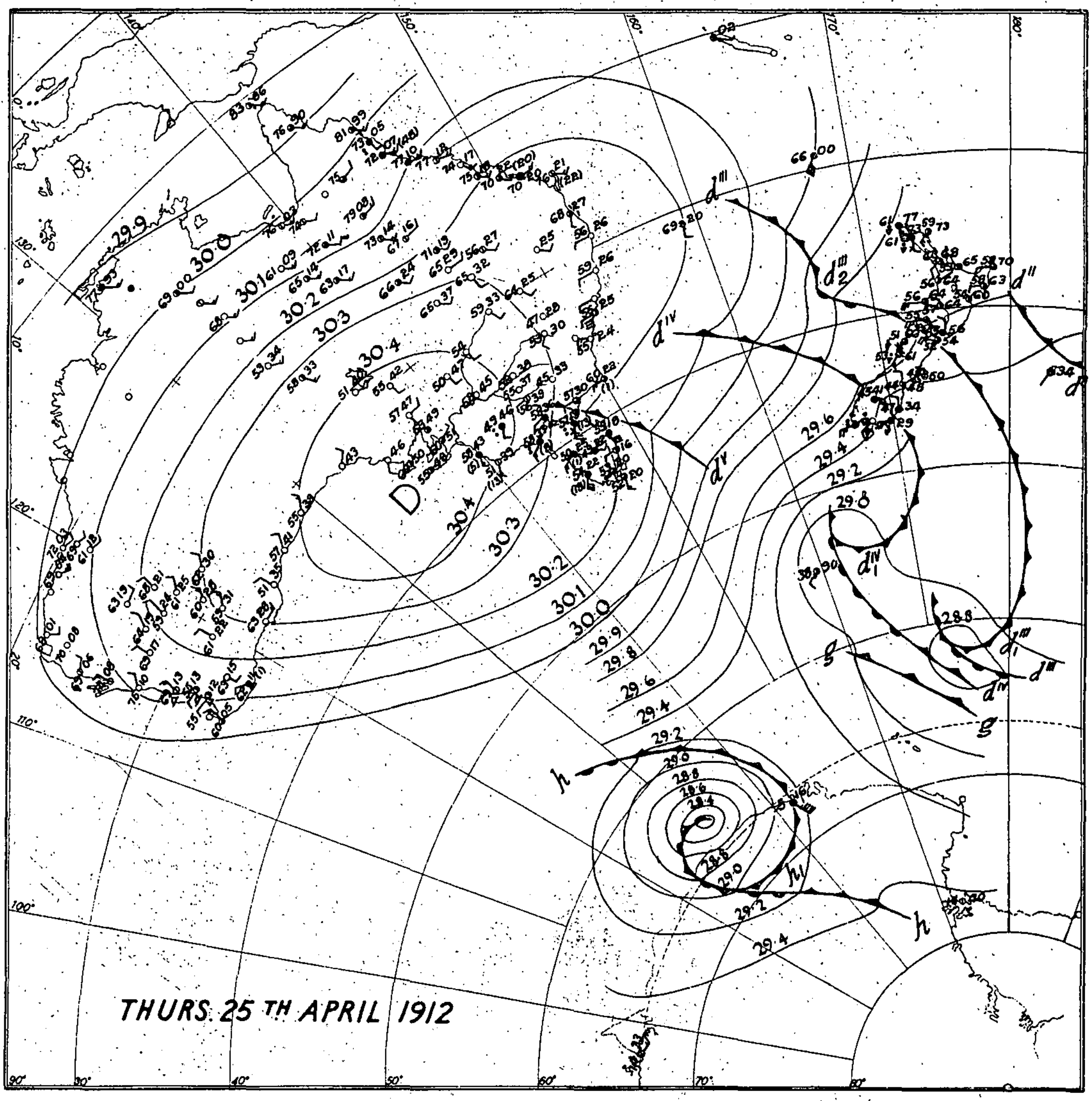
Anticyclone D is still intense and extensive. This and the cyclonic developments in Antarctica are probably associated. The peak in the Adélie Land barogram during the night of the 22nd is not understood.



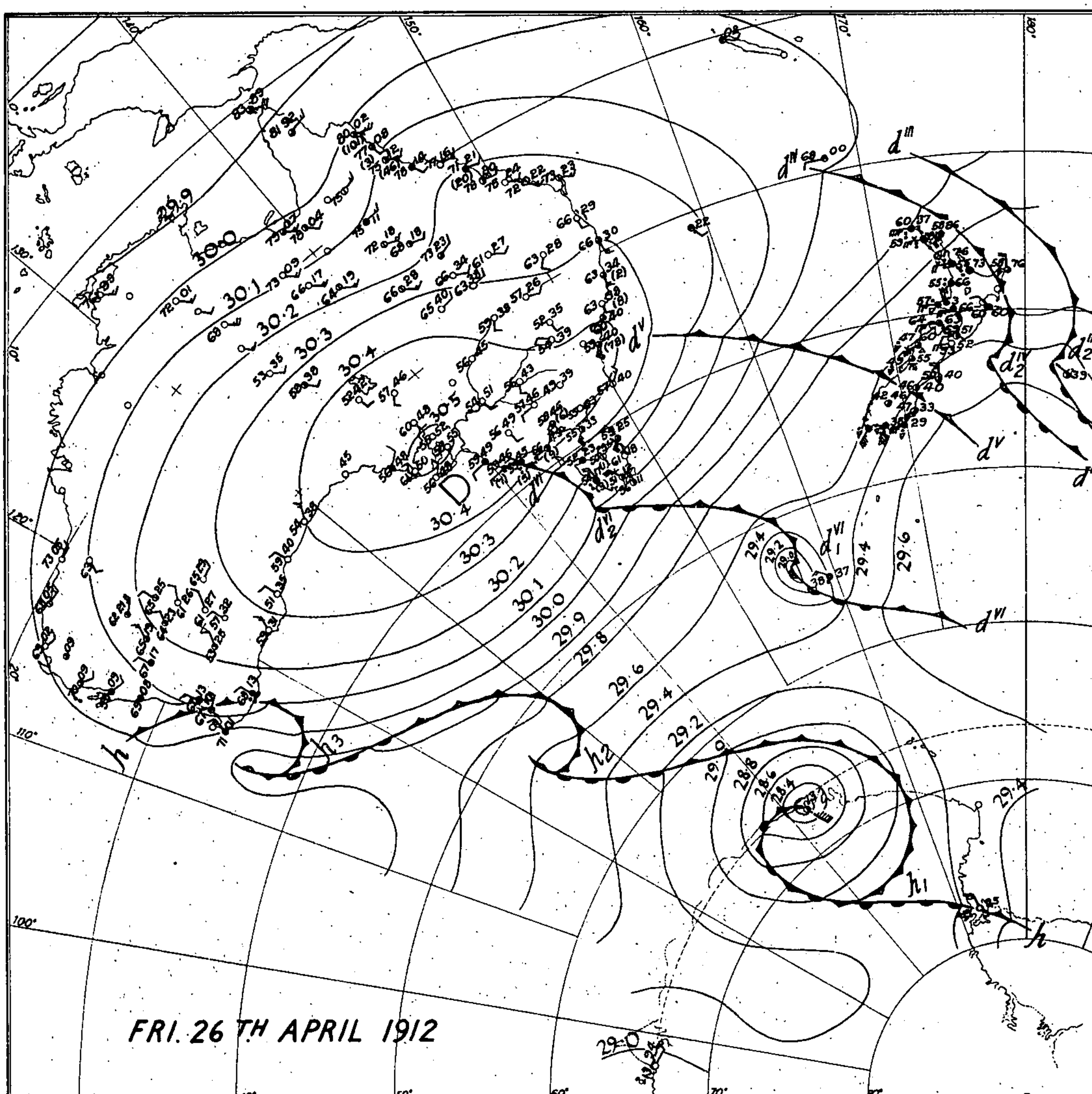
Wave d_5 has developed into an intense cyclone. Note the secondary fronts in the cold air.



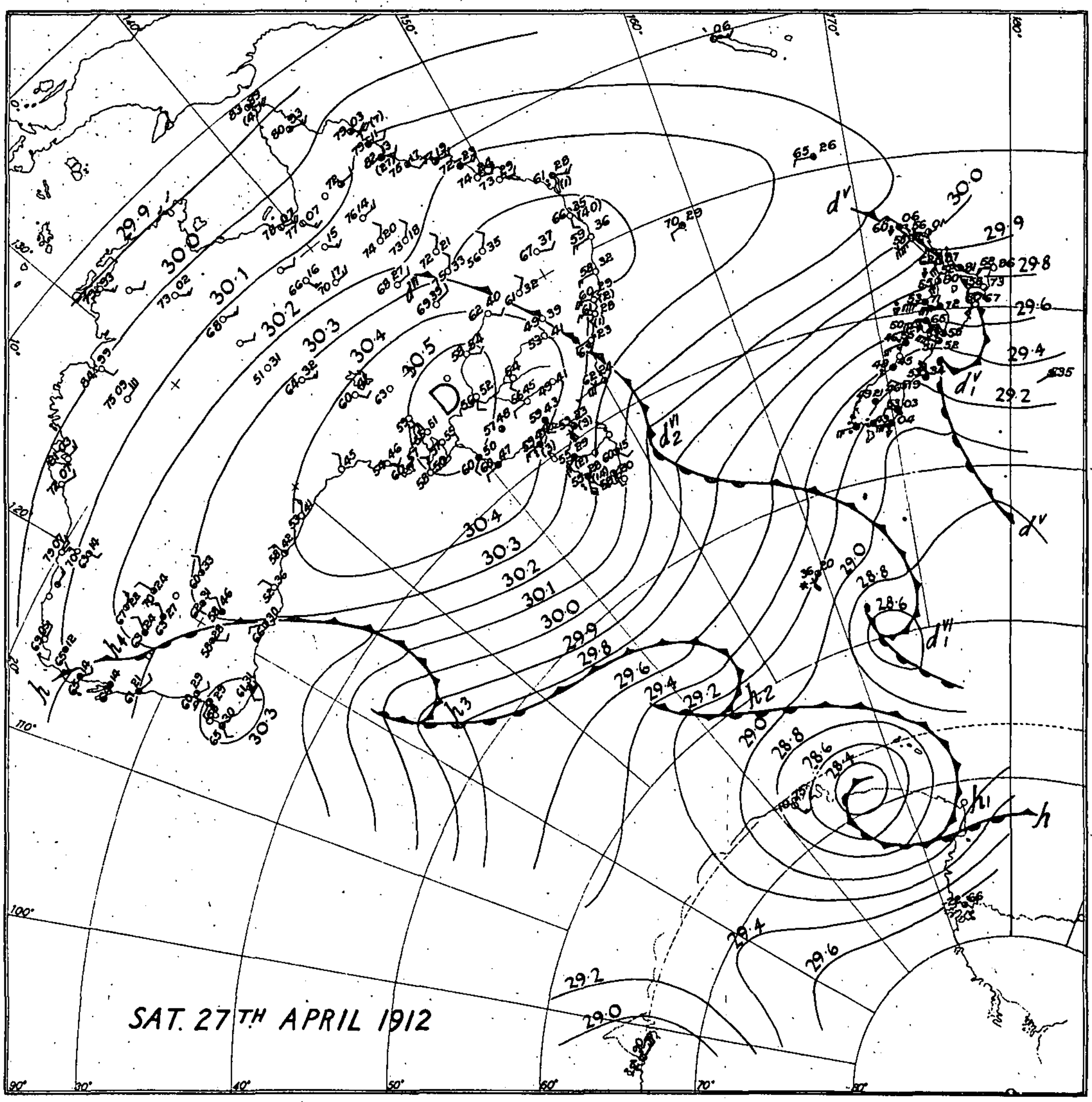
Cyclone d_5 has deepened and there are strong gales and heavy rain about it. The series of secondary fronts to d are strongly developed and waves form on some of them. On the other hand conditions are unfavourable for the propagation of the northward portions of fronts f and g.



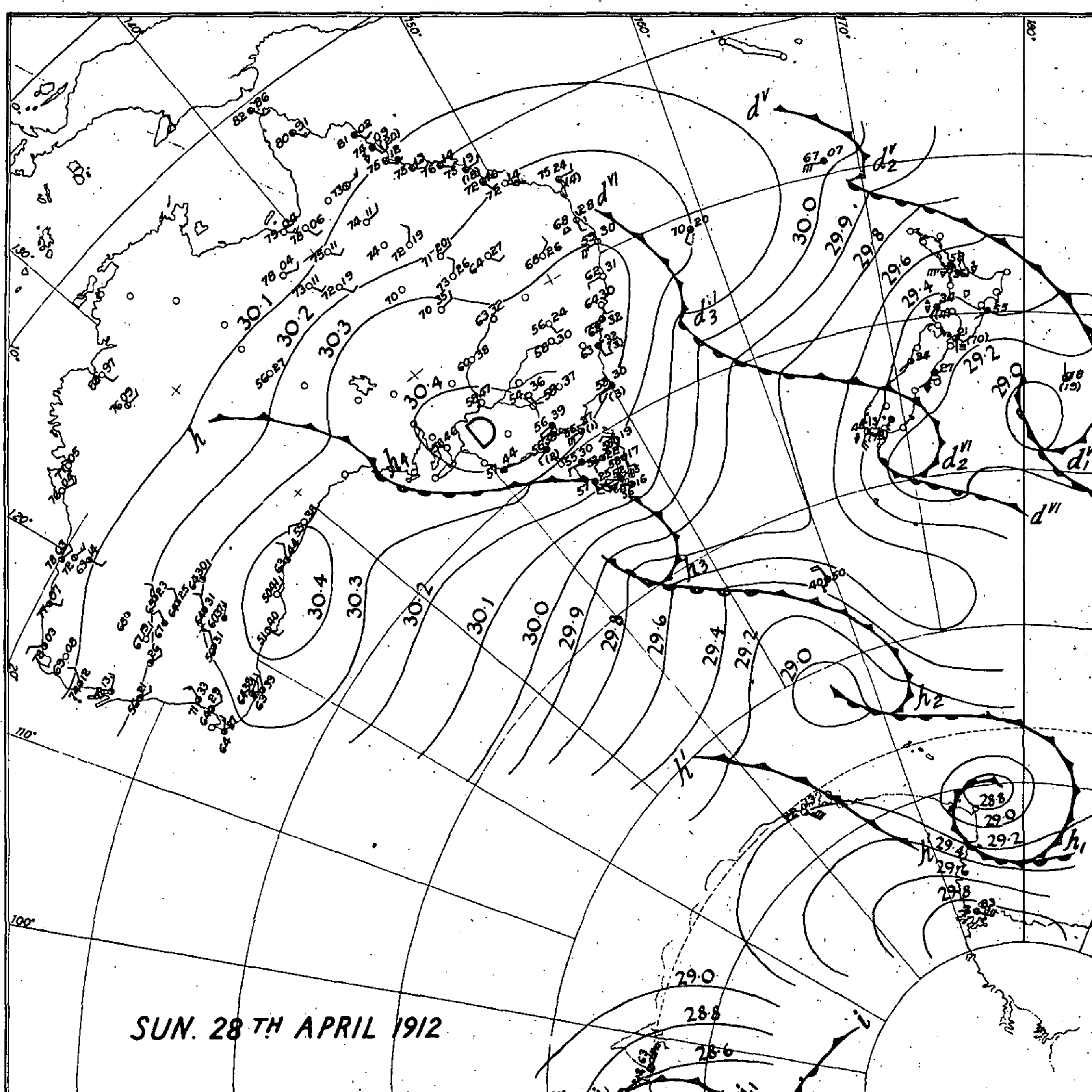
Secondary fronts continue to develop behind *d*. Note the wind discontinuity and the rain over Victoria. A deep cyclone is approaching Adélie Land. The wind direction was not recorded at Cape Evans.



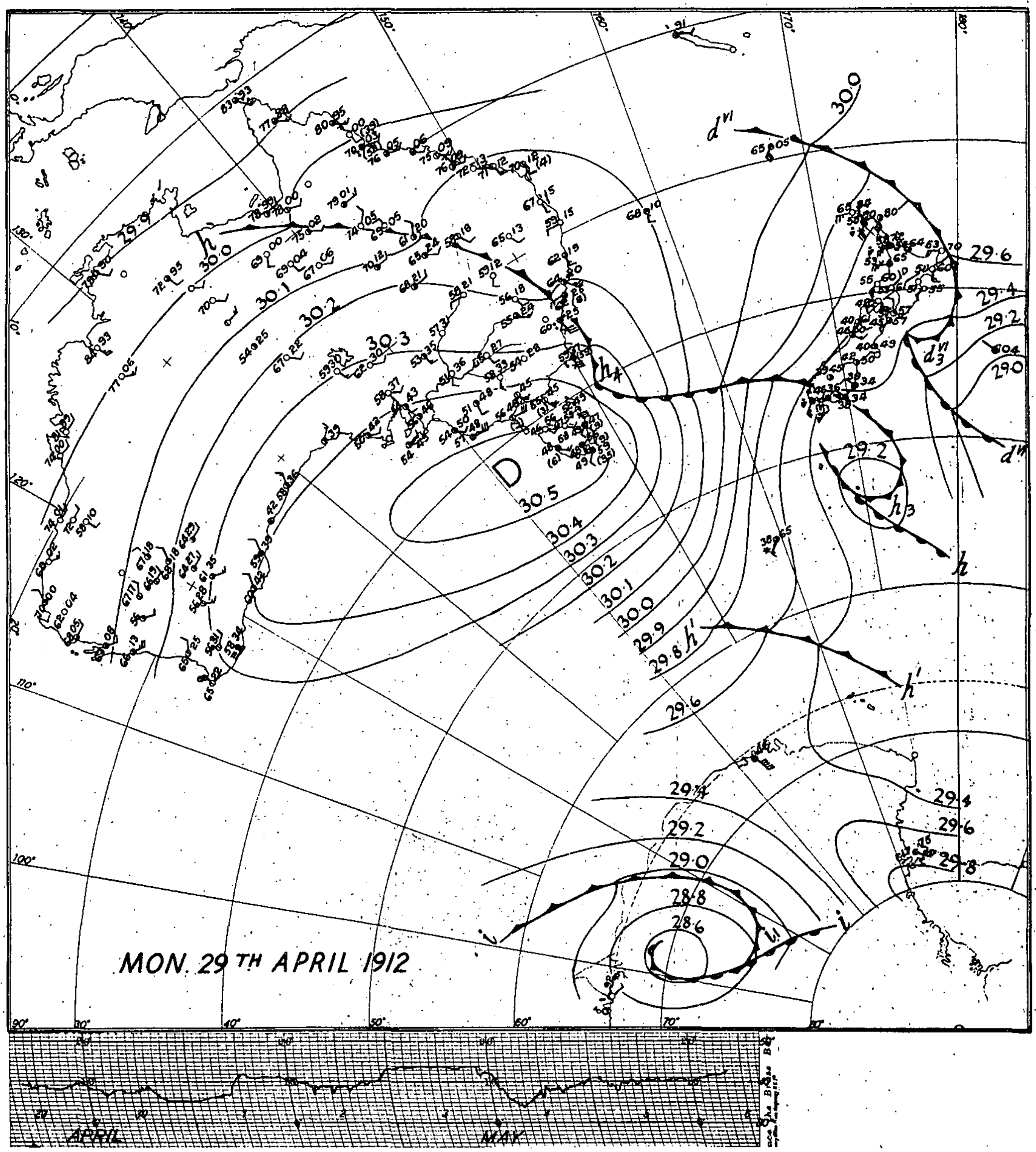
A cyclone is centred near Adélie Land while a low-pressure trough is passing Cape Evans; note the northerly wind at the latter station. A small cyclone is approaching Macquarie Island also; the temperature there rose steadily till 16 hours when a steady fall followed. There are westerly or south-westerly gales in New Zealand.



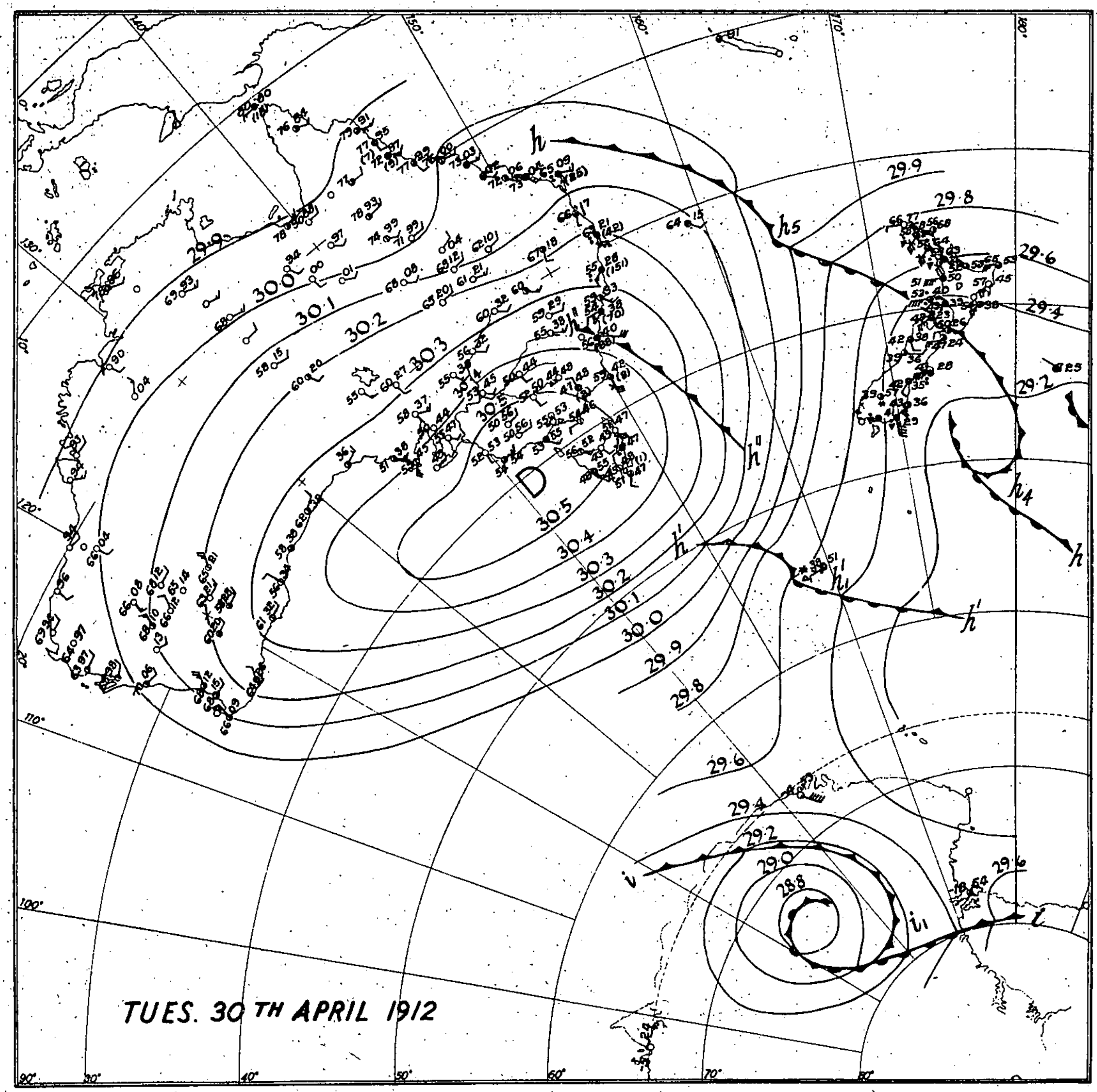
There are still strong gales and widespread rain in New Zealand. The recent series of developments there is typical of what happens in a strong and extensive south-westerly current. The wind direction was not recorded at Cape Evans but was probably south-east and the cyclone passing to the north.



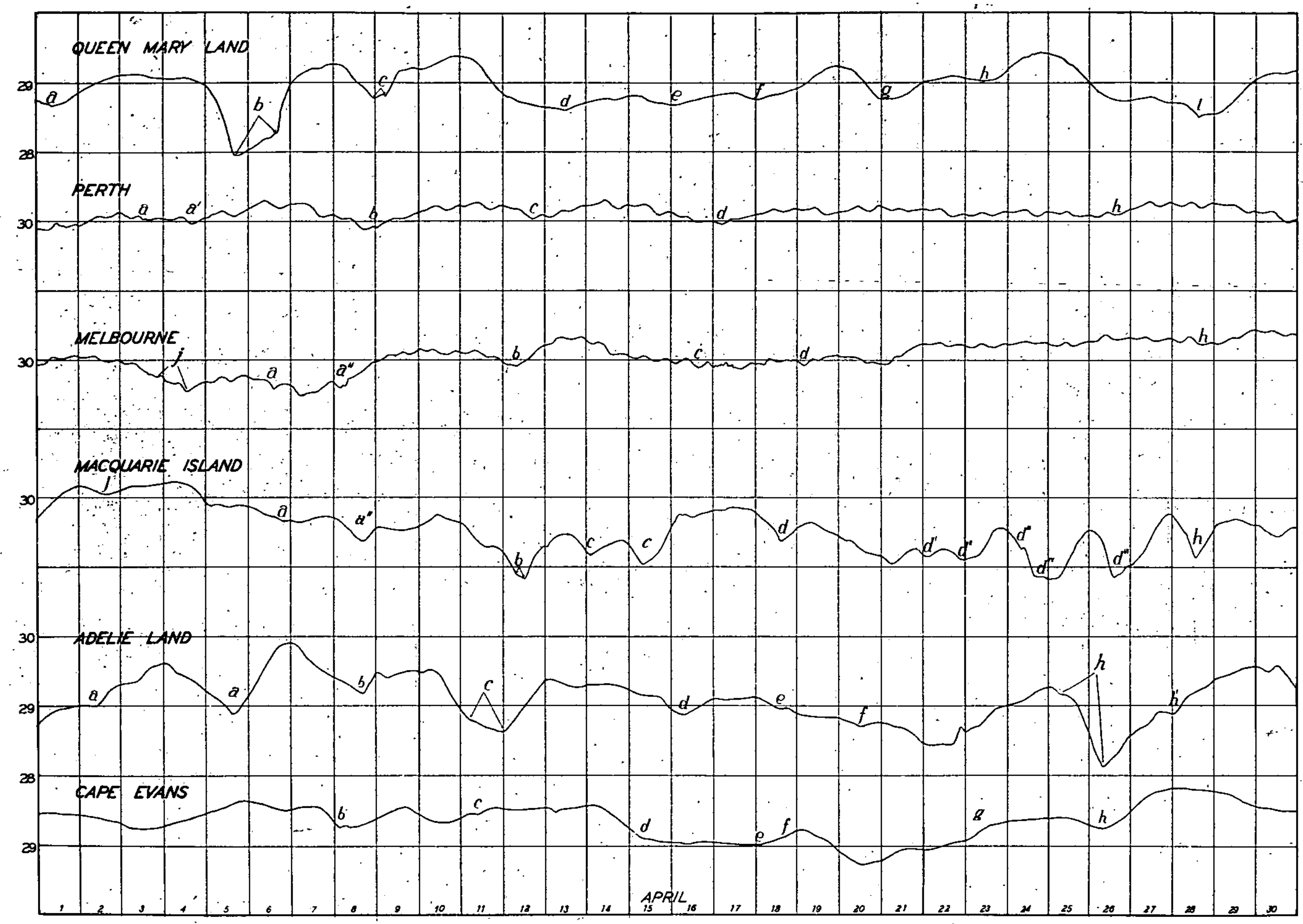
Anticyclone D was intense and persistent over Australia and probably marks the onset of winter conditions. It is now being crossed by front h. The latter was accompanied by marked temperature changes at Macquarie Island.

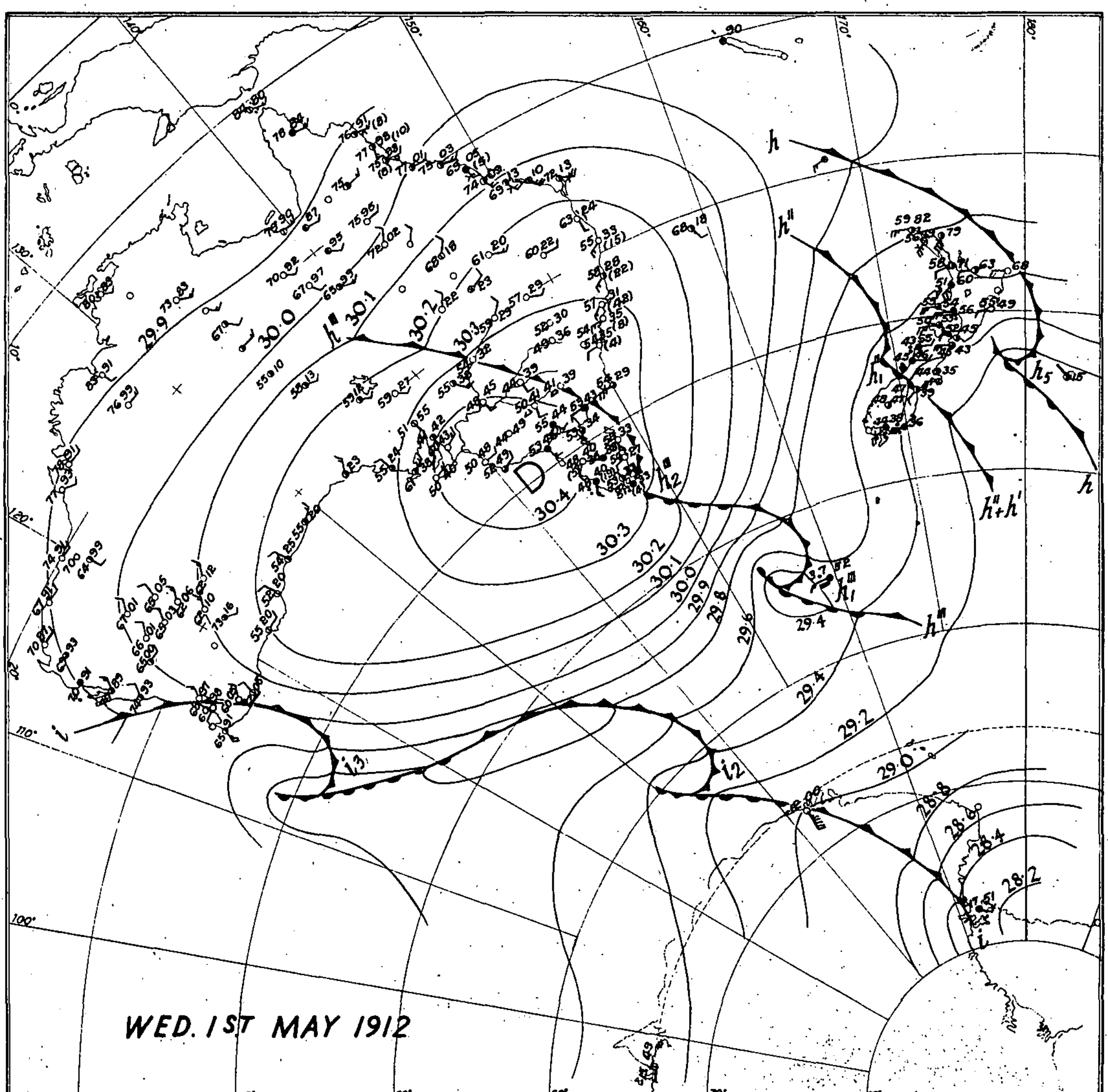


The movement of the northern part of front *h* appears very fast and it is possibly not a true front there.

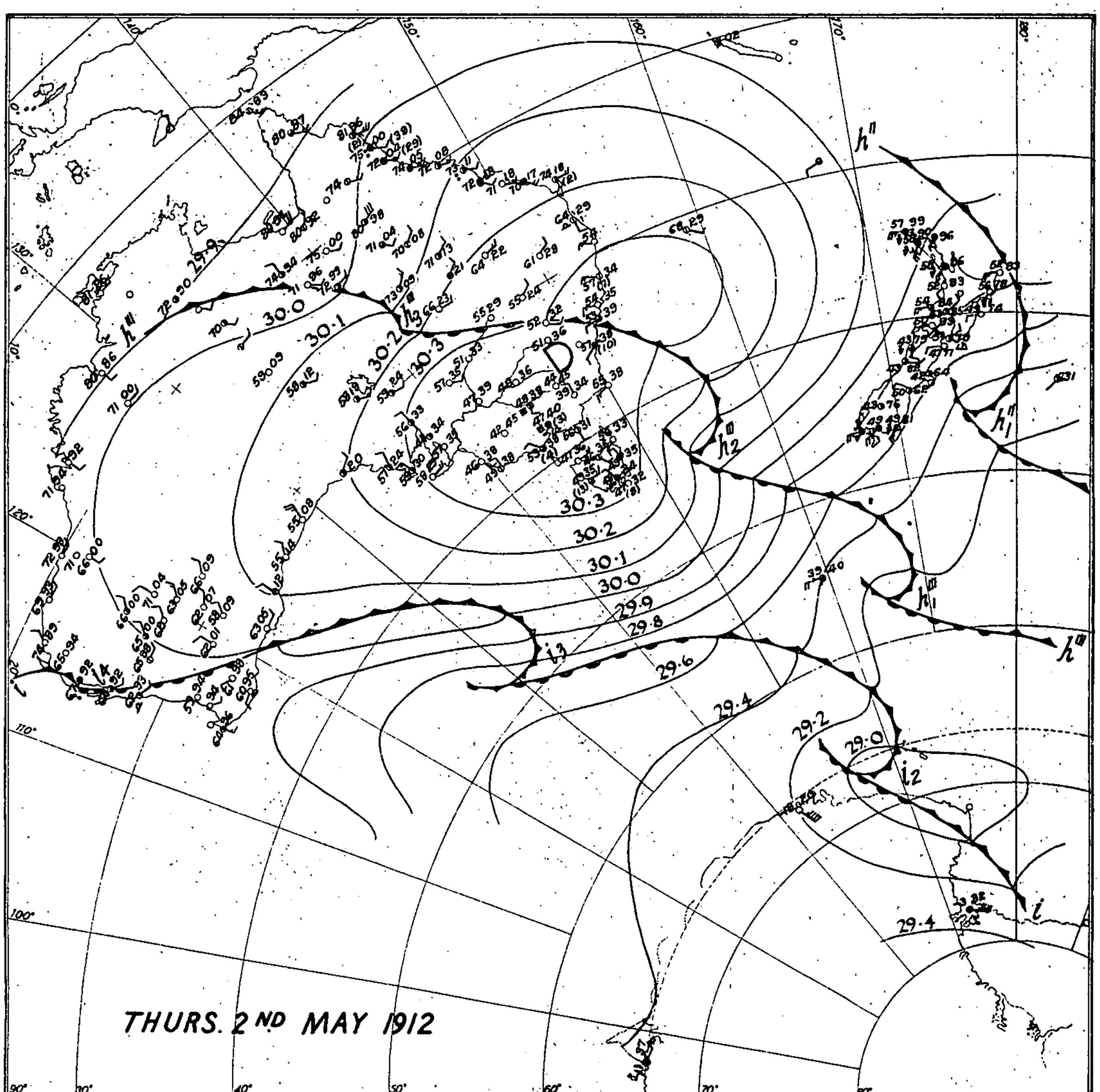


Anticyclone D is still intense. Southerly gales persist in New Zealand.

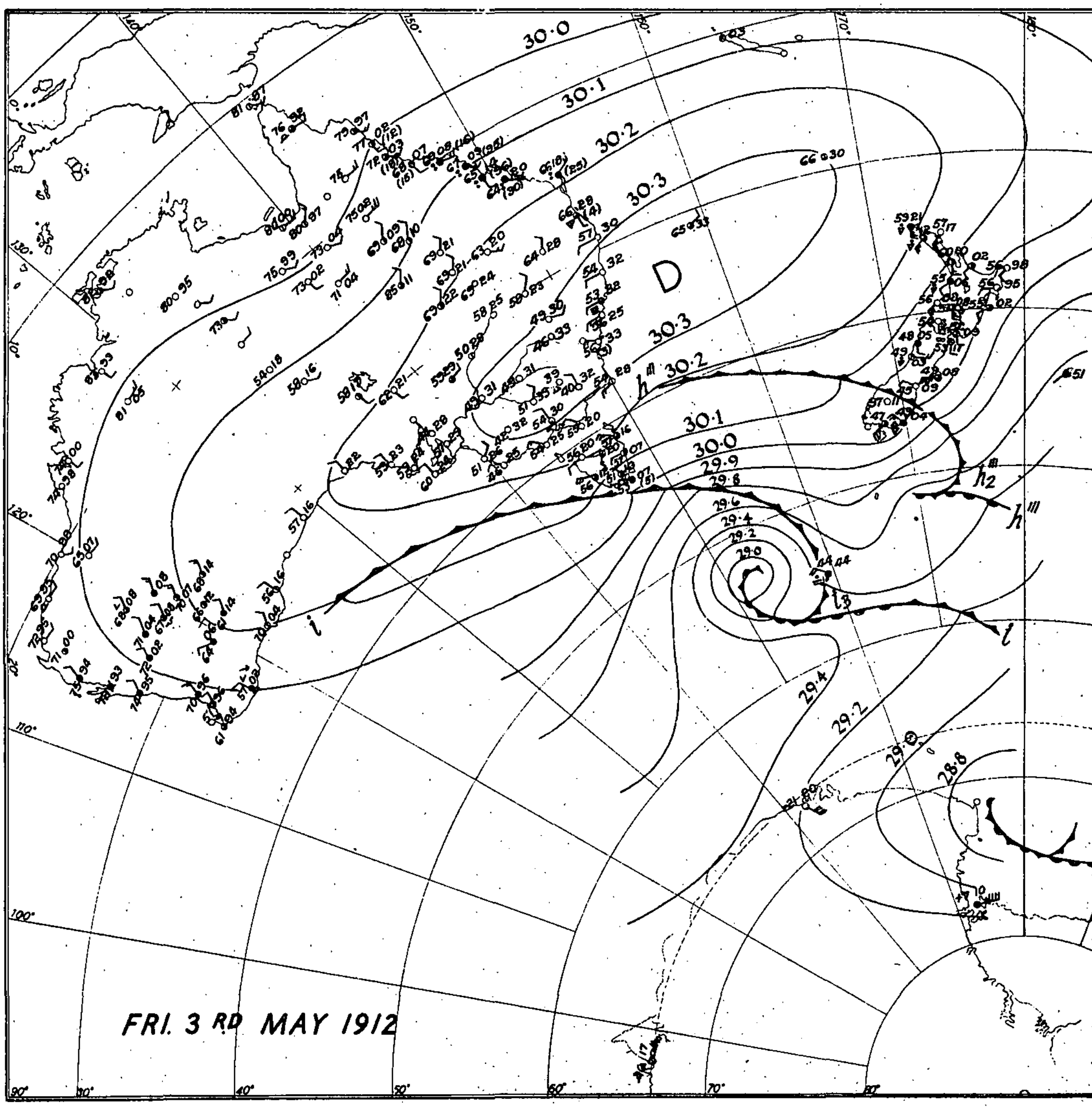

QUEEN MARY LAND
PERTH
MELBOURNE
MACQUARIE ISLAND
ADELIE LAND
CAPE EVANS
APRIL



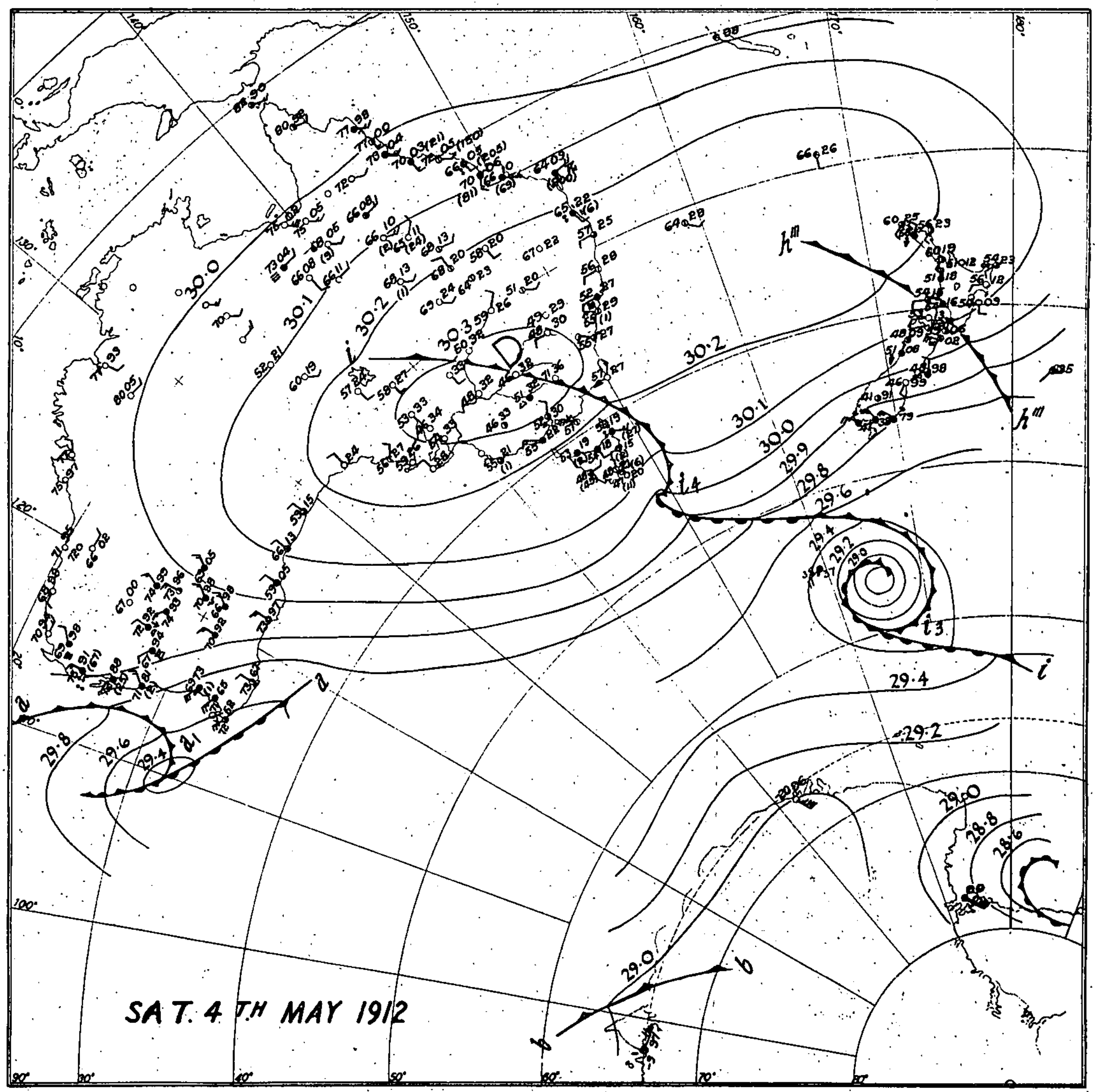
A very sharp rise of temperature occurs at Macquarie Island following the passage of the cold front.



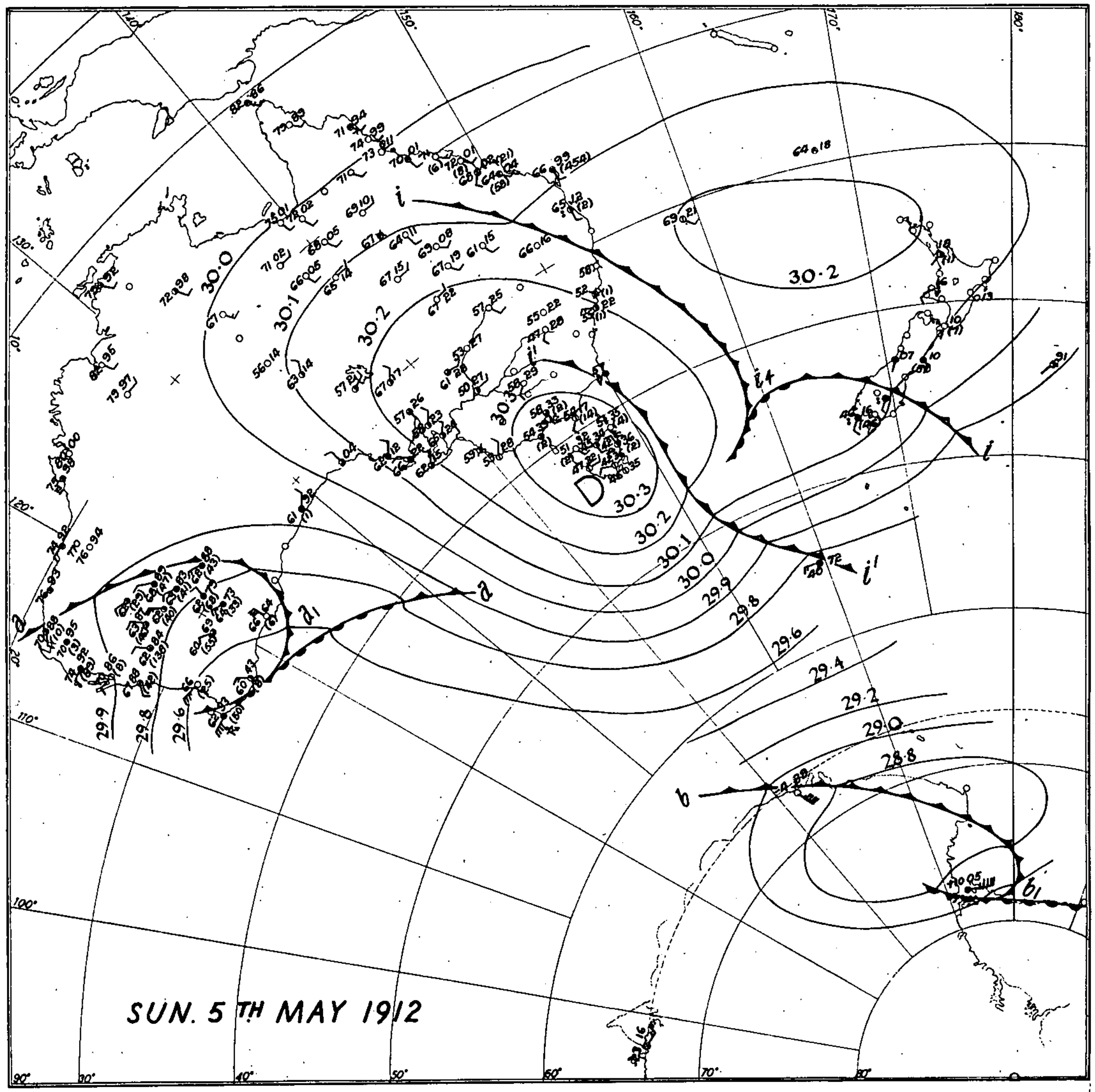
Anticyclone D is at last beginning to move and the spell of south-westerly weather over New Zealand is reaching its close. Note the blizzard at Cape Evans.



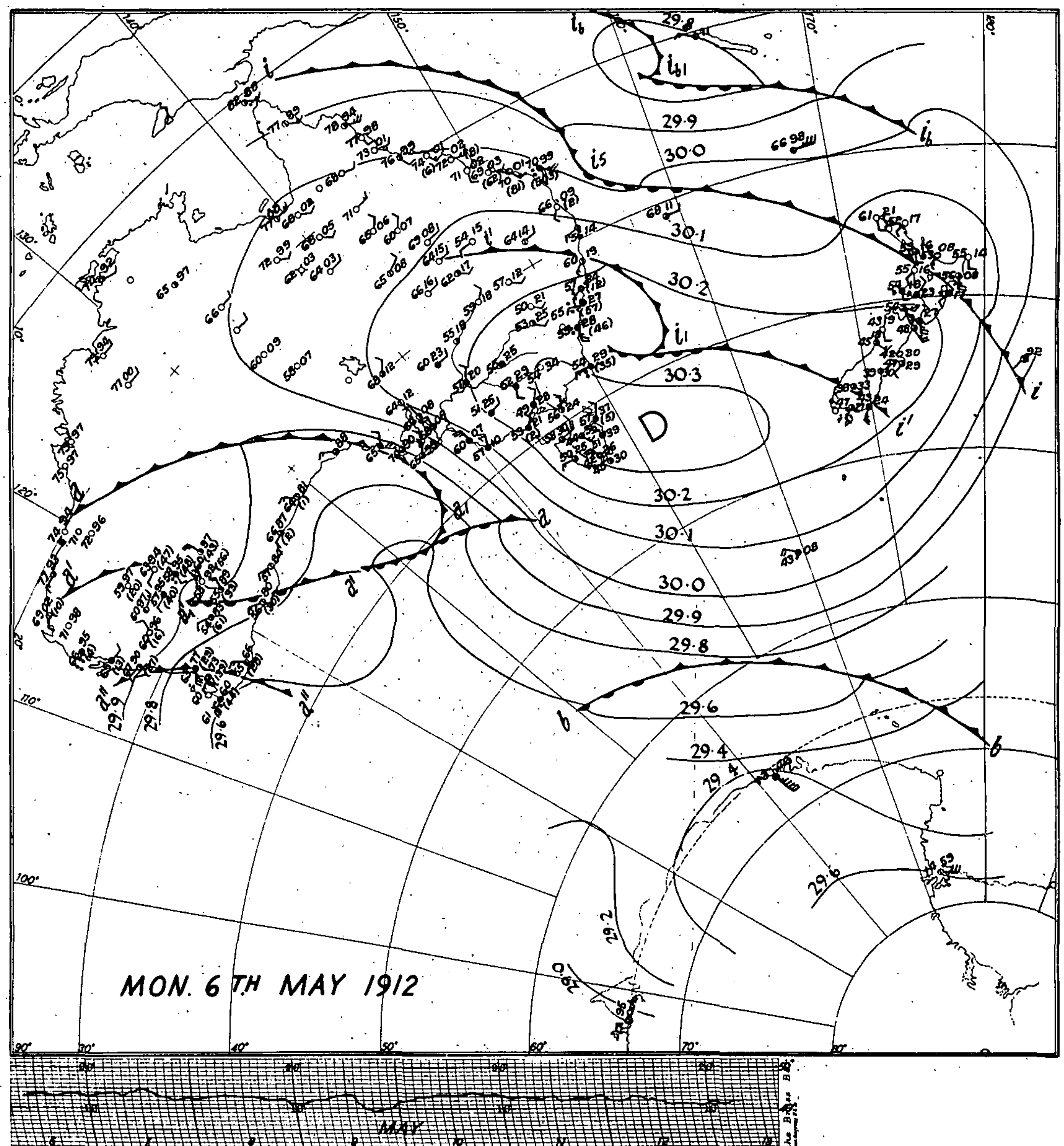
Fronts apparently do not extend on to the Australian Continent, probably on account of the easterly winds on the north side of anticyclone D. The temperature is high at Macquarie Island but a fall of 10° F. follows the passage of the occlusion of i_3. There is a blizzard again at Cape Evans.



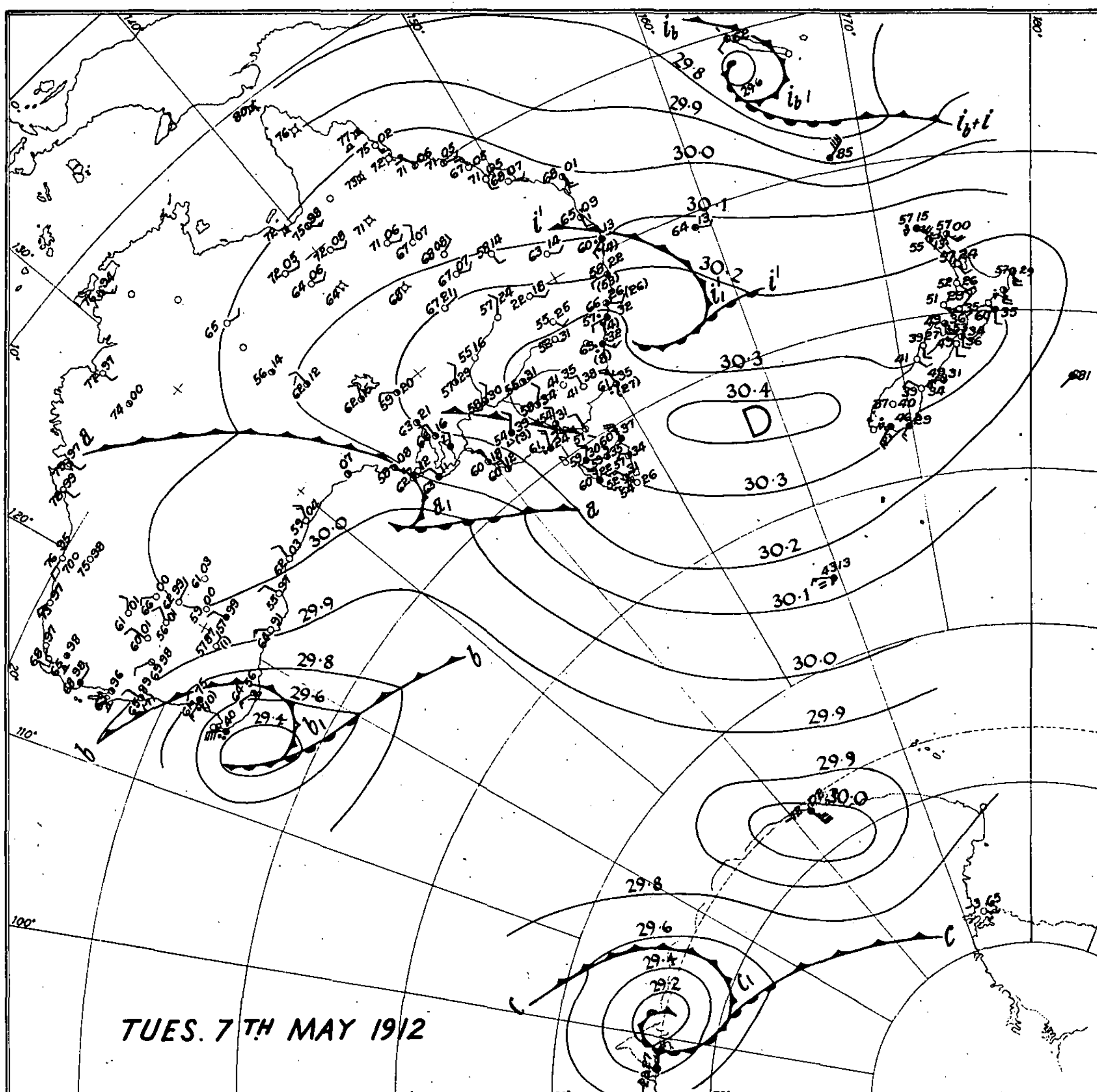
The analysis is difficult in New Zealand and Australia during this month and fronts are poorly marked. The intense blizzard at Cape Evans is assumed to be due to the passage of cyclone i_1 in a south-easterly direction across the Ross Sea.



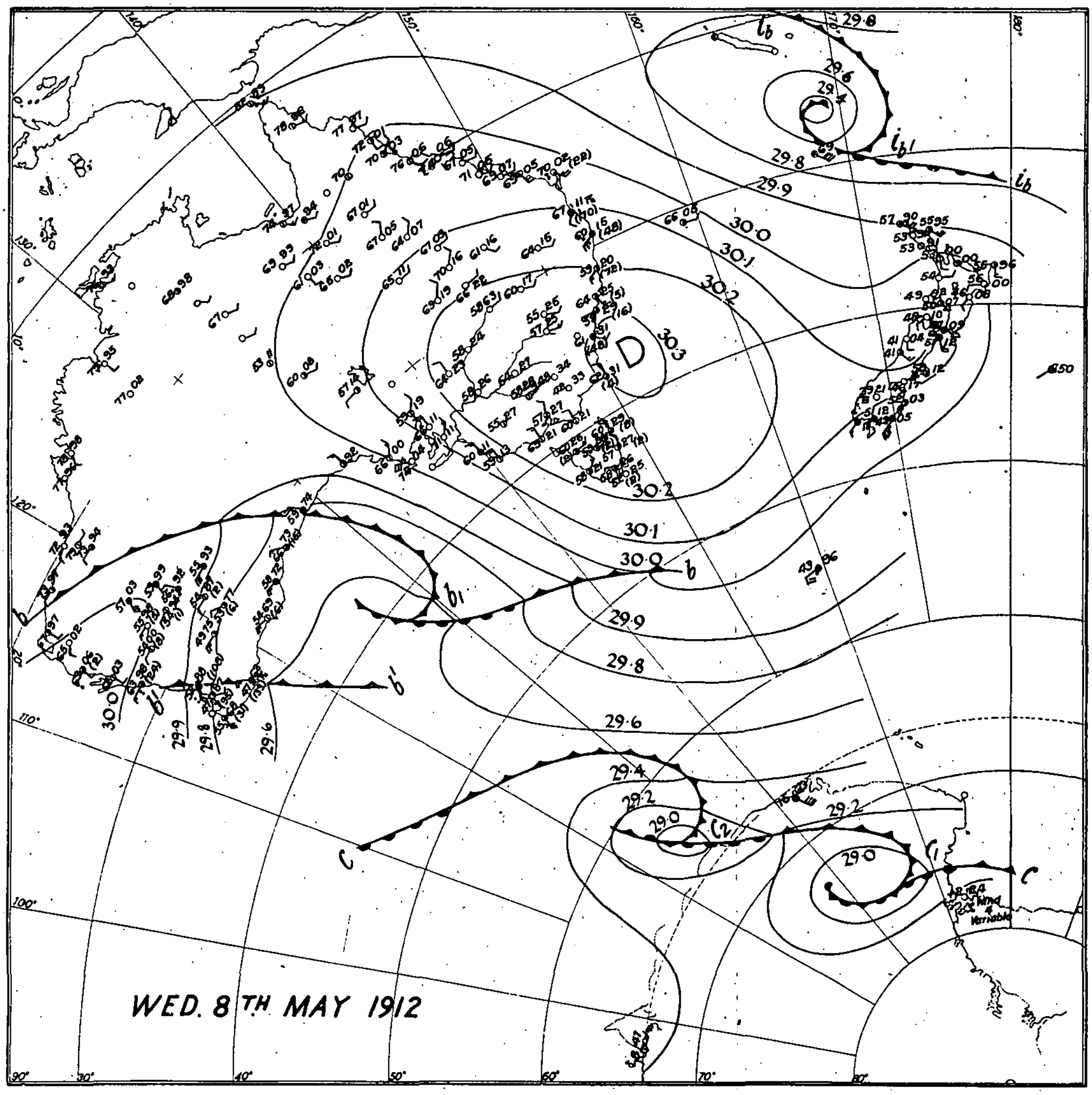
Note the extensive depression over Western Australia with a gale in the west.



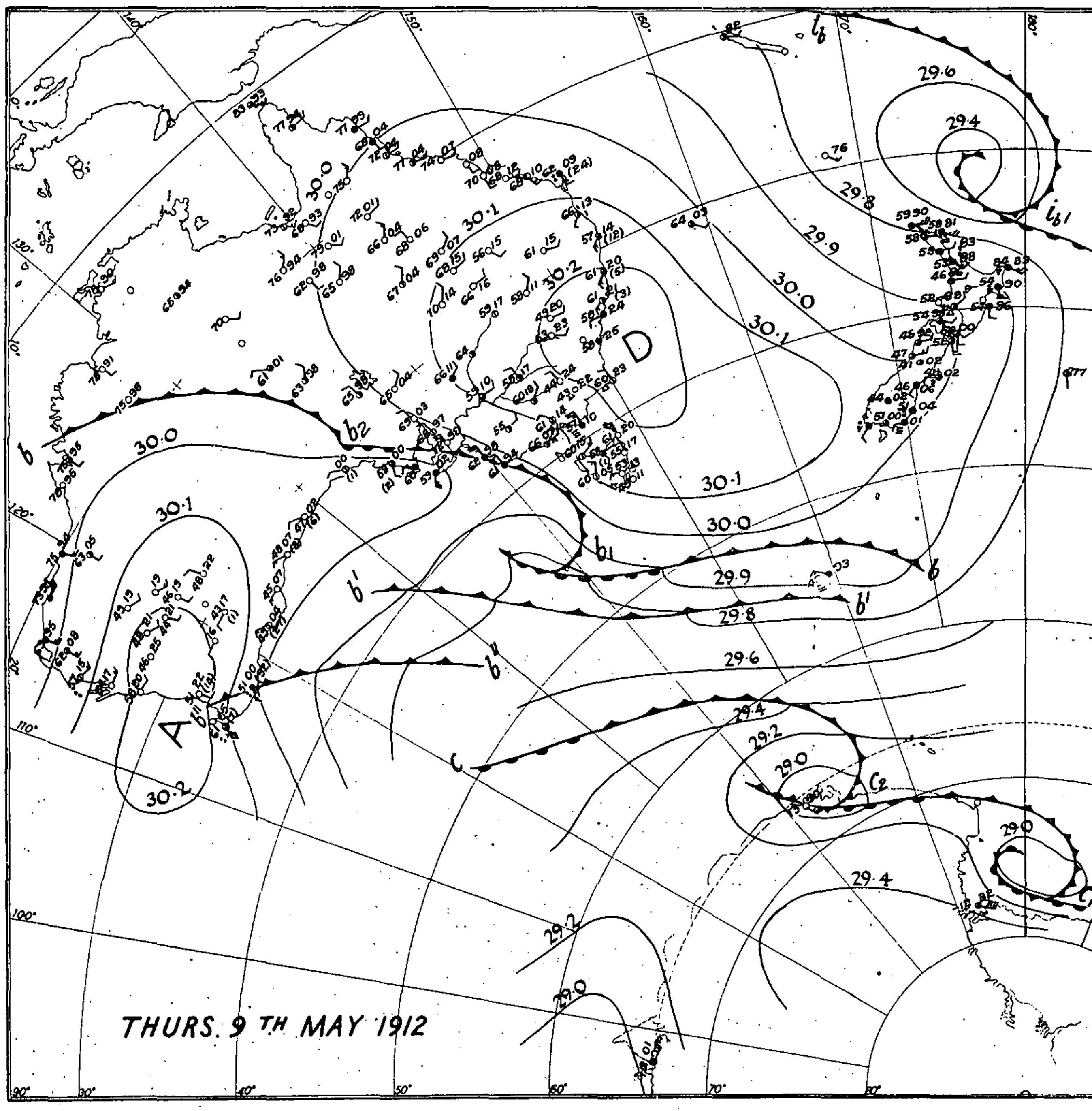
A new front appears to be developing between New Caledonia and Norfolk Island, and a wave to be developing on it.



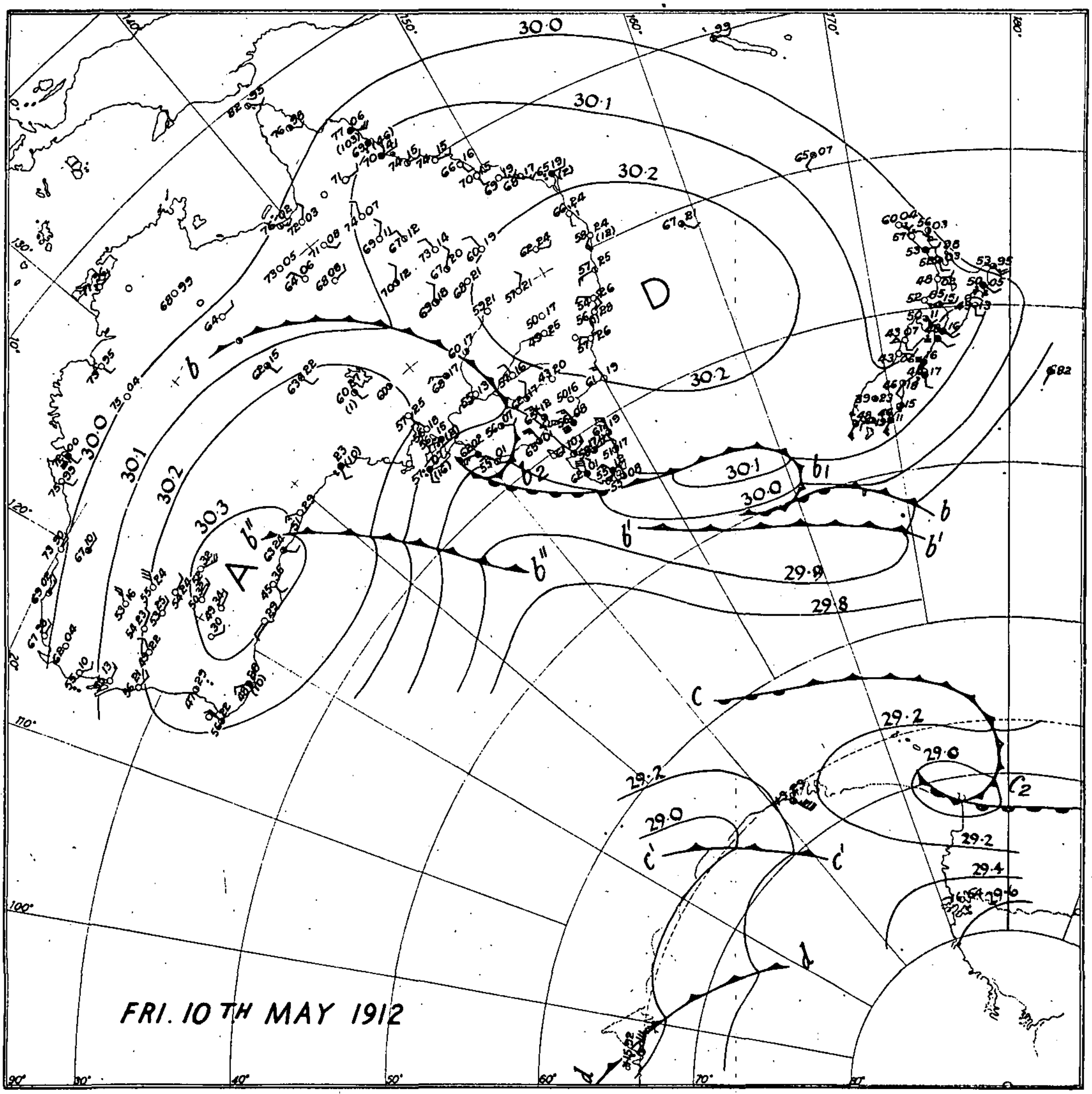
A cyclone has developed on front i_b with which i has merged.



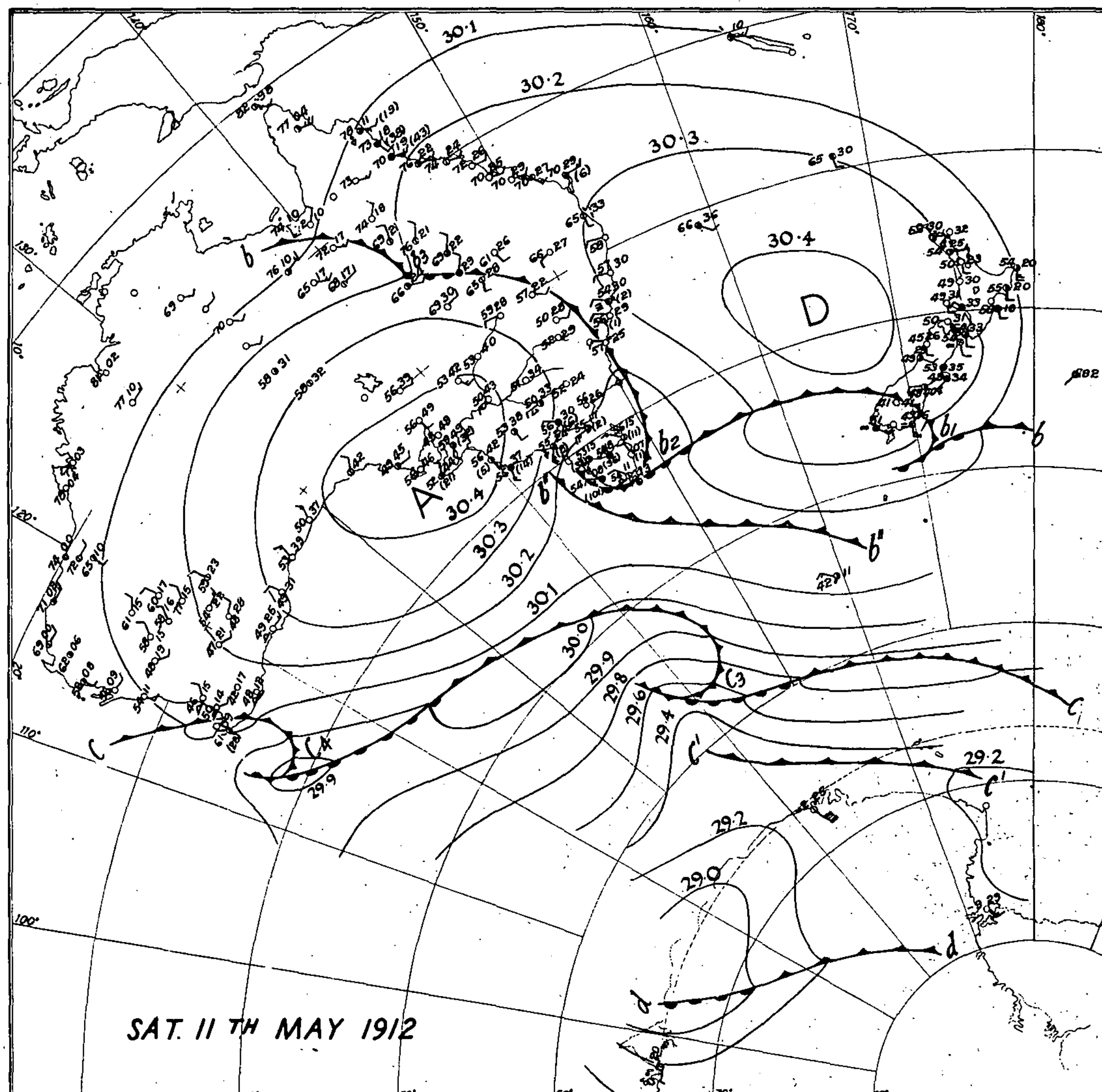
The northern cyclone is now near New Zealand.



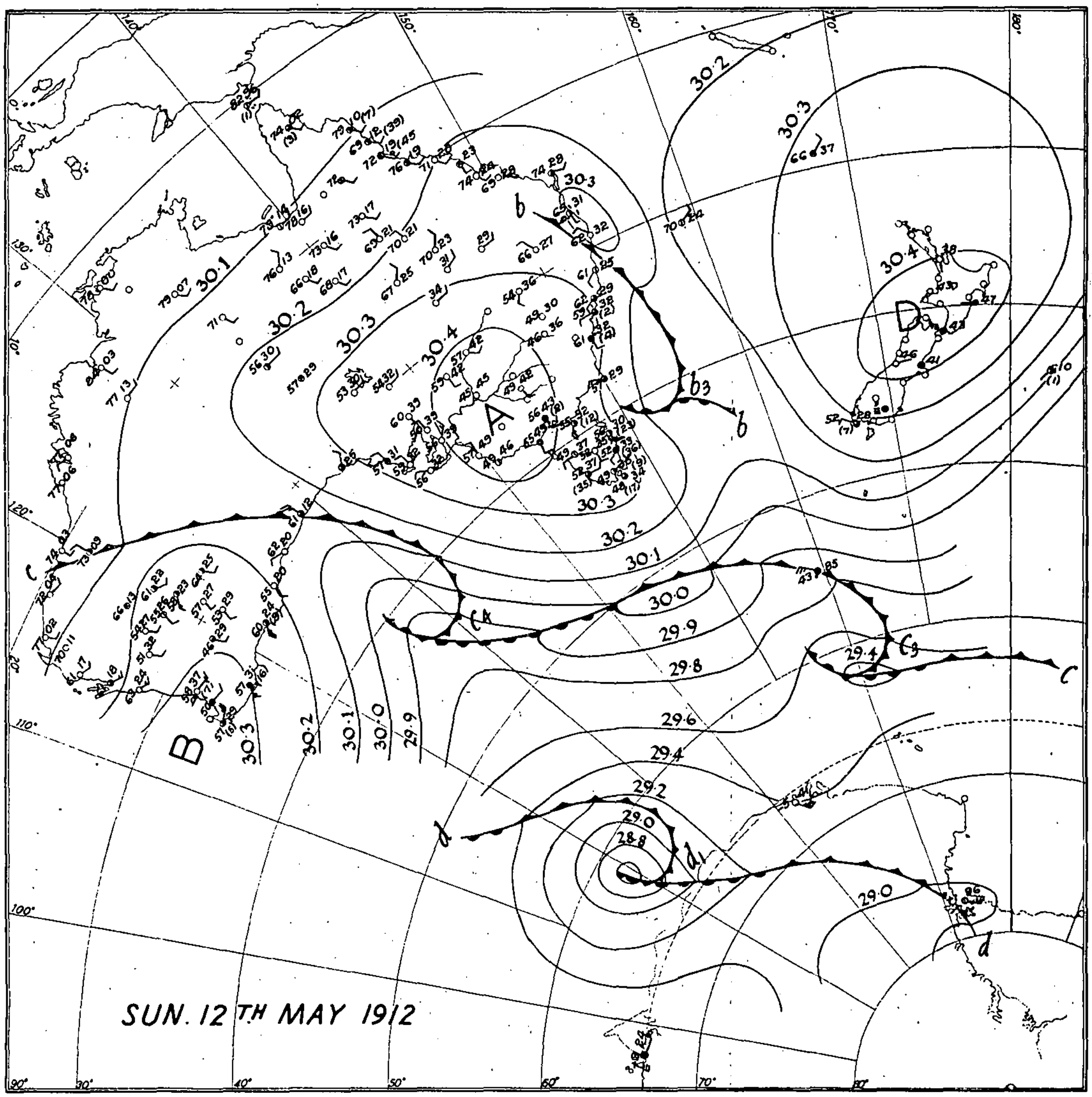
The northern cyclone is moving south-eastwards past New Zealand. There is a blizzard at Cape Evans. The sequence of changes during the past three days suggests that a cyclone has passed from Queen Mary Land almost over Cape Evans. Unstable and probably thundery conditions prevail in Western Australia.



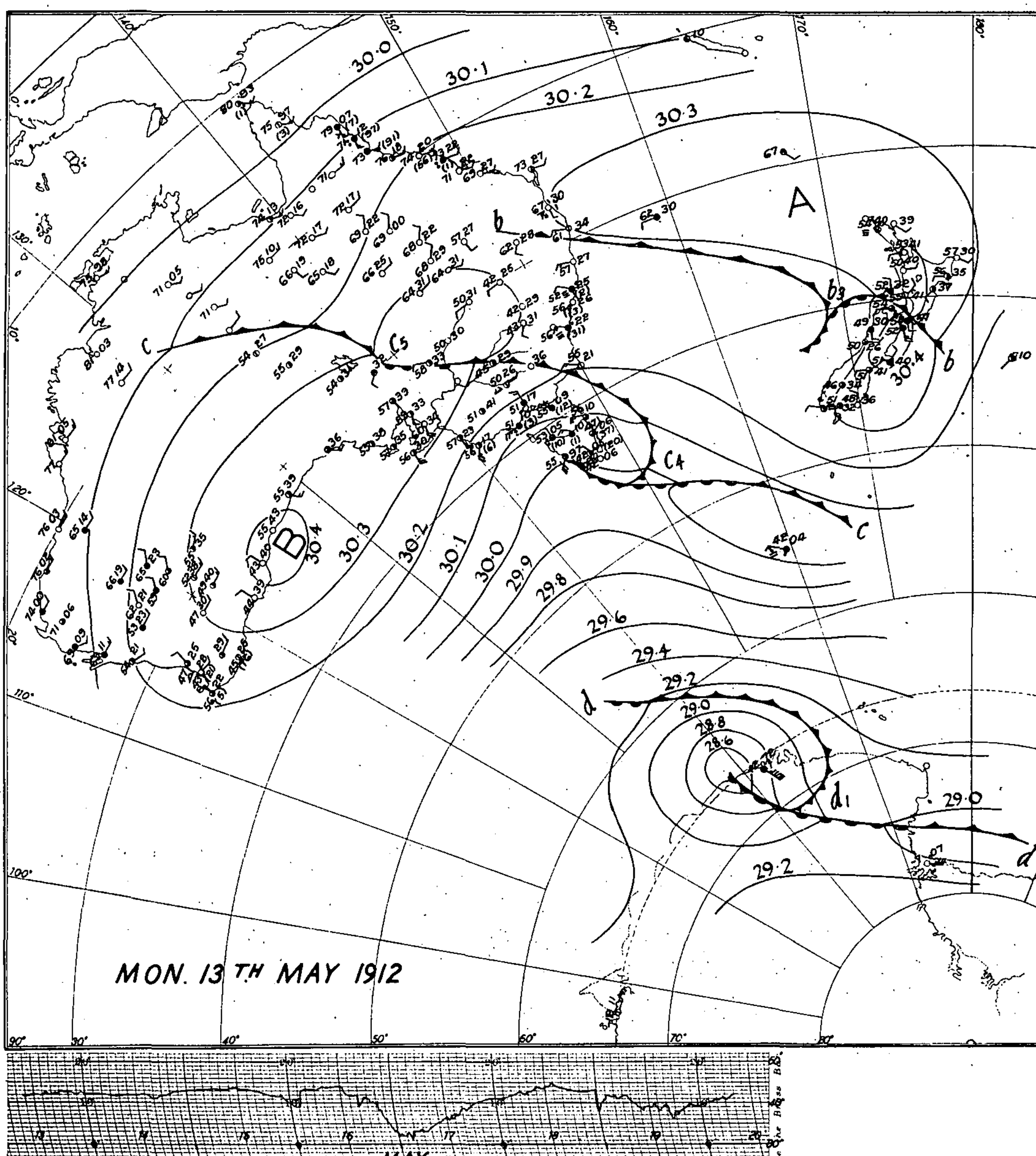
The strong wind at Queen Mary Land suggests that a cyclone is passing to the north. Front b' is well marked over Australia.



Note the westerly wind at Queen Mary Land. It is probably blowing towards the cyclone centre.

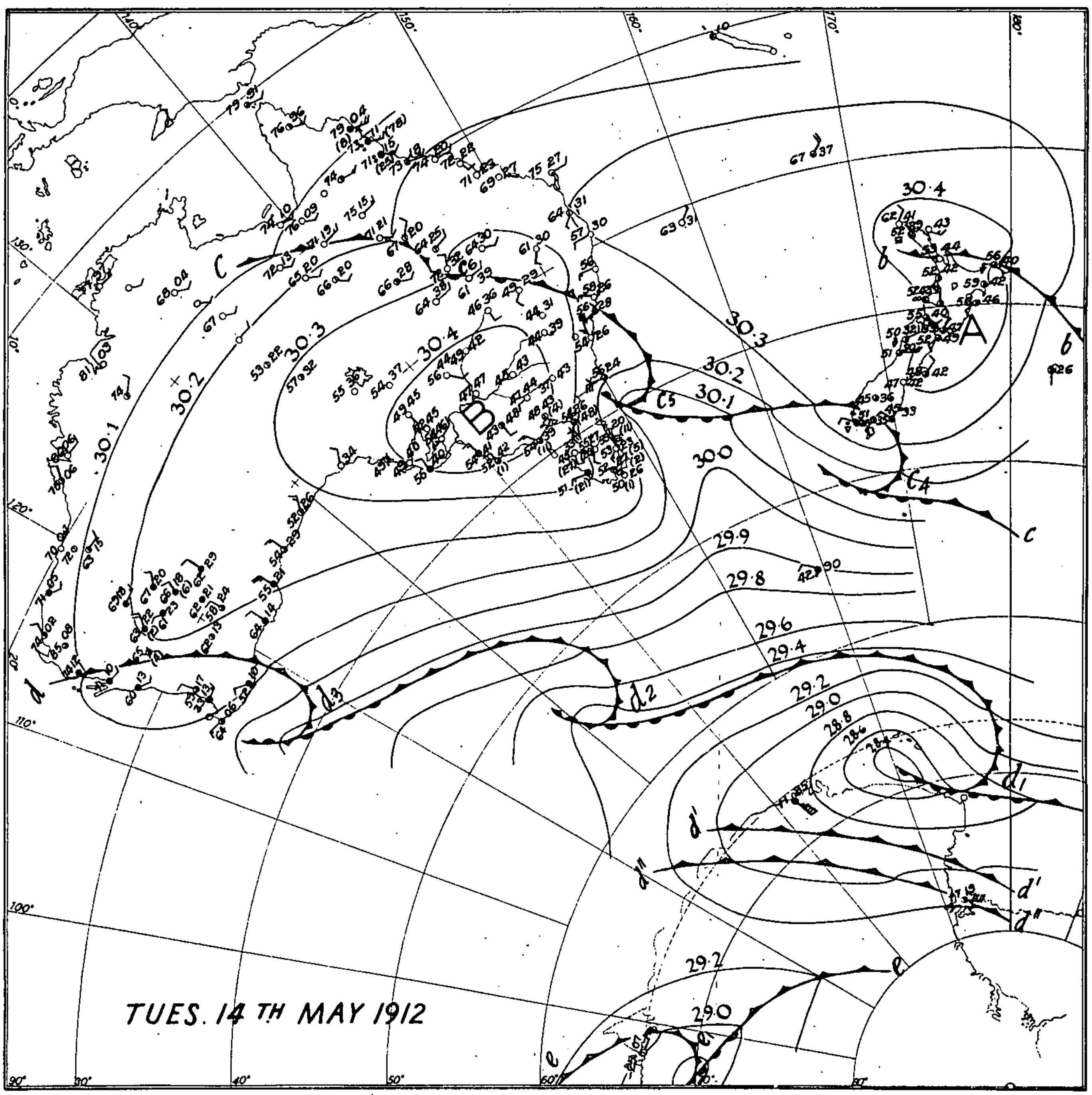


Pressure changes and wind indicate that a front is now approaching Cape Evans. The anticyclone D is finally disappearing.

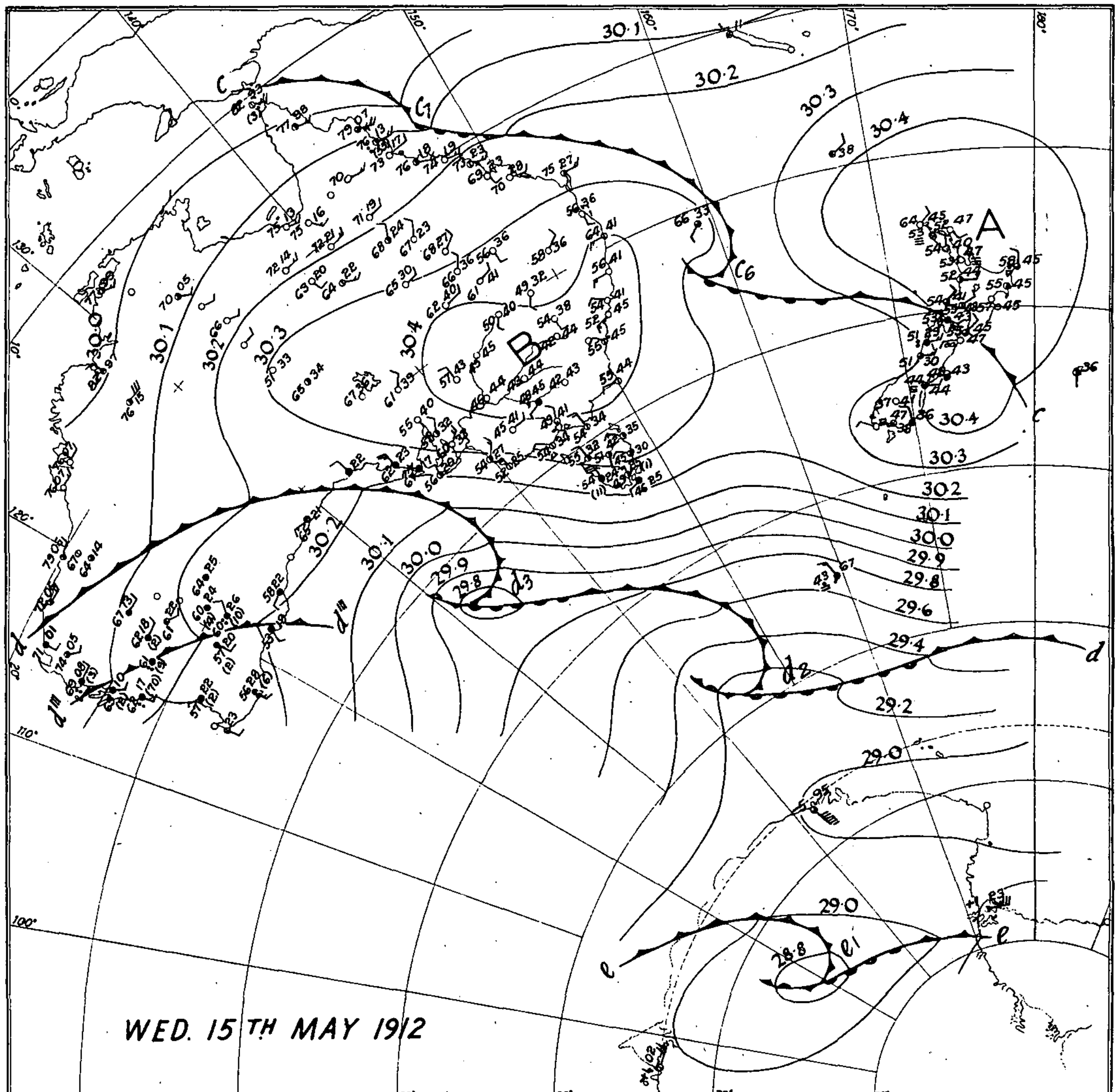


Cyclone d_1 is approaching Adélie Land. There is a slight blizzard at Cape Evans.

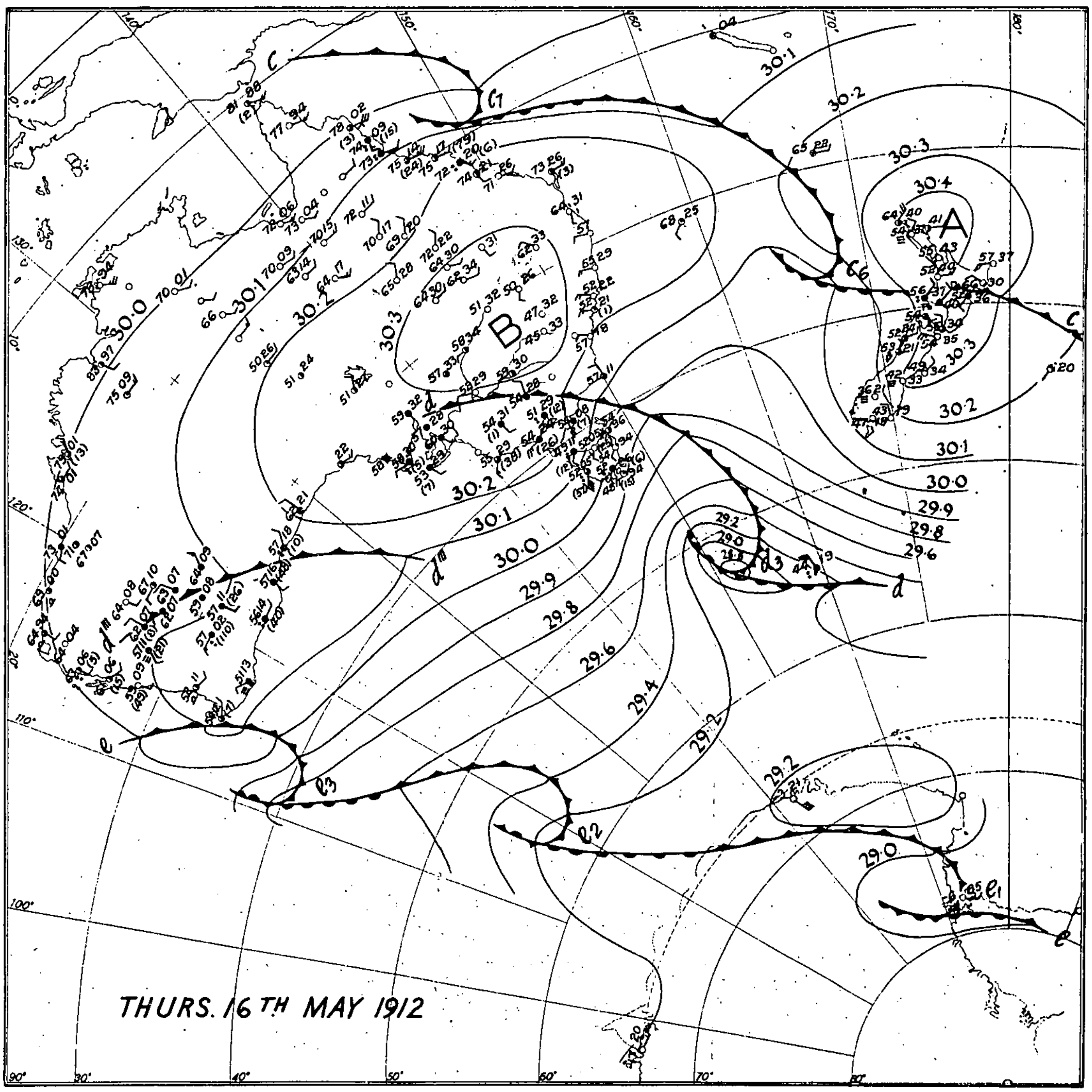
M 4



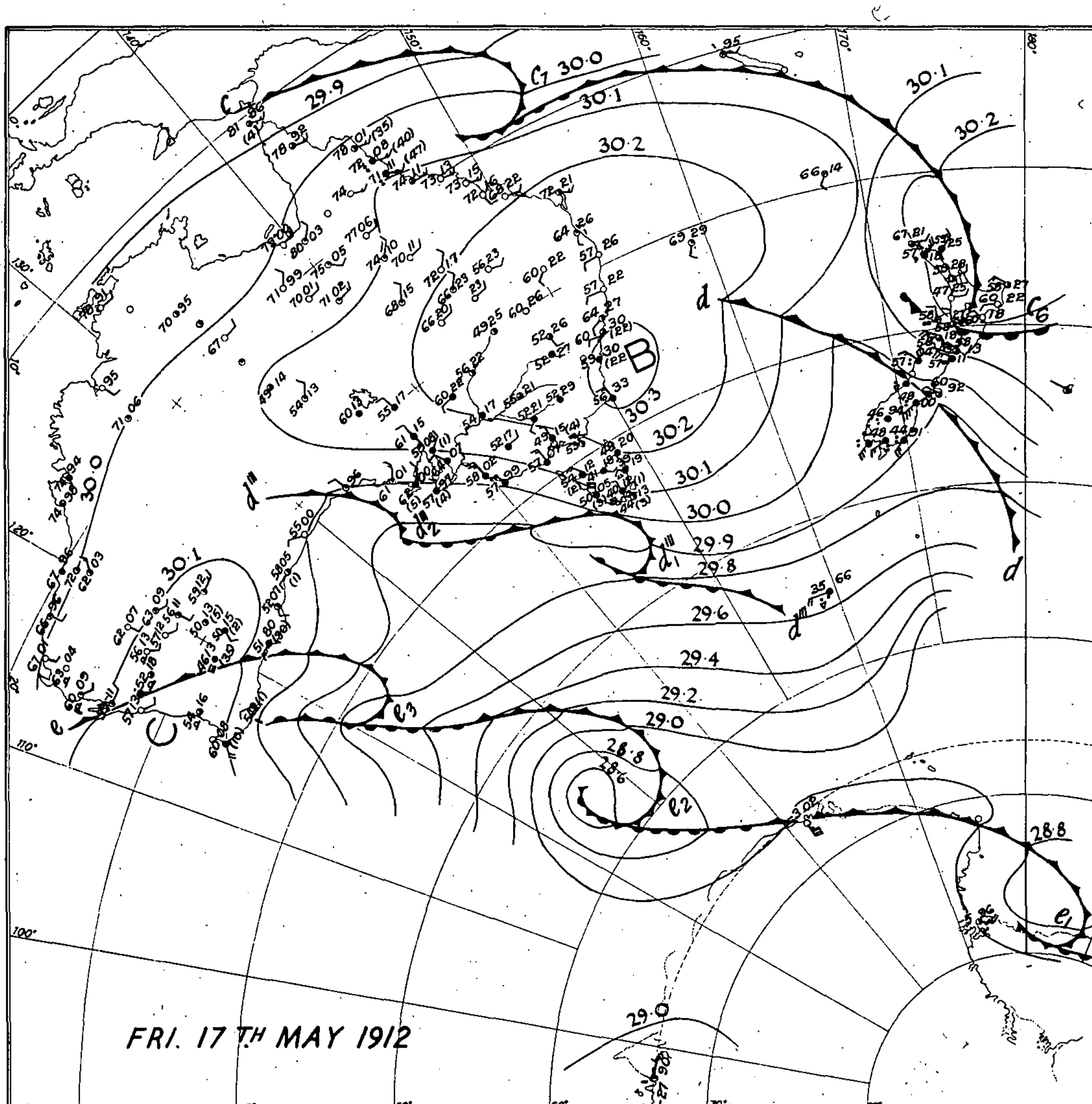
The pressure changes at Queen Mary Land indicate the passage of a cold front followed by an occlusion. A cyclone centre is, therefore, drawn to the south. The blizzard at Cape Evans has increased.



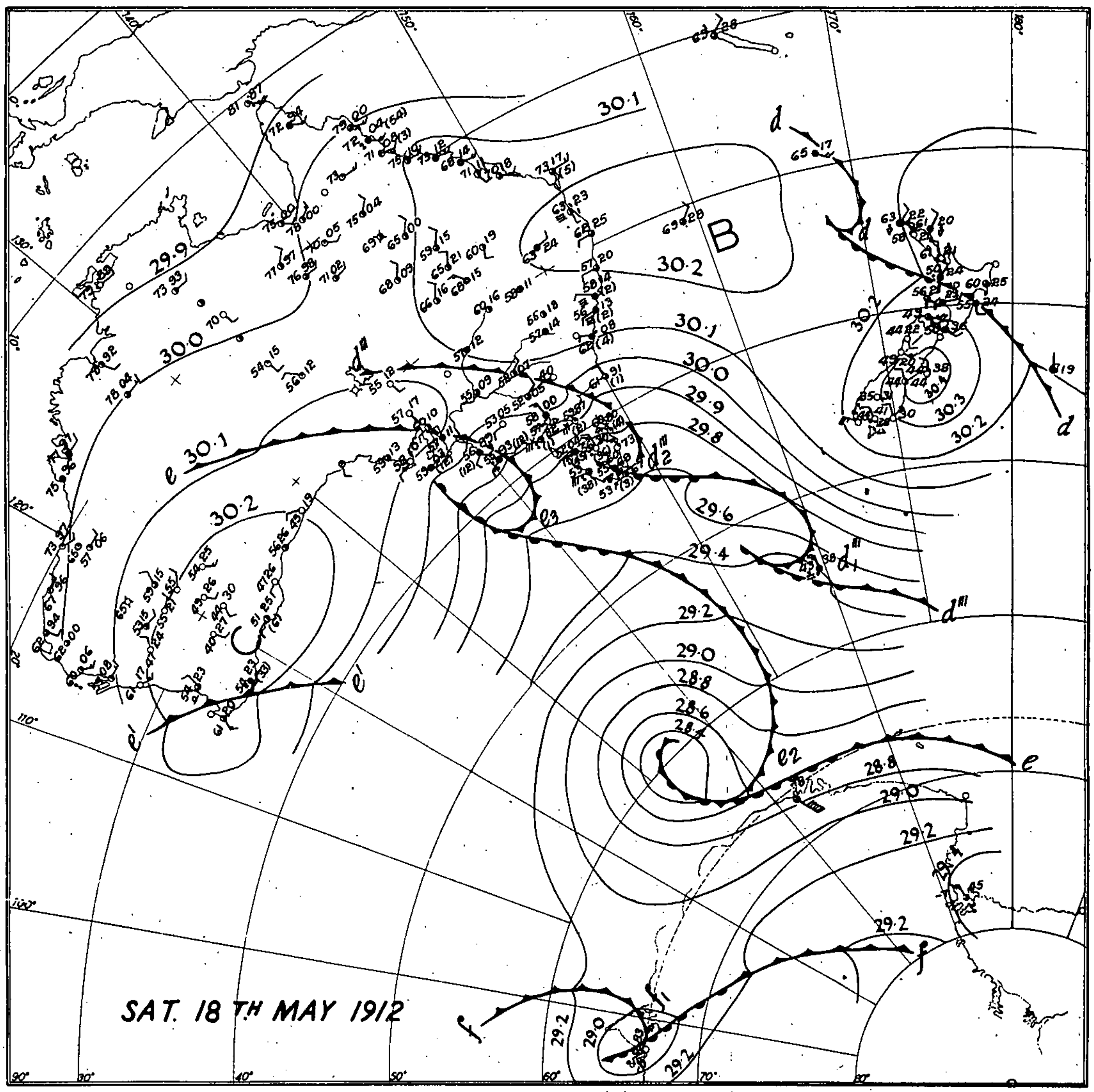
Front c is beginning to cross anticyclone A.



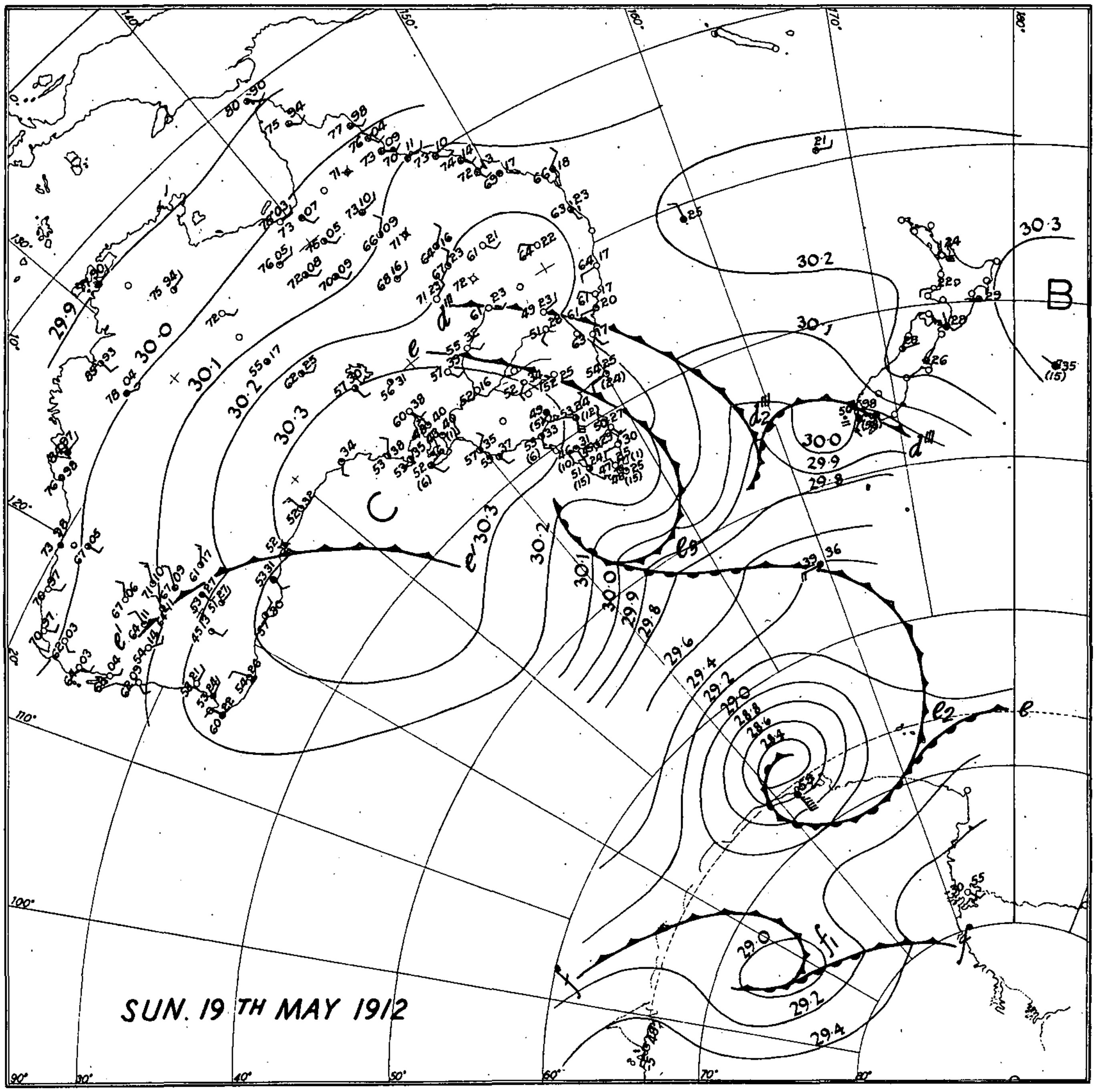
Note the remarkable series of temperature changes at Macquarie Island. *d* appears to have passed first as a cold front on the afternoon of the 15th, bringing a fall of temperature and to have recrossed as a warm front at 02 hours on the 16th, giving a sharp rise. The cold front of d_3 then passed at about noon and a progressive fall of temperature followed. The fall was rapid after 20 hours when the occlusion passed in the upper air. Some snow fell.



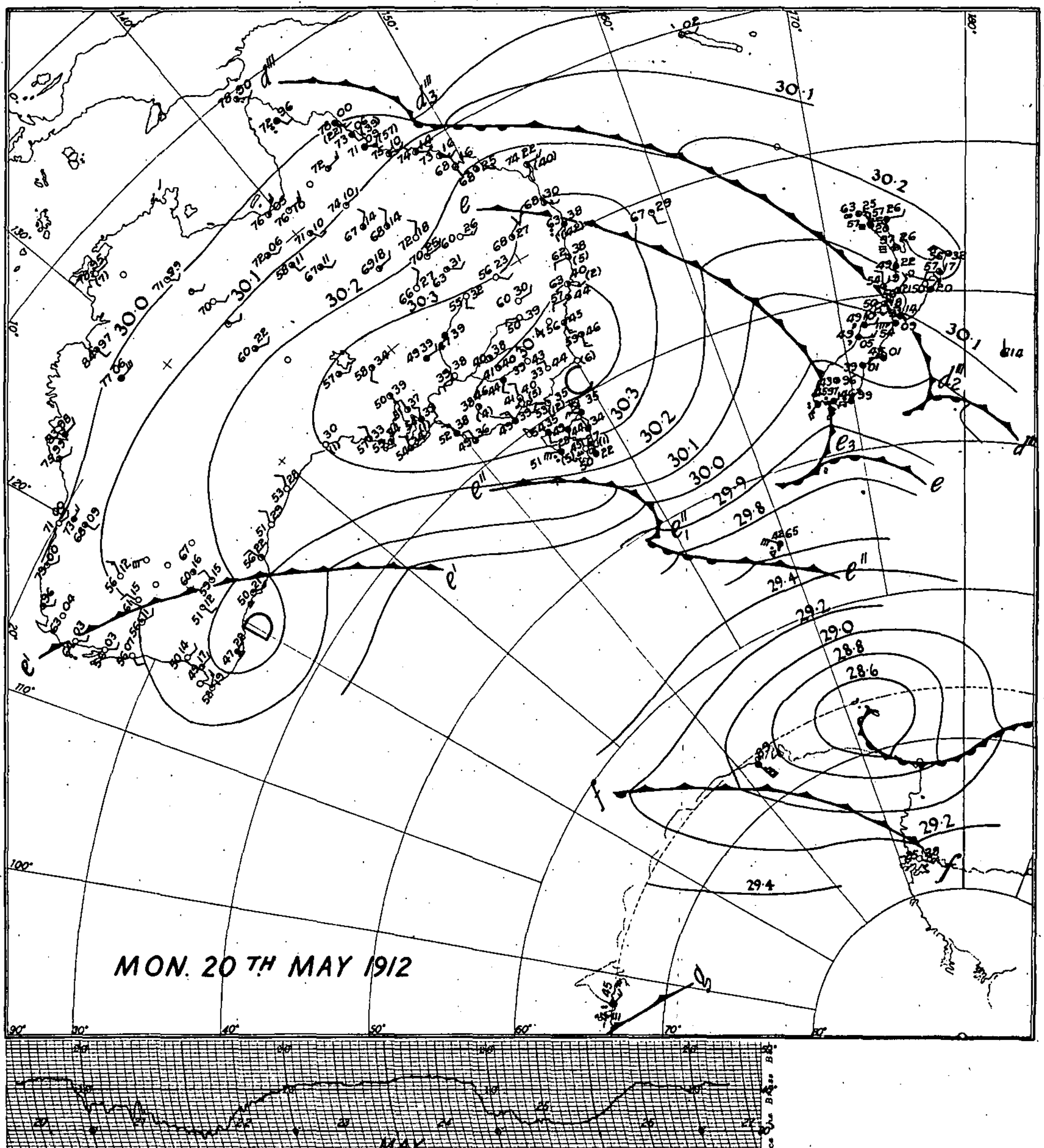
There has been some rain on the Queensland coast for several days. The passage of front e is shown in the Perth barogram.



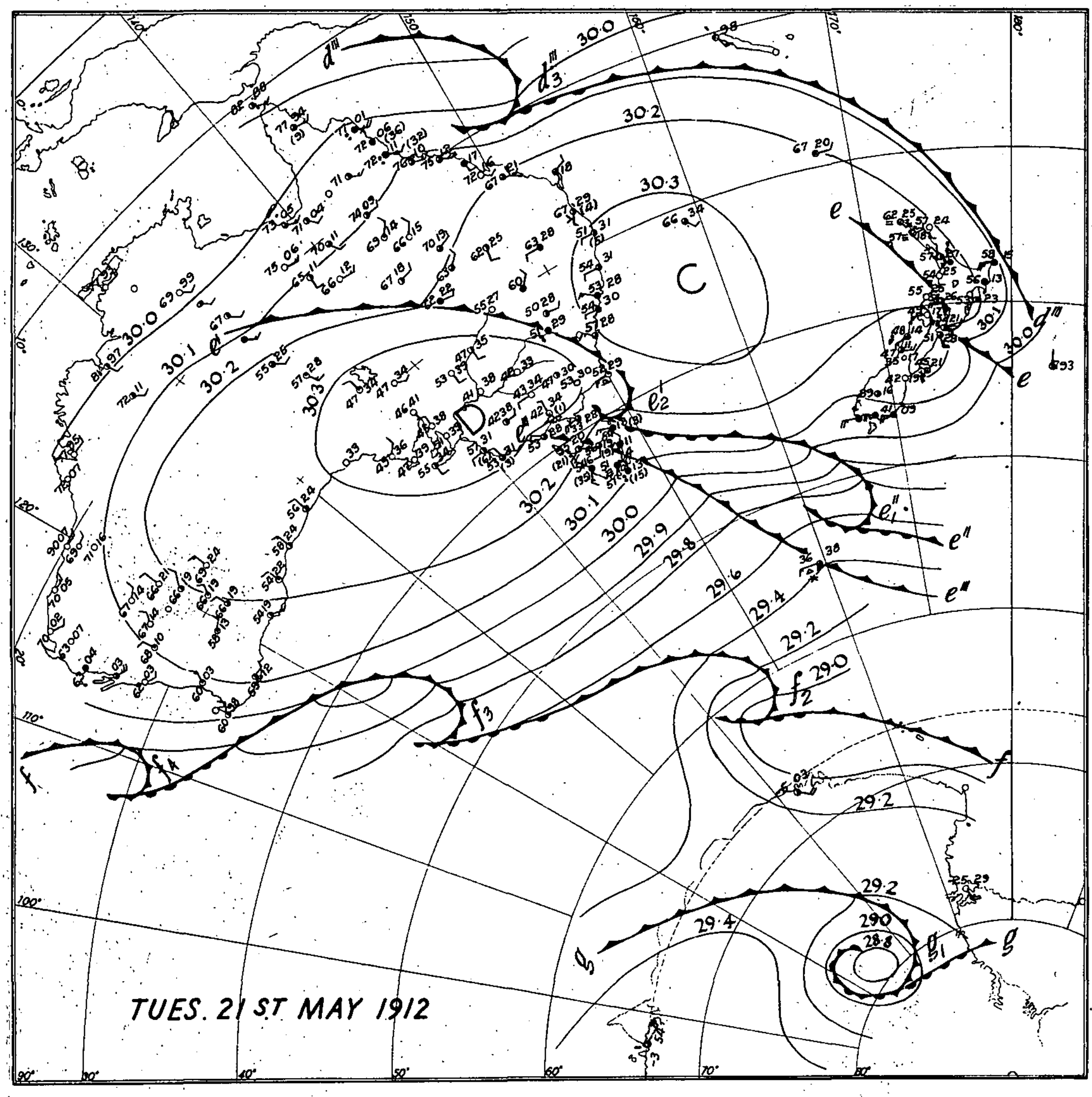
A cold front and an occlusion appear to pass Queen Mary Land. There is another interesting series of temperature changes at Macquarie Island on this and the next day.



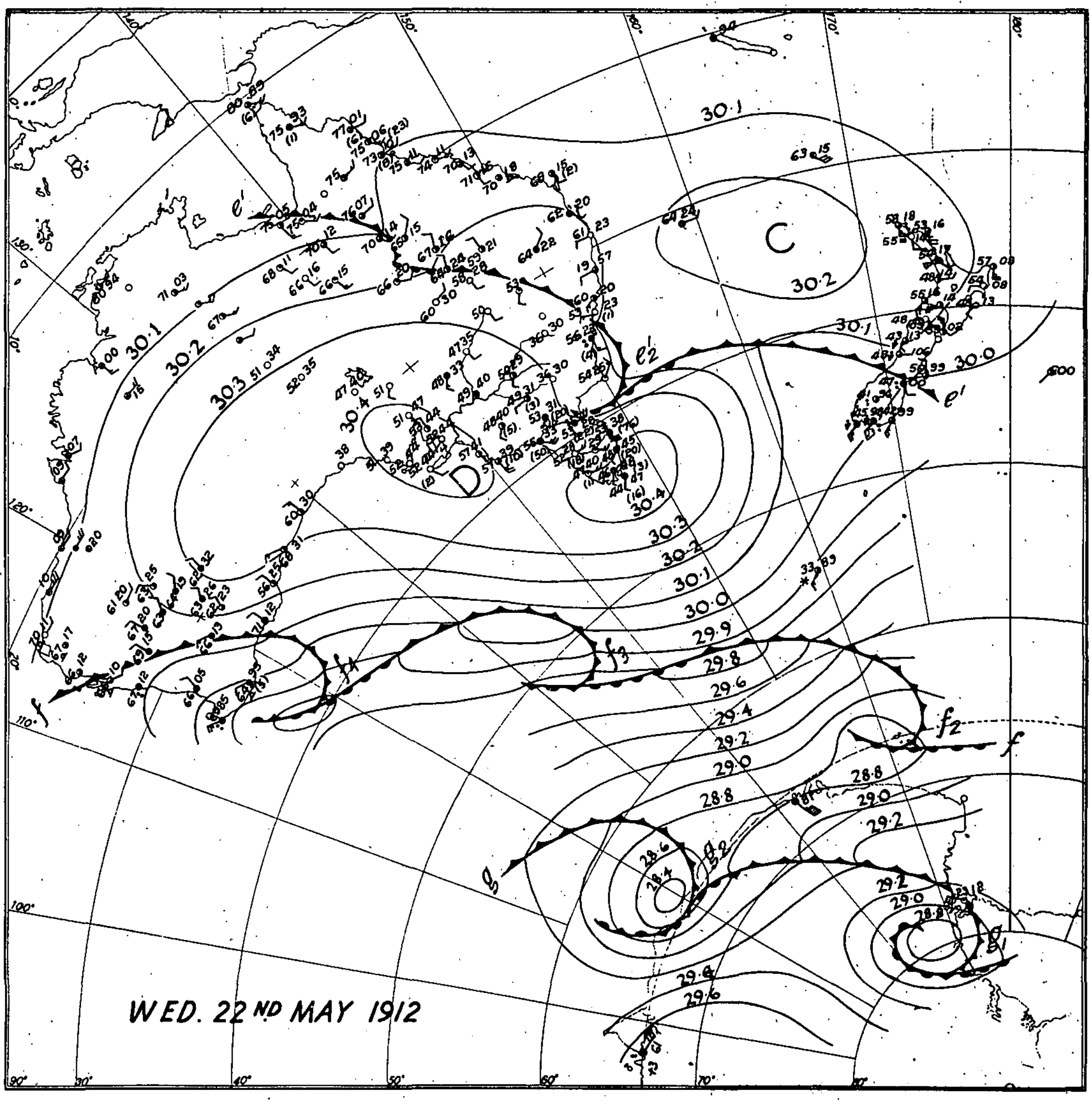
A deep cyclone is passing Adélie Land. The extraordinary pressure variations there cannot all be accounted for. The cyclone is controlling the circulation at Cape Evans.



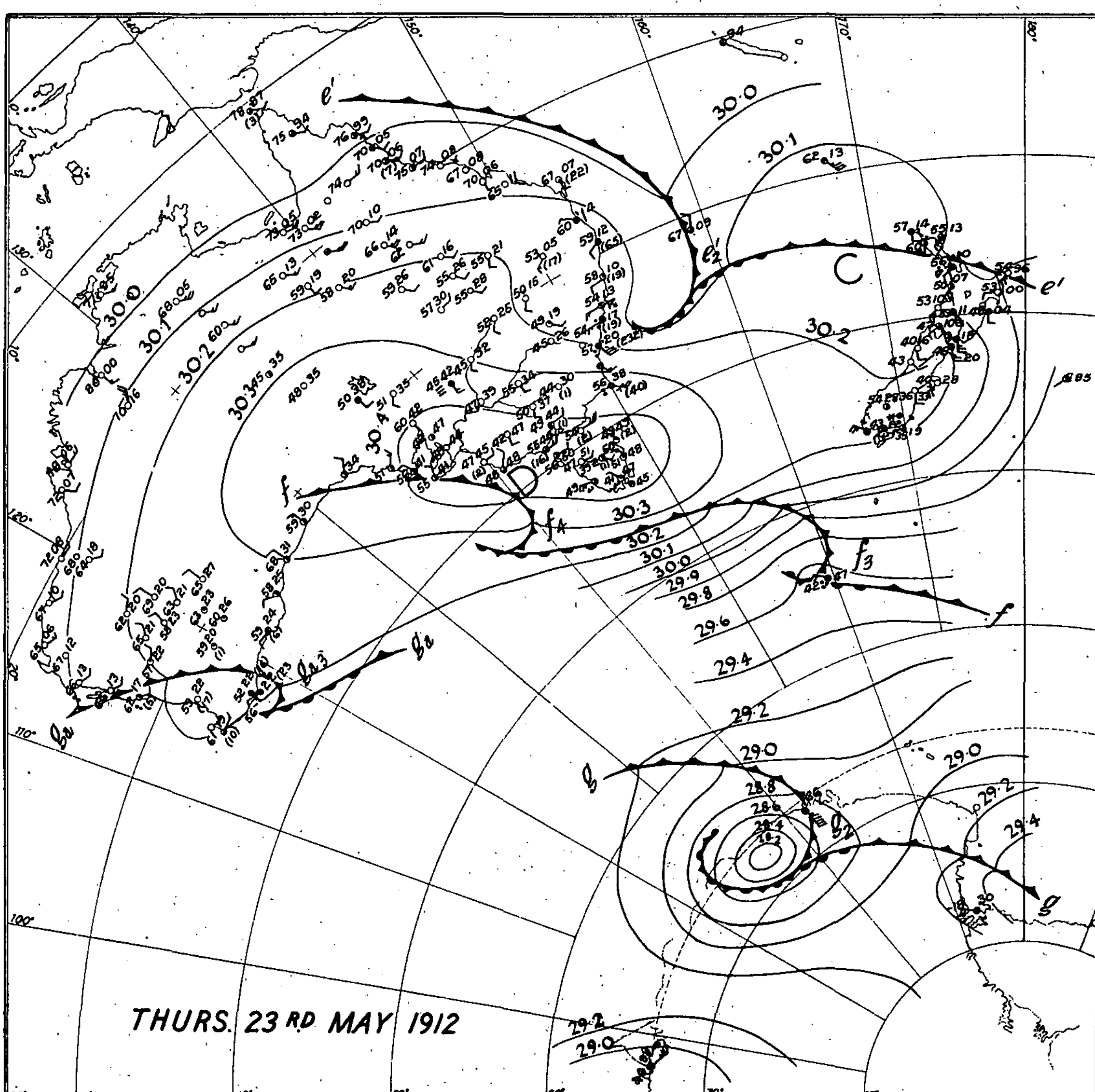
The passage of front e'' is followed by a fall of temperature of 8° F. at Macquarie Island. Hailstorms and very variable temperatures occur during the next two days.



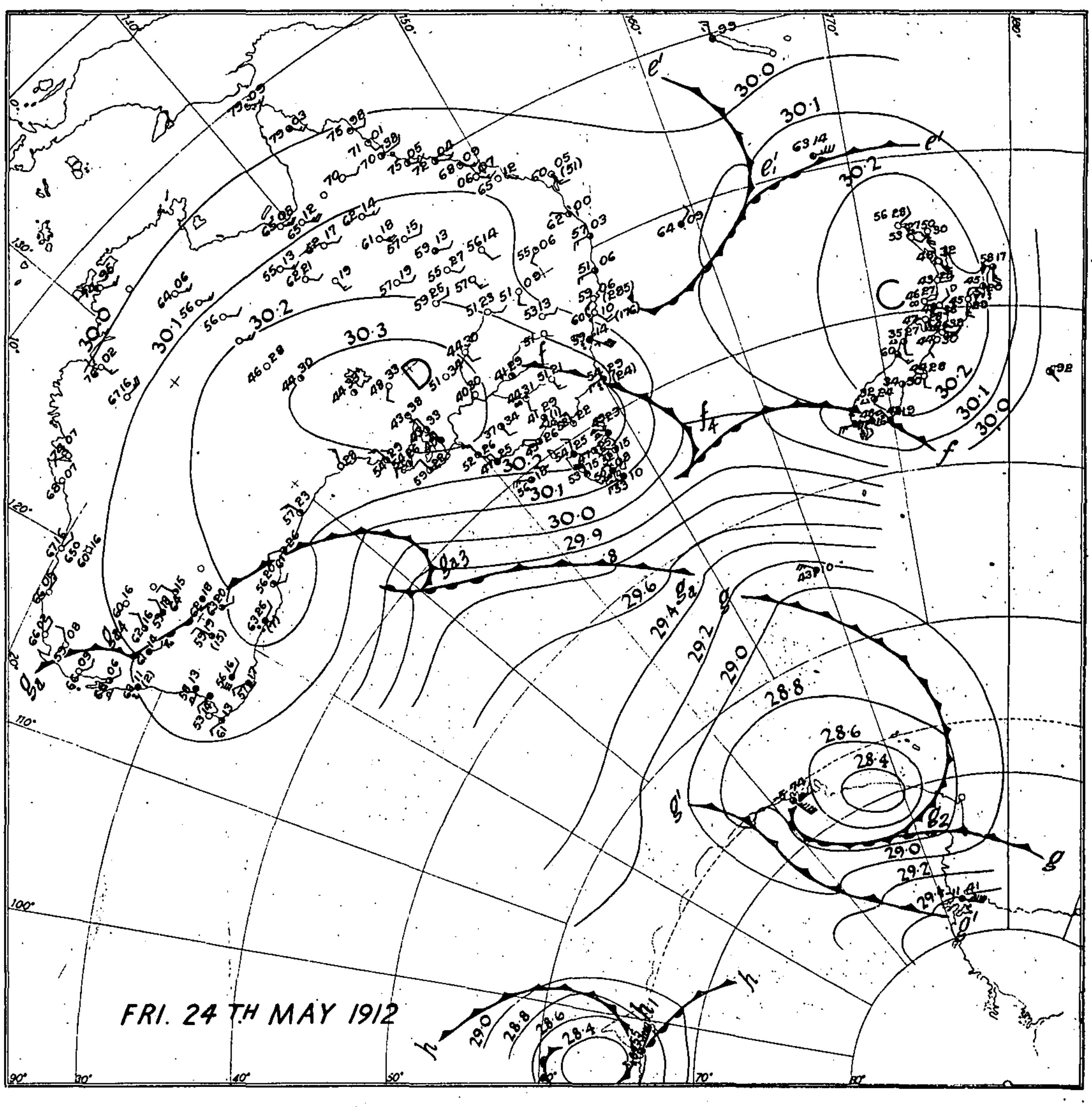
Wave g_1 is drawn to account for changes at Cape Evans, especially the northerly wind on the next and following days. Heavy snow and hail squalls occur at Macquarie Island. Snow lay on the ground.



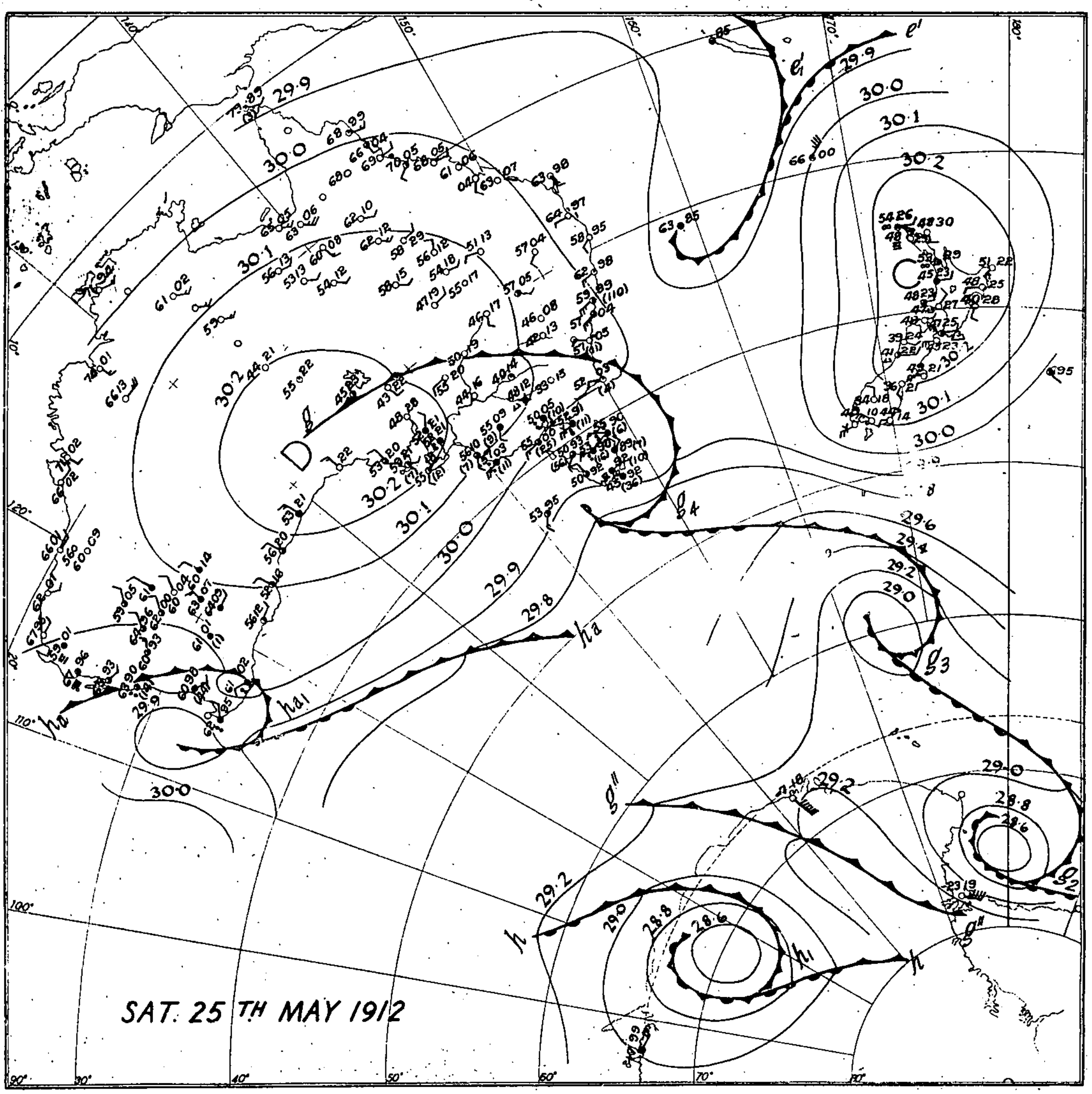
There are strong winds at Queen Mary Land. Cyclone g_2 is drawn to account for this and the weather next day at Adélie Land.



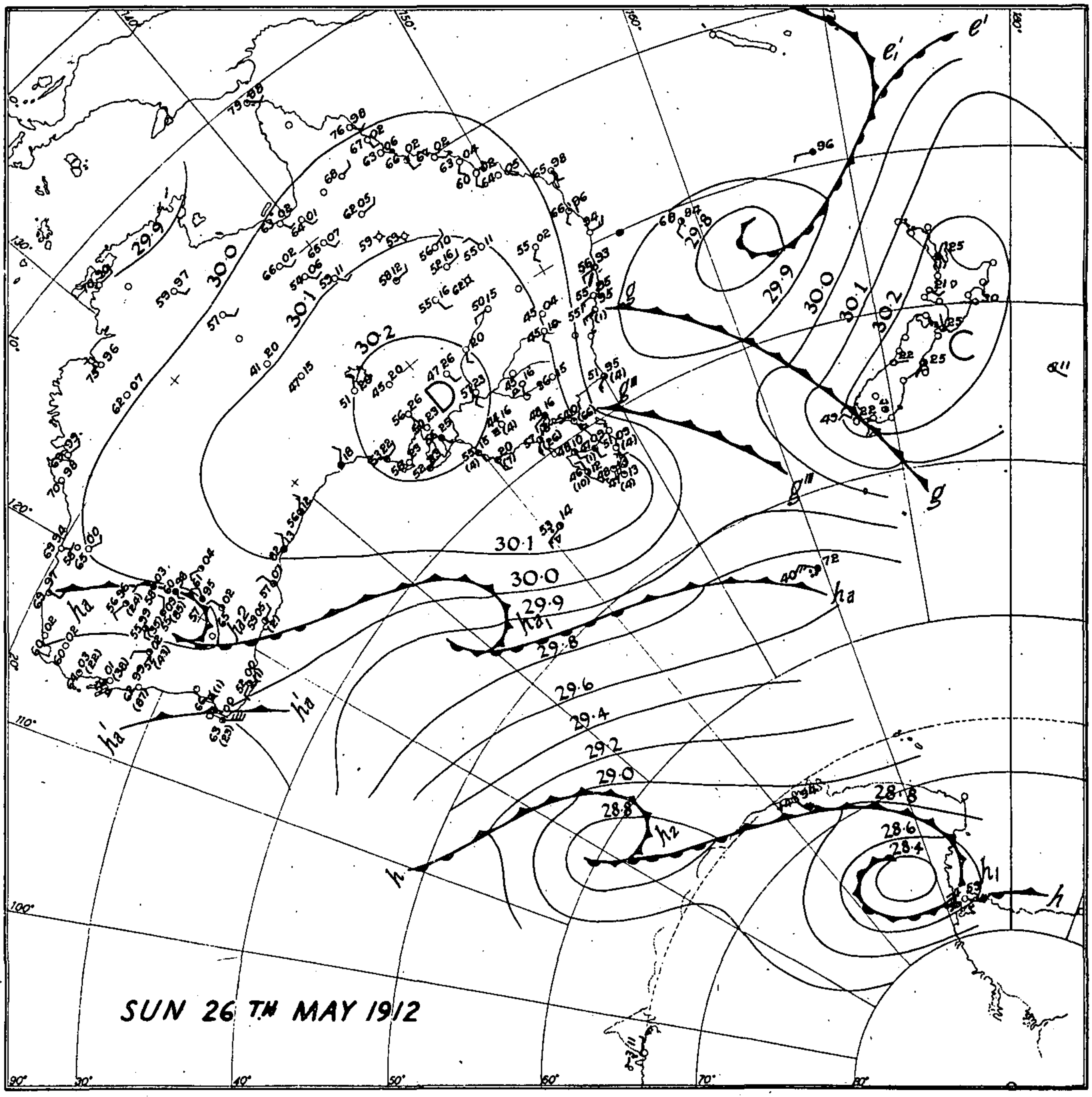
Winds are strong again at Queen Mary Land. A violent storm is approaching Adélie Land. The northerly wind at Cape Evans is taken to be in front of the occlusion of g_1. The analysis is difficult.



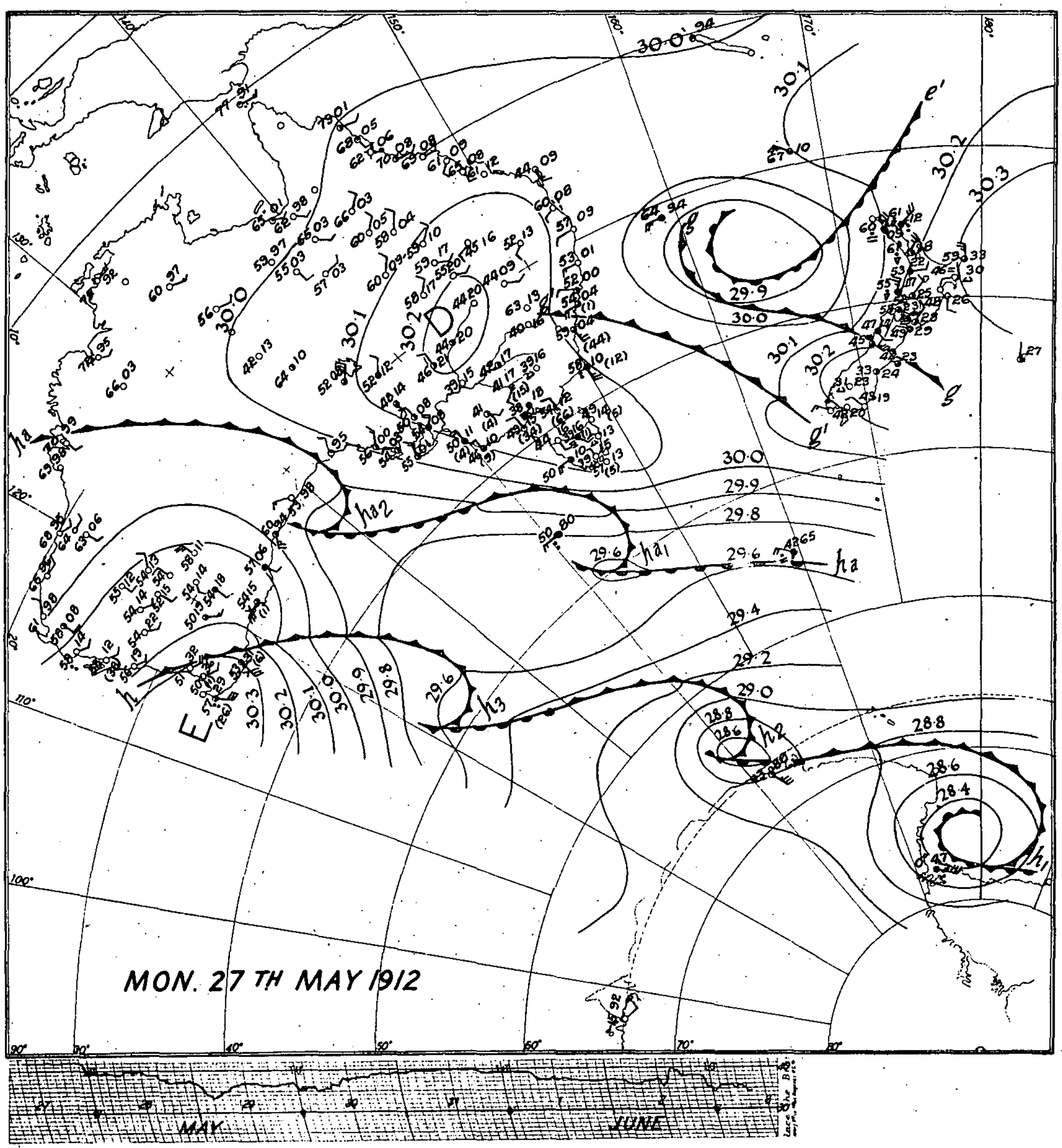
Strong blizzards are blowing at all the Antarctic Stations. Cyclone g_2 has passed Adélie Land while a new one h_1 is approaching Queen Mary Land. Temperatures fell very sharply in the evening at Macquarie Island and the development of a cyclone to the south of it is indicated.



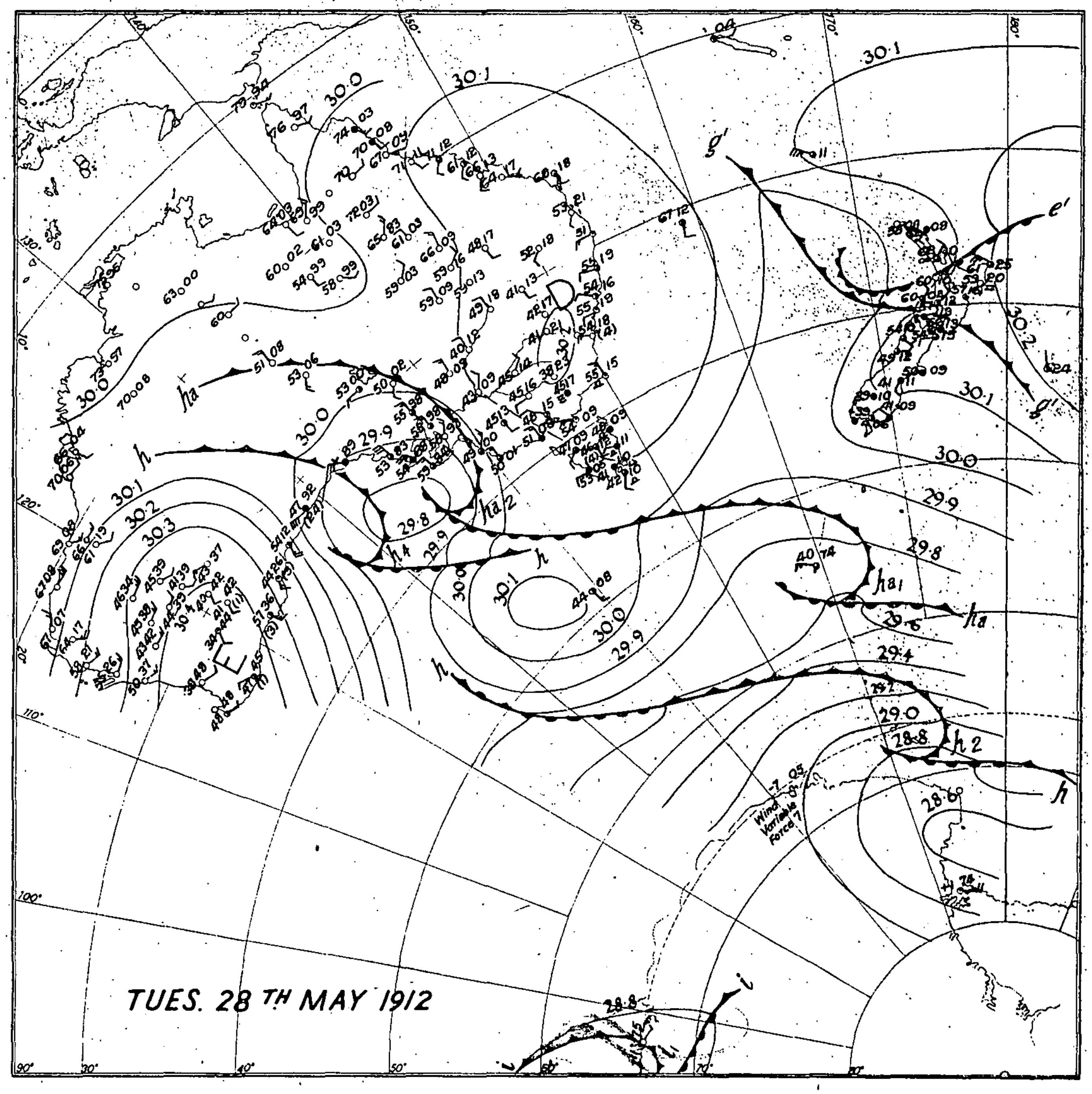
Cyclone g_2 is now crossing the Ross Sea. Note the developments over the Tasman Sea during the preceding and following days.



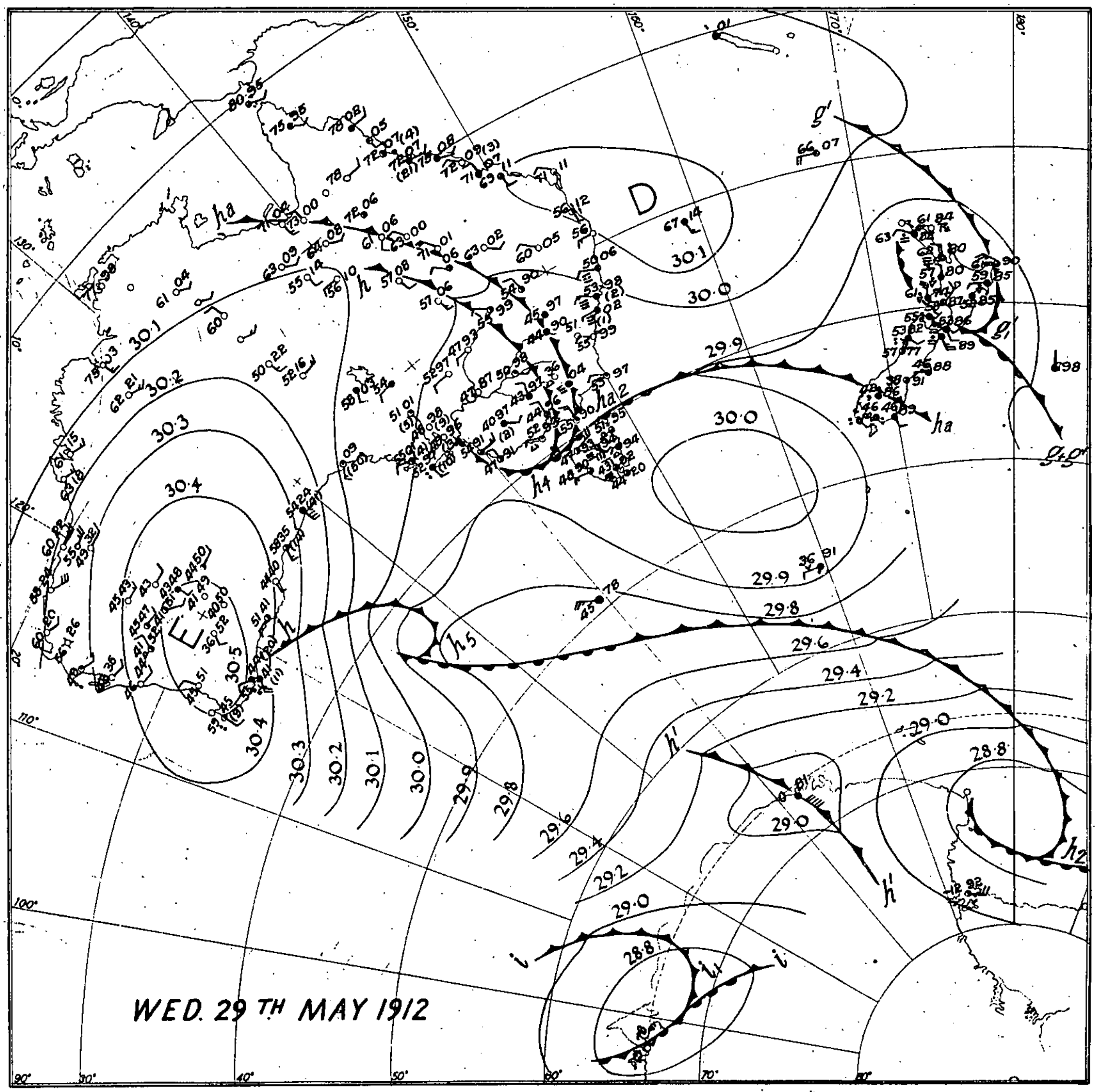
Cyclone h_1 is now approaching Cape Evans.



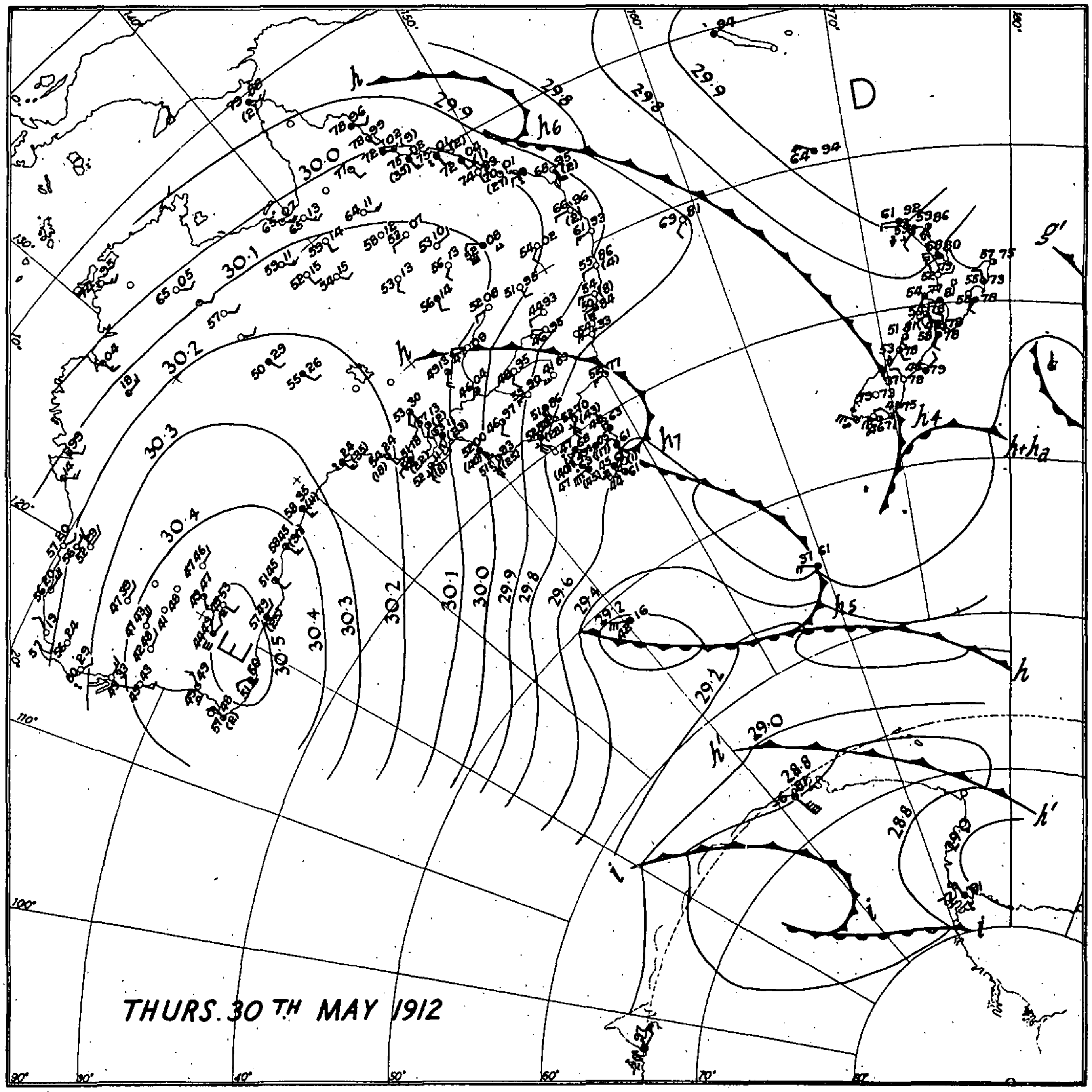
Another depression is passing north of Adélie Land. A shallow cyclone over the north Tasman Sea is causing strong winds and heavy rain in northern New Zealand.



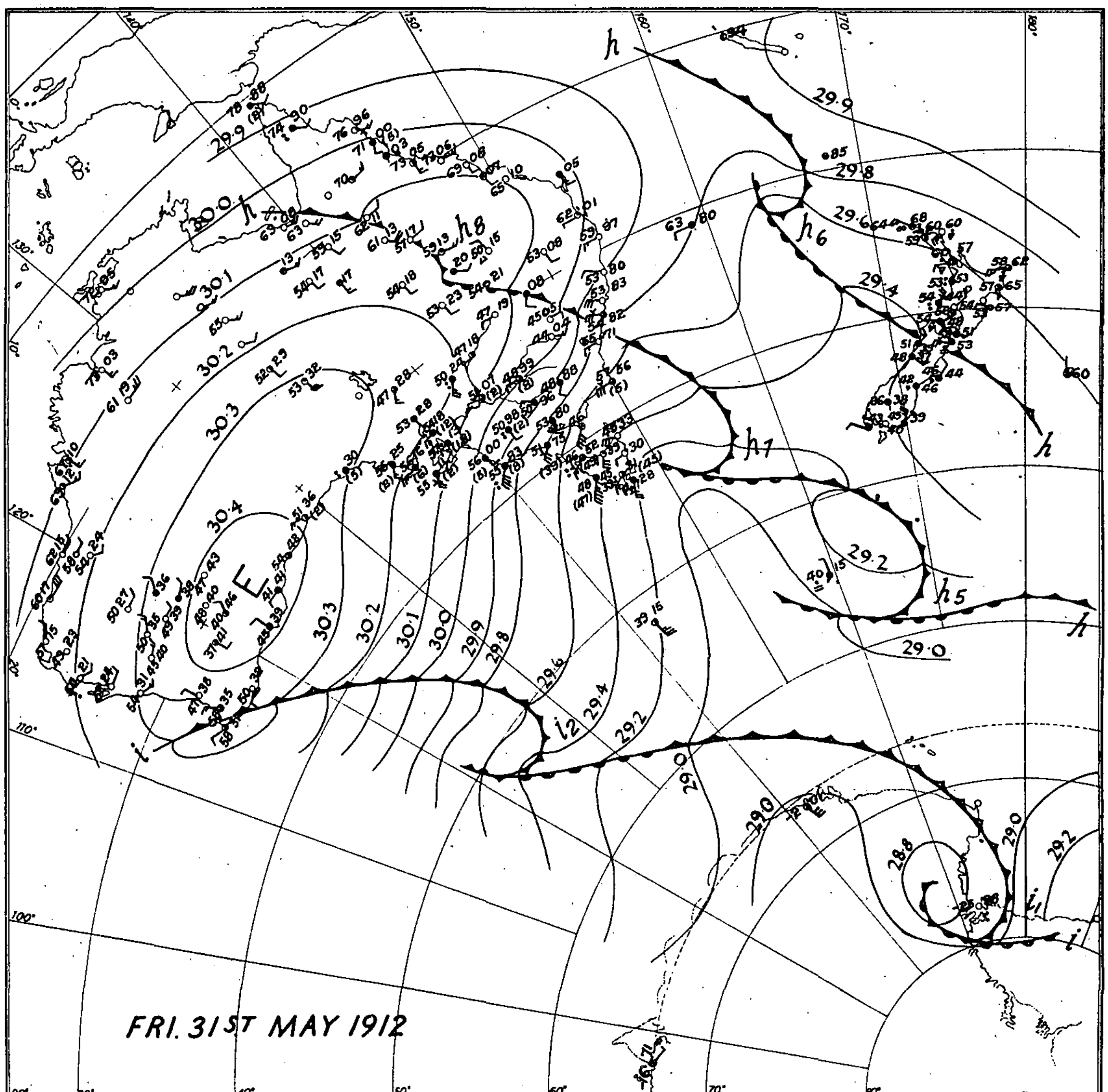
Note the high pressure recorded by the "Aurora" south of Adelaide. Only one front appears to pass it, and the cold front of h_3 is taken to have disappeared.



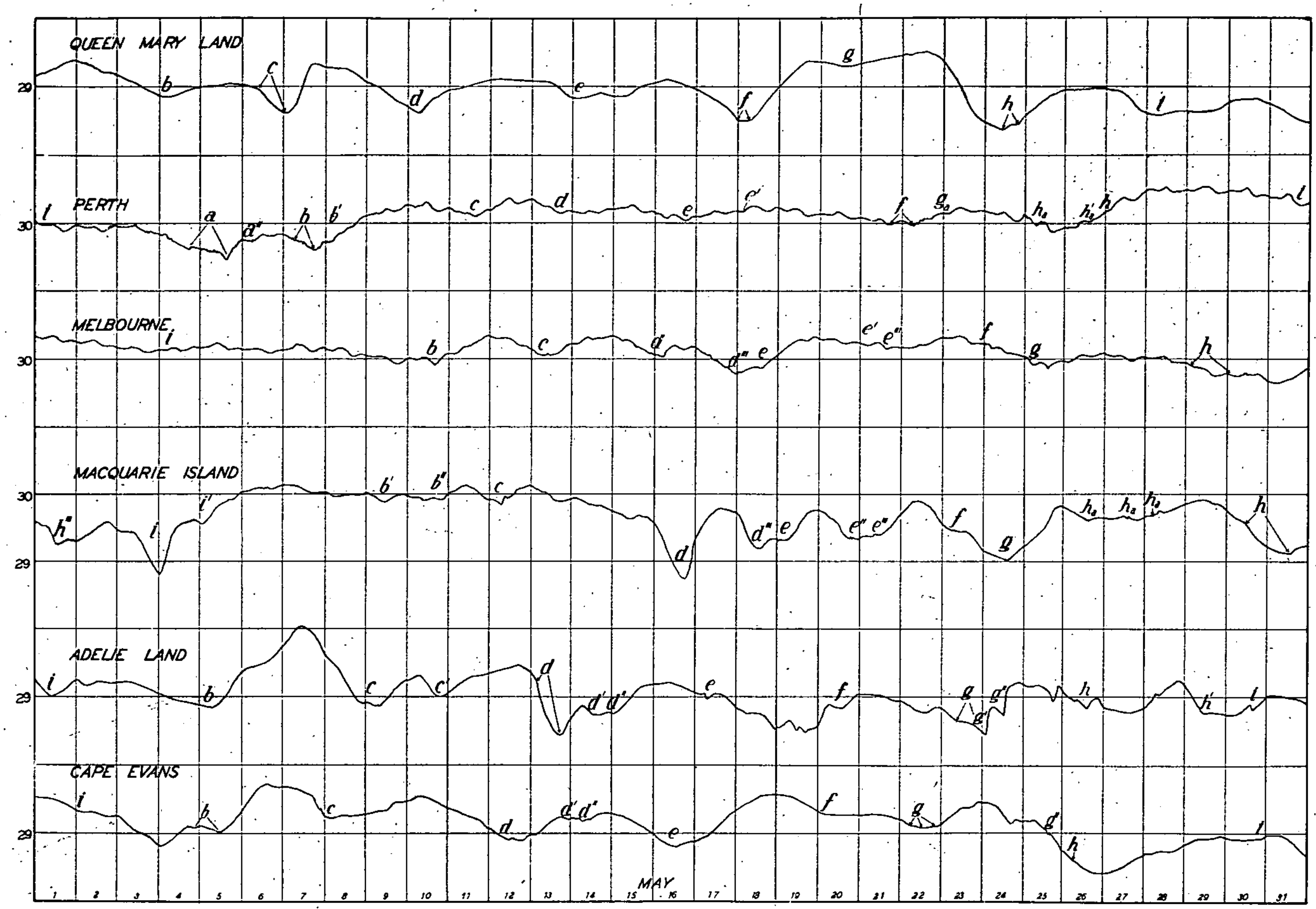
Note the widespread rain over New Zealand where g_1' appears to owe its energy to the field left by the old occluded depression. Front h_2 is extending northwards. The movement of the waves now over Victoria is slow owing to the presence of the anticyclone to the south and consequent easterly winds although to the westward there has been a strong south-westerly outbreak.

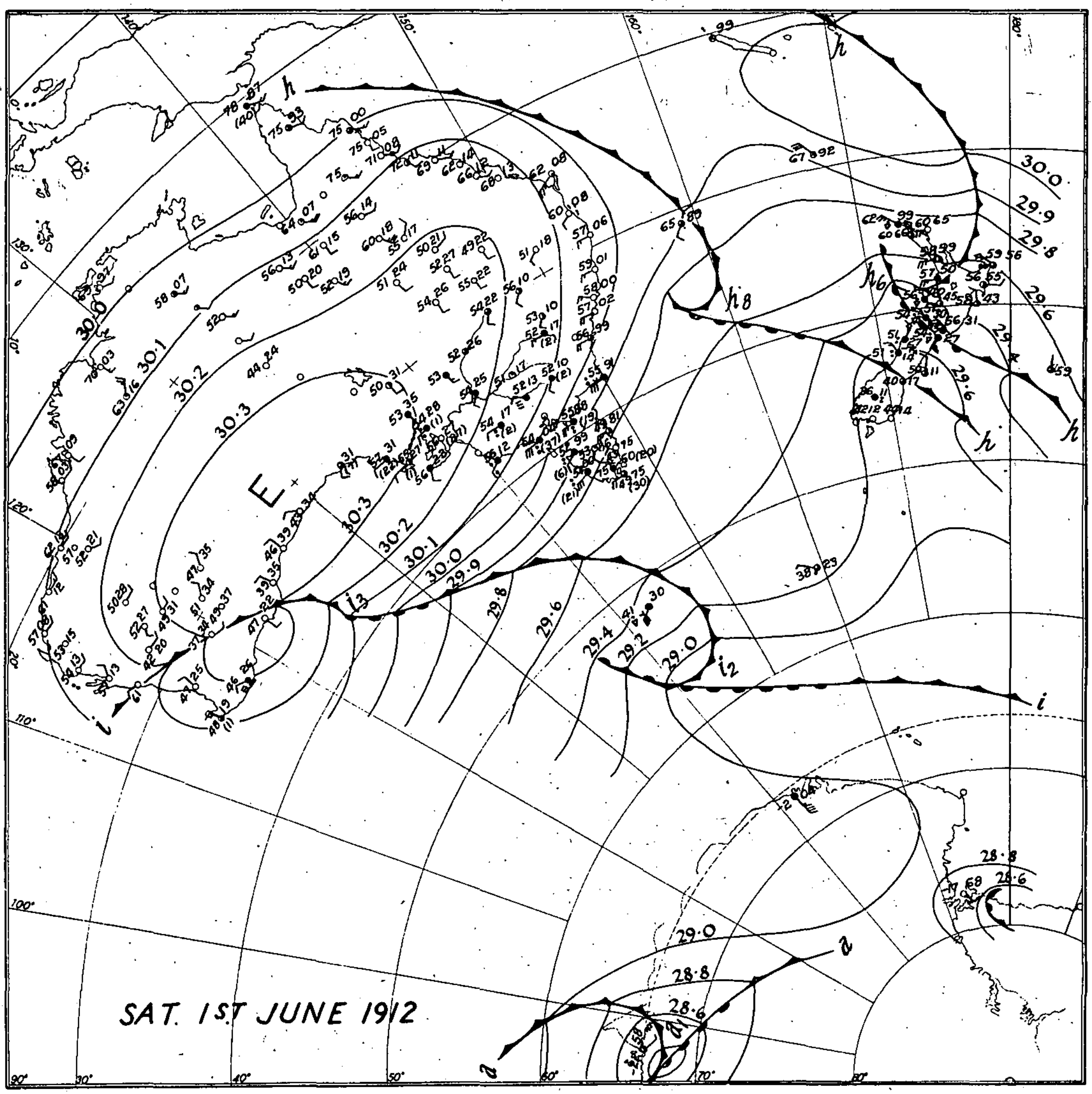


Note the weather changes experienced by the "Aurora" and the northerly wind at Cape Evans. The southern anticyclone has disappeared.

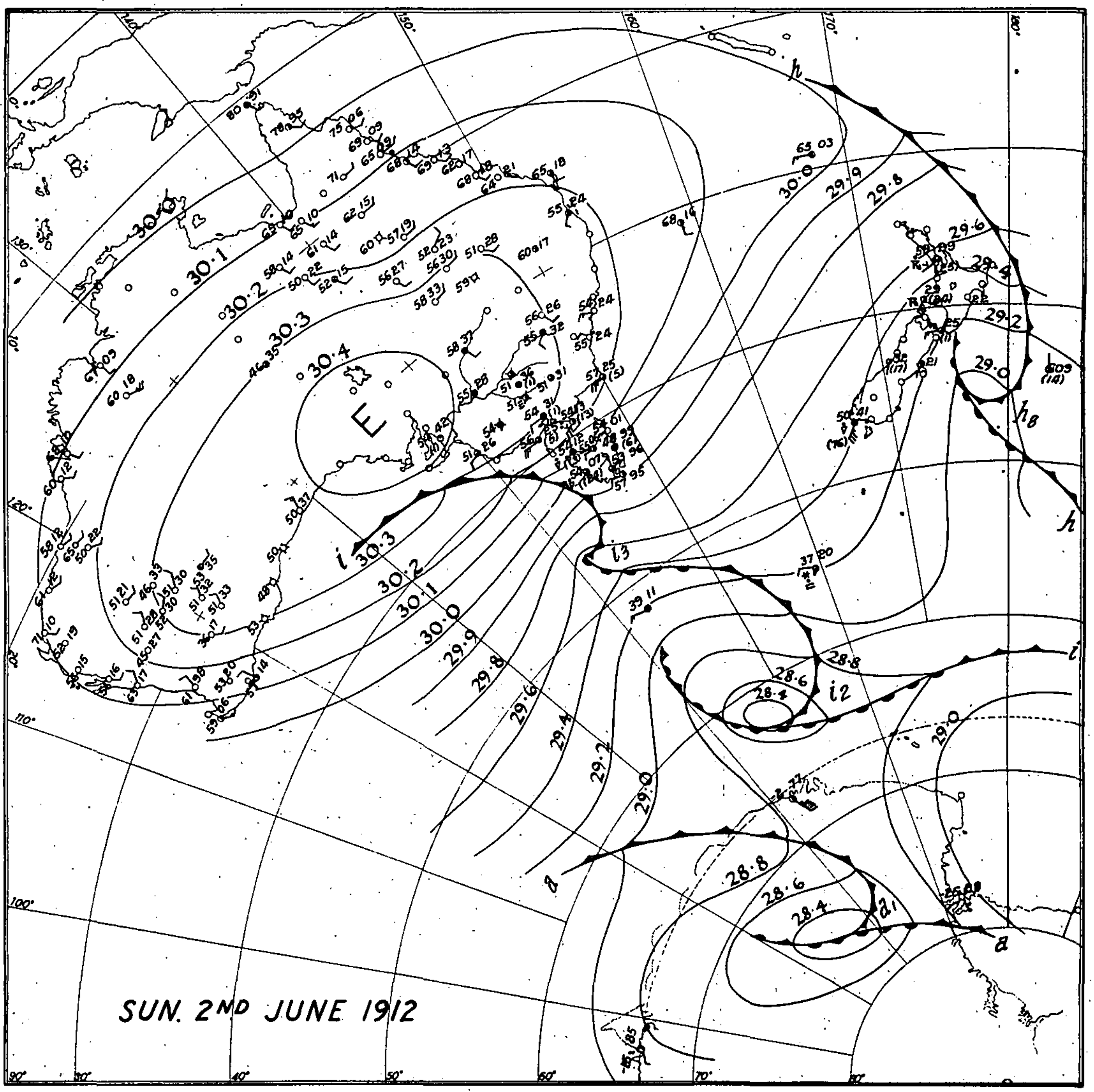


Note the widespread rain over New Zealand. A cyclone is passing Cape Evans.

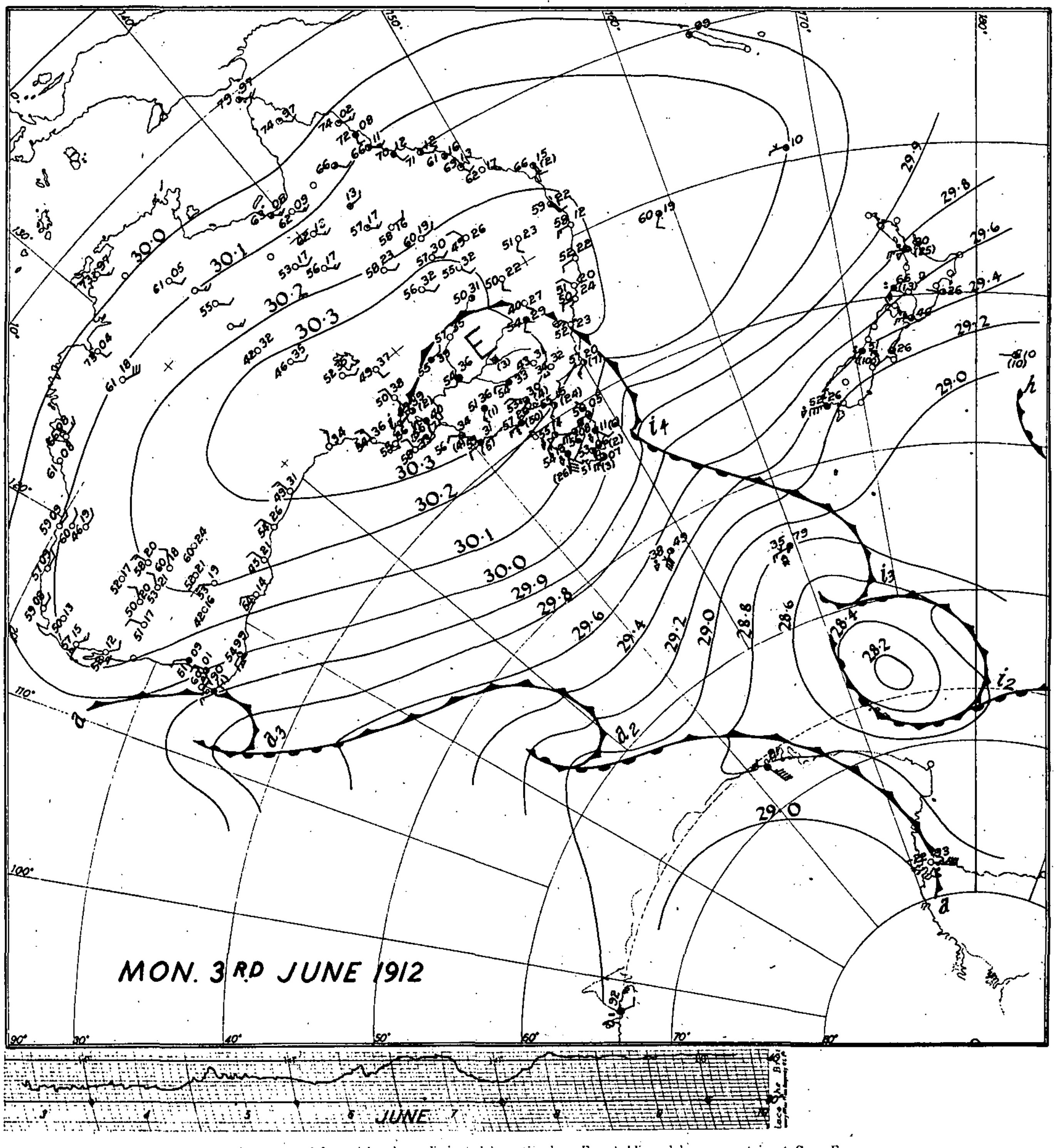

QUEEN MARY LAND
PERTH
MELBOURNE
MACQUARIE ISLAND
ADELIE LAND
CAPE EVANS
MAY



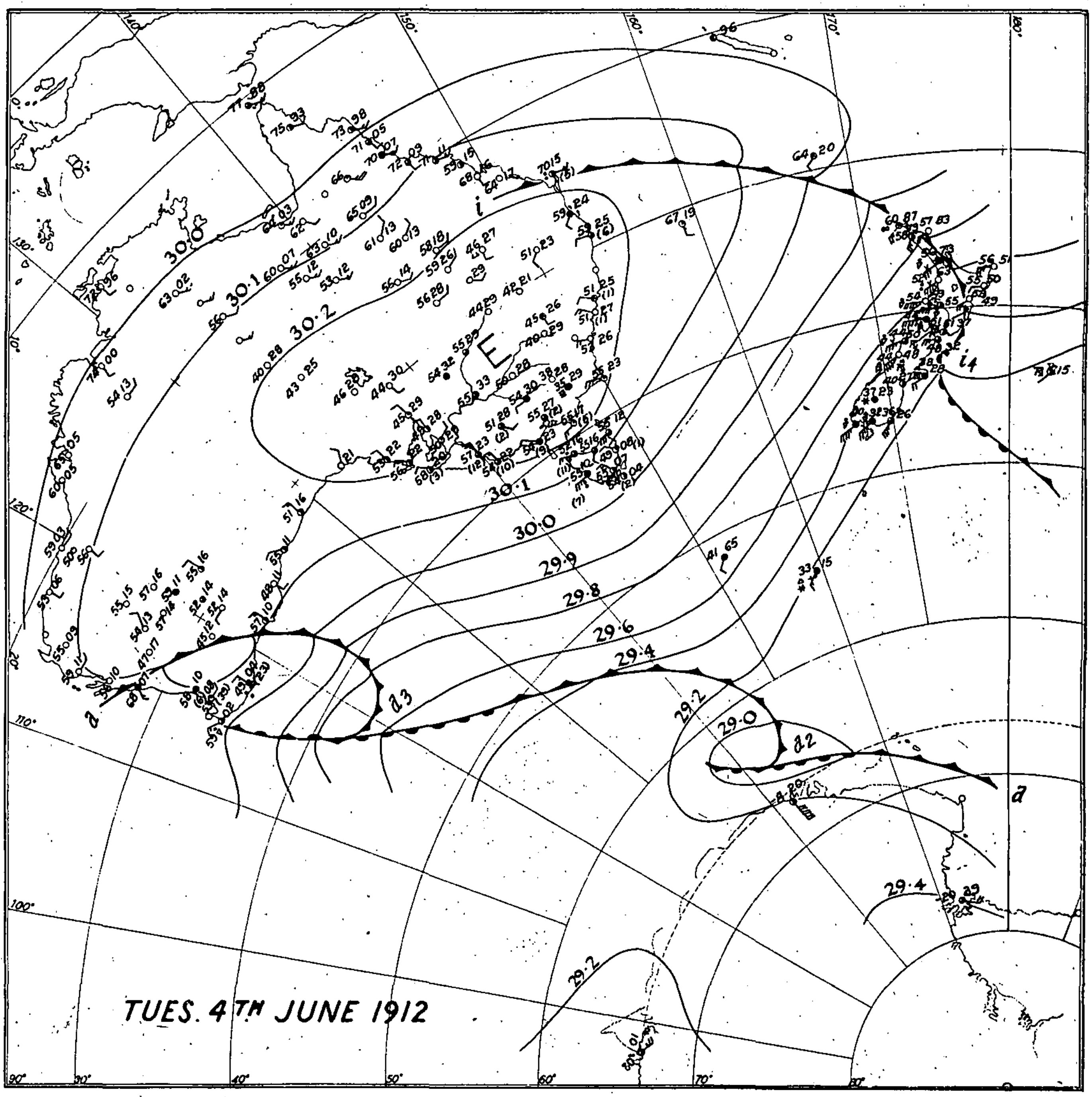
Note the series of changes observed by the "Aurora" west of Macquarie Island.



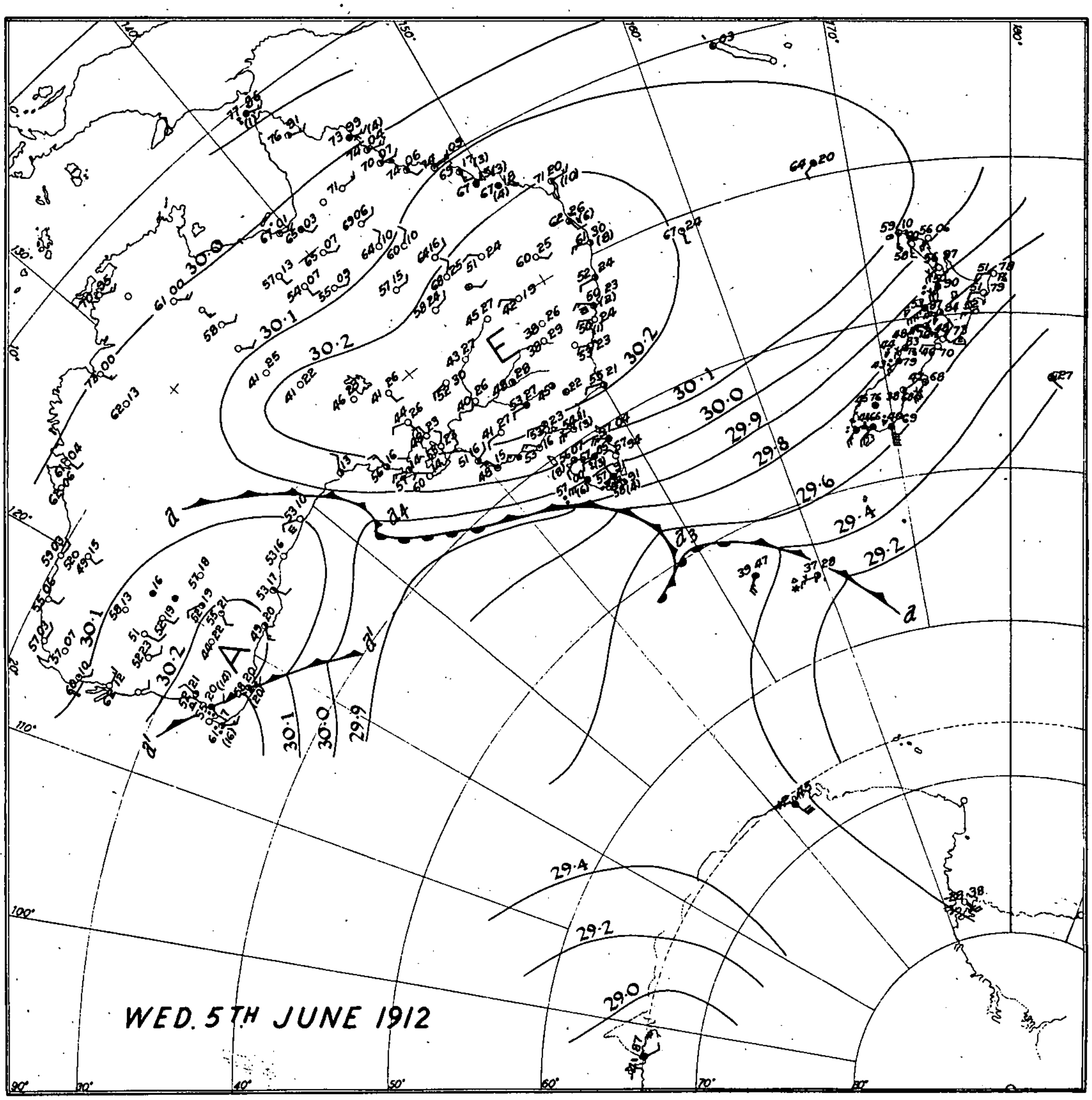
Note the temperature changes at Macquarie Island. Front *i* appears to have crossed it three times.



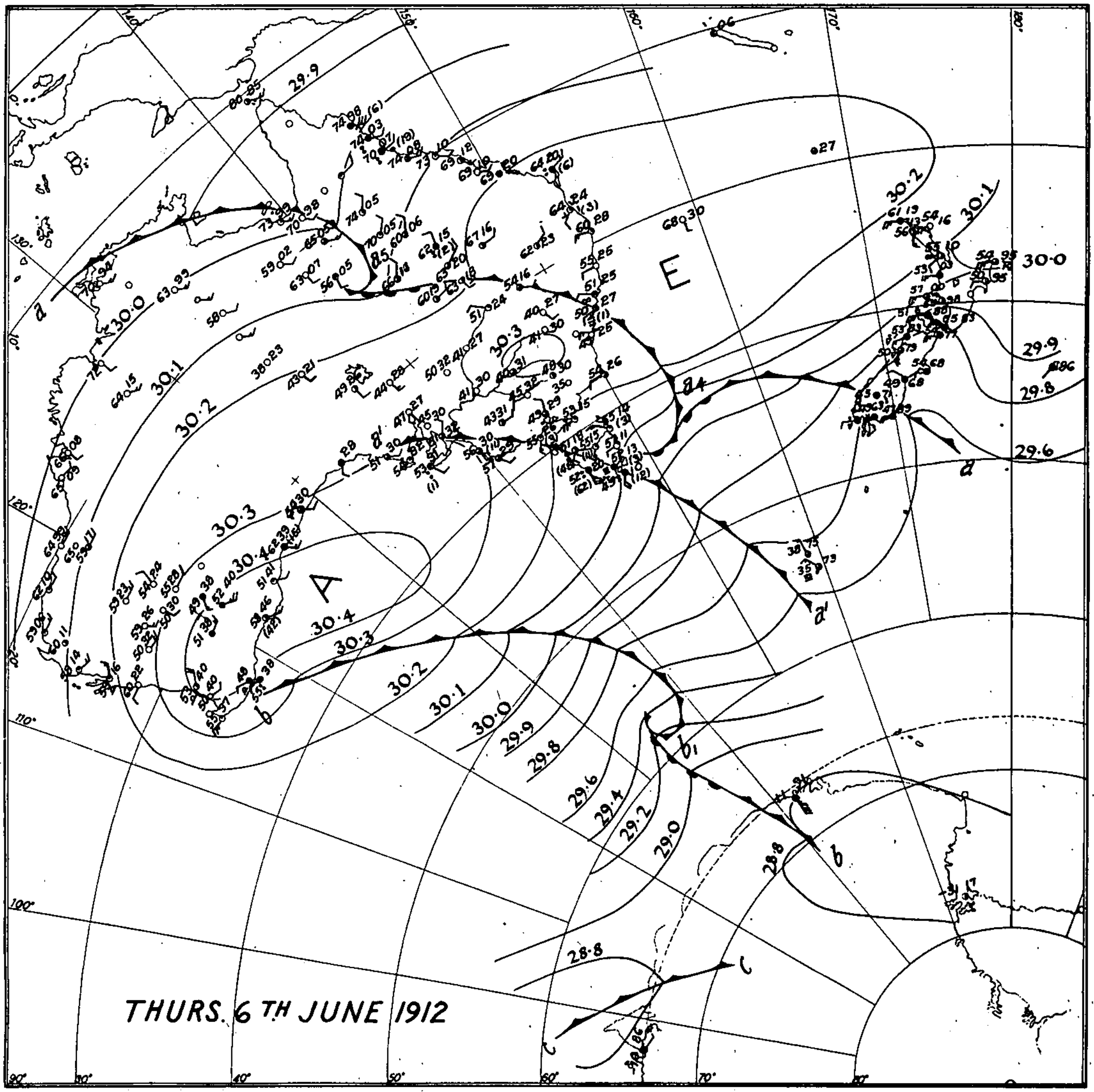
The northern part of front i has been dissipated in anticyclone E. A blizzard has now set in at Cape Evans.



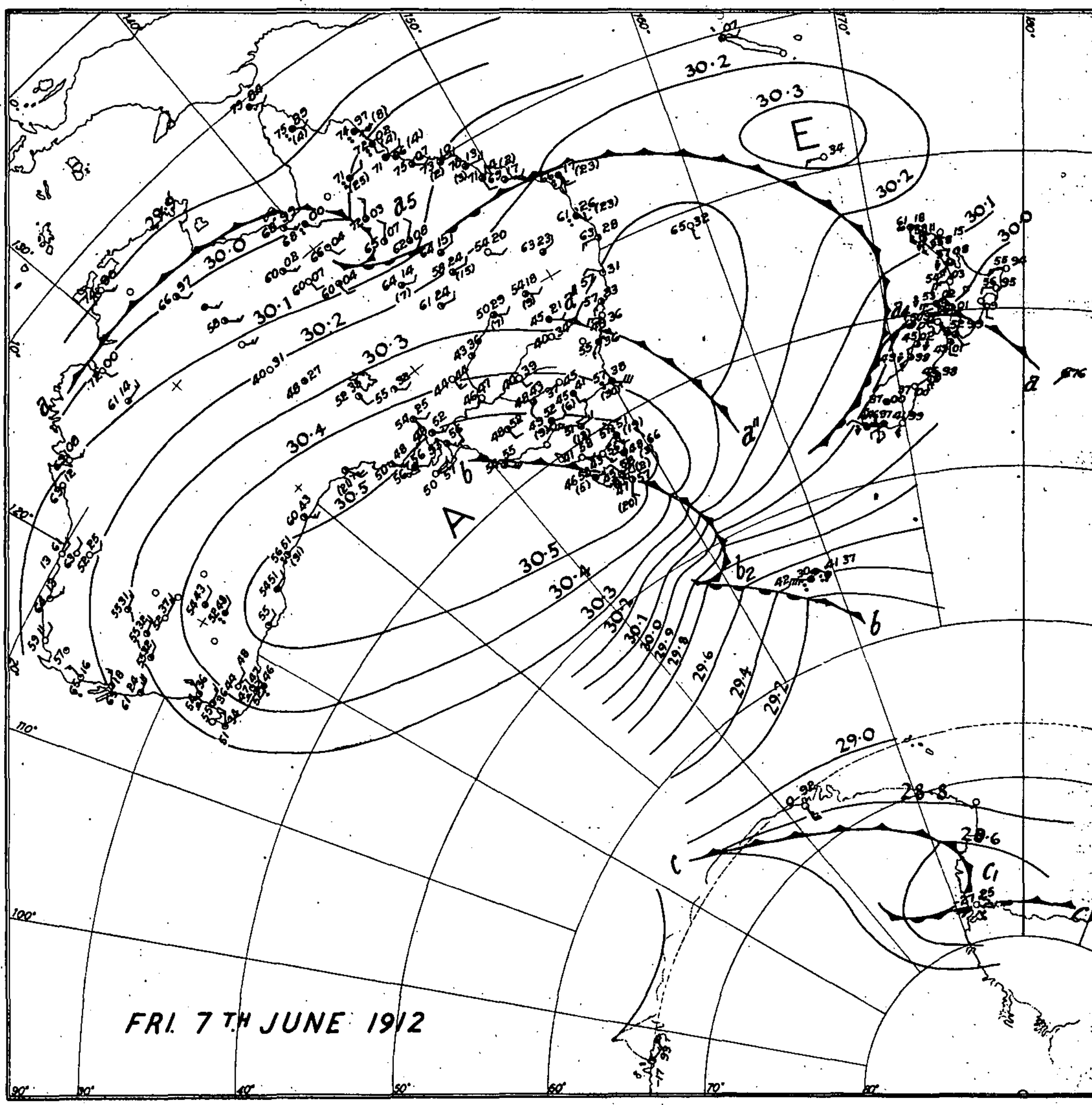
The air behind front *i* is very cold and there are many thunder and hail showers in New Zealand with snow on the ranges of the South Island.



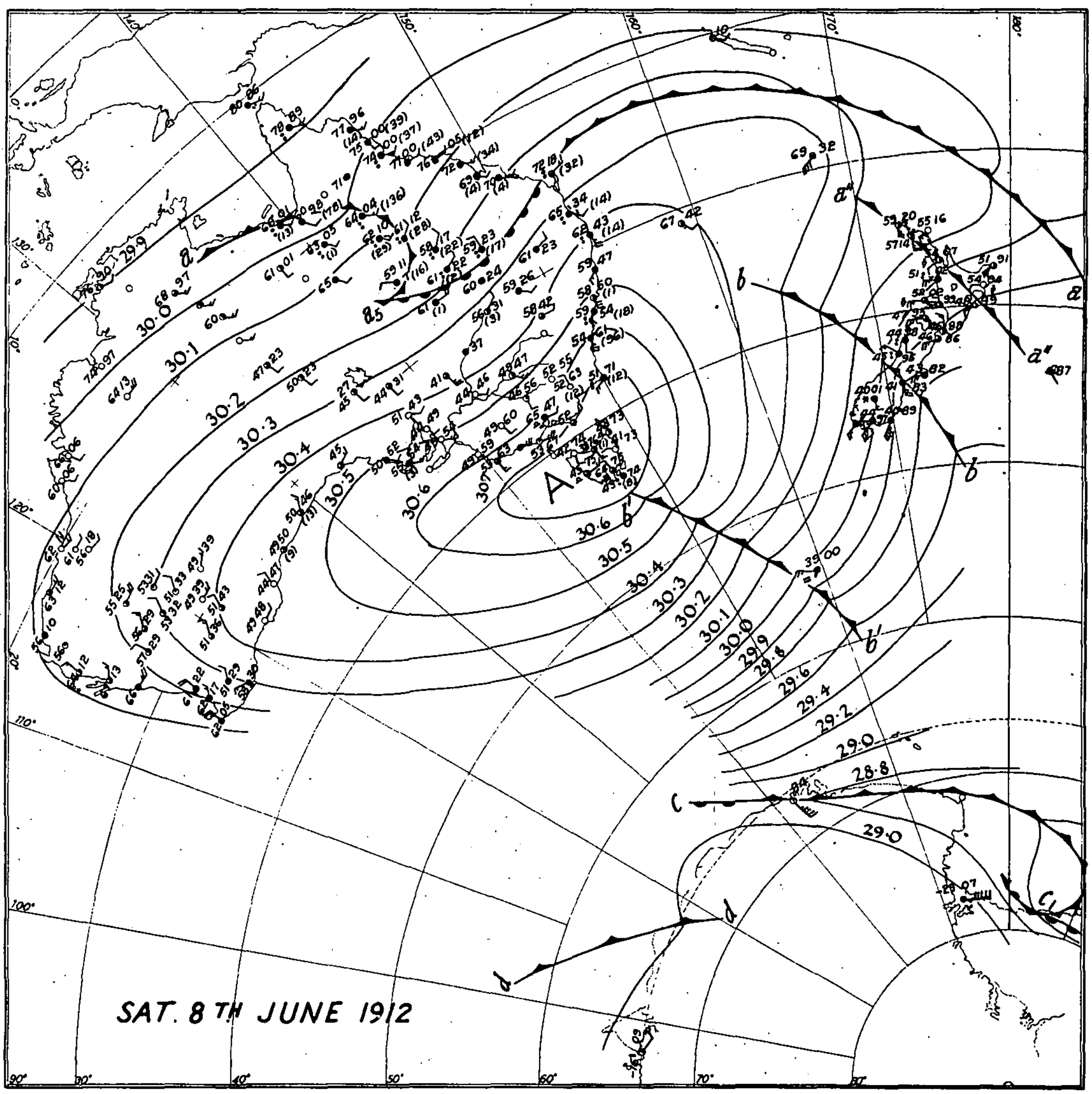
South-westerly gales still prevail over New Zealand. Front *a* has passed the "Aurora" and Macquarie Island. The temperature rose prior to its passage and though falling subsequently did not reach so low a value as in the preceding outbreak.



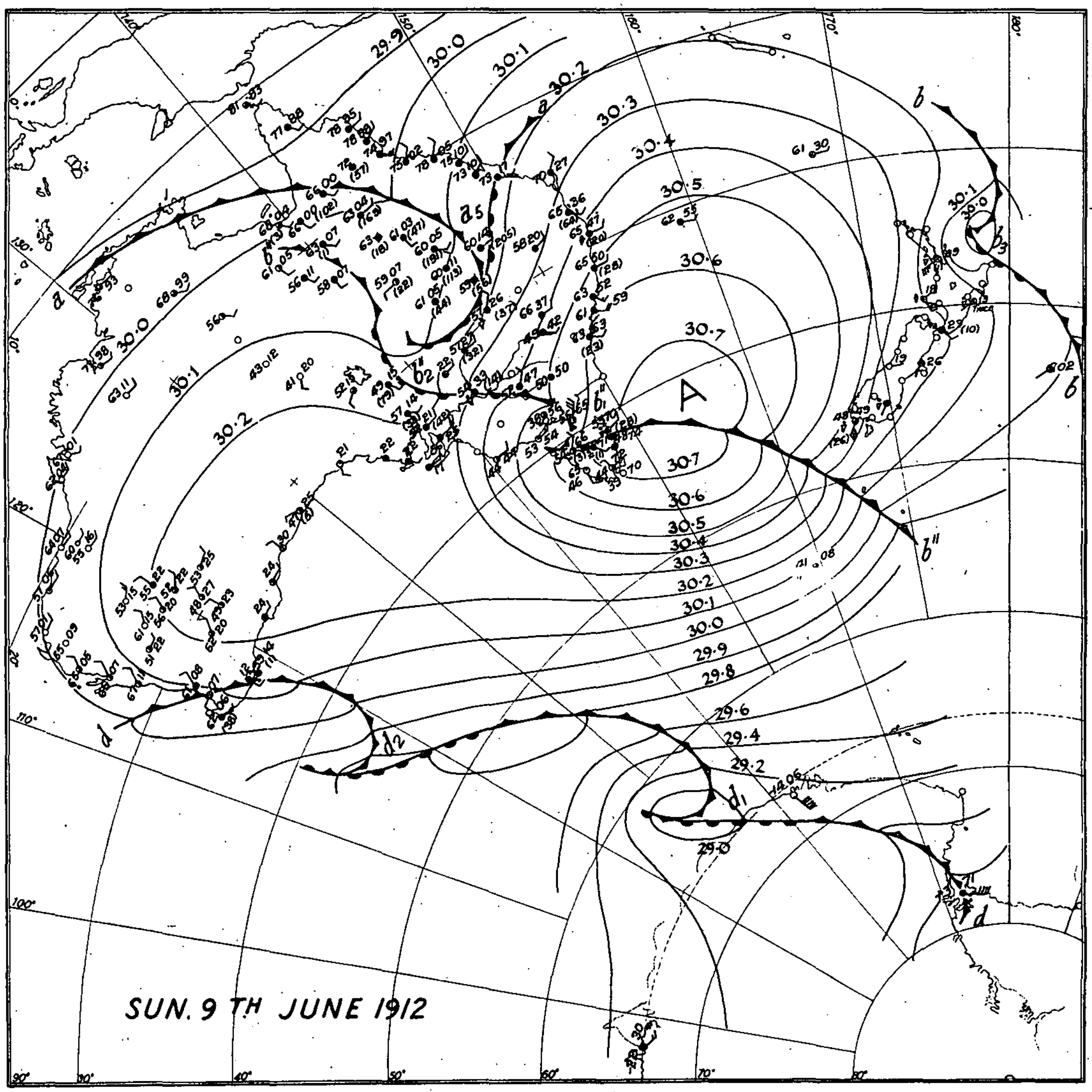
There was no trace of front *b* at Cape Evans. Note the shapes of the occlusions of waves on *a* which has winds with a southerly component on both sides of it.



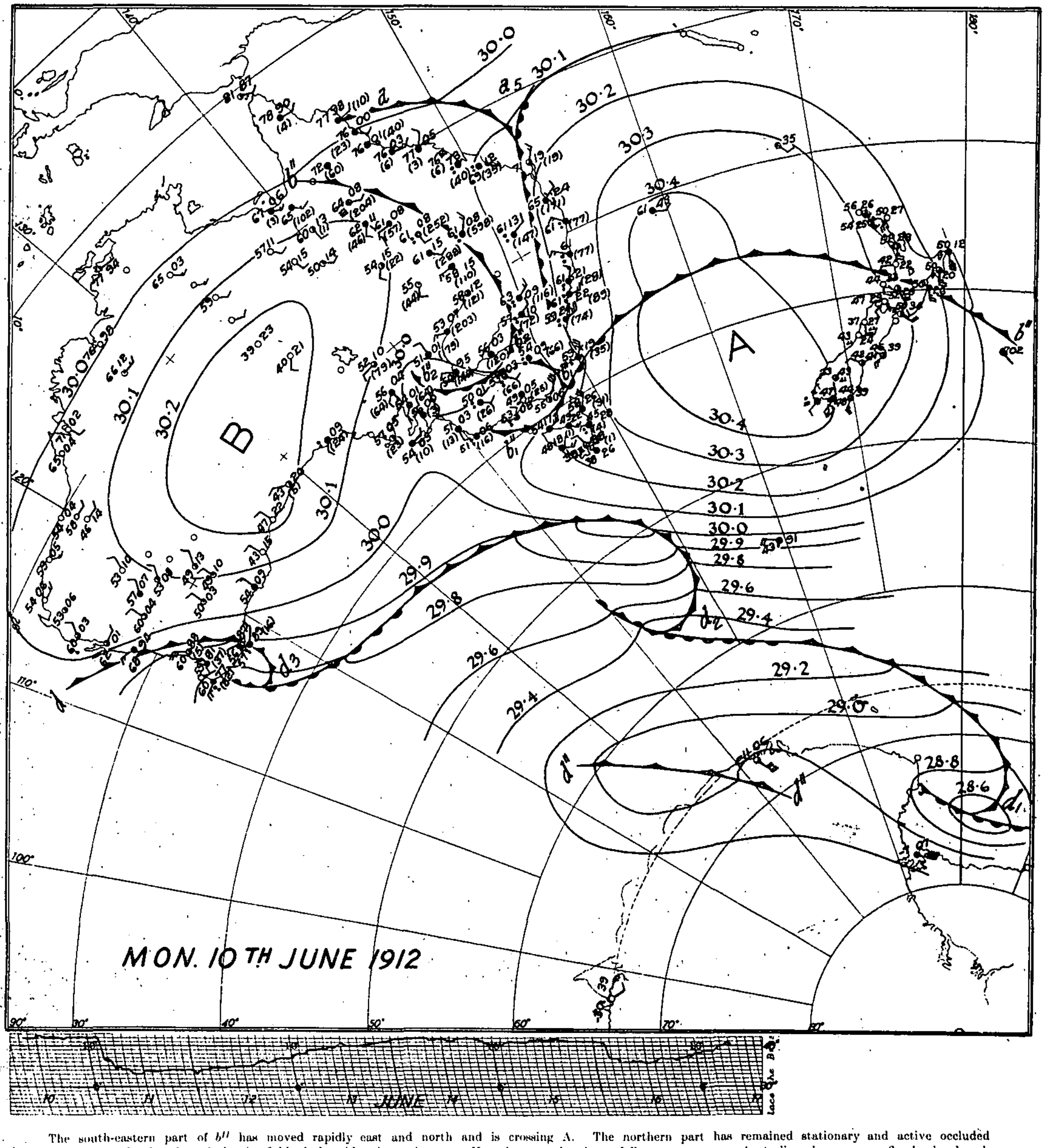
A deep cyclone is passing over Cape Evans. The movements of the front in northern Queensland and the wave on it and the rain there are unusual. Anticyclone A has intensified and winds have increased to both north and south. This is possibly associated with the outbreak of cold air over New Zealand since the 2nd June.



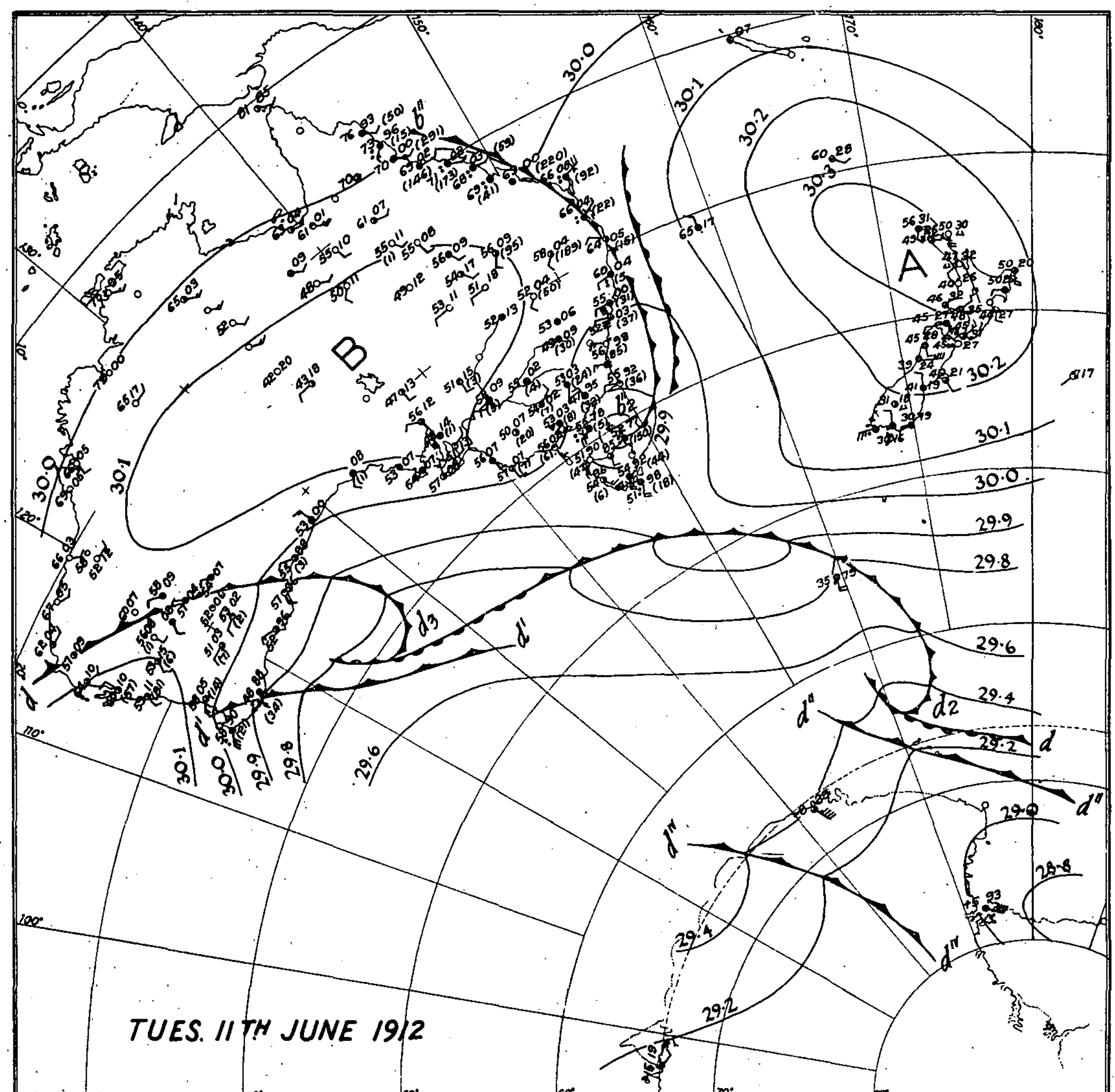
There is a blizzard at Cape Evans. Another strong outbreak of cold air has occurred over New Zealand. There is snow on the ranges in the South Island but temperatures are not so low as in the previous outbreak. Note the gale at Norfolk Island. Anticyclone A is now very intense. Wave *a* in Queensland is increasing in energy and widespread rain is falling.



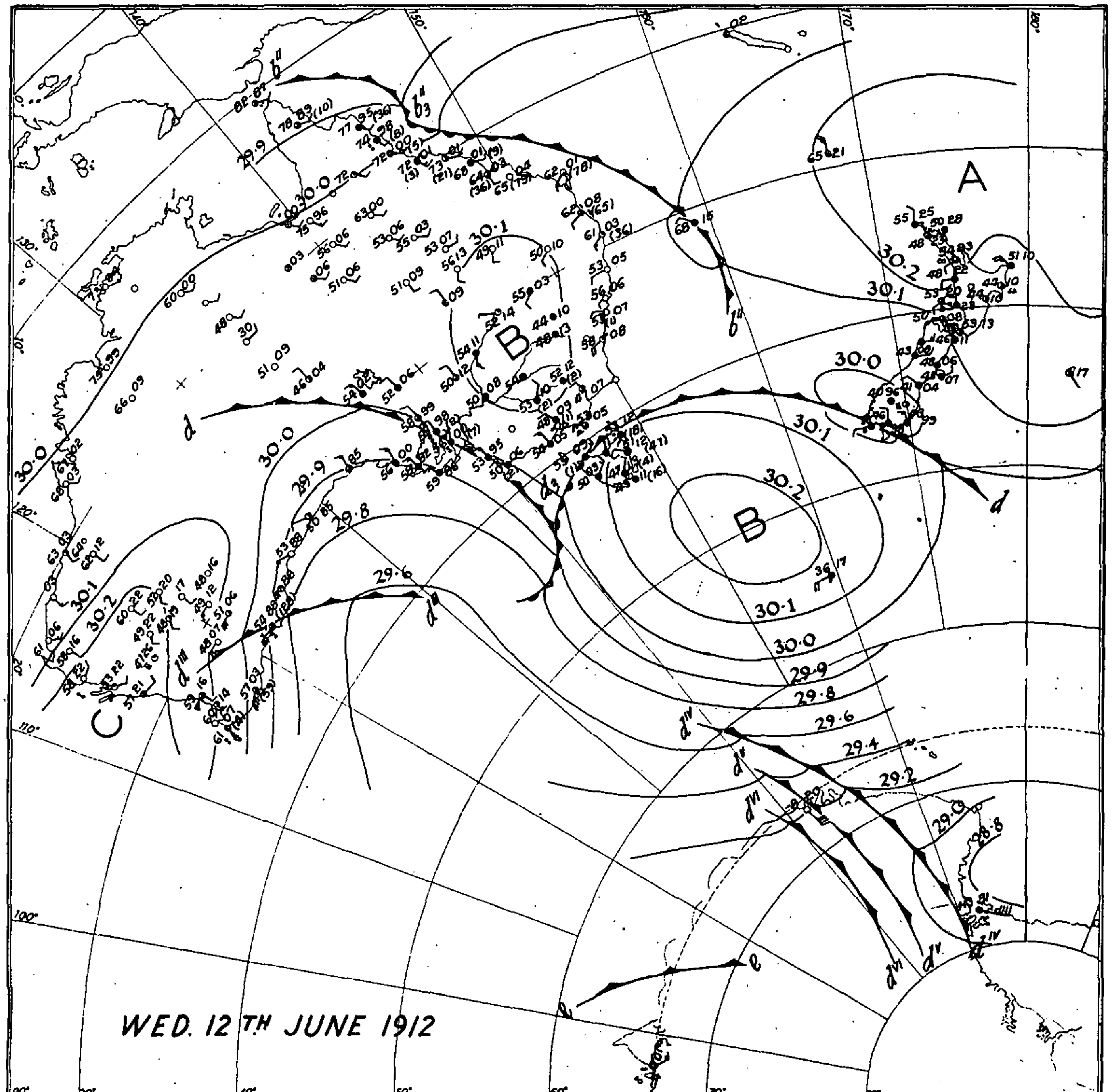
Note the rain near the centre of Anticyclone A which is still very intense. Wave a_5 has caused some heavy rains but is dying out. b^{II} is becoming a very active front.



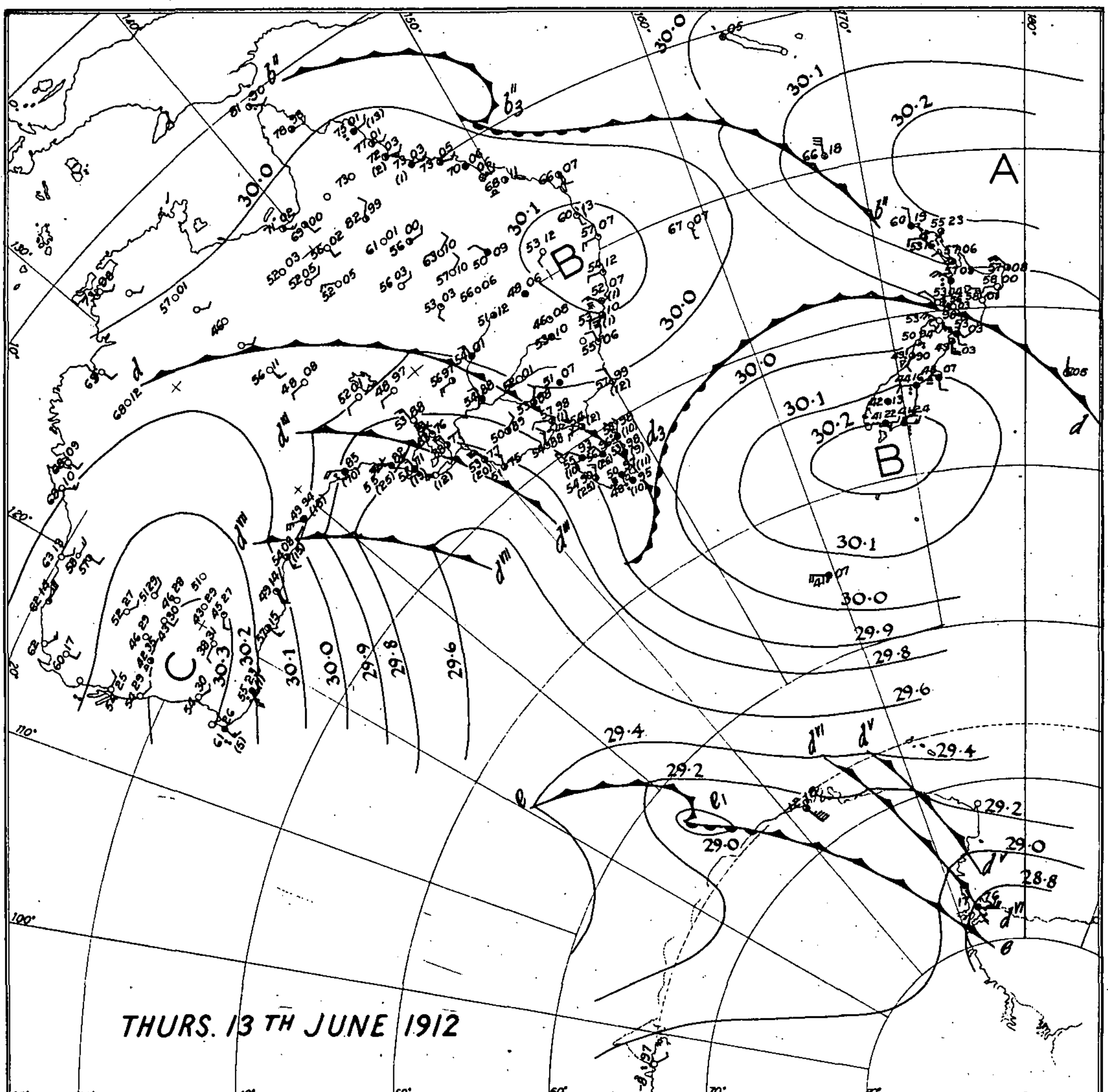
The south-eastern part of b'' has moved rapidly east and north and is crossing A. The northern part has remained stationary and active occluded waves have developed on it in the field of the older depression a_5. Very heavy rains have fallen over eastern Australia where severe floods developed.



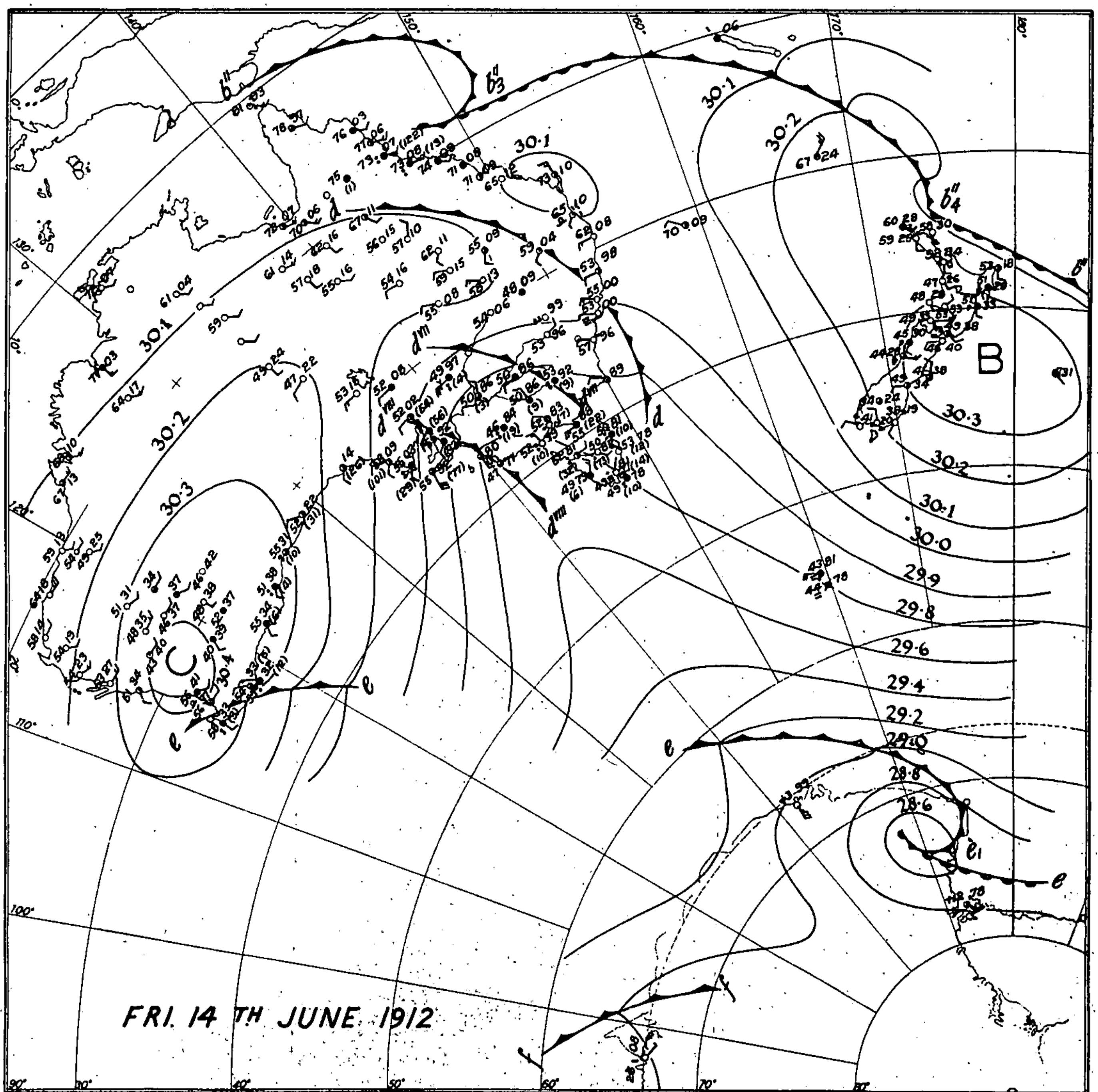
The warm front of wave b_2^{II} has probably become diffuse and the whole front, the supply of cold air in rear of it having ceased, is dissipating. Rain is still widespread, however, along the east coast of Australia. There was a very sharp fall of temperature of $5\frac{1}{2}°$ when front *d* passed Macquarie Island. There is still a blizzard at Cape Evans.



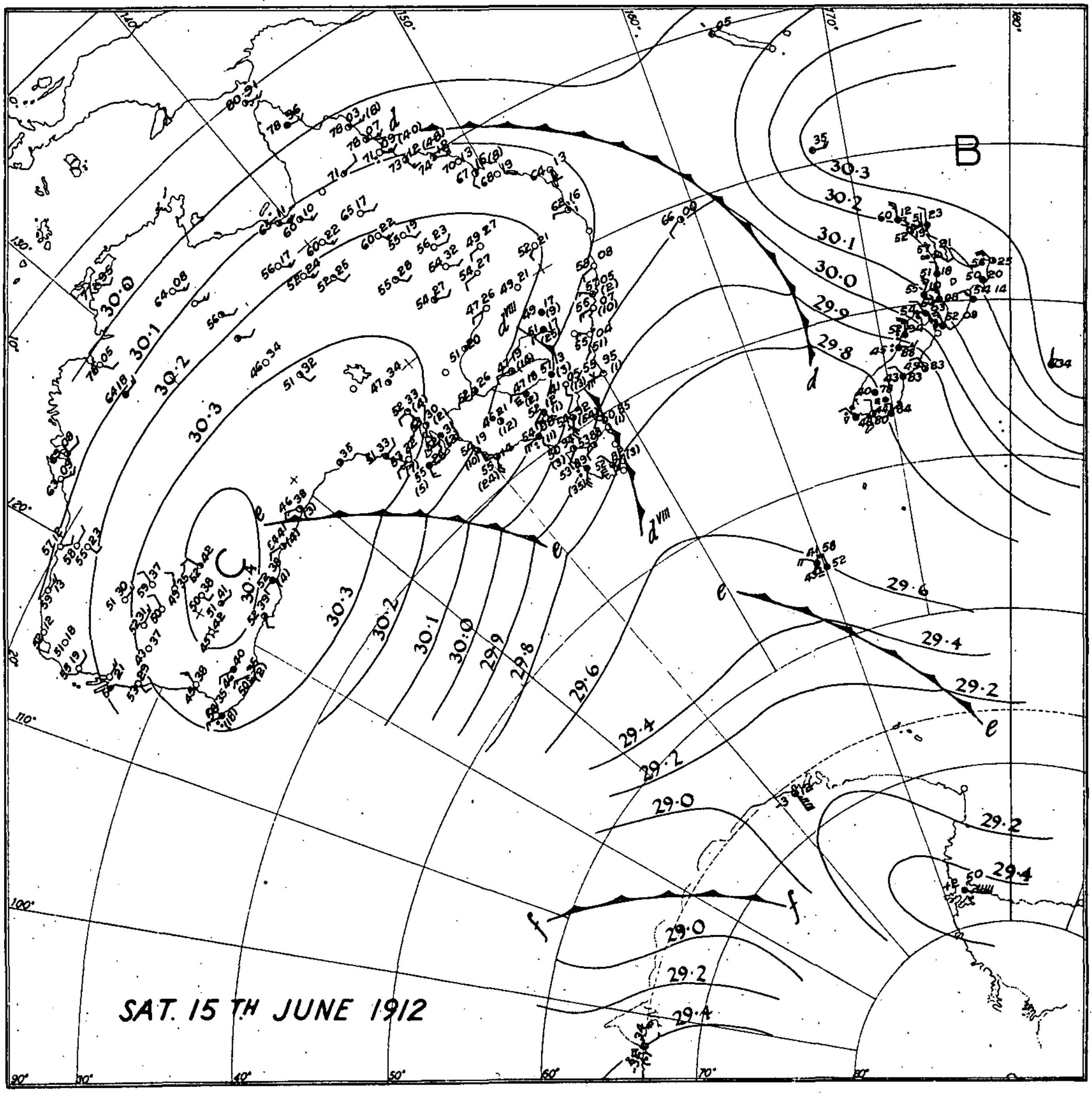
Anticyclone B is centred unusually far south. There is still a tendency for storm activity over south-eastern Australia. Note the continuance of the blizzard at Cape Evans; also the south-westerly gales in south-west Western Australia.



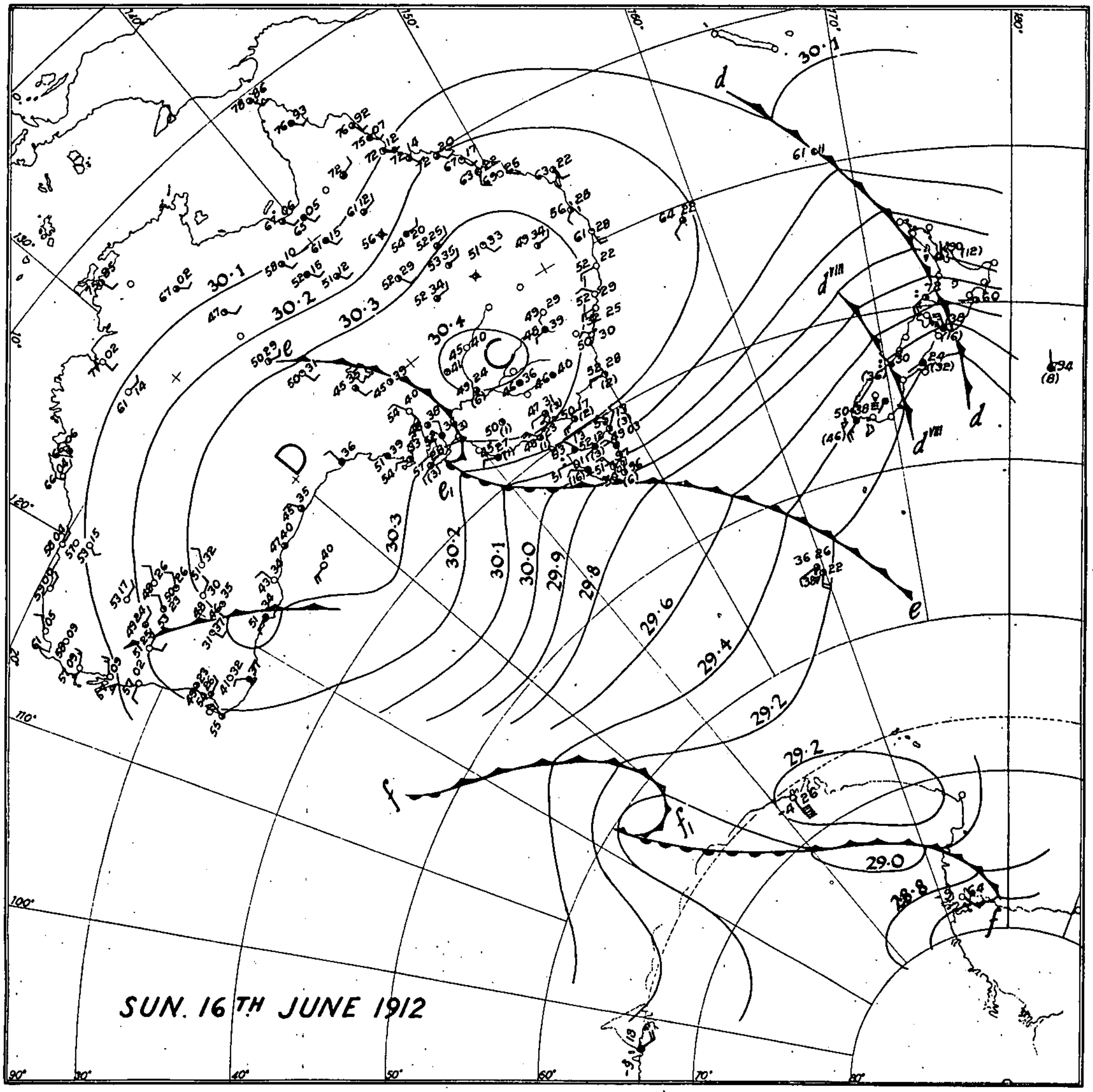
The activity over south-eastern Australia is still noticeable but is beginning finally to die out. Note the secondary fronts in the south-westerly outbreak which has extended from Western Australia into South Australia. There is no trace of these fronts at Macquarie Island. The development is typical but seen more often over New Zealand where latitudes are higher.



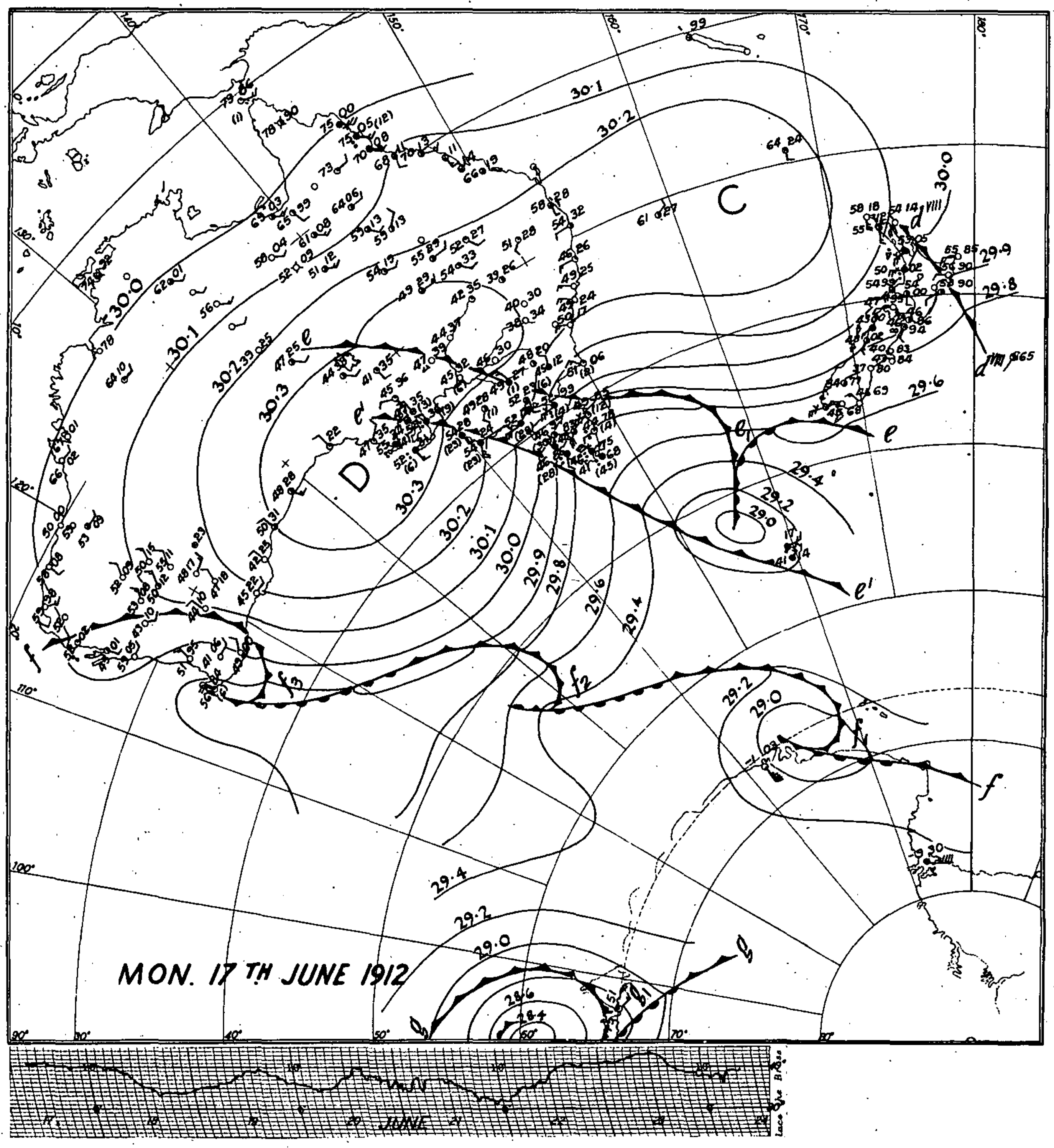
A cyclone is passing to the north of Cape Evans, otherwise there is little activity.



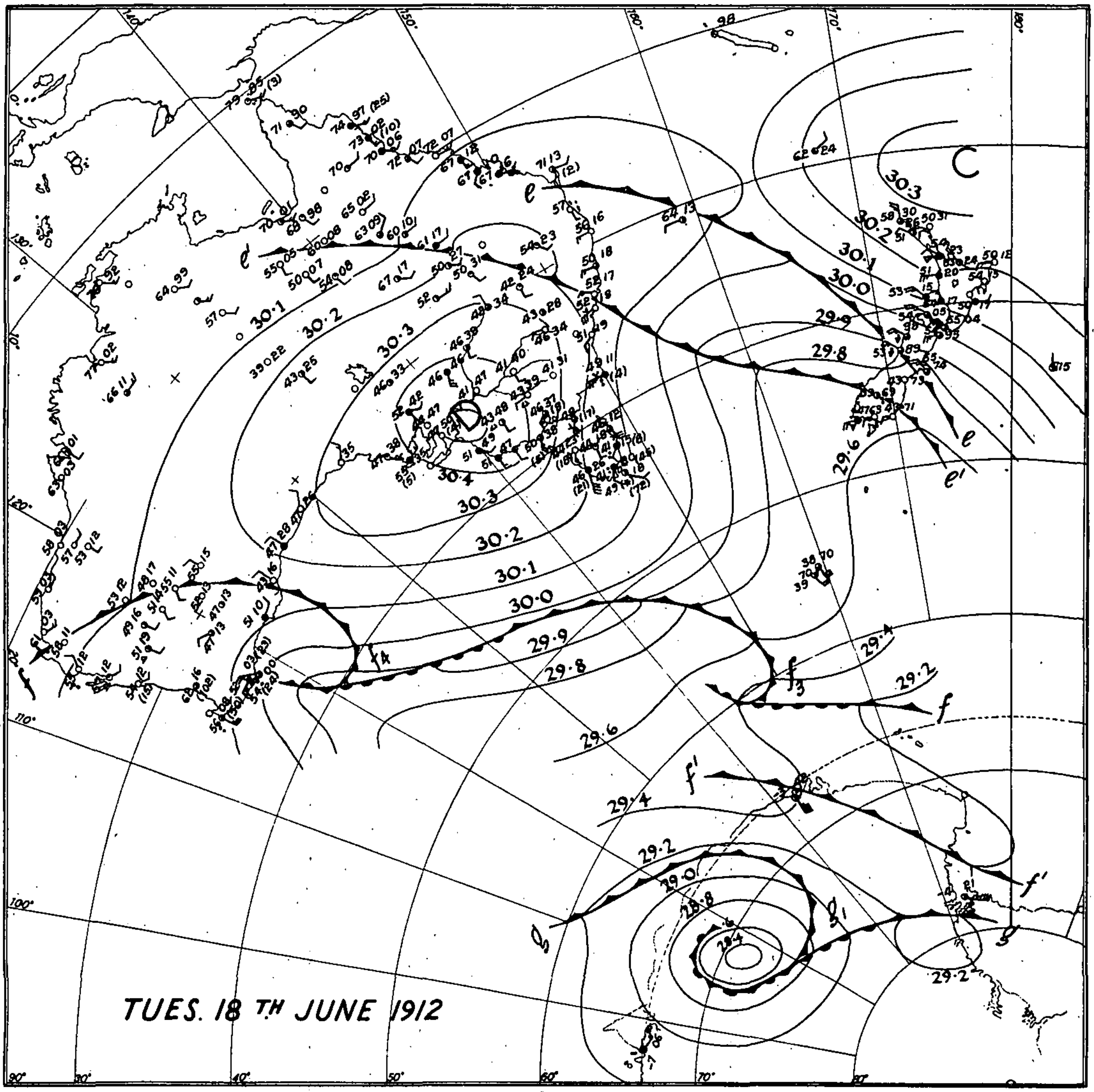
It is not possible to say whether the two branches of front *e* are joined. The situation is a quiet one.



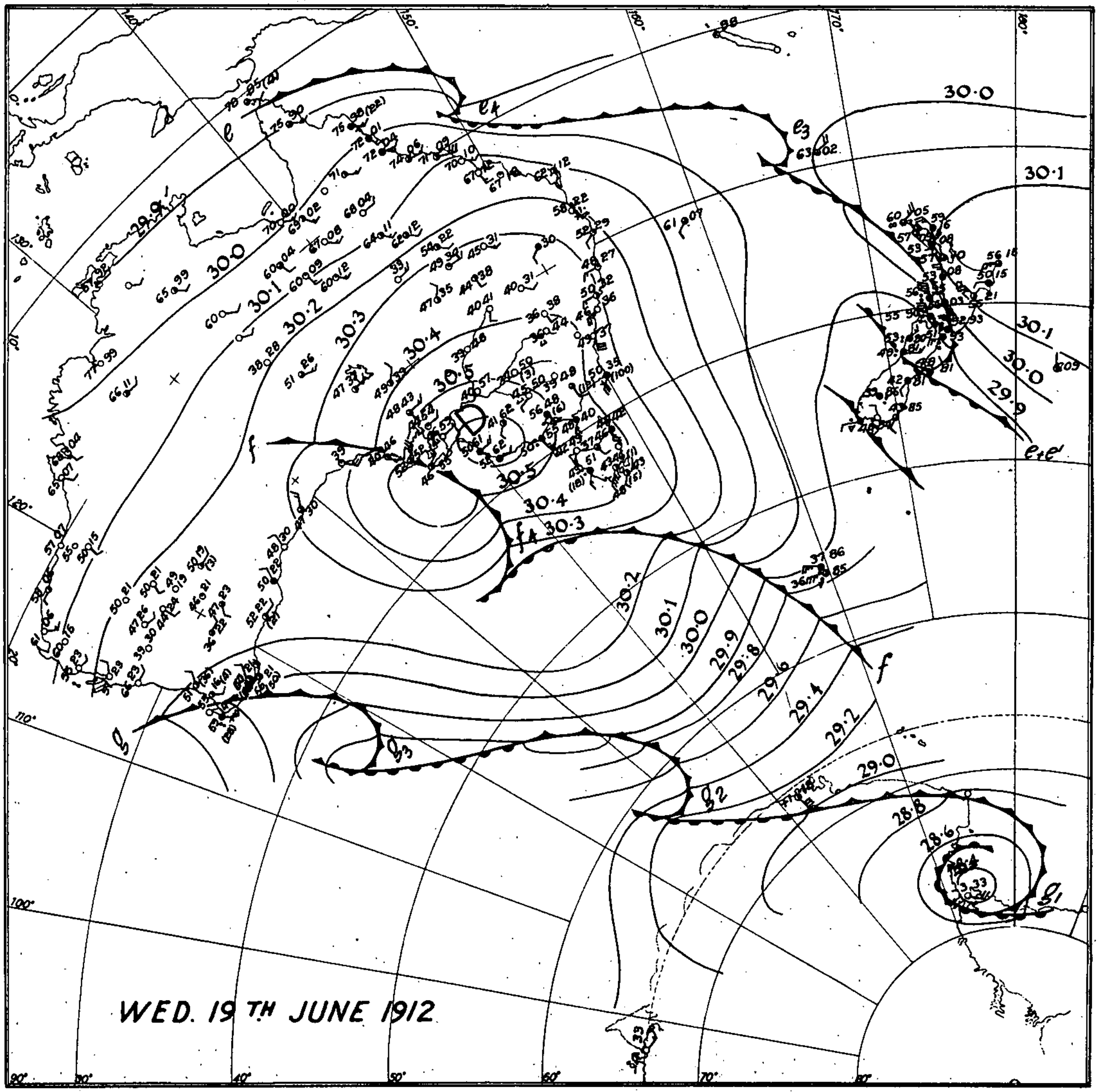
There is little doubt that *e* is now a continuous front. It was well marked at Macquarie Island causing a sharp fall of temperature



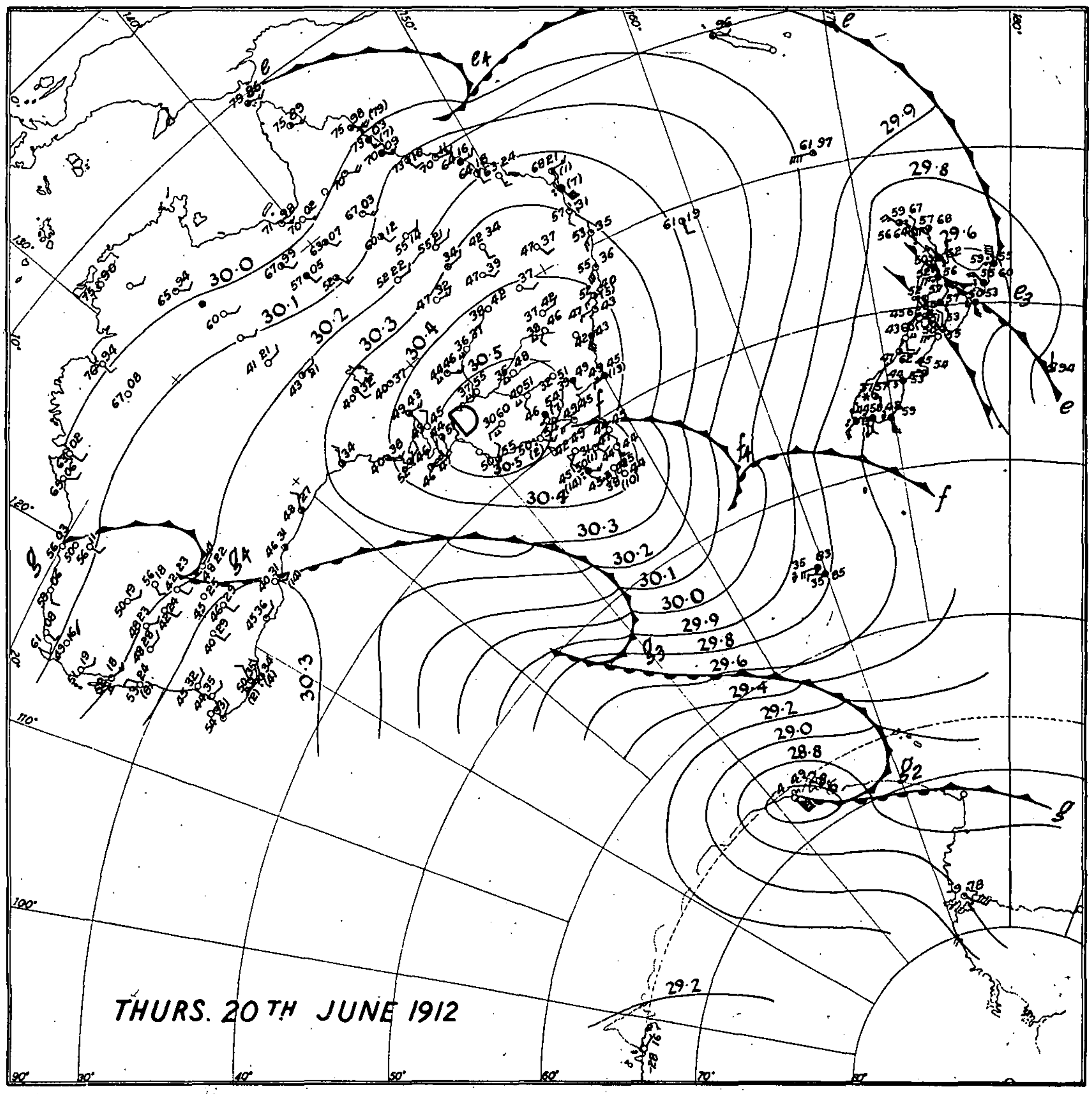
Note the developments in Tasmania, at Macquarie Island, and over the south Tasman Sea. The analysis in this region is based largely on the barograms and thermograms at Macquarie Island and the barogram at Melbourne. A deep cyclone is approaching Queen Mary Land.



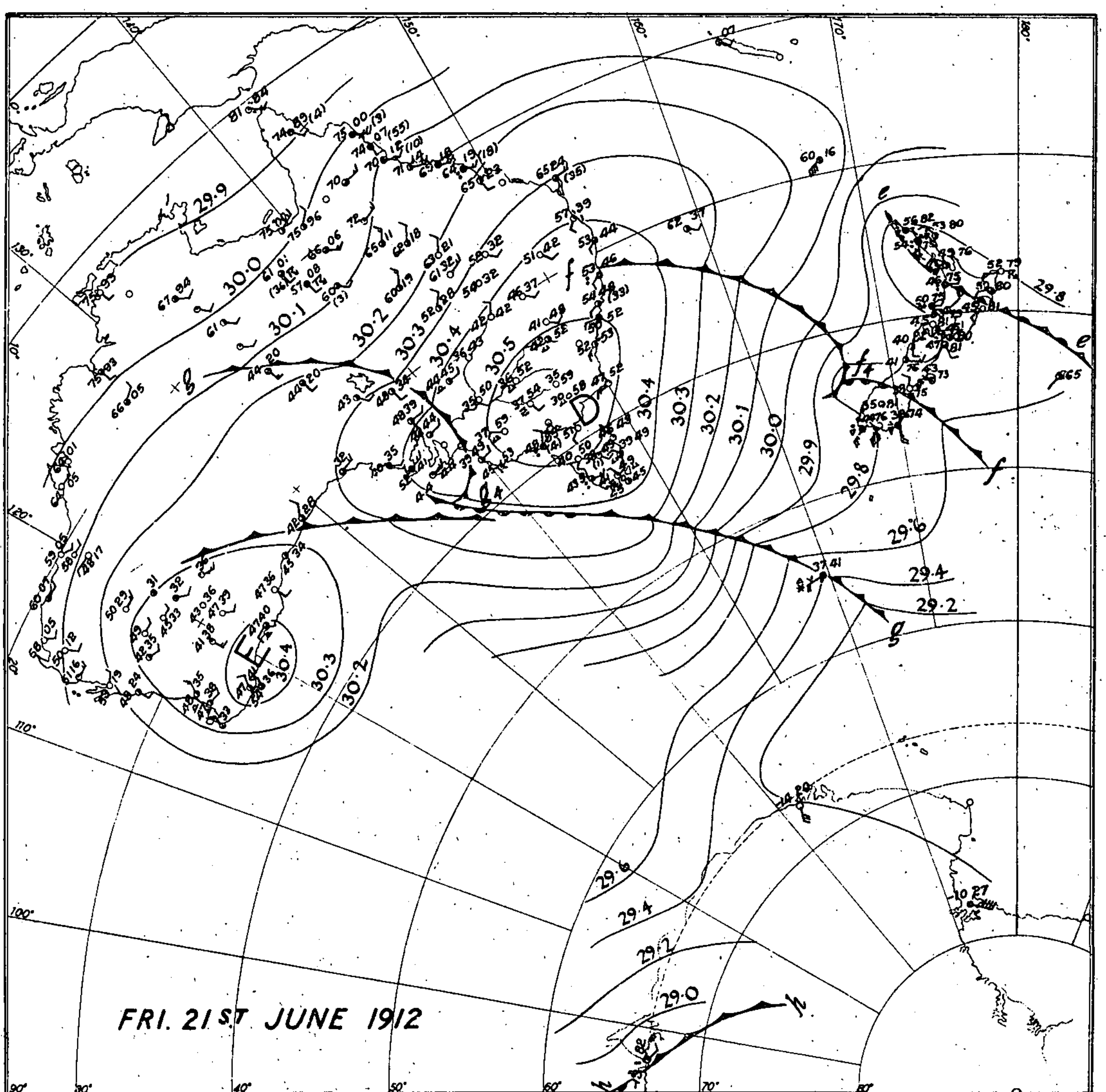
Front *e* is intensifying over New Zealand.



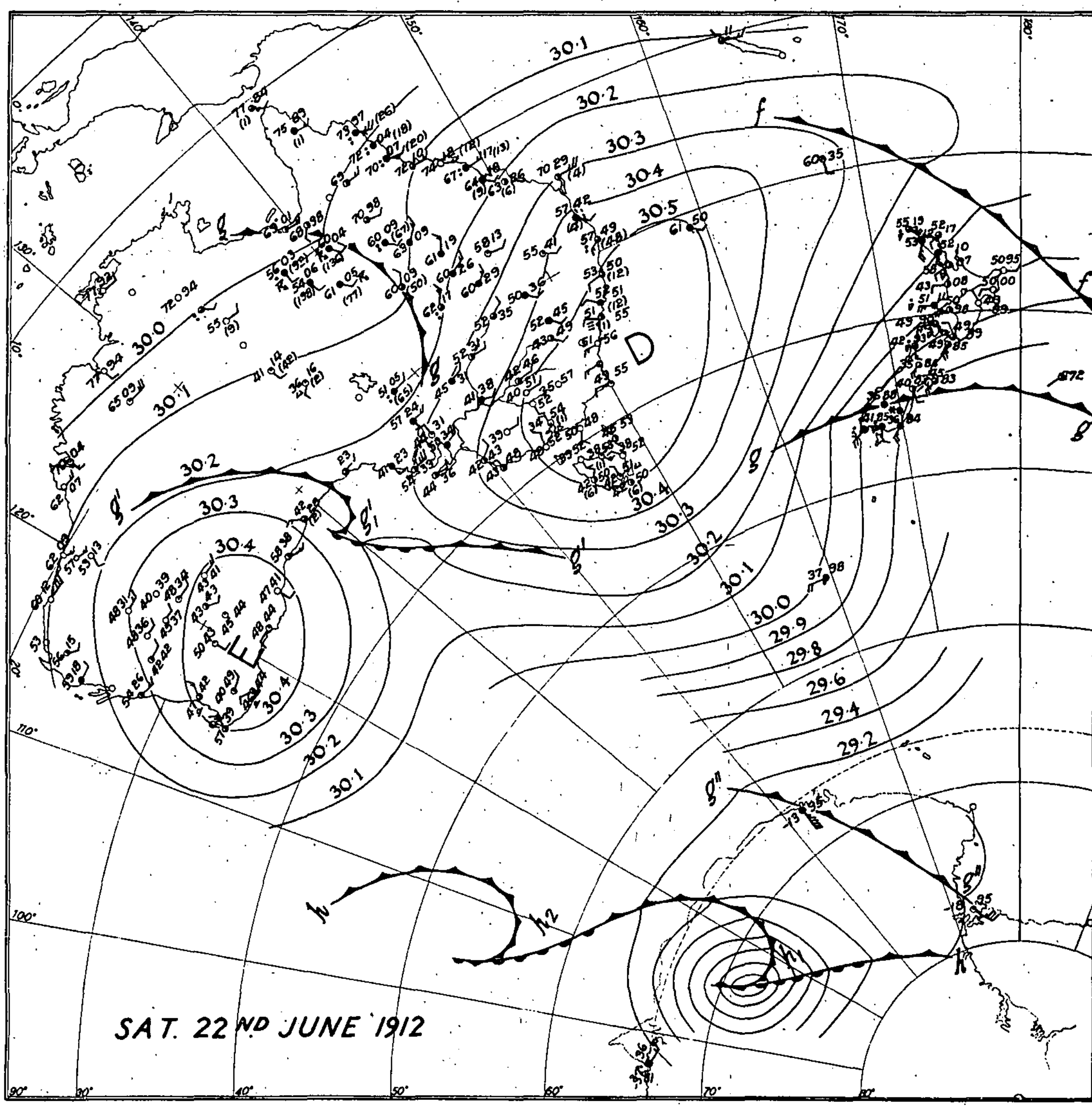
Waves are forming on front *e* with which *e'* is being merged. A cyclone is now centred north of Cape Evans. The northern part of front *f* is suffering frontolysis.



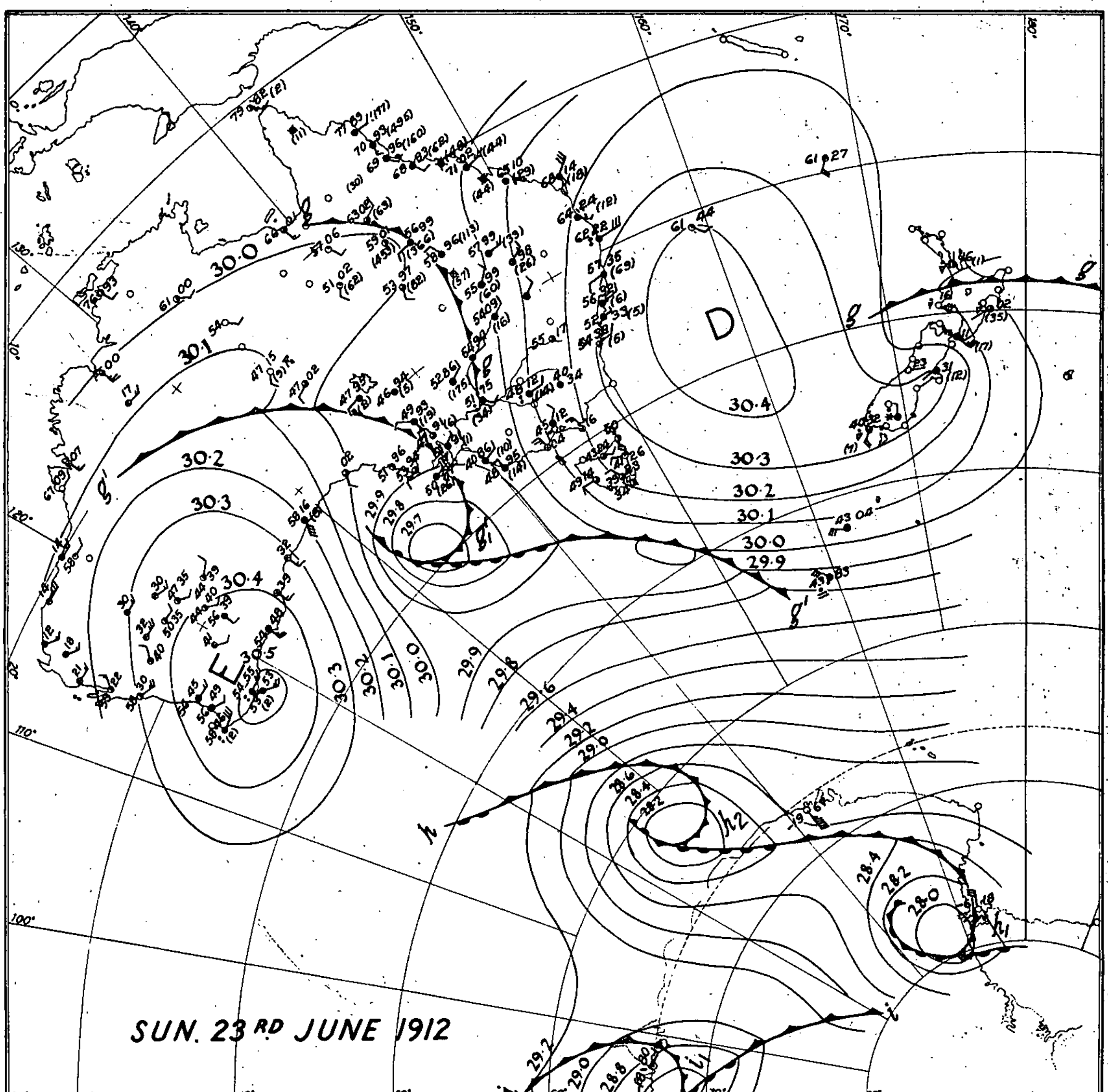
Cyclone g_1 has now moved away from Cape Evans while g_2 has approached Adélie Land. Depression e_3 over the North Island of New Zealand is causing widespread and heavy rain. These developments over New Zealand are associated with the invasion of low latitudes by cold air flowing round the intense anticyclone D.



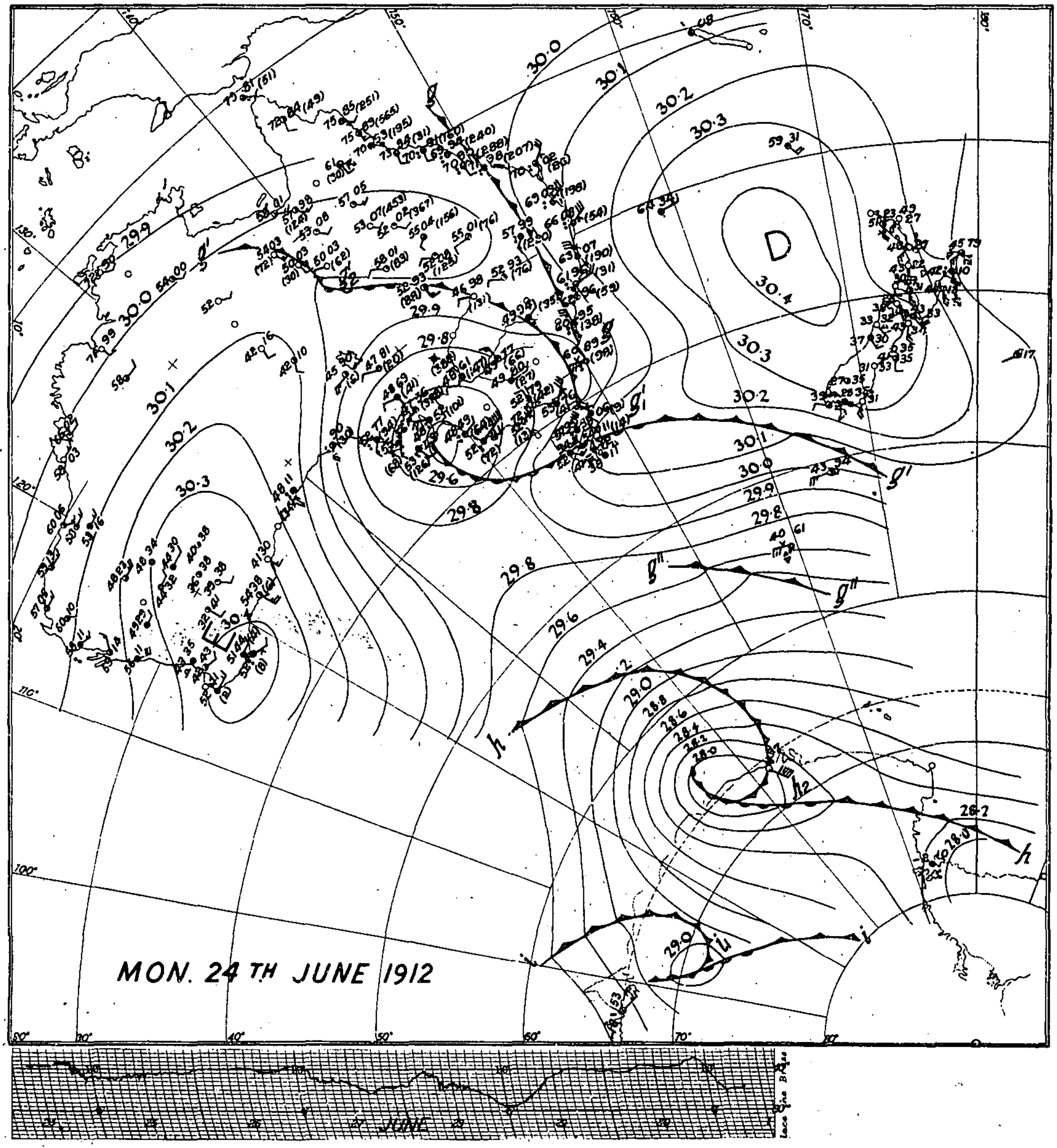
Note the temperature changes at Macquarie Island during the preceding 24 hours. There are rapid fluctuations due to hailstorms.



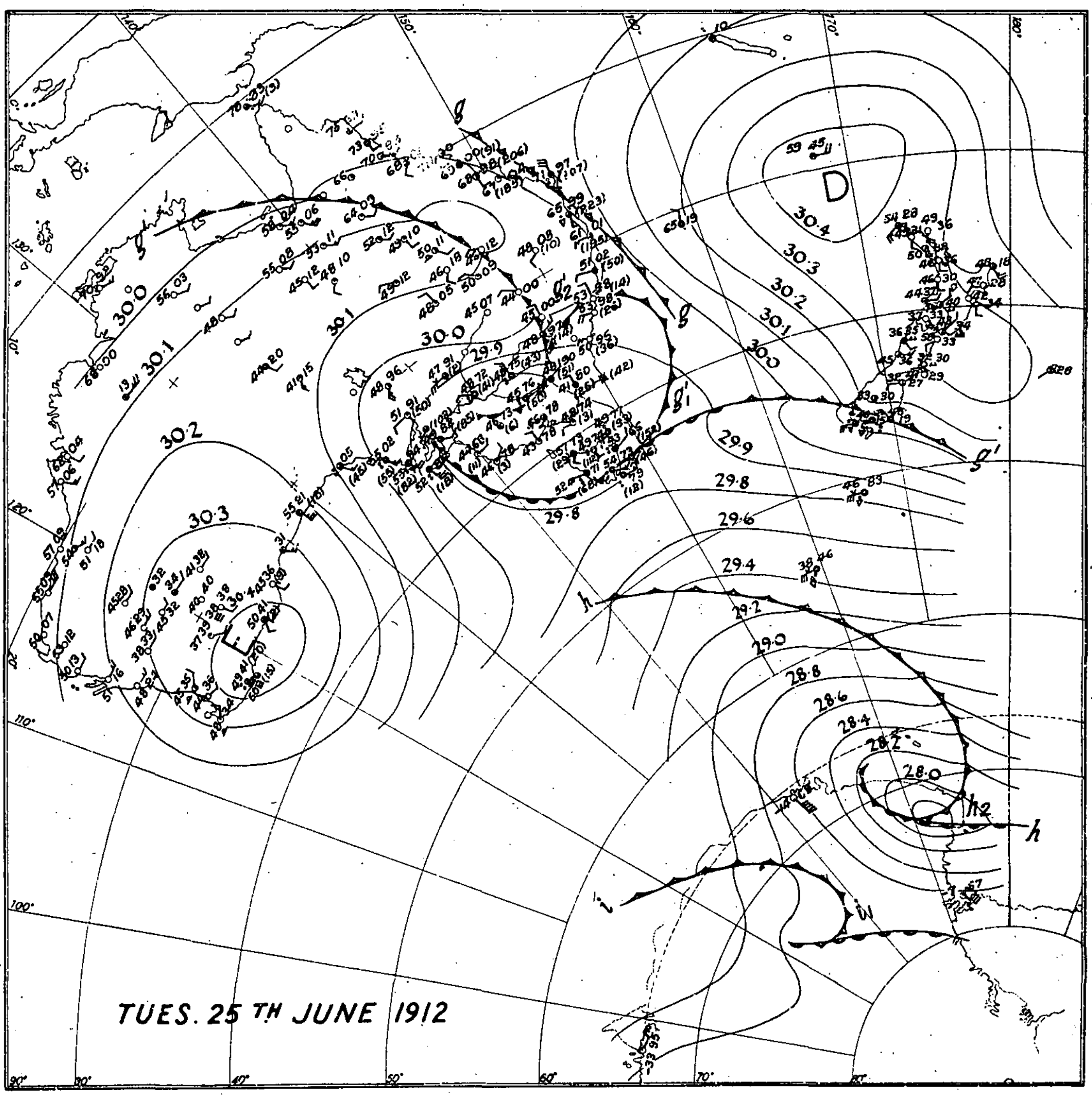
A very deep cyclone has passed Queen Mary Land. Note the winds and the marked frontogenesis in Queensland and surrounding areas. Some heavy rains fell in the succeeding 24 hours.



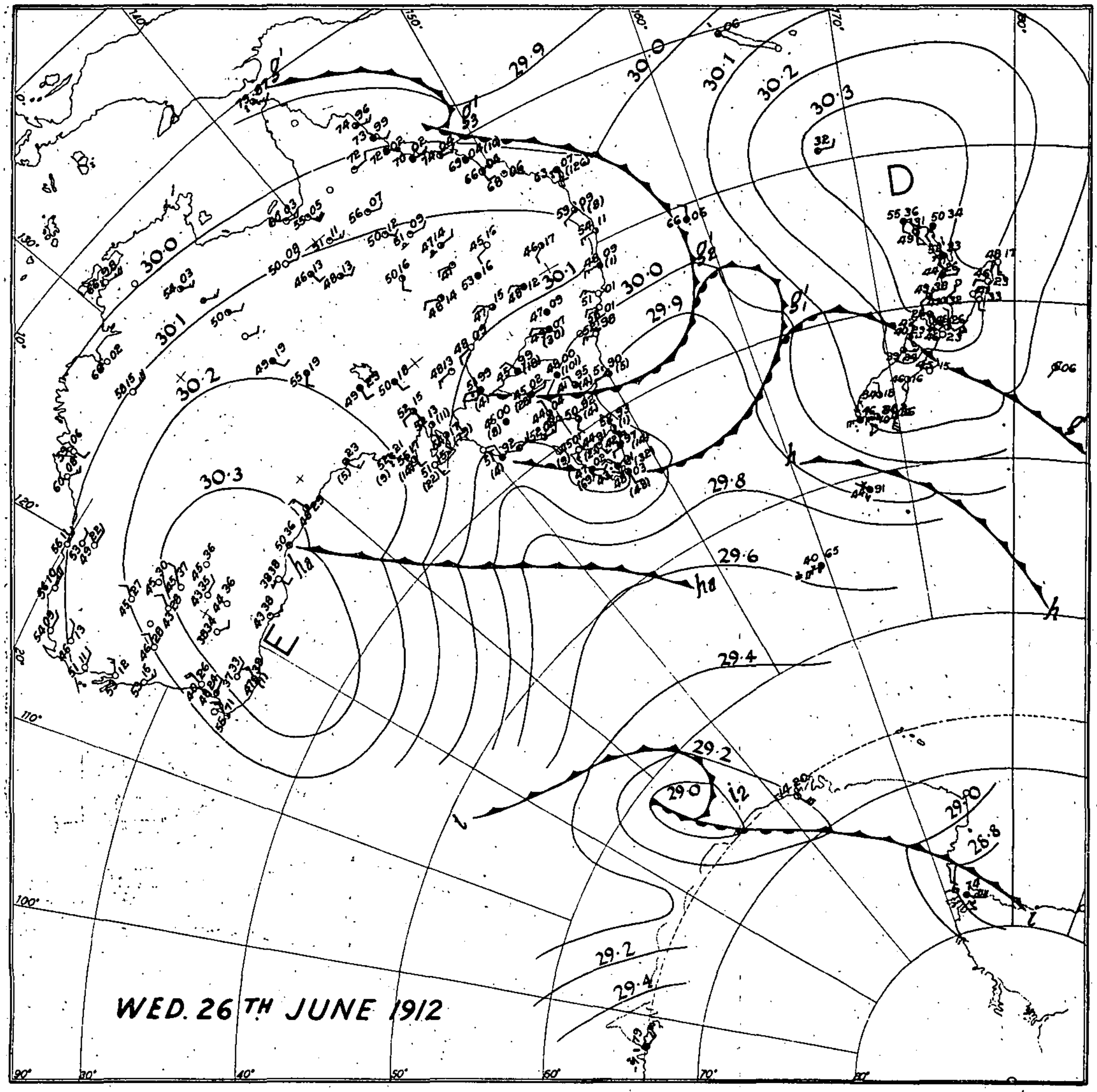
Cyclone h_1 is approaching Cape Evans (note the northerly wind), h_2 Adélie Land, and a new one i_1 Queen Mary Land. Anticyclone E is intense and a south-westerly gale is blowing at Eucla while over eastern Australia there is a rather marked drift from the north-east. This is leading to the development of a cyclone south of South Australia.



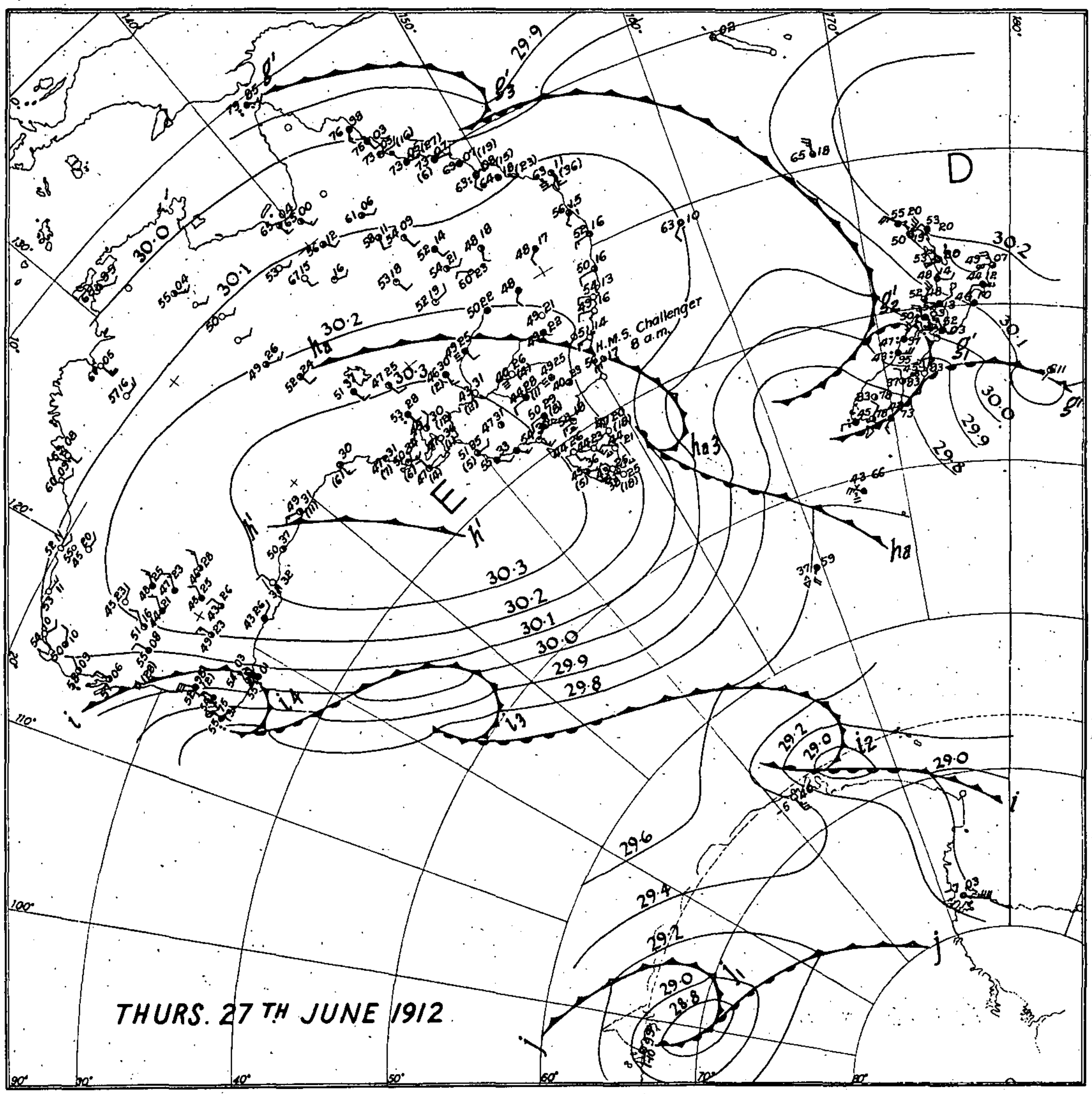
Front g which has been quasi-stationary is now reaching the east coast of Australia; remarkably heavy and widespread rains are associated with it. Cyclone g_1' also has become intense and caused much heavy rain. There is a very deep cyclone over Adélie Land. Anticyclones D and E are both intense.



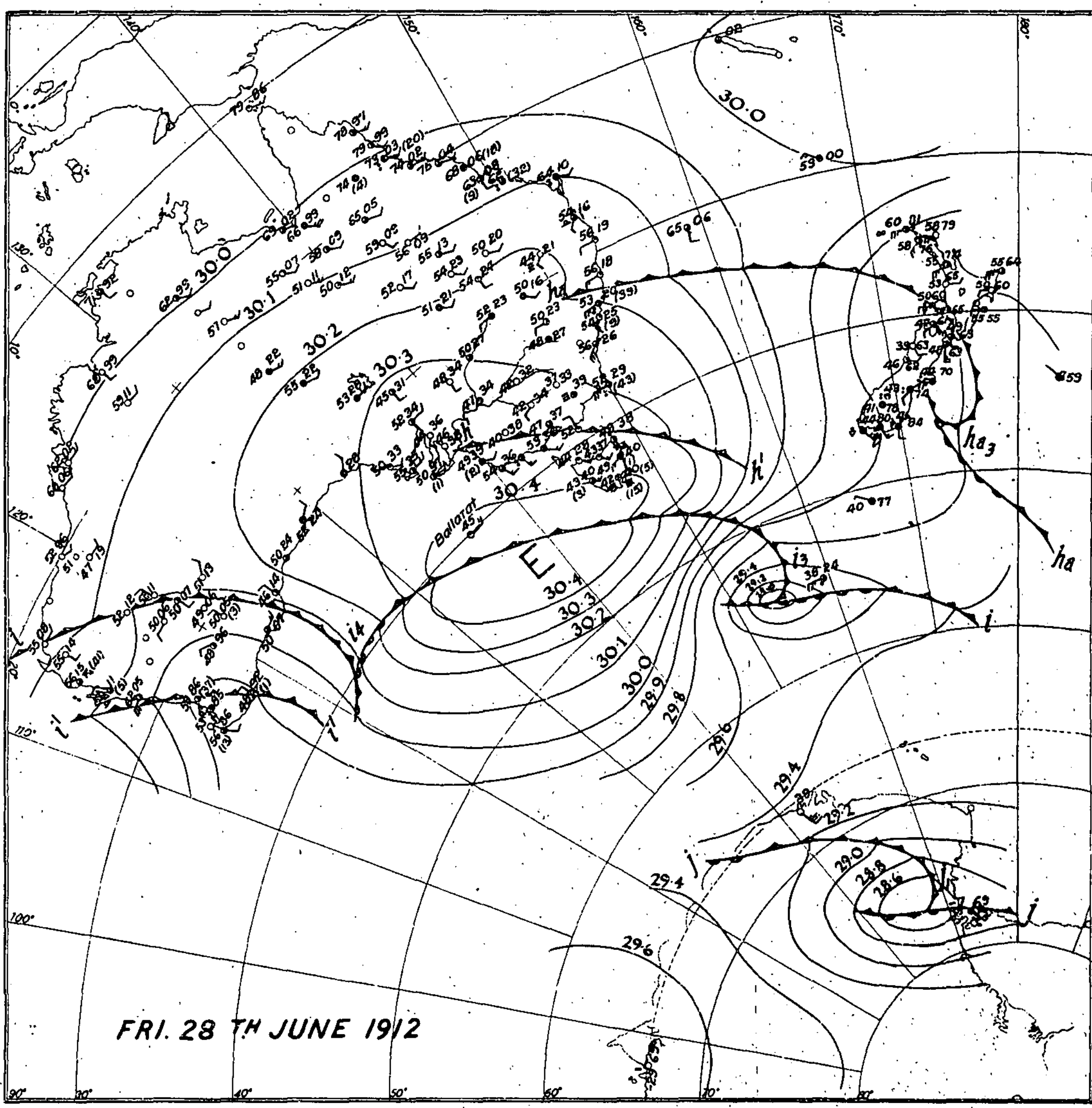
A second wave $g_2^{\prime}$ is moving into cyclone $g_1^{\prime}$, which, however, is beginning to lose energy. Anticyclones D and E are still intense.



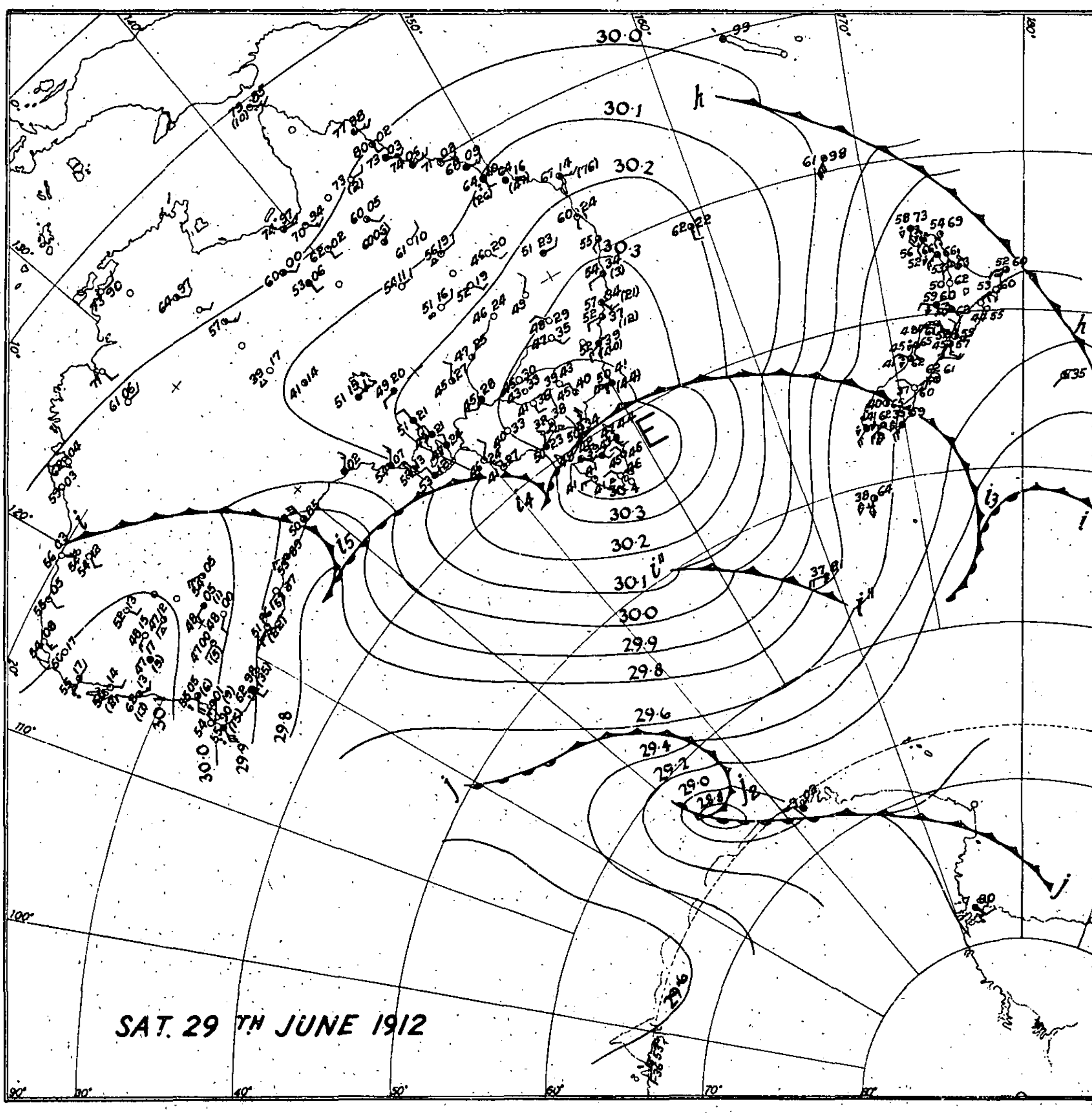
The pressure field in the Australia-New Zealand region is losing energy. The northern part of front h was not traceable across anticyclone E. There is a blizzard at Cape Evans.



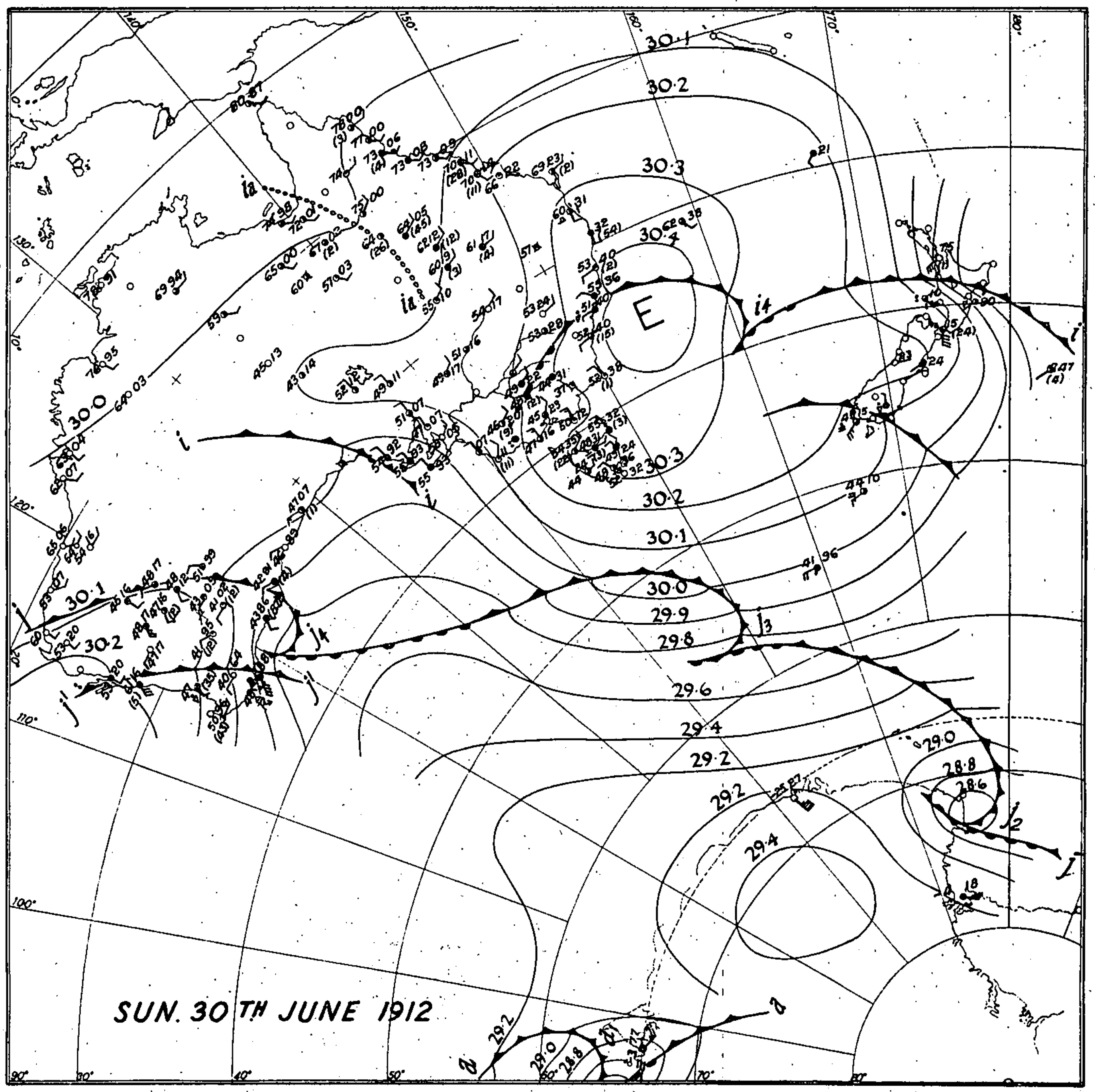
Note the westerly wind at Queen Mary Land; a cyclone has passed to the south. The blizzard has intensified at Cape Evans.



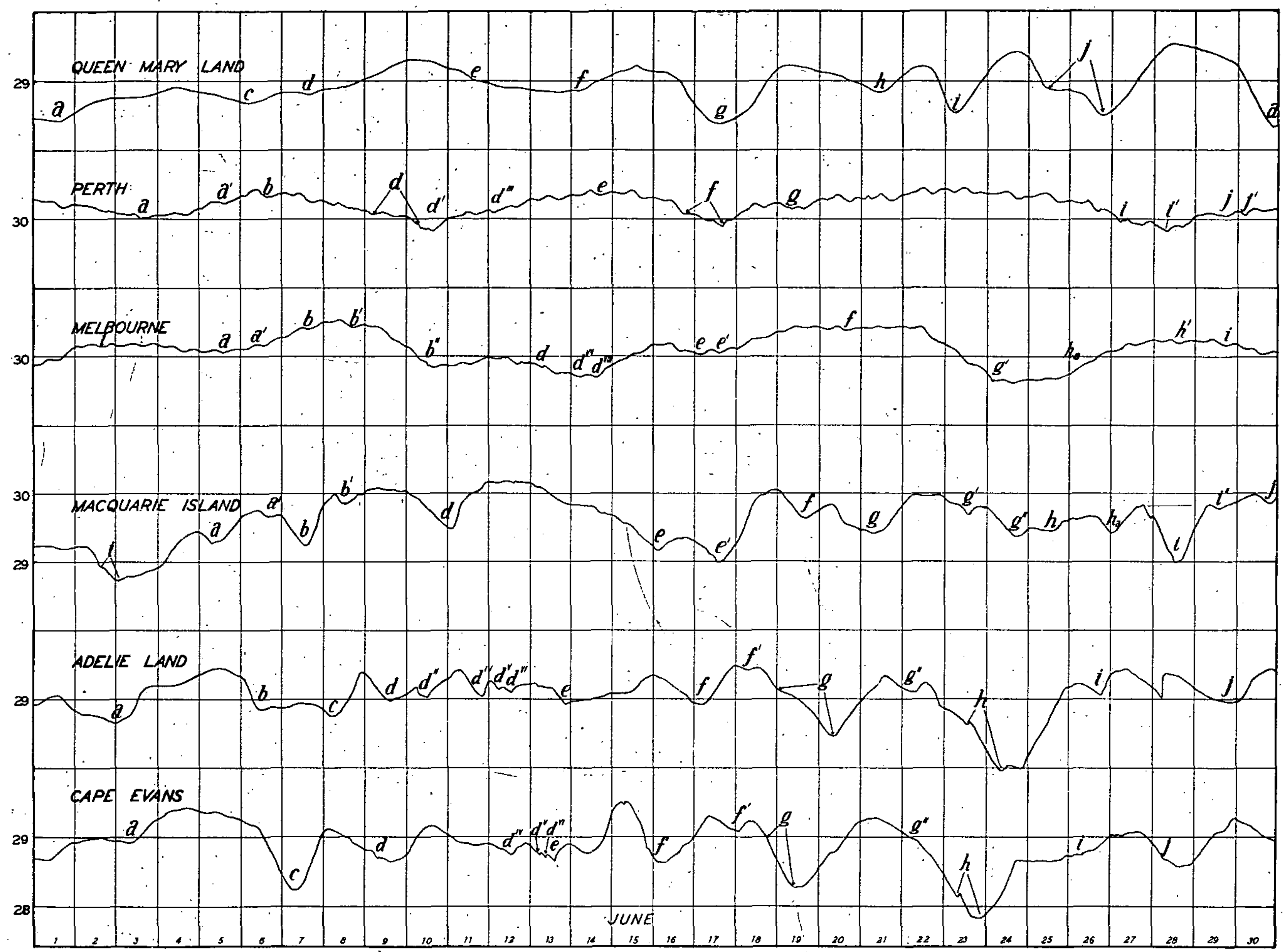
Cyclone j_1 is approaching Cape Evans. Another, i_3 is near Macquarie Island. Fronts g^1, h_{ii} and i' are all well-marked at Macquarie Island, and followed by very unstable conditions.

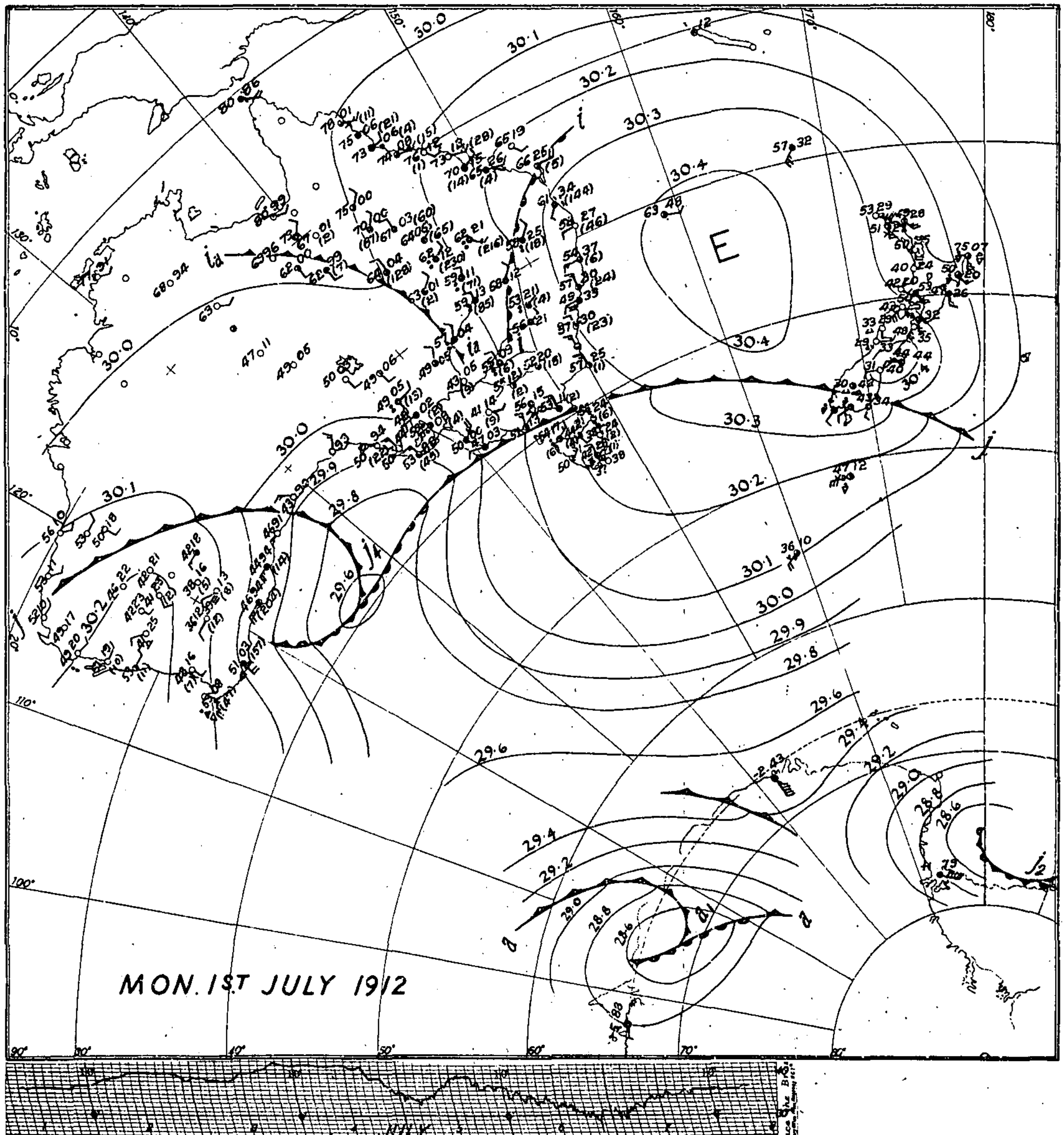


Front *i* is crossing anticyclone E, the western part is lagging and the front consequently taking an east to west orientation.

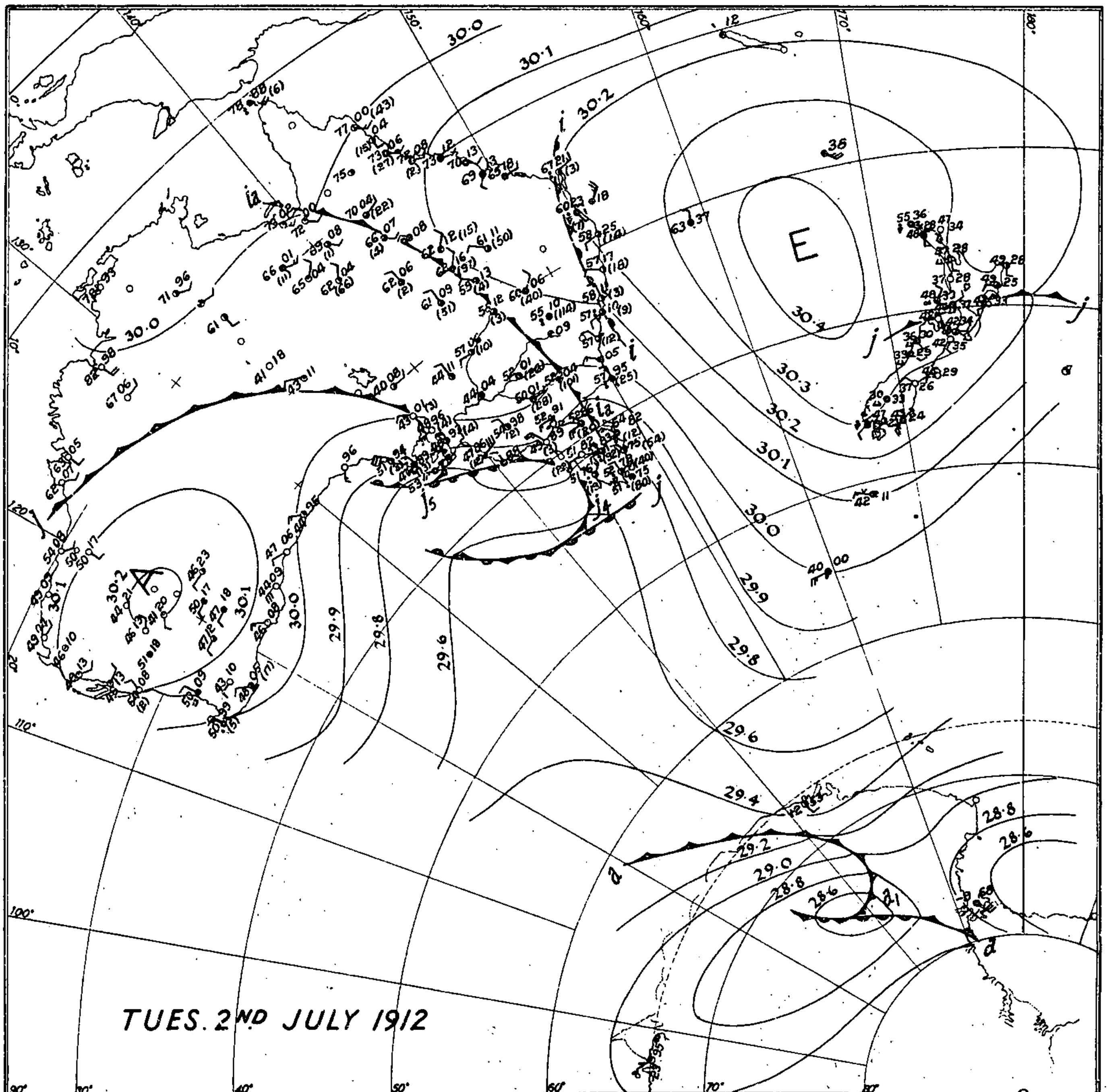


Front *i* is dividing in its western part; the eastern part is rather active. A fresh cyclone is approaching Queen Mary Land.

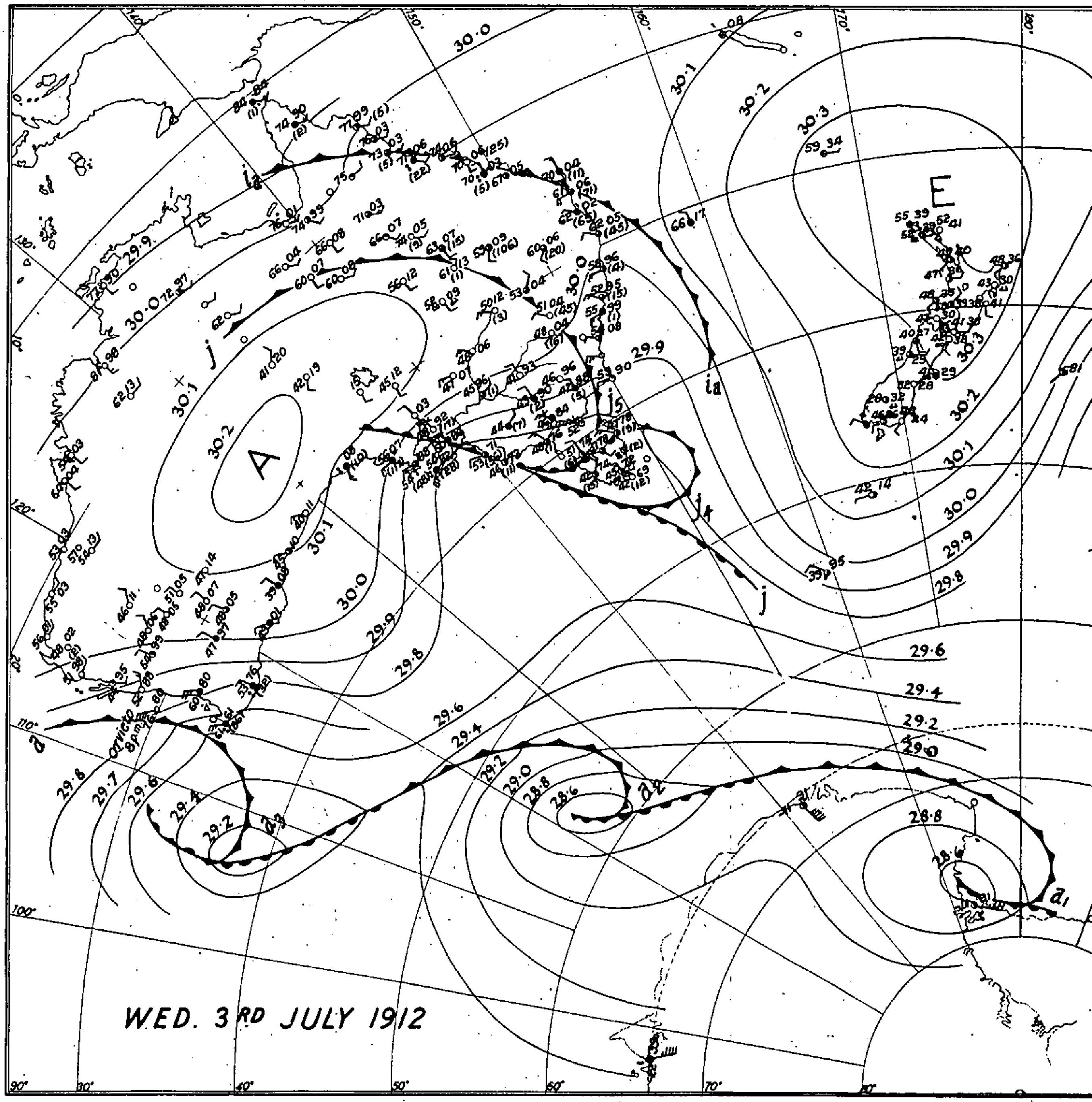

QUEEN MARY LAND
PERTH
MELBOURNE
MACQUARIE ISLAND
ADELIE LAND
CAPE EVANS
JUNE



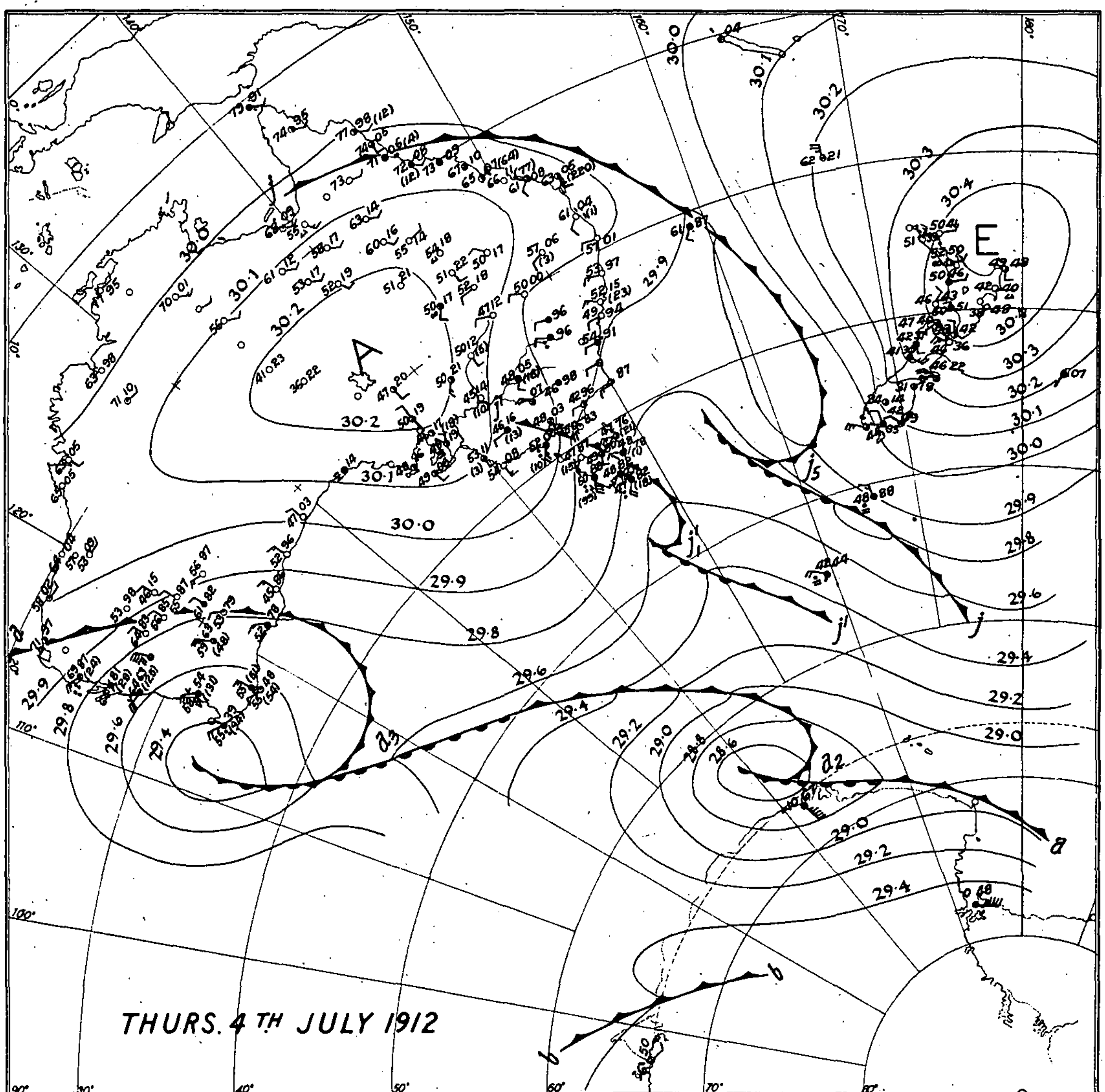
The fall of temperature at Macquarie Island as front j passed was rather slow. A blizzard is blowing at Cape Evans behind j_2. There appears to be frontogenesis in western Queensland where there have been steady rains.



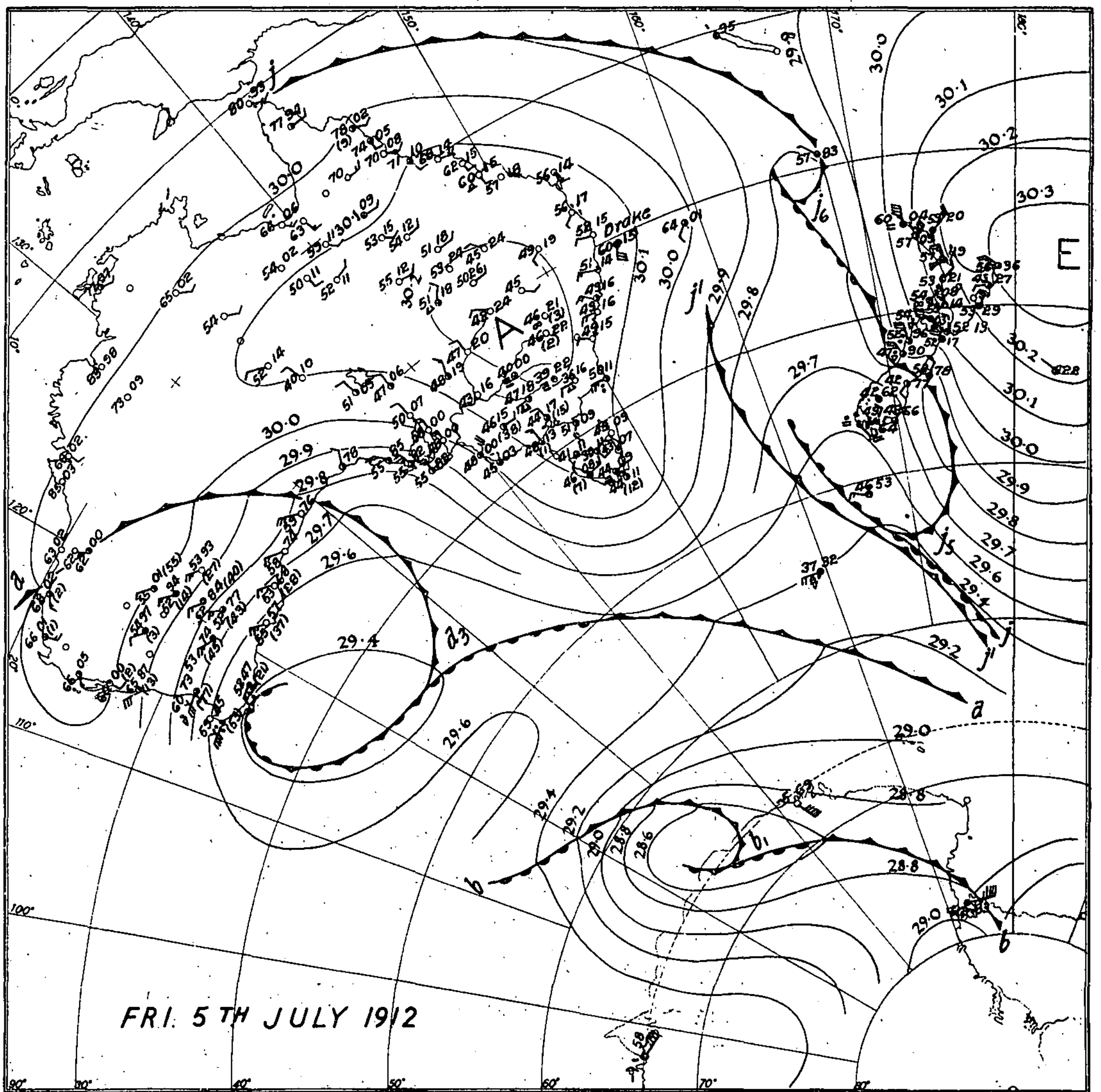
There is further widespread rain over eastern Australia where front i_a is quasi-stationary. Front j is crossing E but becoming diffuse.



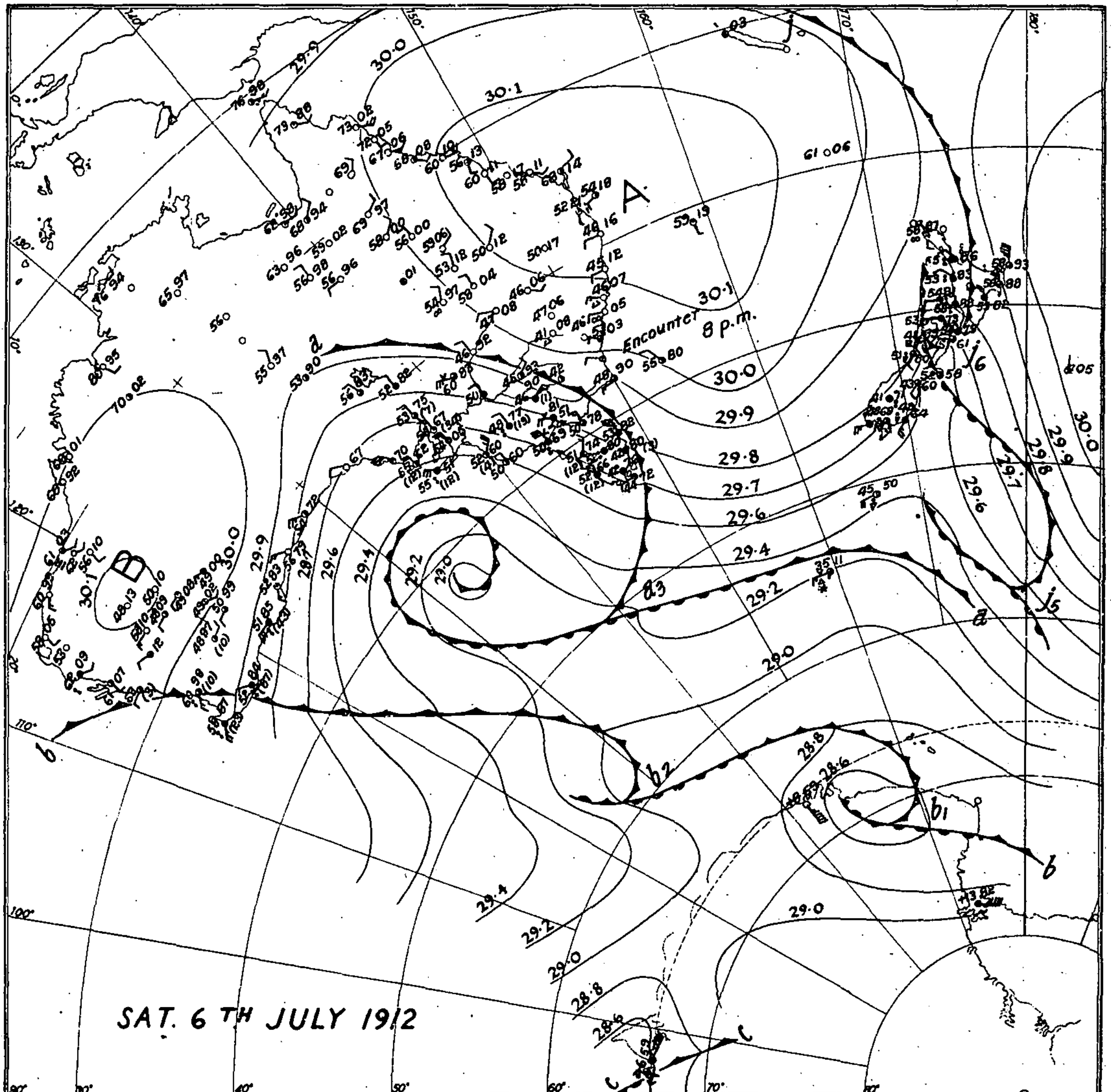
Cyclone a_1 is passing Cape Evans; the blizzard then decreases temporarily during the day and there is a brief interval of northerly wind, suggesting that the occlusion crosses and re-crosses it. Activity still persists in eastern Australia. Front j is now separated from its eastern part and is extending southwards. An extensive and vigorous depression is located off Western Australia.



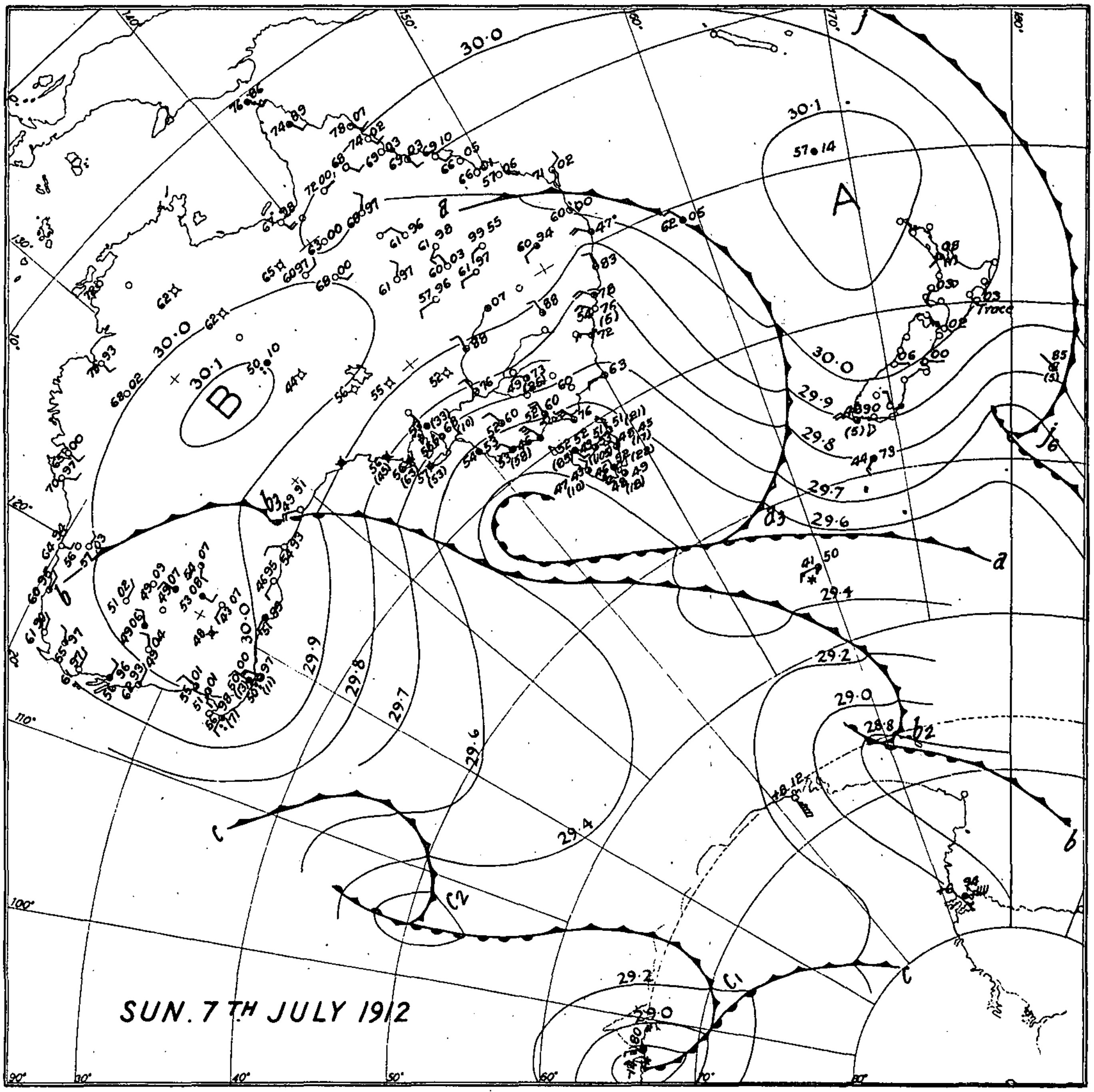
The part of front *j* now shown is probably developing into a separate principal front from the original one. A cyclone is approaching Adélie Land.



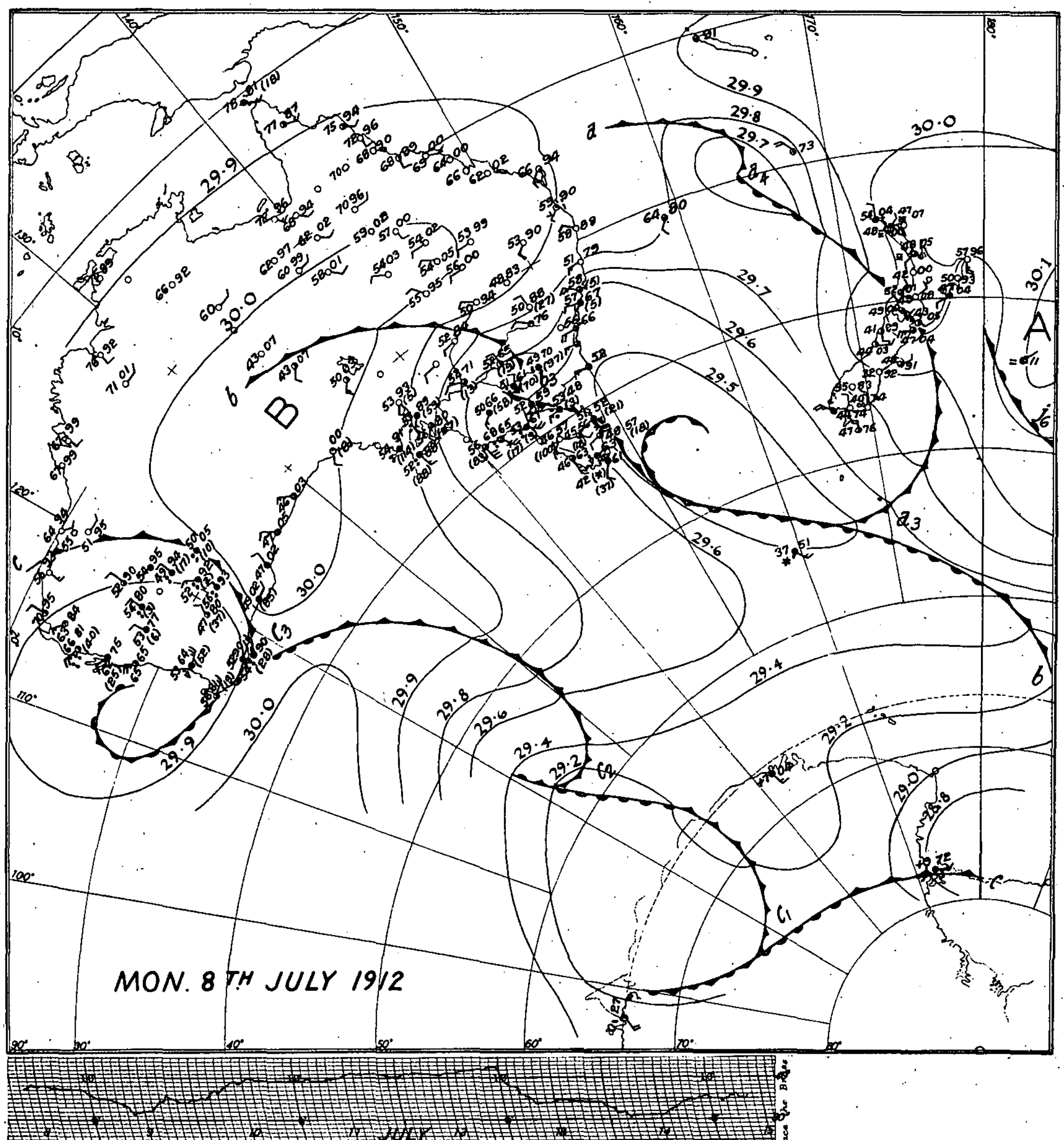
There have been rapid changes in Antarctica. Note the blizzard conditions at Cape Evans and Queen Mary Land. Another cyclone is approaching Adélie Land. A very extensive depression is still located south of Western Australia. Front *j* is becoming active over New Zealand.



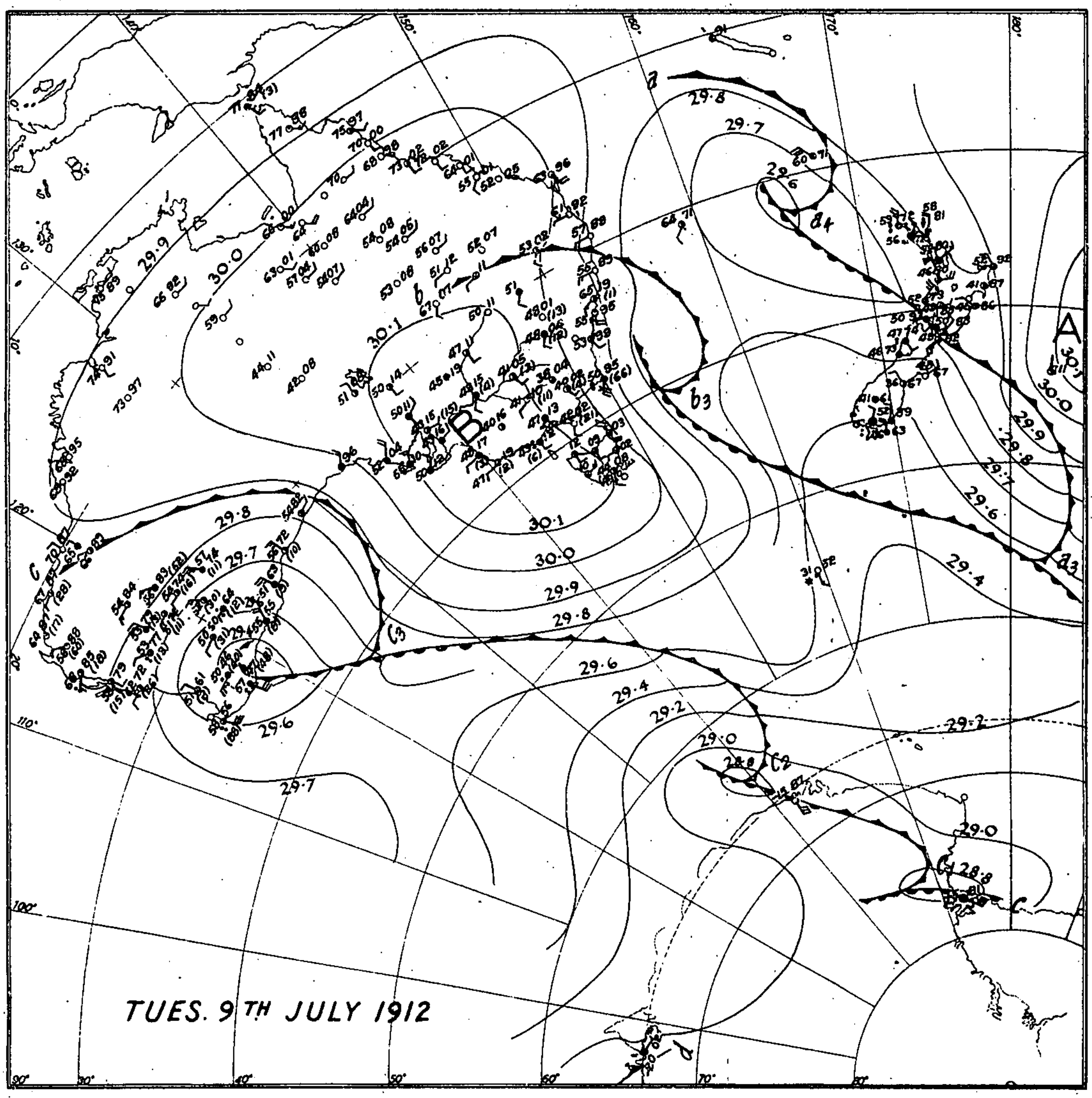
Blizzards are still raging in Antarctica. The depression south of Australia is very active and extensive.



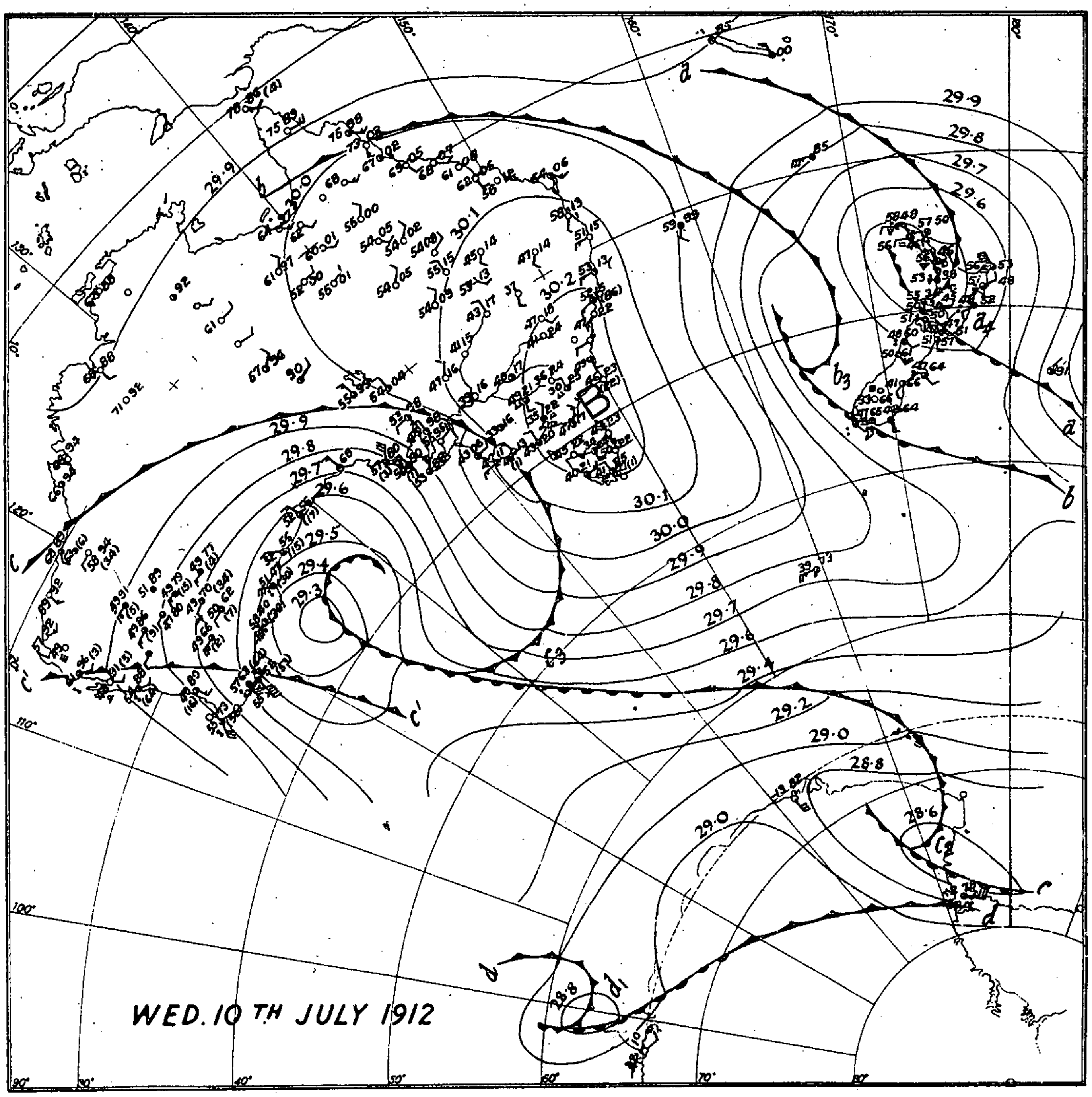
A cyclone centre is passing south of Queen Mary Land; note the northerly wind. Depression a_3 is now losing intensity and front b is closing up to the occlusion. Low and very variable temperatures and frequent hail showers occur at Macquarie Island from the 5th to the 7th.



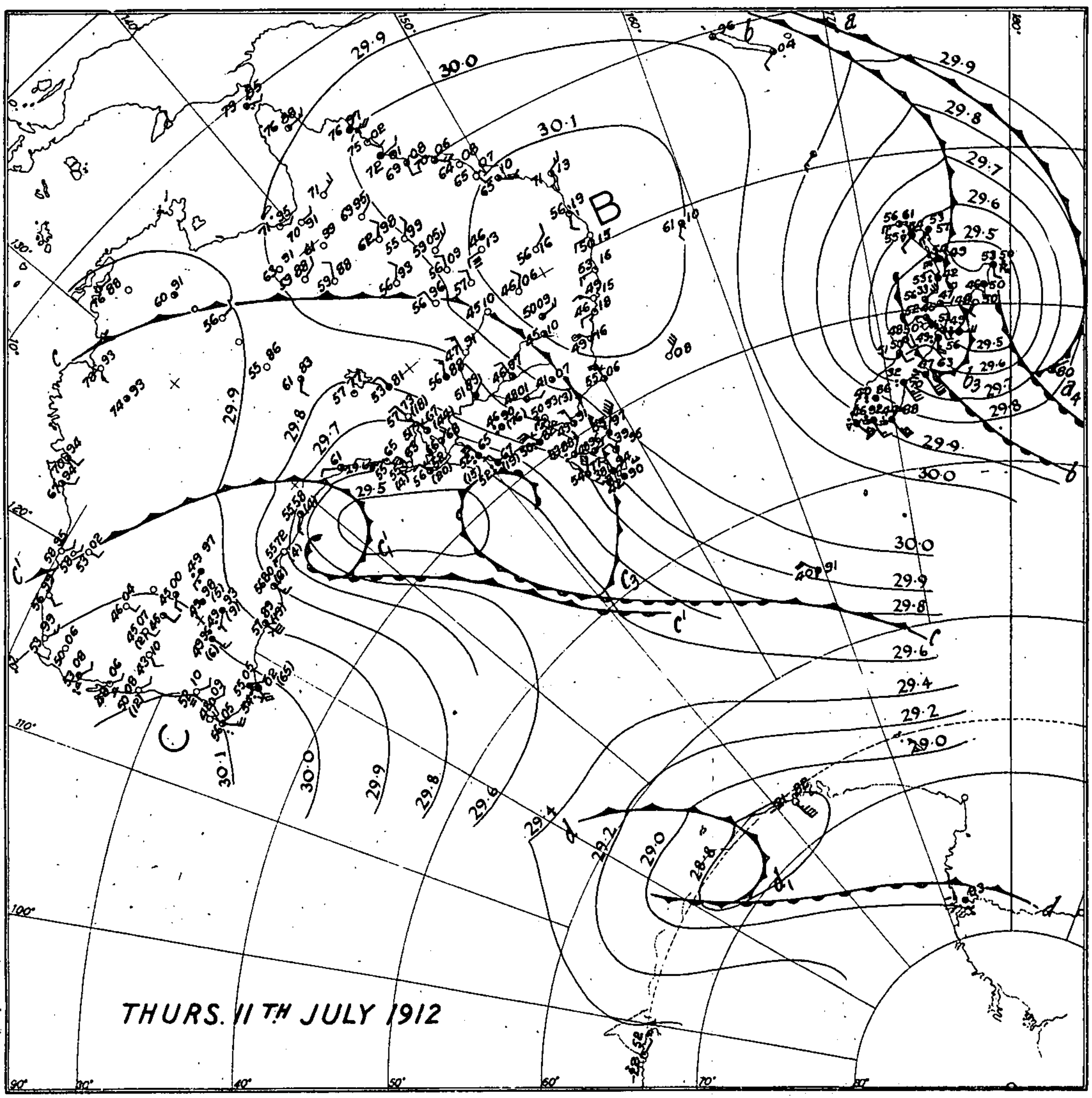
Cyclone c_1 must have been very deep when approaching Queen Mary Land on the 5th and 6th but is apparently filling up. It does not greatly affect Cape Evans. Note the light wind at the latter station which is put north of front in consequence. A fresh depression, c_3, is moving on to Western Australia and rather resembles its predecessor a_3.



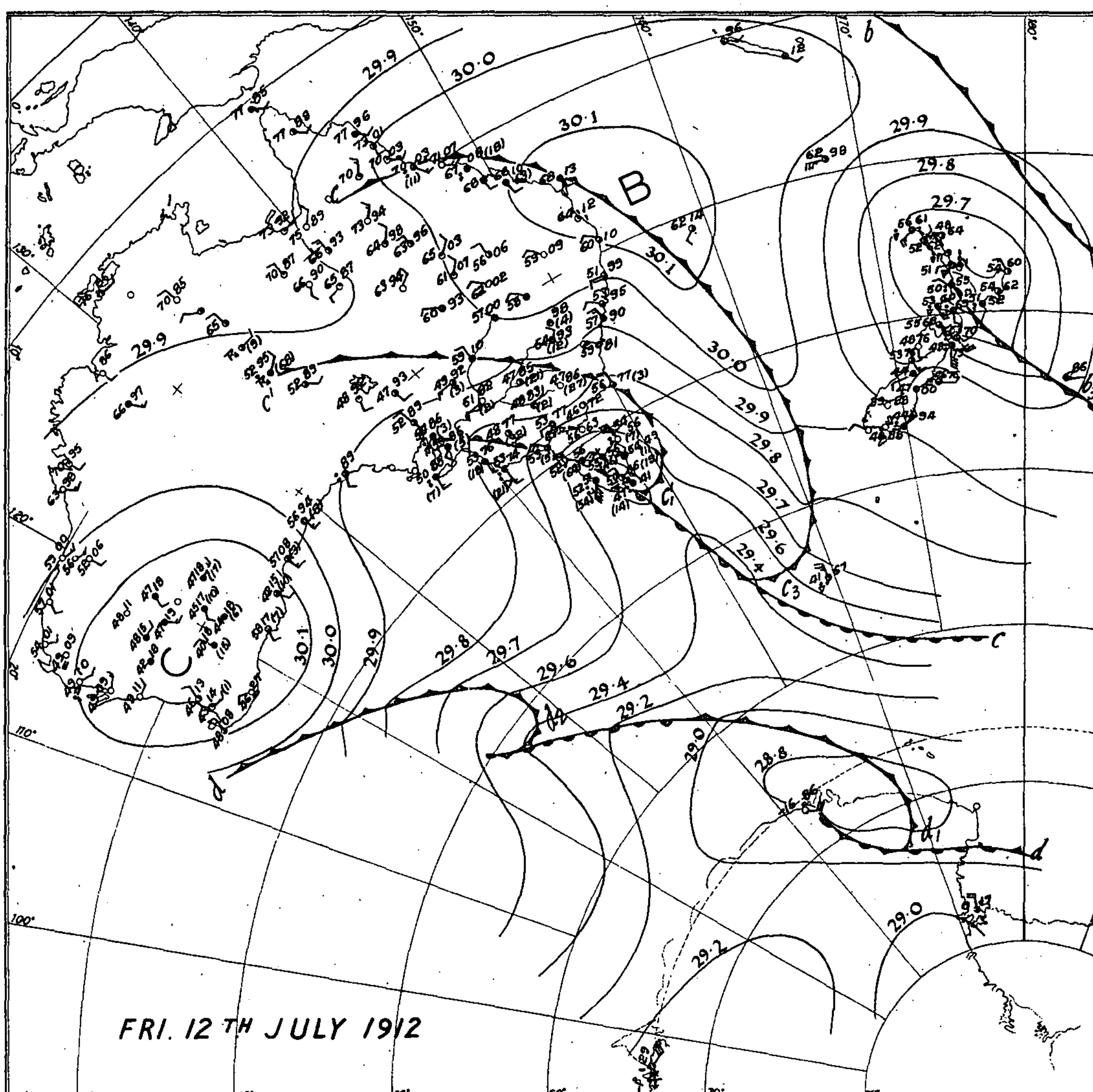
c_3 has a definite cyclonic centre. Front *b* has been crossing anticyclone B. A cyclone is developing in the north-east Tasman Sea.



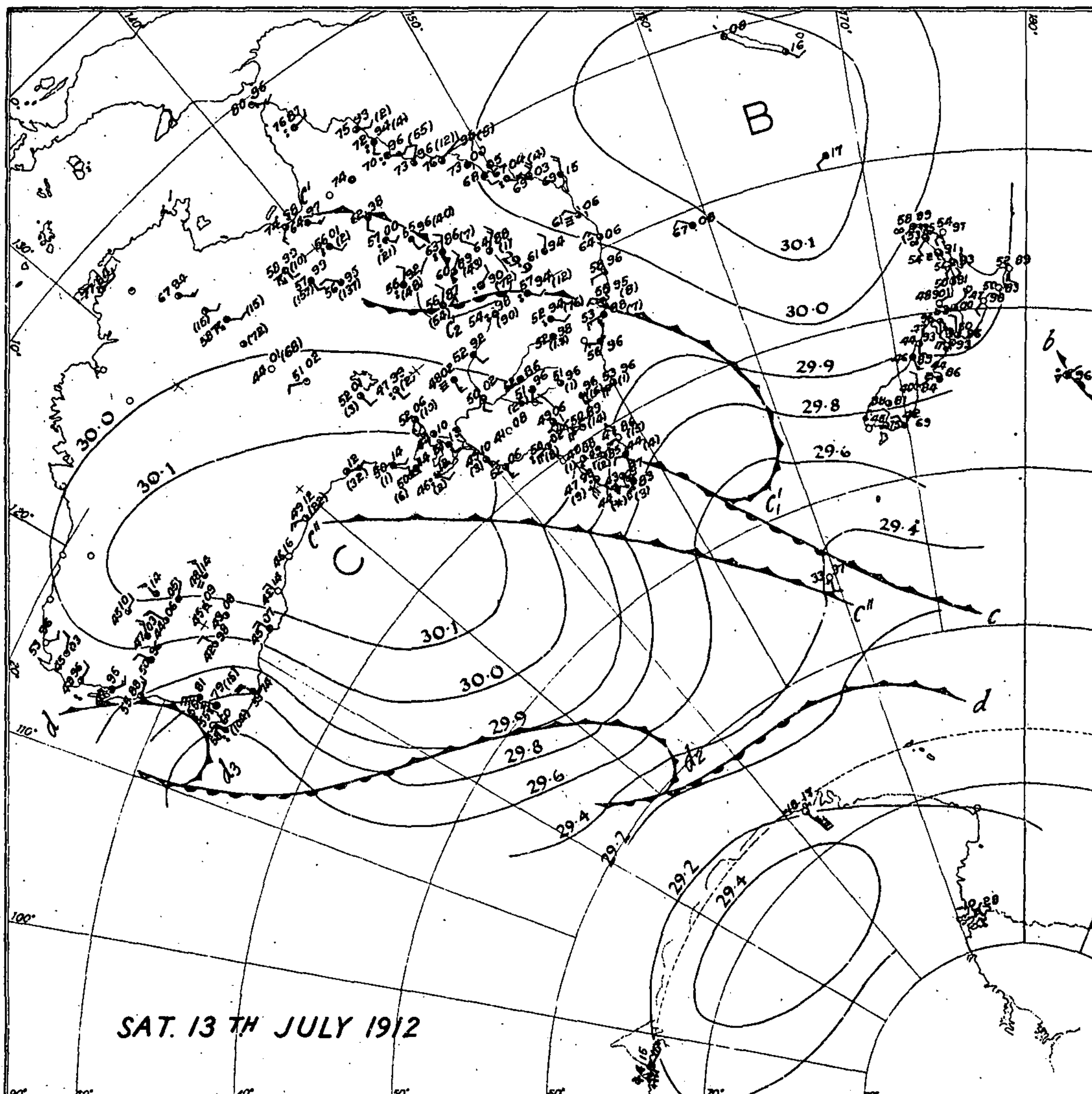
Cyclone a_4 is now west of the North Island of New Zealand. c_3 is still more extensive and is causing stormy weather.



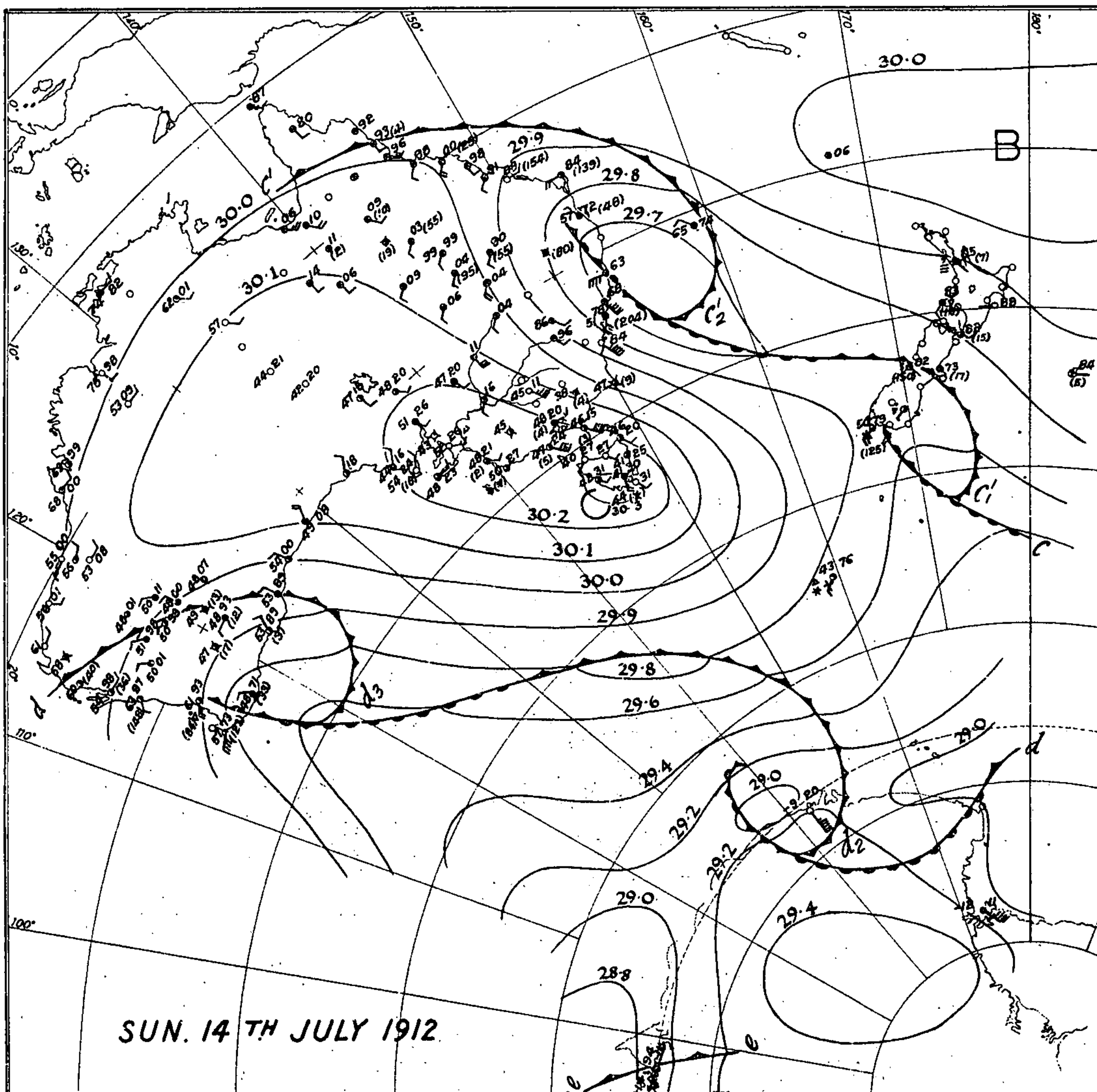
Wave b_3 is moving into the field of cyclone a_4 which lies over the central portion of New Zealand and has caused stormy weather and general heavy rain. Cyclone c_3 has passed its maximum development.



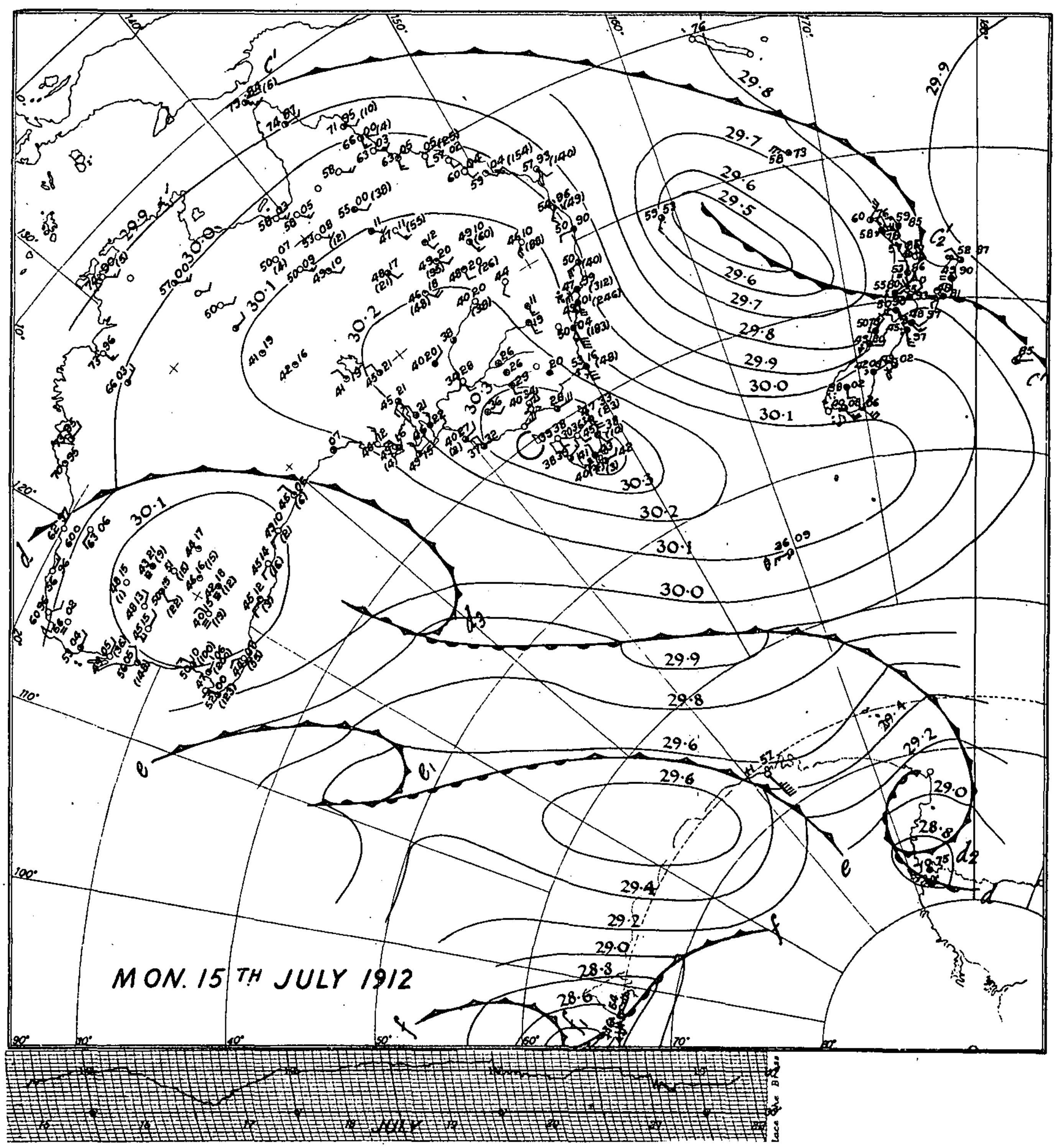
The New Zealand cyclone is now centred about the tip of the occlusion of b_3 and is beginning to fill up, as also is c_3. A sharp fall of temperature follows the passage of the latter at Macquarie Island. The northerly wind at Cape Evans is not explained; it is probably due to a depression centred to the south. A fresh cyclone is slowly approaching Queen Mary Land.



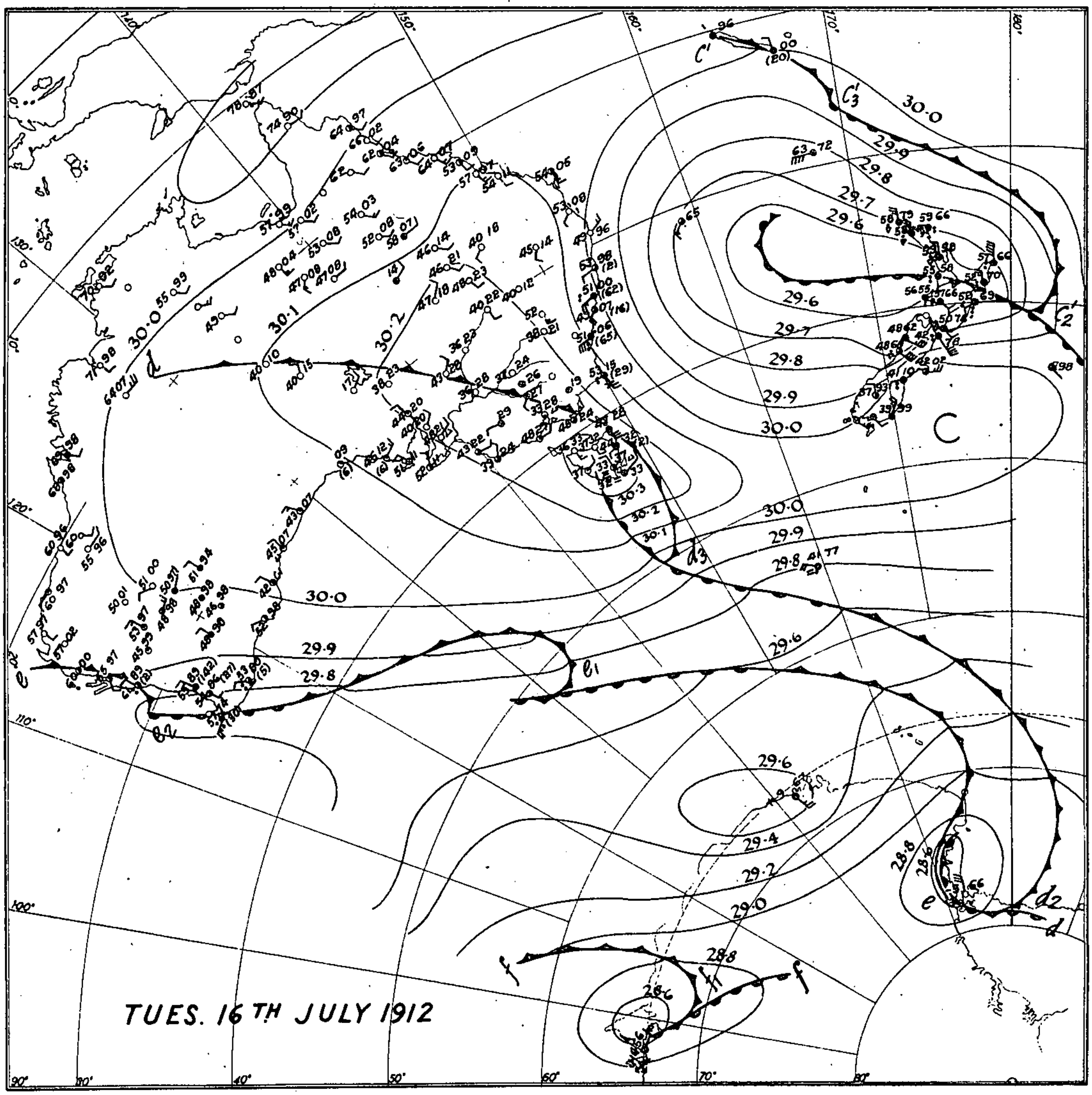
Stormy weather prevails at Queen Mary Land. Conditions are quieter in the Australia–New Zealand region but an active wave has developed in south-western Queensland. The temperature became very low at Macquarie Island following the passage of front c''.



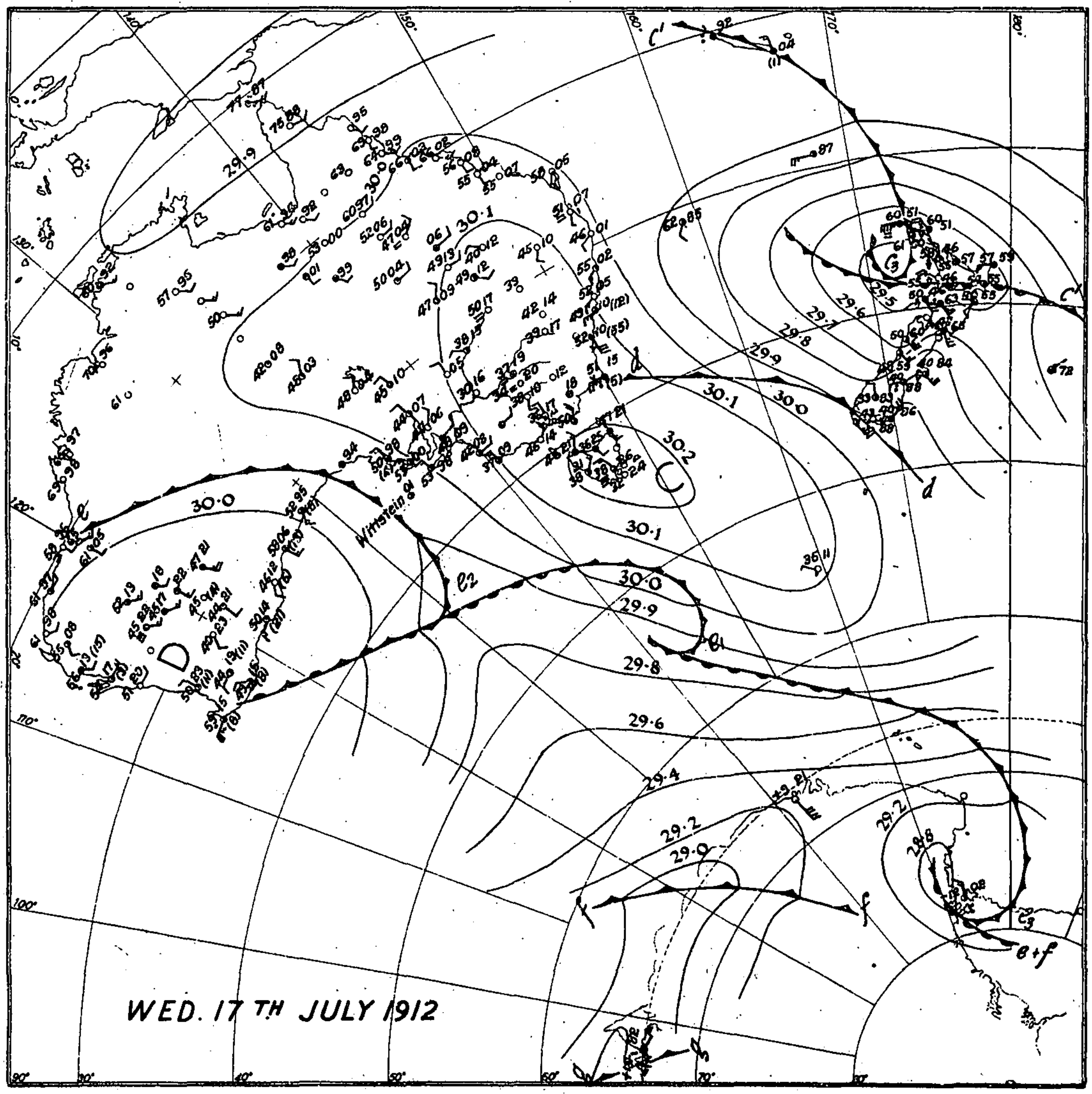
Wave c'_2 is becoming a fully developed cyclone. Its development may be due to a marked invasion of cold air into the tropics behind the New Zealand cyclone of the 11th and 12th. An extensive depression is located south of Western Australia. Cyclone d_2 appears to have come to Adélie Land on a southerly course.



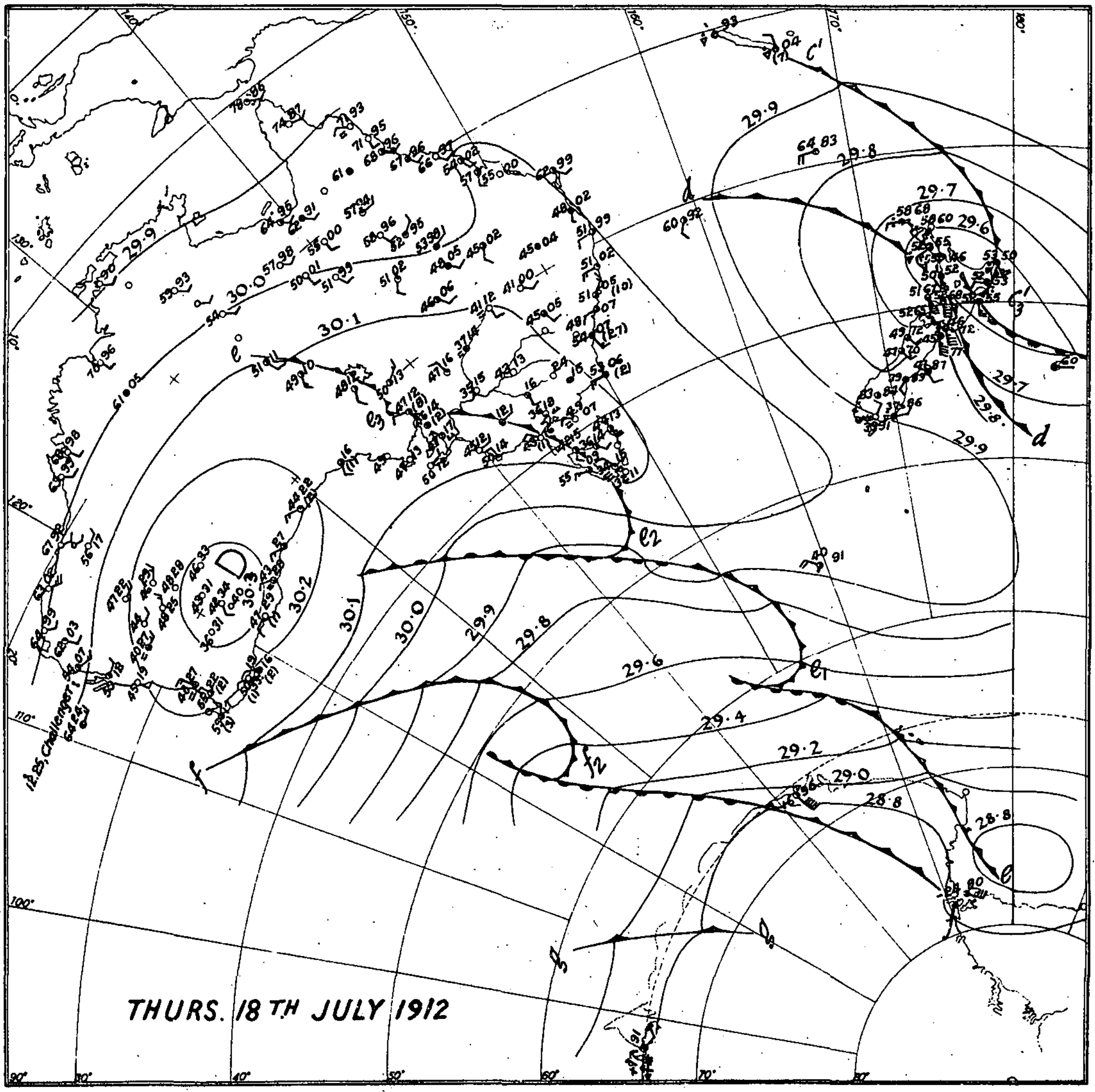
Cyclone c_2' has developed further. d_2 is now over Cape Evans; note the calm there. A new cyclone f_1 is approaching Queen Mary Land.



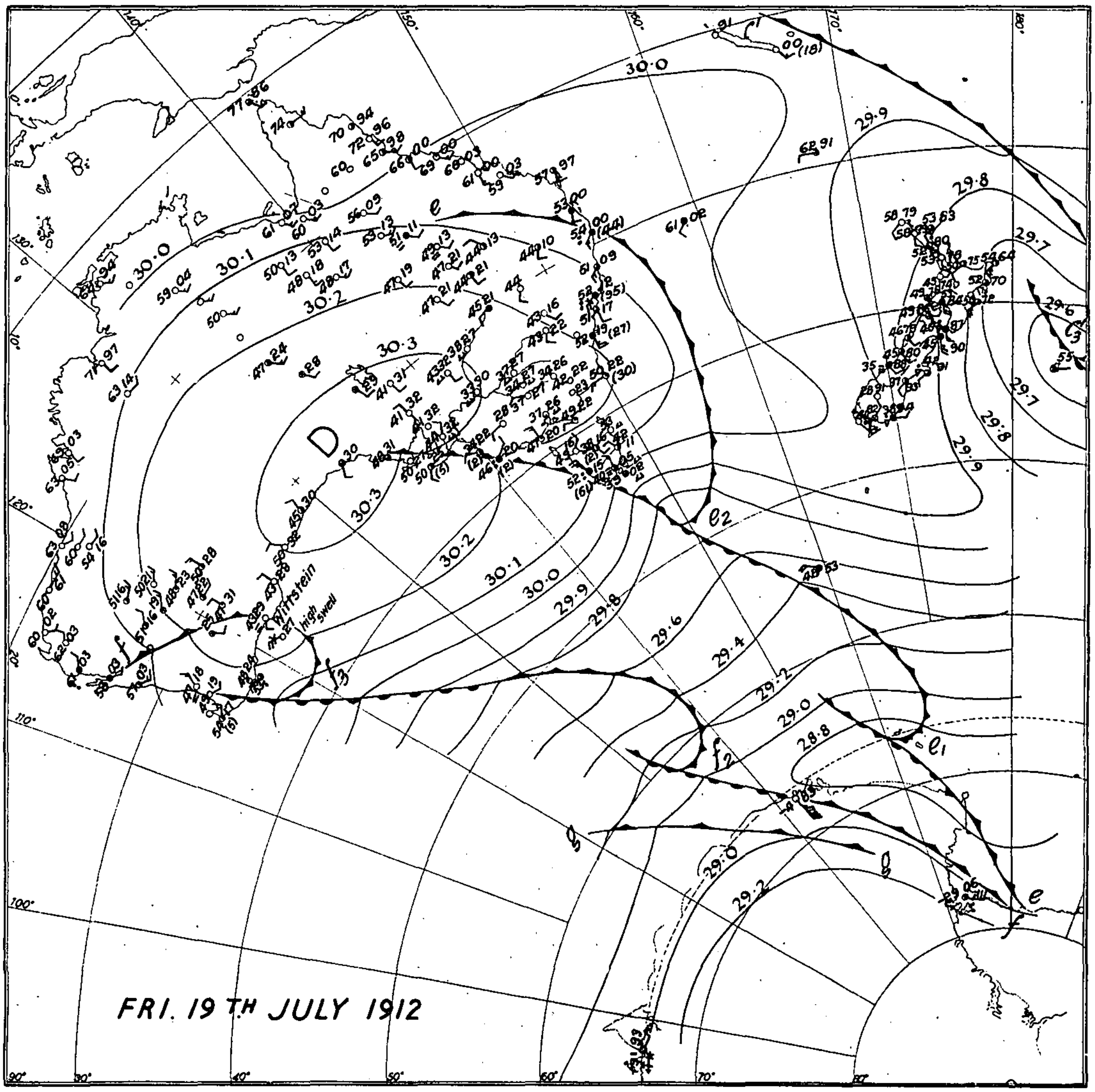
The occlusions of cyclones d_2 and f_1 are passing Cape Evans and Queen Mary Land respectively; note the north wind at the former and the light wind at the latter. Stormy weather and widespread rain were caused by the cyclone over New Zealand. Anticyclone C is passing round the south side of cyclone c'_2.



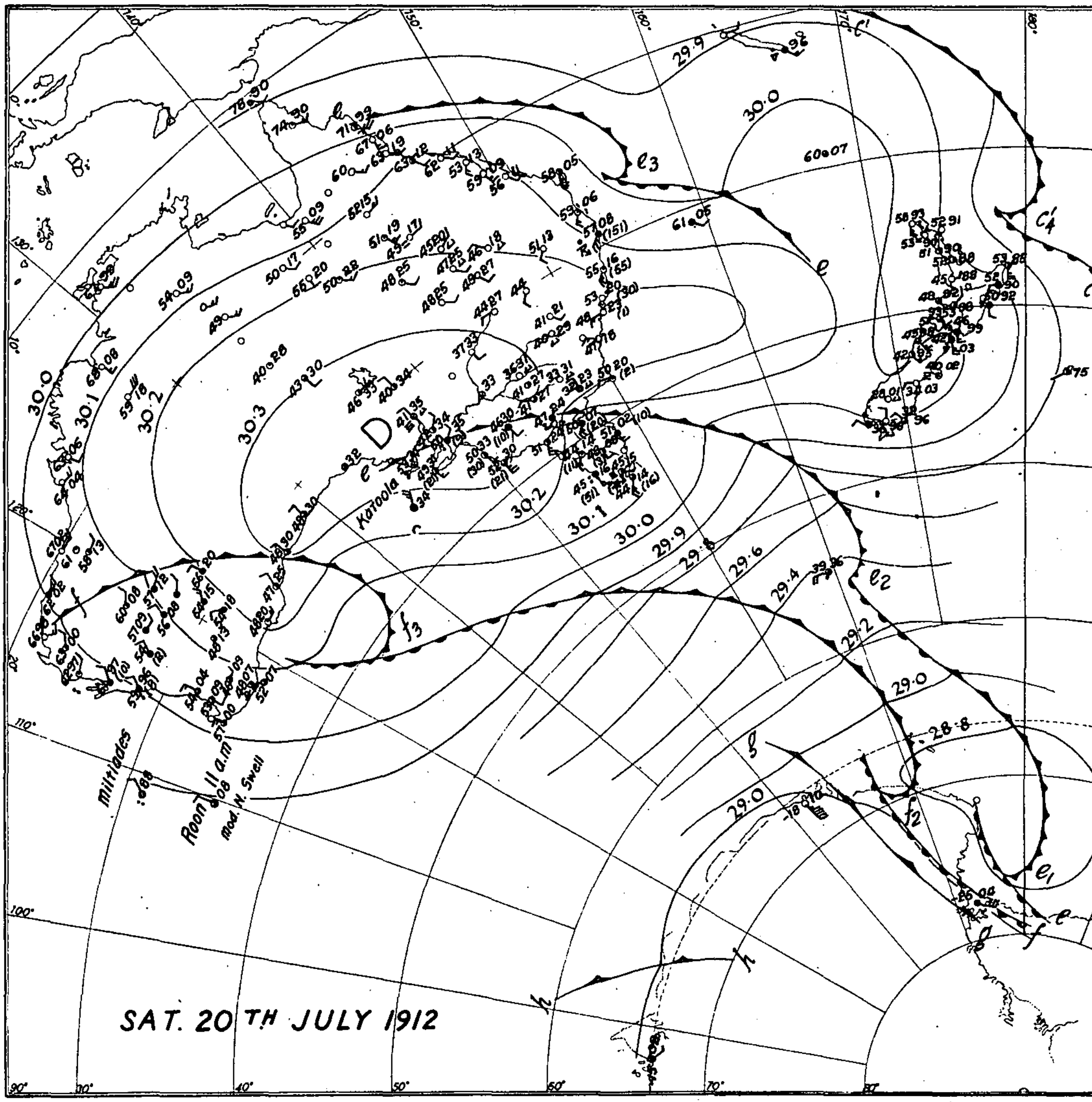
Note the development over New Zealand where the cyclone is now, however, filling up. There is still a cyclone over Cape Evans: fronts d, e and f appear to have been absorbed into this central cyclone in the Ross Sea region.



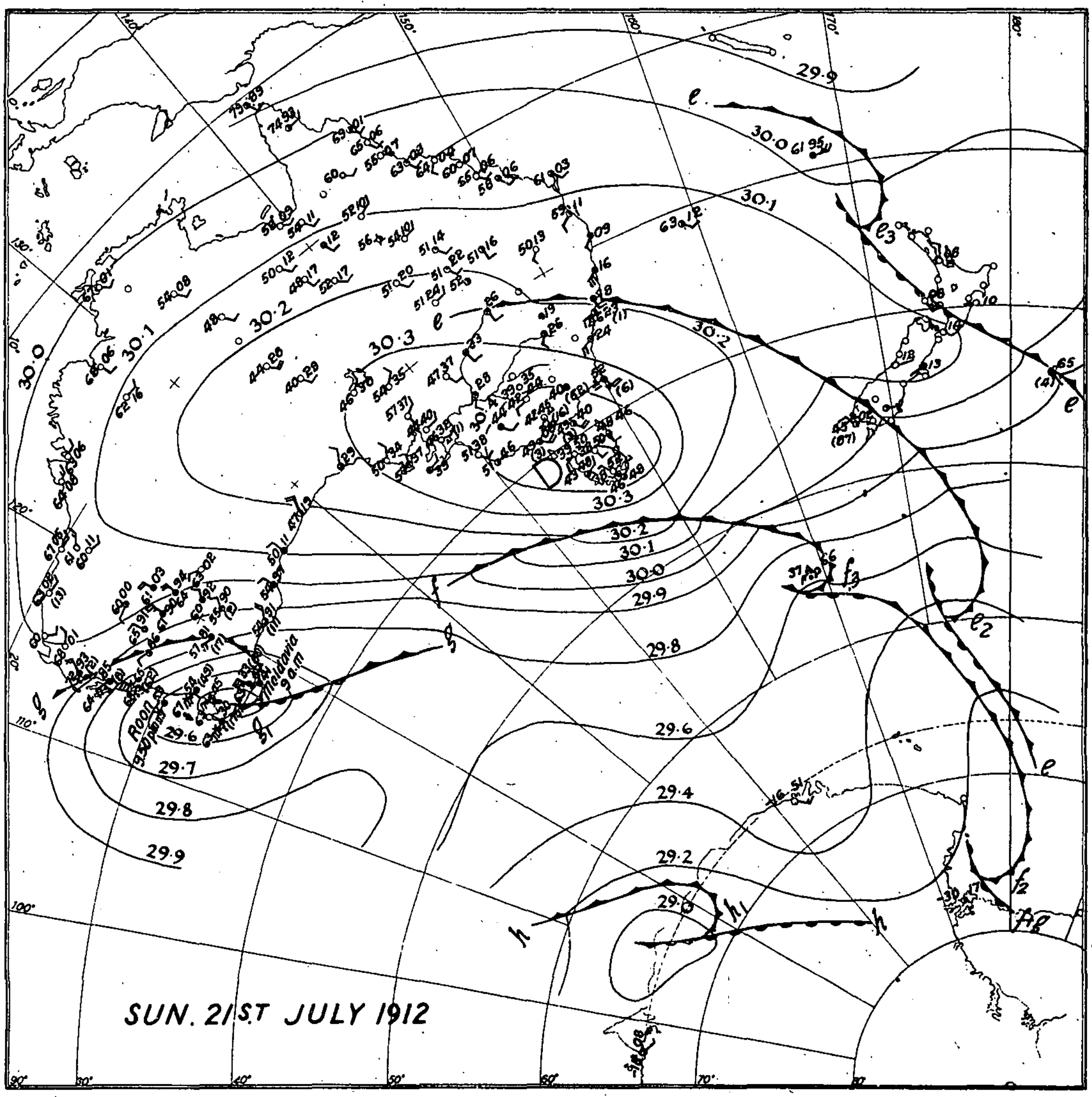
The cyclones are now passing away from both New Zealand and Cape Evans.



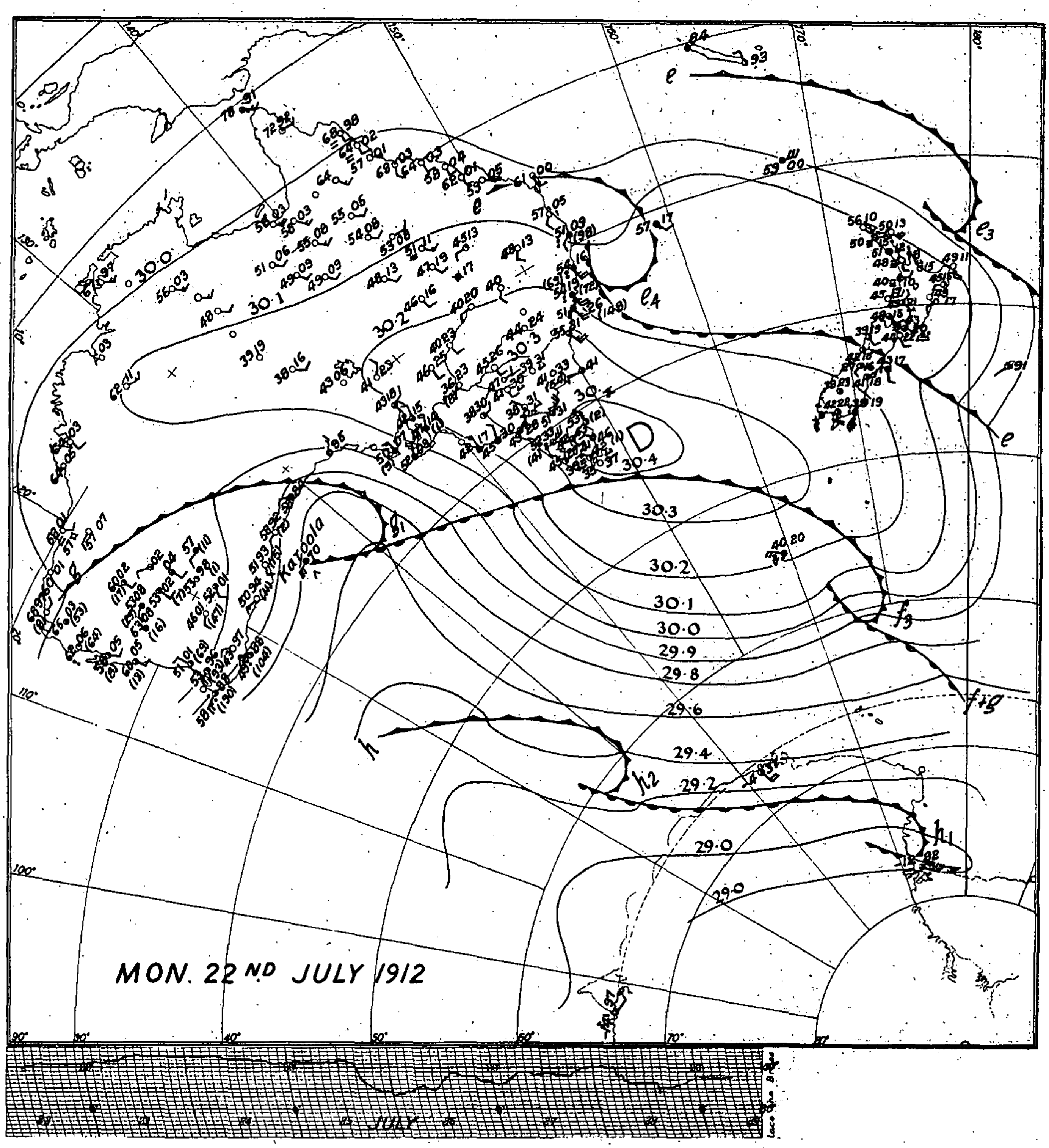
Fronts still appear to be circling round a central depression in the Ross Sea area. Front *e* was a sharp one as it crossed Macquarie Island.



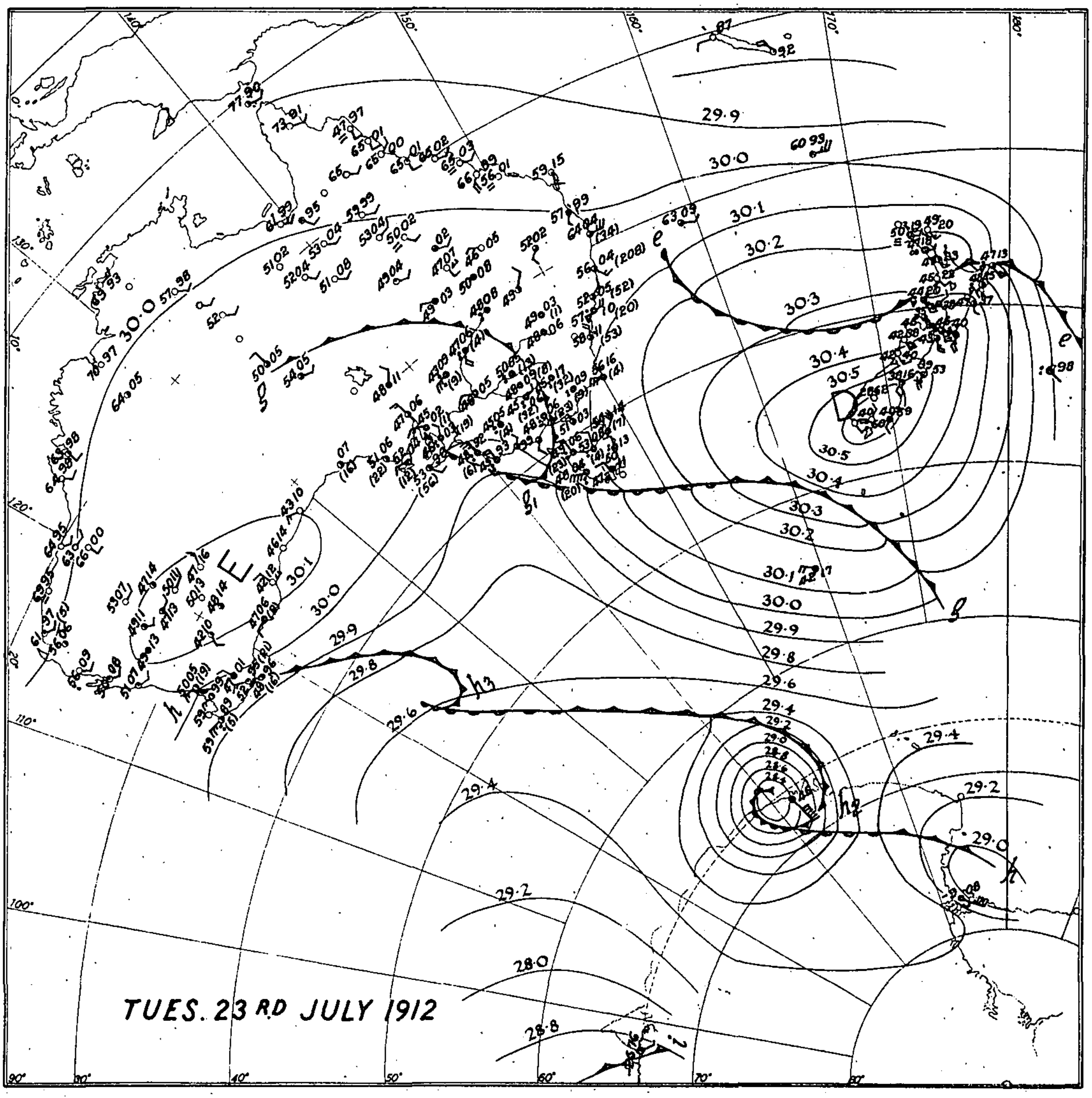
Front *e* is becoming divided, the cold front of e_2 disappearing while the occlusion is developing into a new cold front.



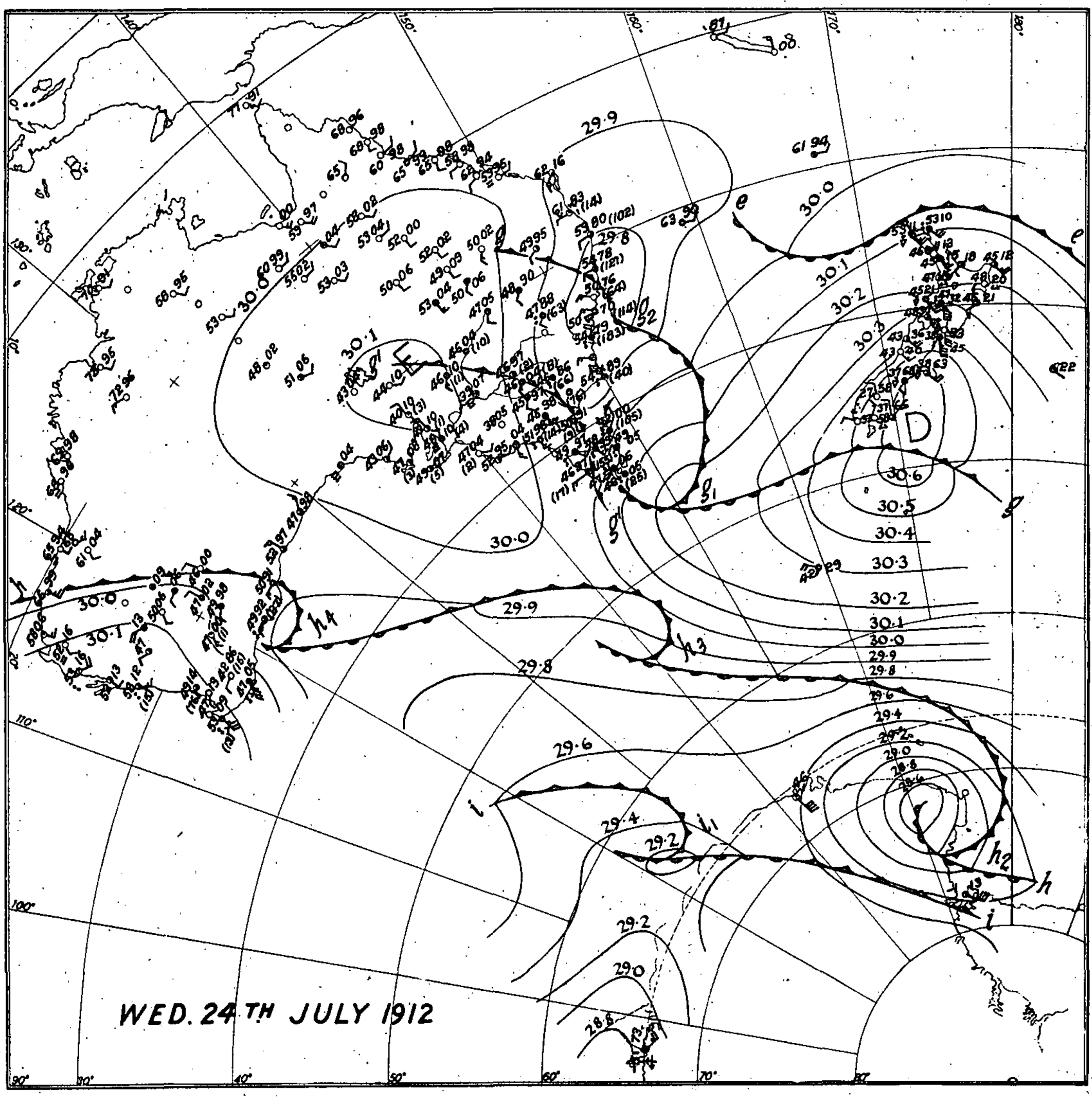
Note the temperature record at Macquarie Island on this and the preceding day. Anticyclone D has intensified. A cyclone is centred near Western Australia. There is a very interesting weather sequence during the succeeding week.



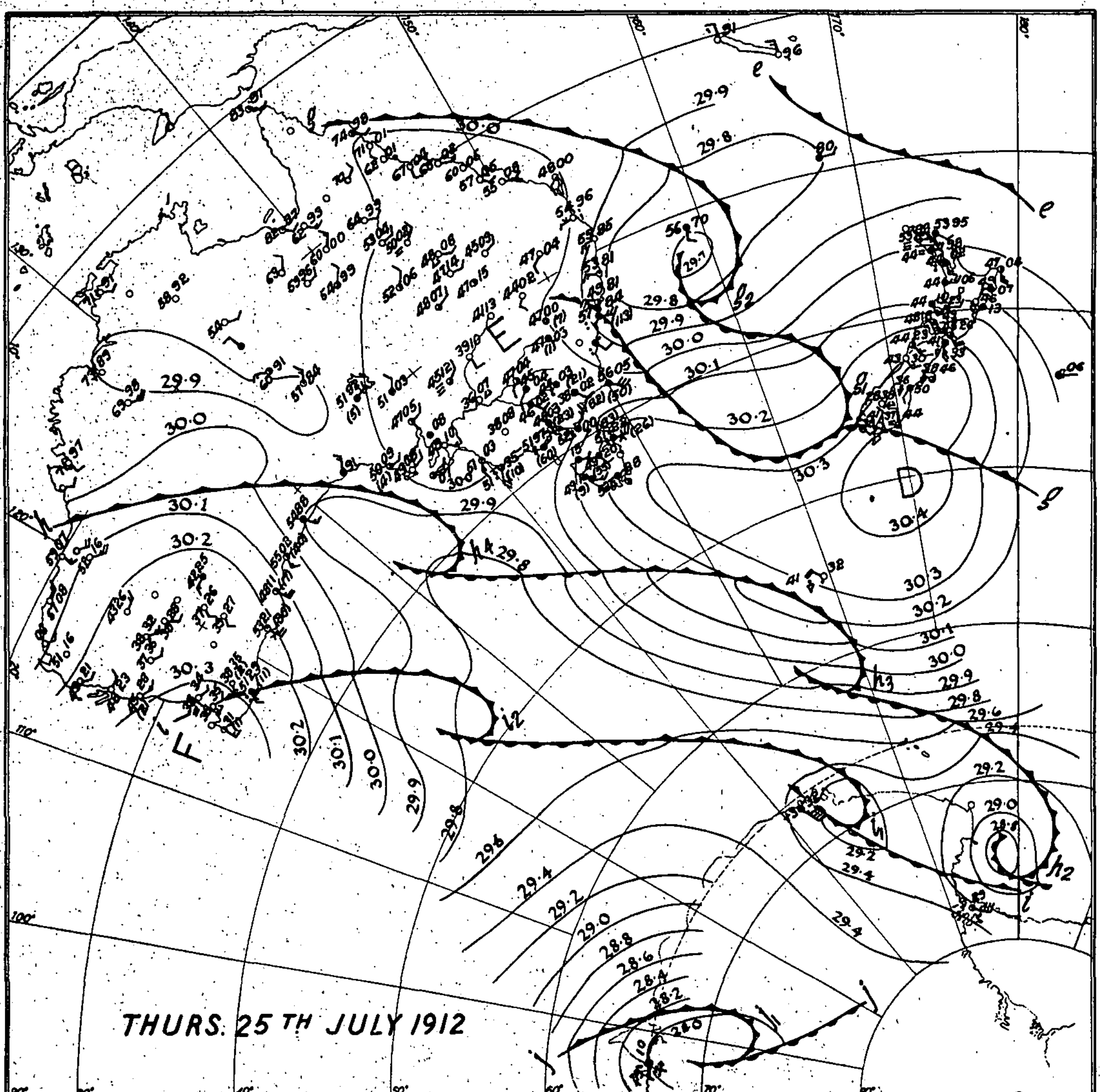
A cyclone is forming off the New South Wales coast but the cold air in rear was not coming very directly from the south and the cyclone did not become very deep. g_1 is still an active depression. Note the very high pressure at Macquarie Island.



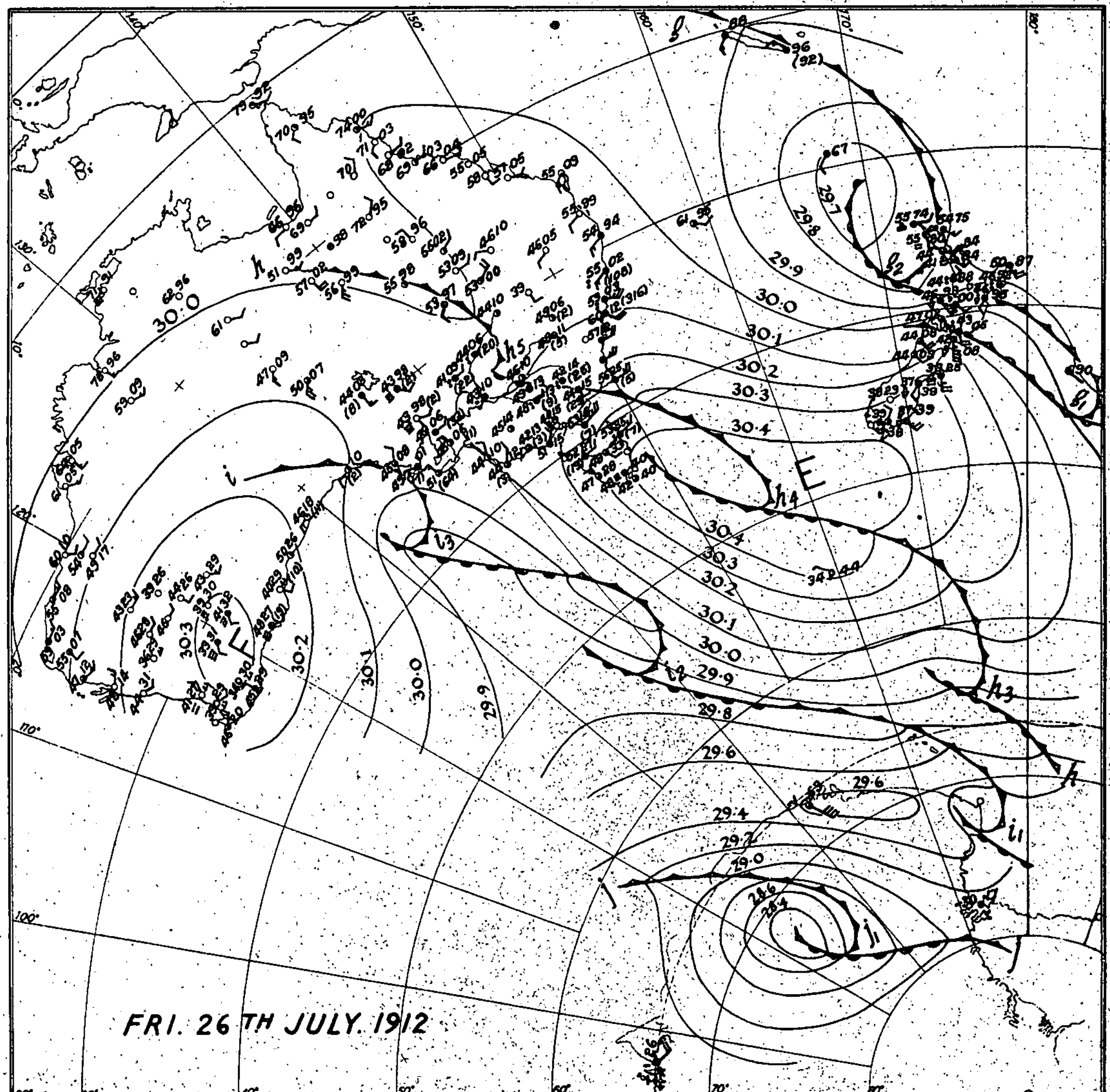
A deep cyclone is passing Adélie Land. Anticyclone D is very intense. Note the widespread rain over south-eastern Australia where there is evidence of marked convergence.



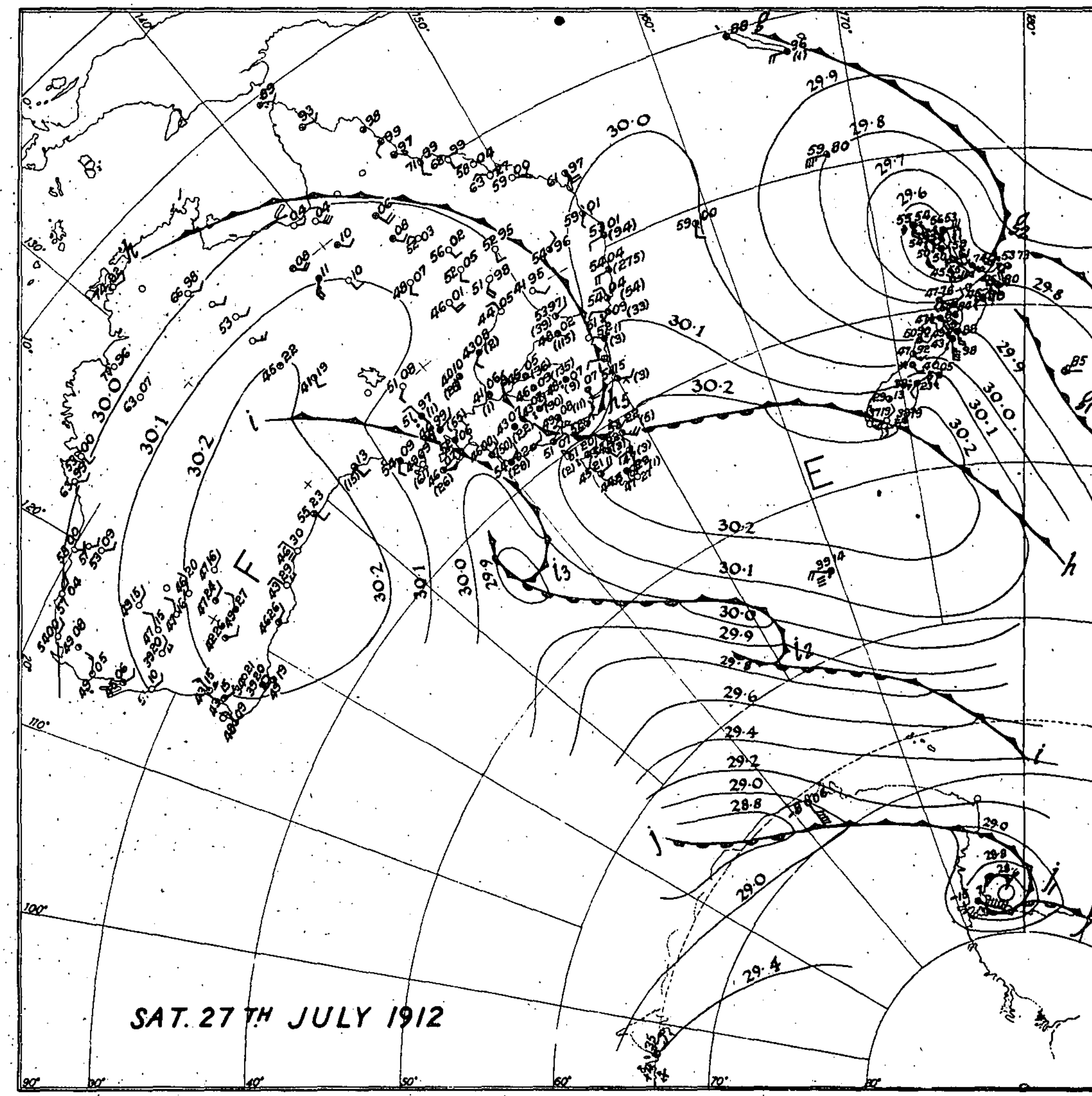
Strong southerly gales are blowing in central New Zealand. There is considerable activity to the north and also over the western Tasman Sea. Note the rain with very high pressure over New Zealand.



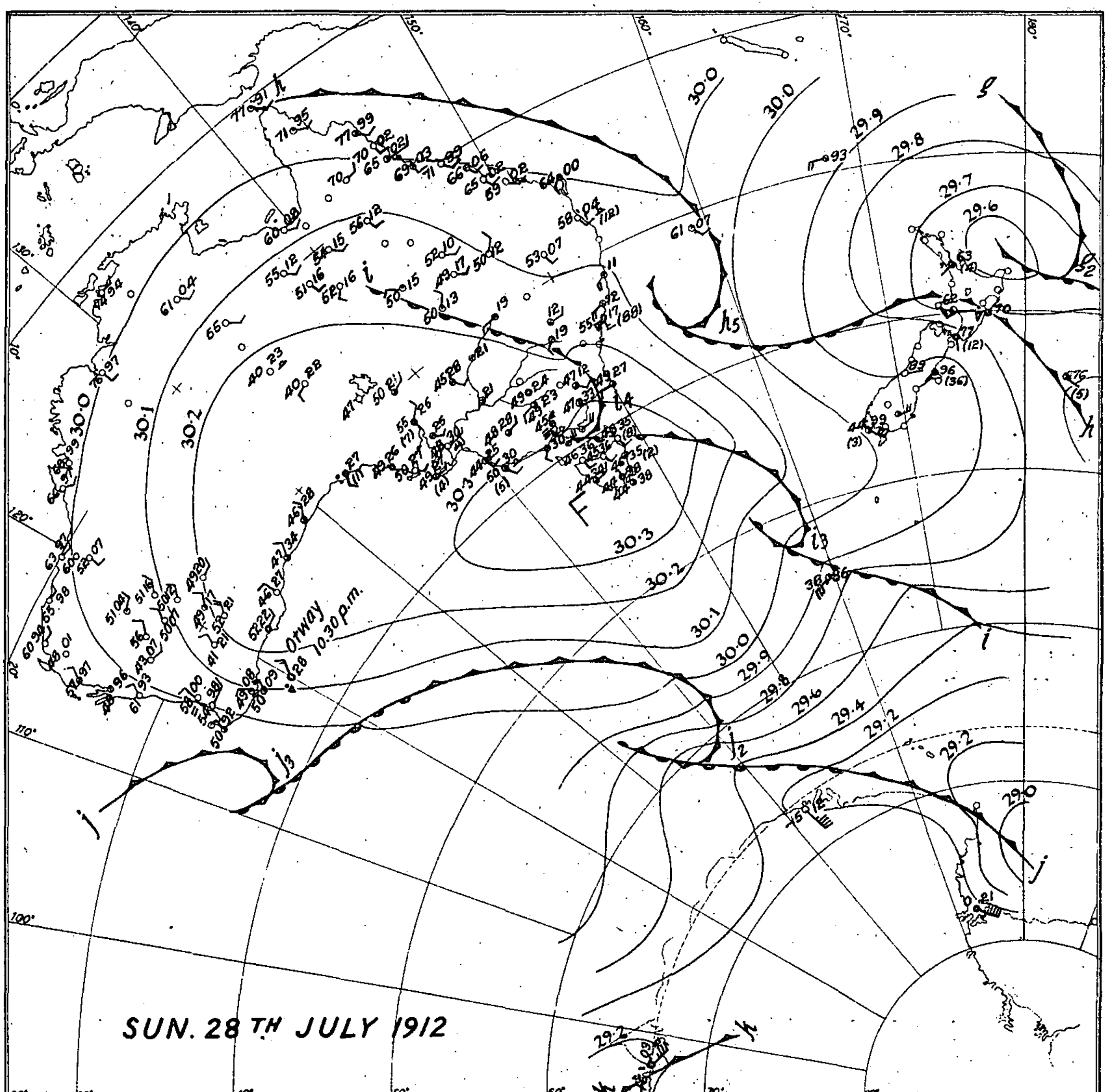
Great activity persists on the northern side of Anticyclone D. There is a shallow cyclone in the north Tasman Sea. Part of Anticyclone D has probably passed eastward. A marked fall of temperature followed the passage of front *h* at Macquarie Island.



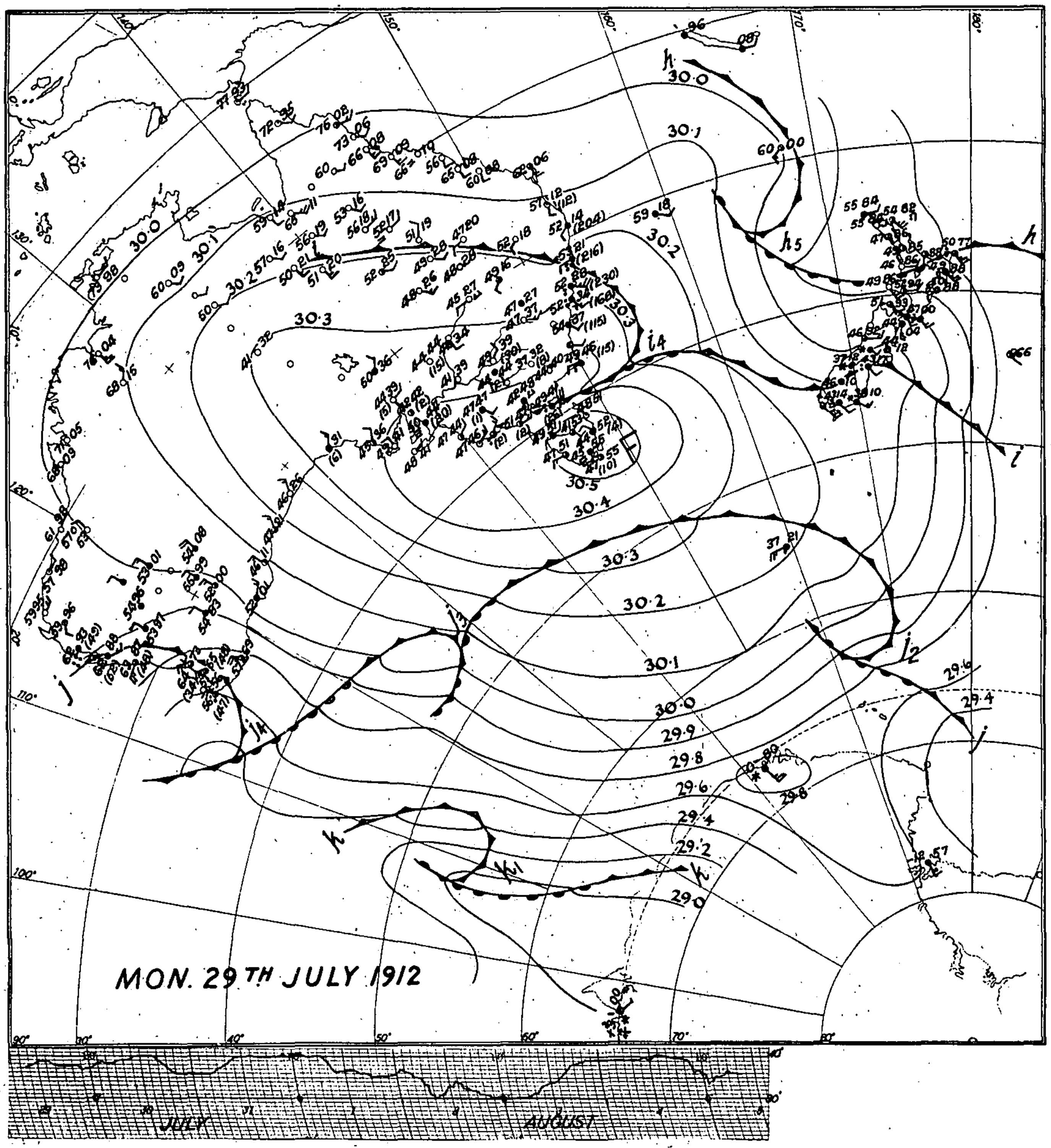
Note the very high pressure at Macquarie Island. Cyclone g_3 is now moving on to northern New Zealand. There is a calm at Cape Evans due to the approach of cyclone j_1.



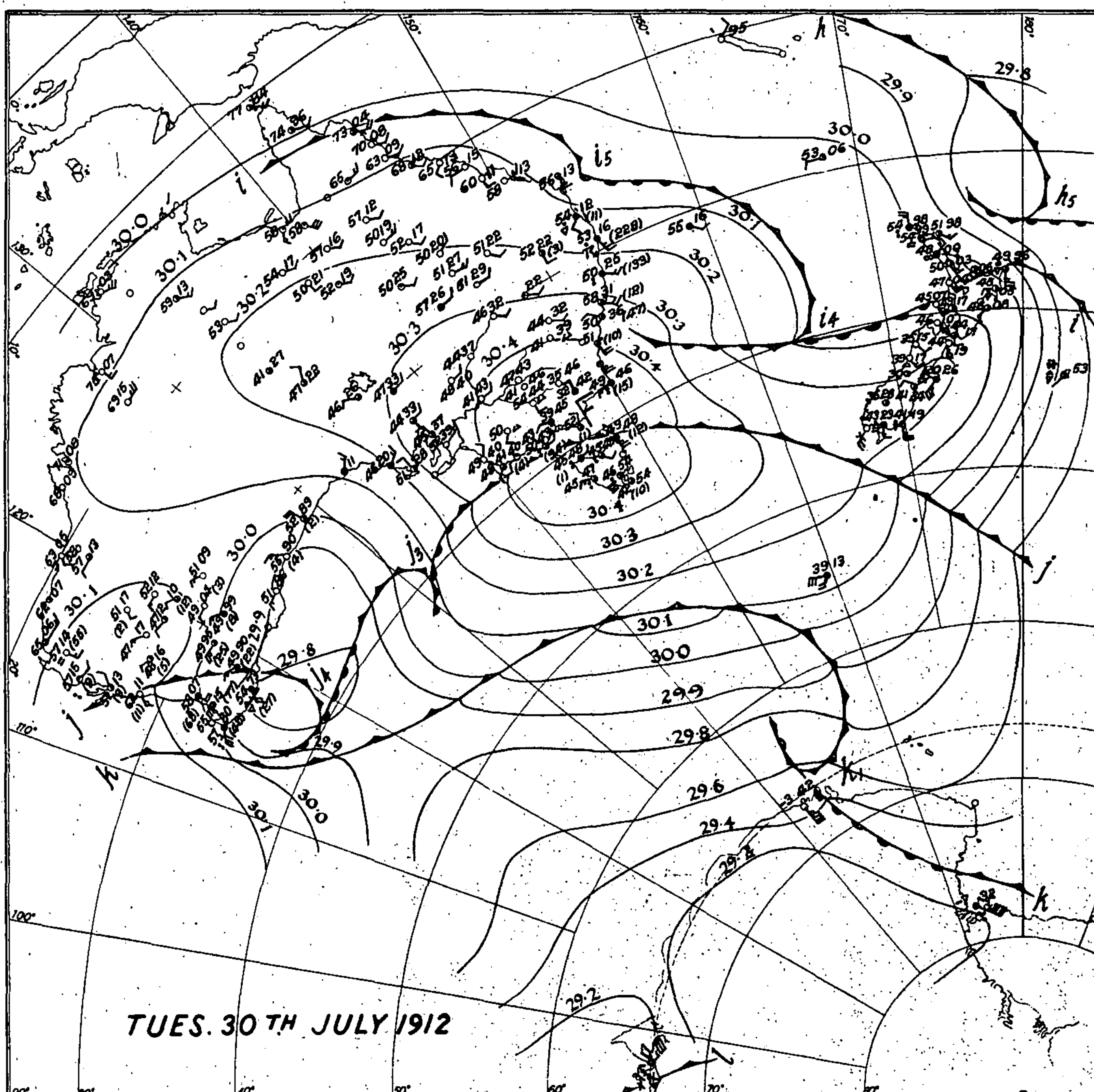
A cyclone has just passed Cape Evans and a severe blizzard is blowing after a strong northerly wind earlier in the morning. The cyclone in northern New Zealand has deepened.



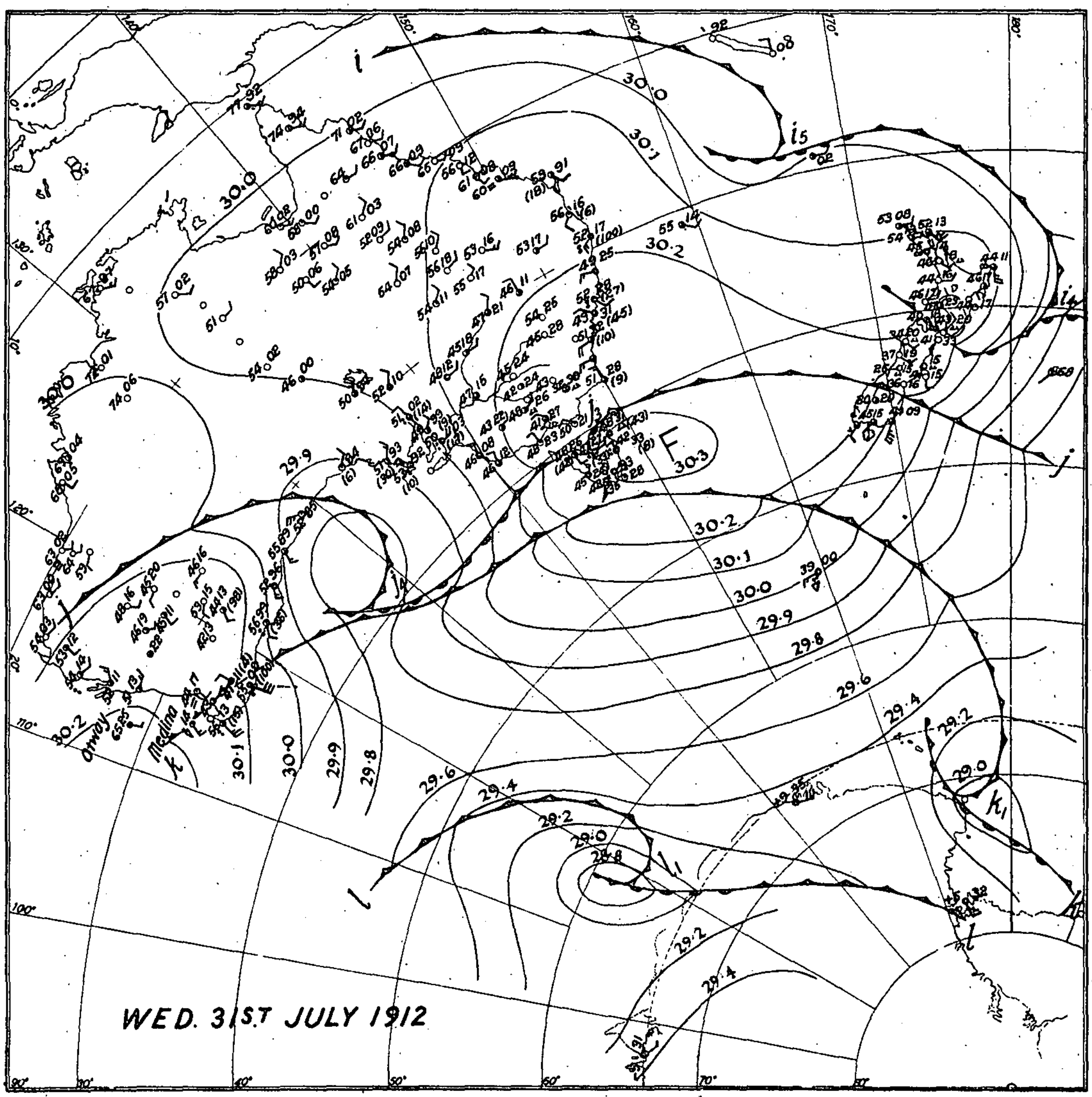
A blizzard is still blowing at Cape Evans. Note, also, the high wind at Queen Mary Land. Cyclone g_2 is moving off New Zealand.



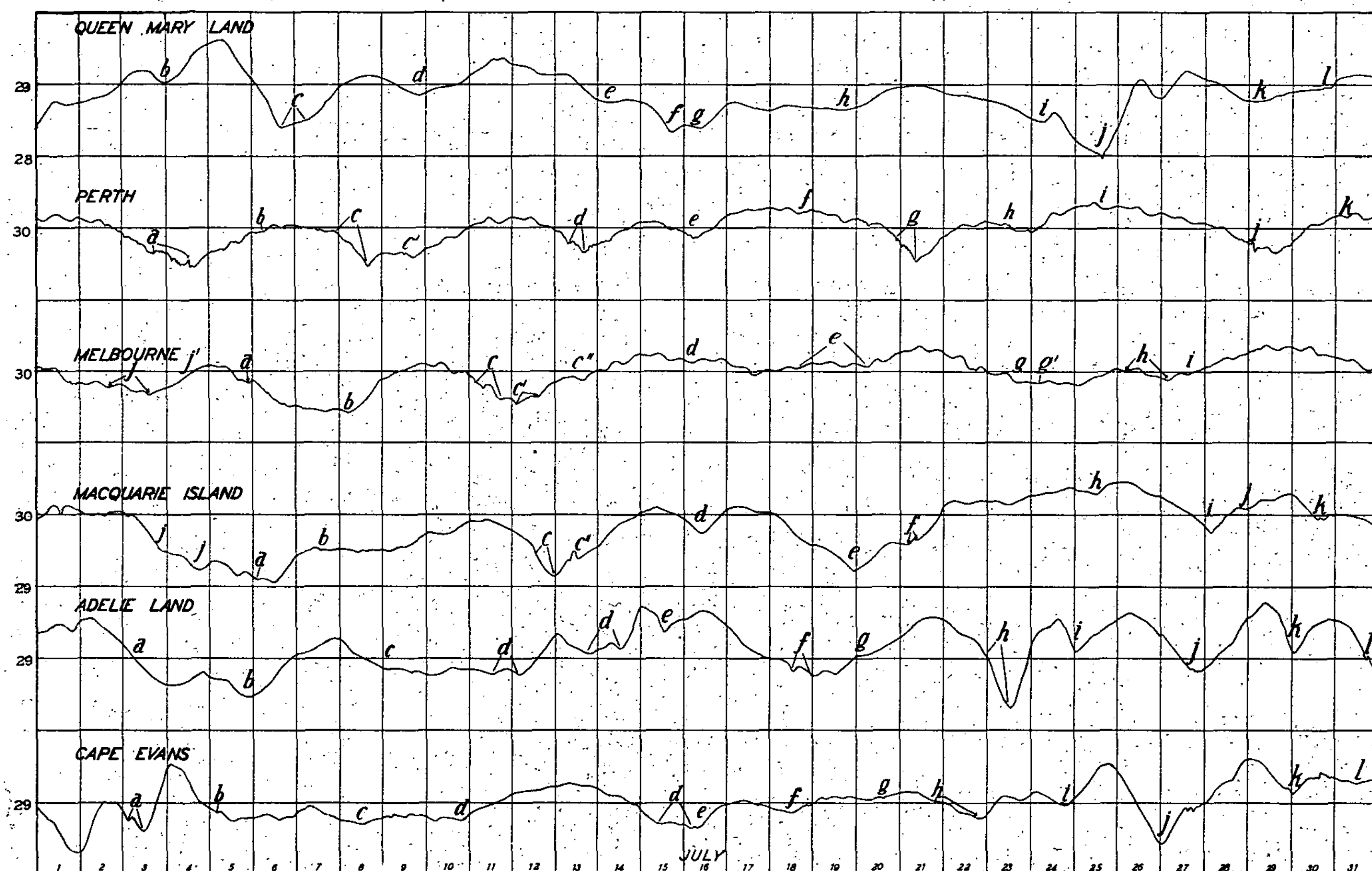
Anticyclone F has become intense.



Note the blizzards at Cape Evans and Queen Mary Land.



Pressure is high in the Antarctic. Front *i* is an active one.


QUEEN MARY LAND
PERTH
MELBOURNE
MACQUARIE ISLAND
ADELIE LAND
CAPE EVANS
JULY
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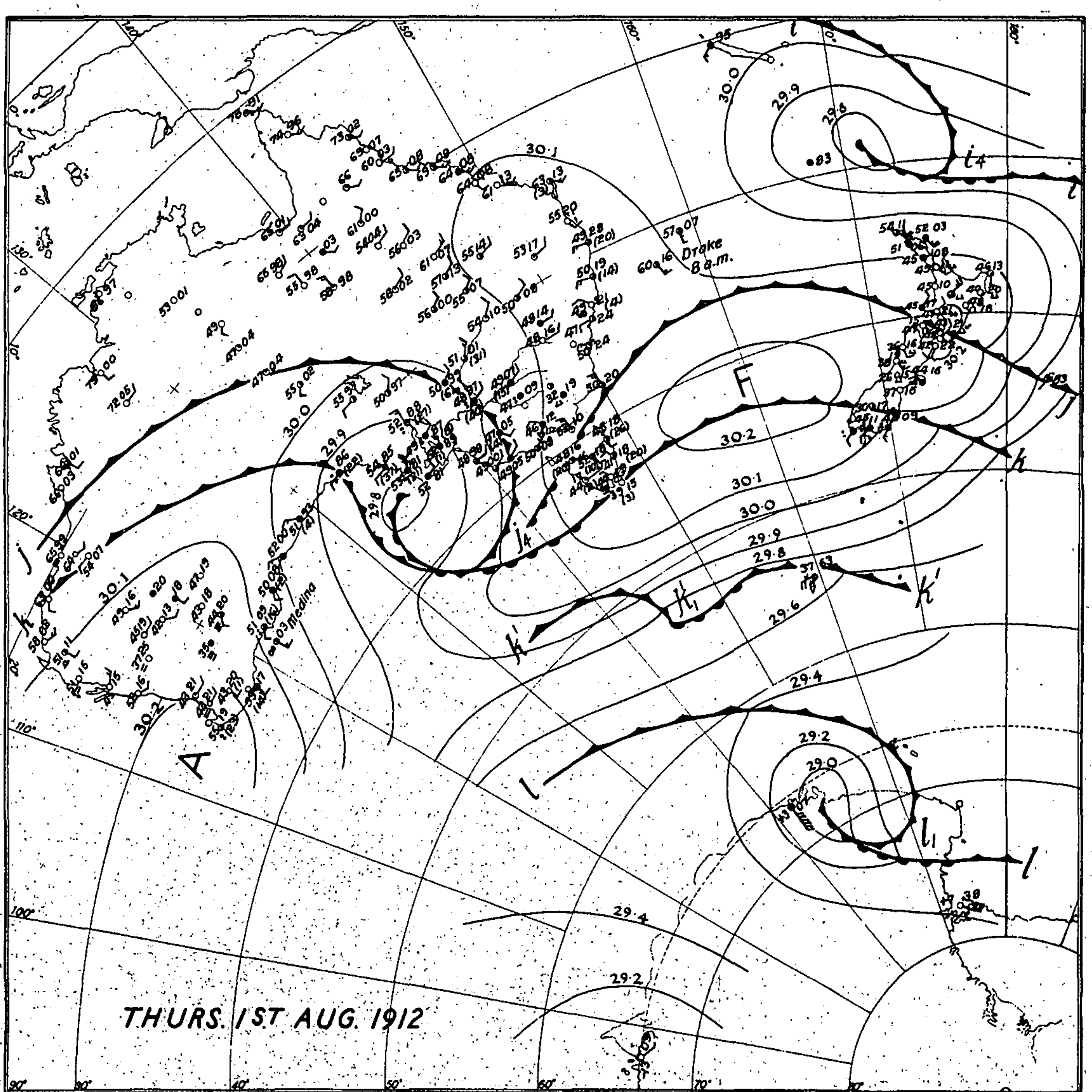
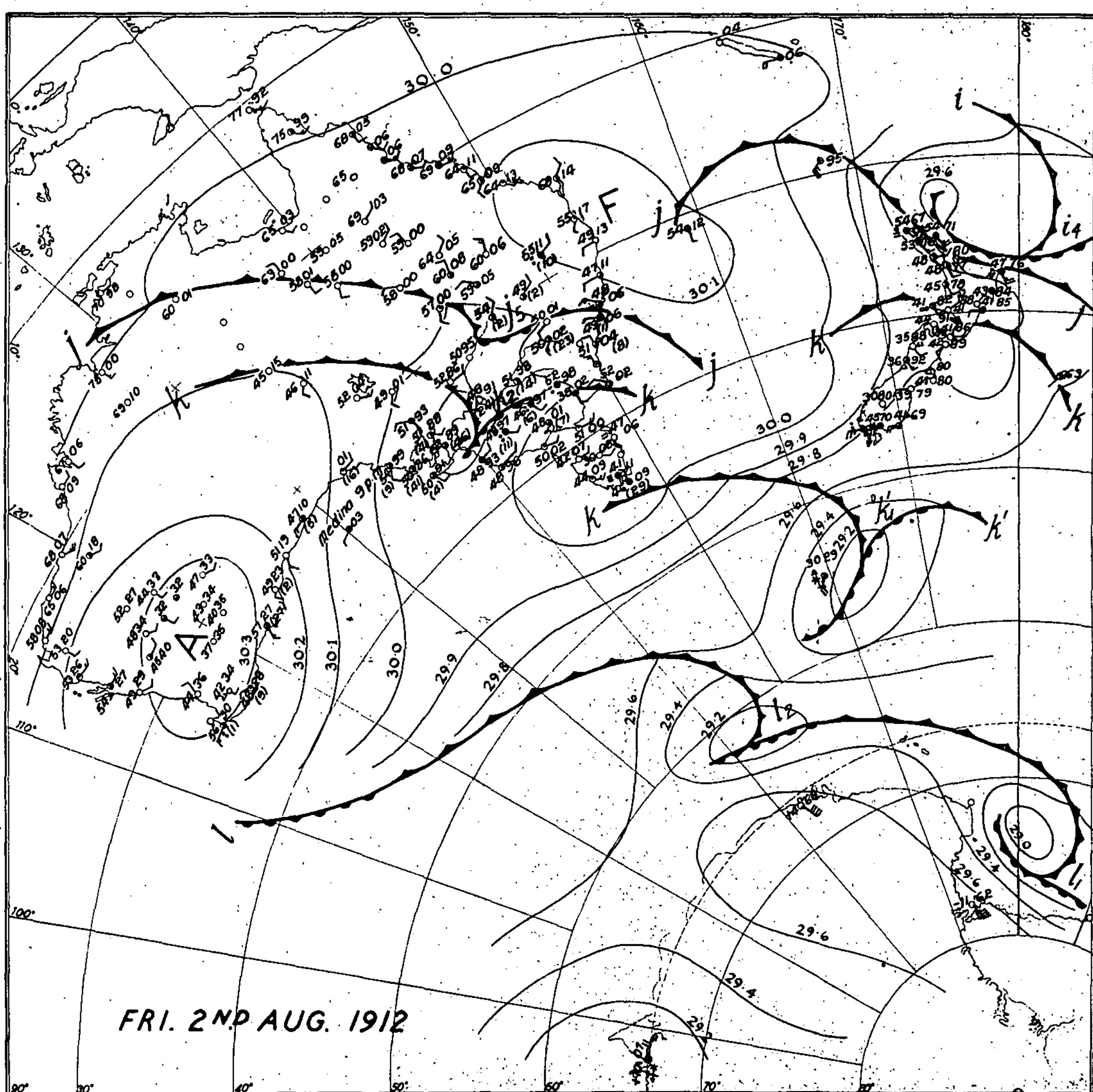
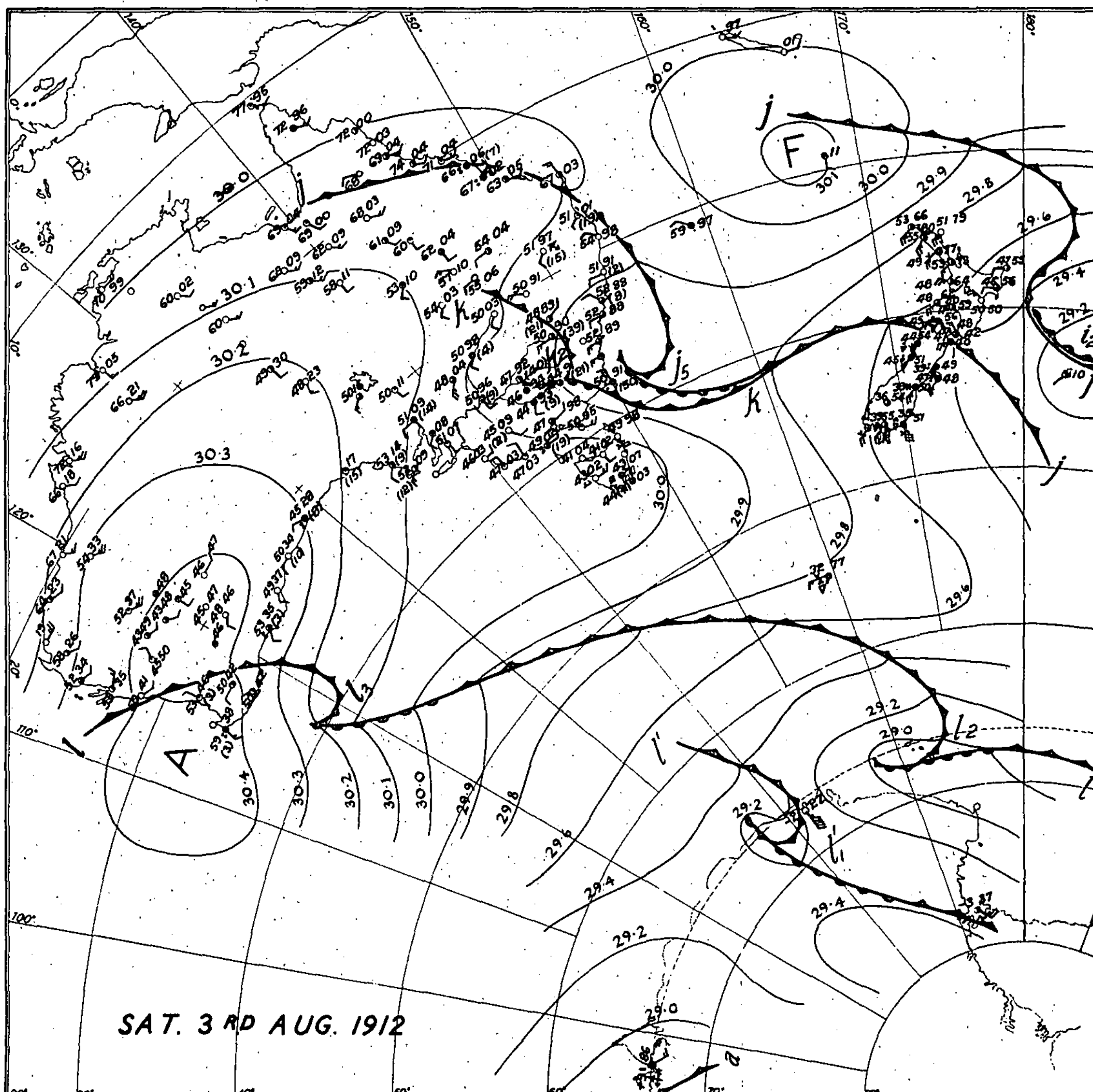
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31



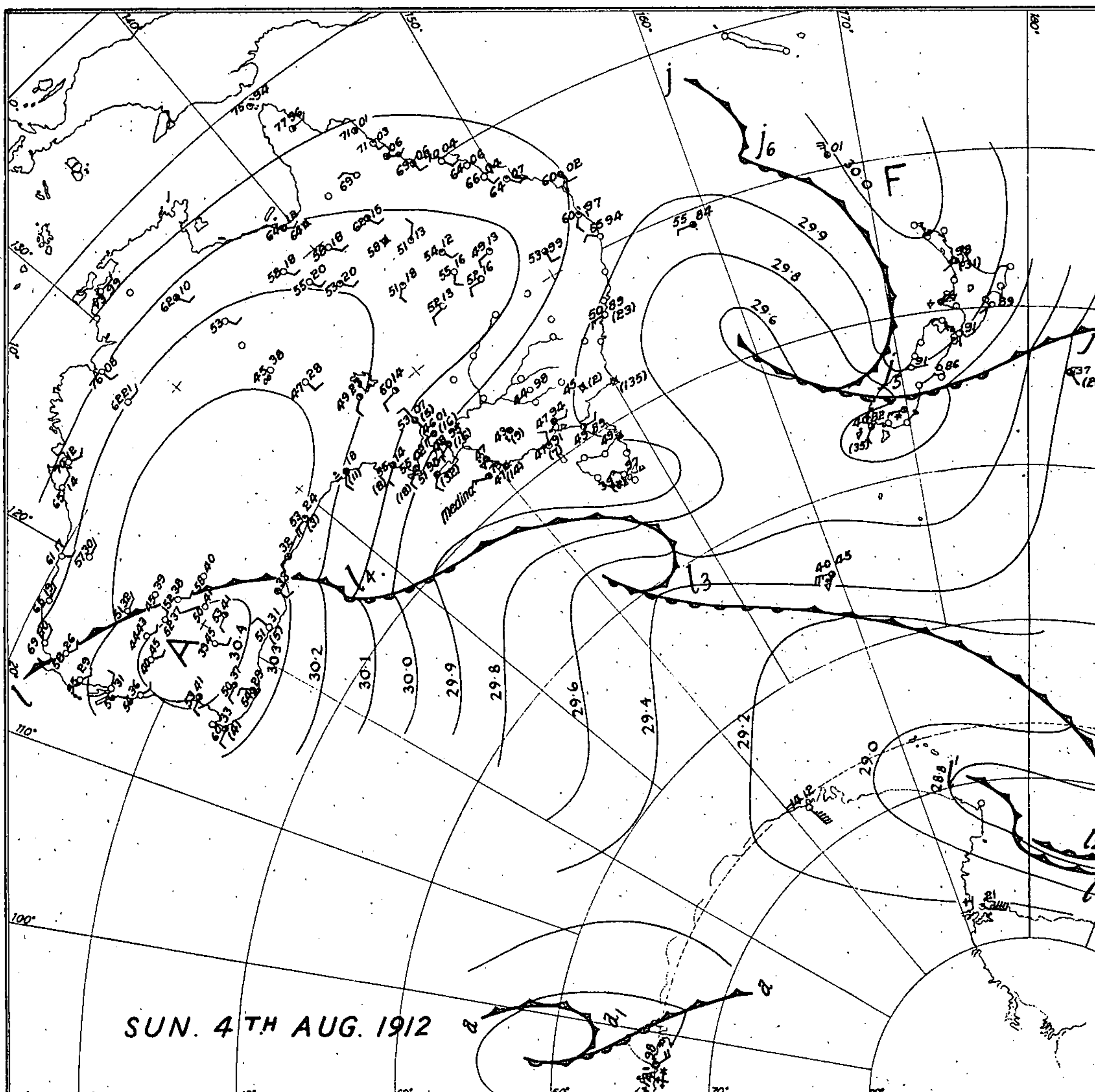
Note the large number of fronts which have crossed anticyclone F. There is a shallow cyclone south of South Australia. At Adélie Land and Cape Evans there are blizzards.



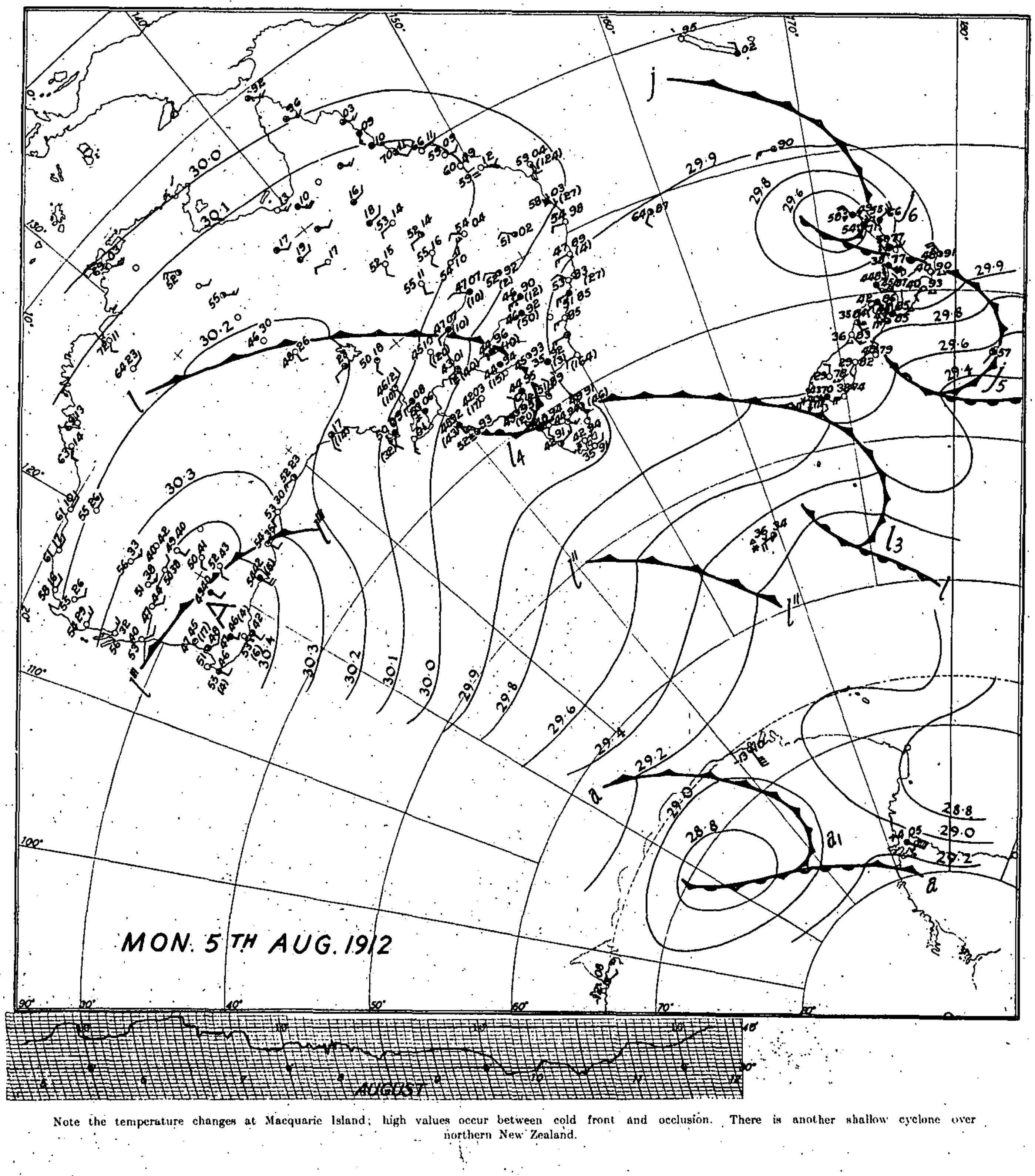
Analysis very difficult and continues so for the next week. The temperature is low at Macquarie Island. Pressure is falling over northern New Zealand about cyclone i_4.



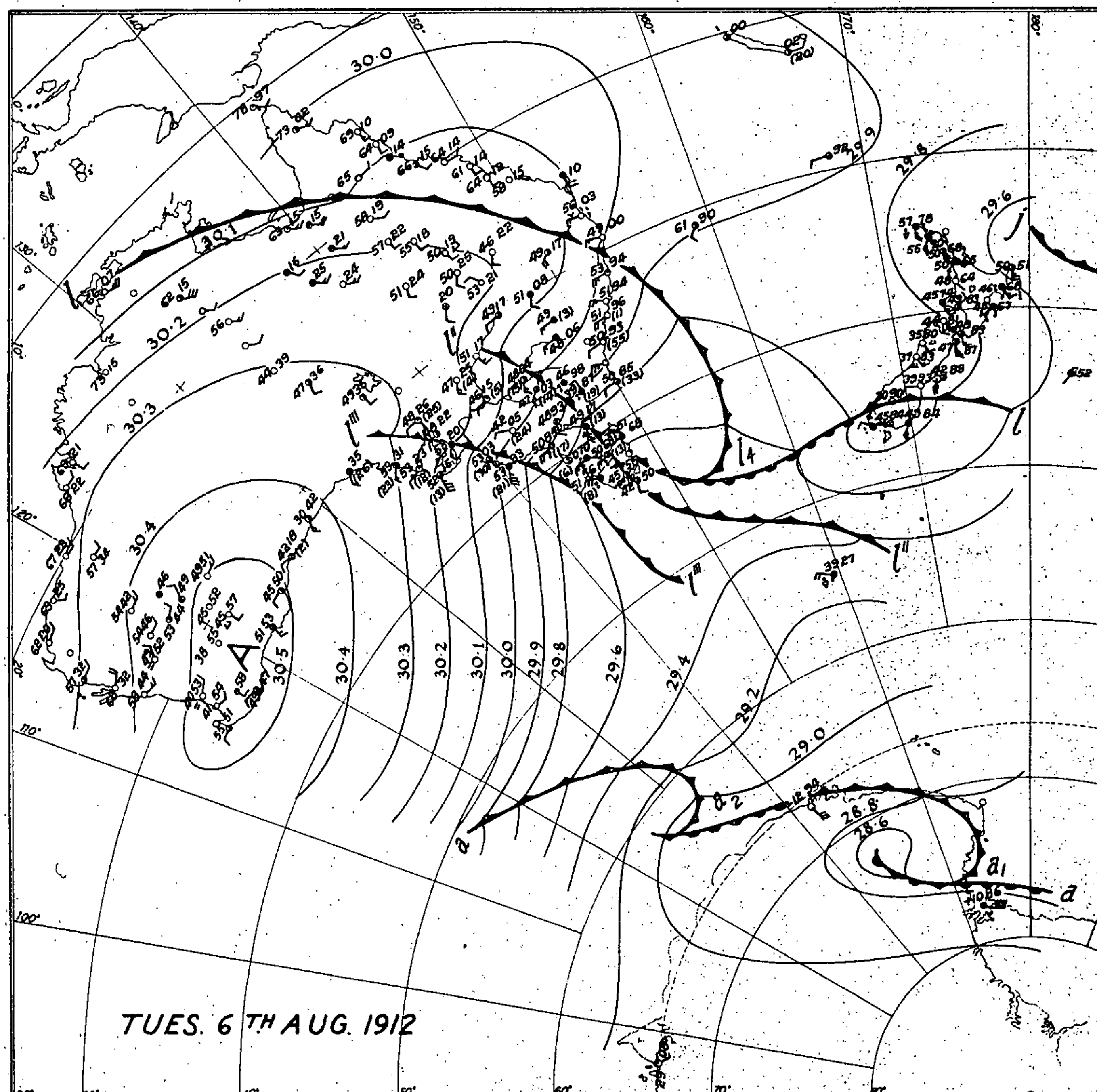
Several fronts have become divided or have disappeared in the eastern Australia to New Zealand area. There have been persistent easterly winds in low latitudes. Note the pressure changes at Adélie Land and wind and weather changes there and at Cape Evans during the next 24 hours. There is widespread snow in the South Island of New Zealand.



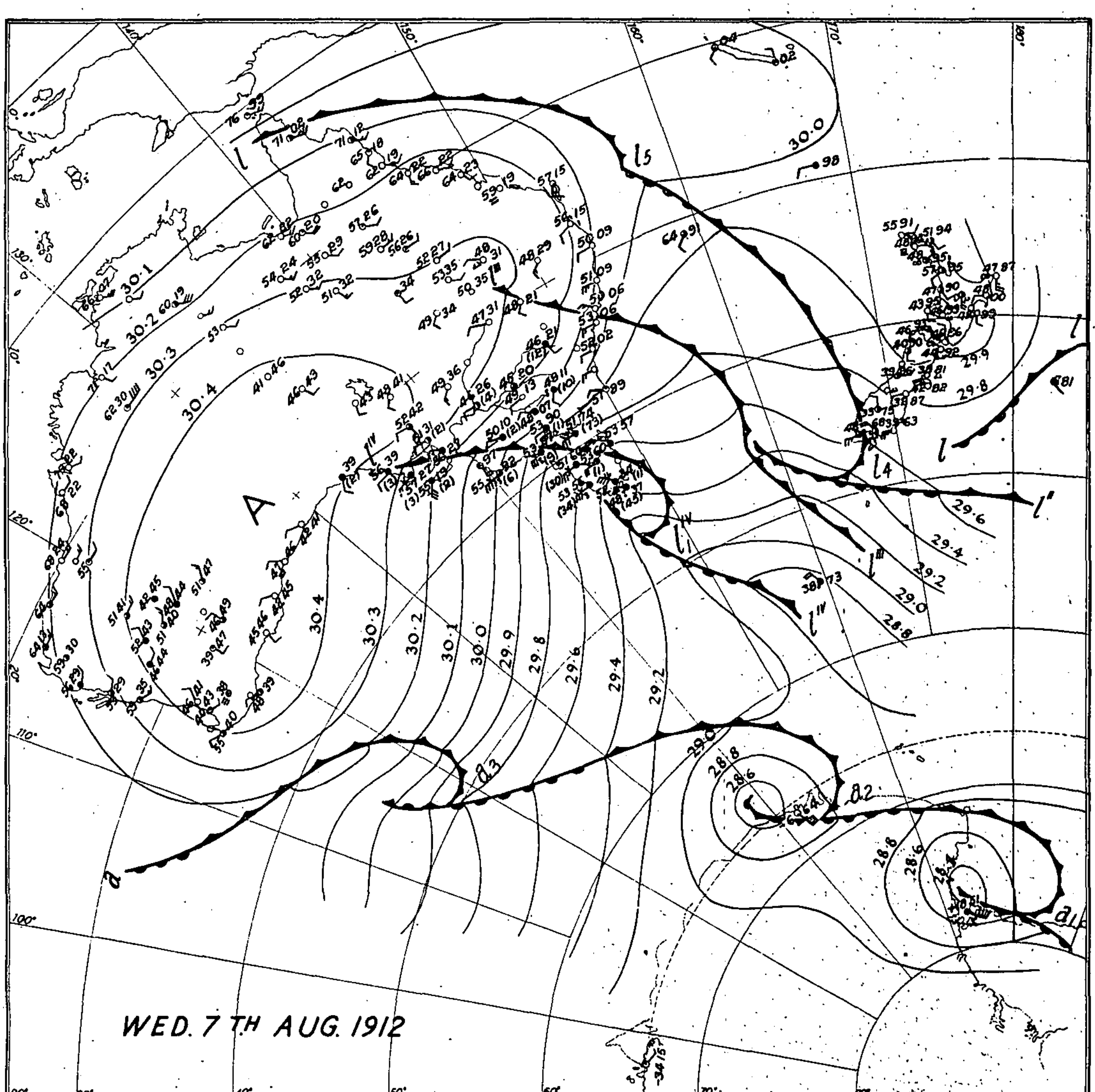
There is a blizzard at Cape Evans following the passage of front l^I and the approach of the occlusion of wave l_2. Front j is active and snow is again falling in southern New Zealand.



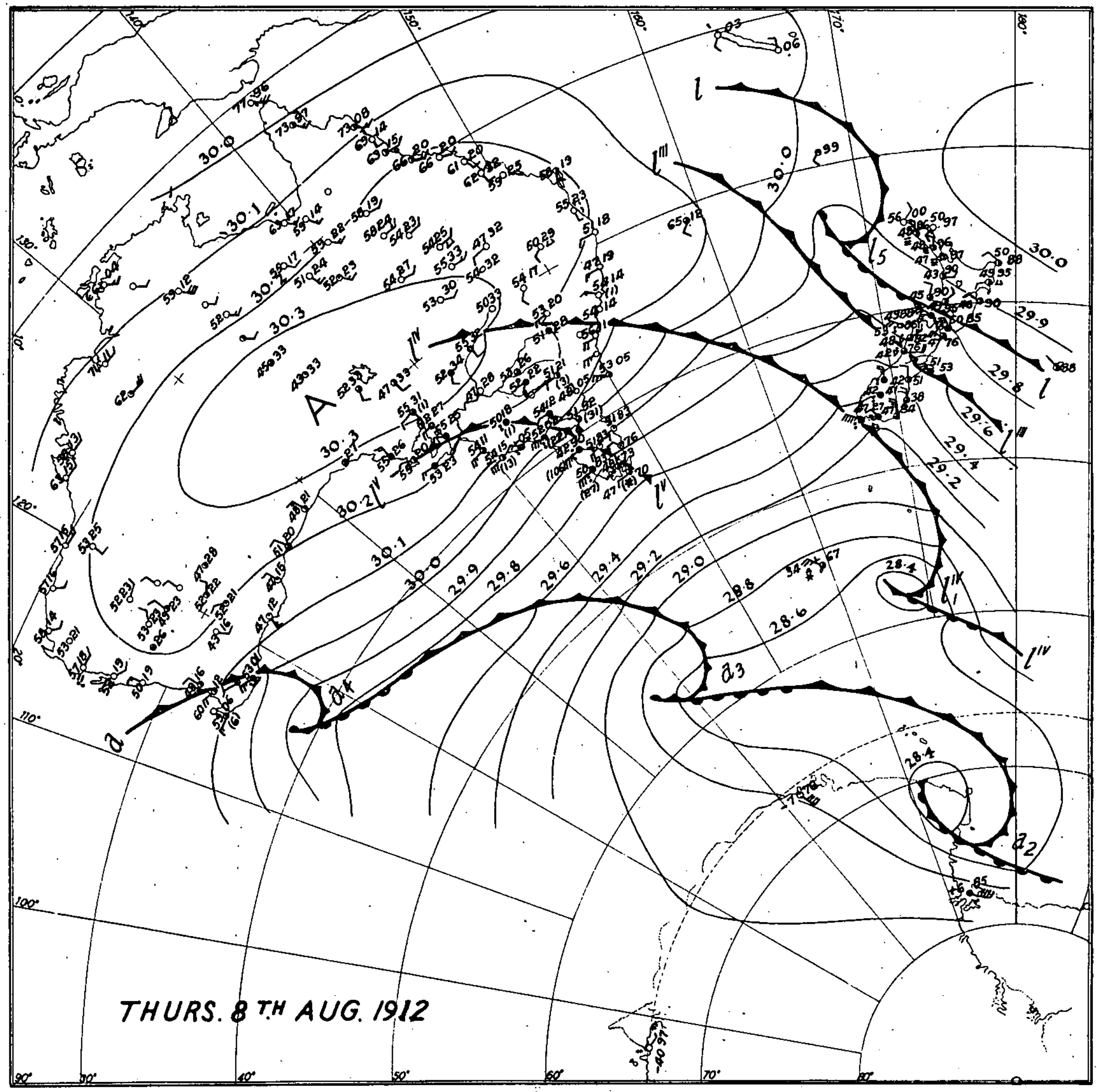
Note the temperature changes at Macquarie Island; high values occur between cold front and occlusion. There is another shallow cyclone over northern New Zealand.



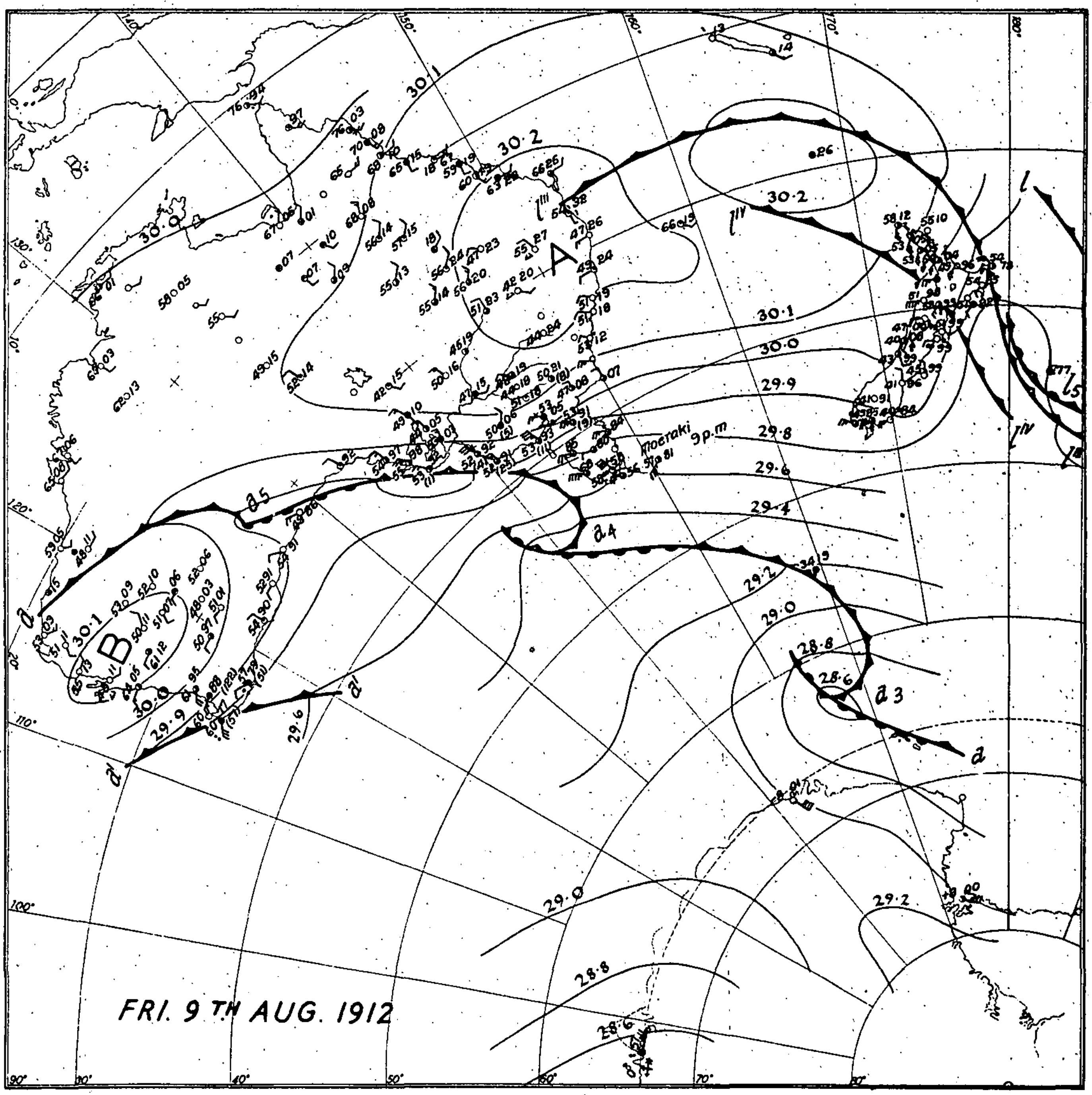
Note the sequence of changes in Antarctica from the 5th to the 8th and the analysis given. At Cape Evans. there was a continuous blizzard.



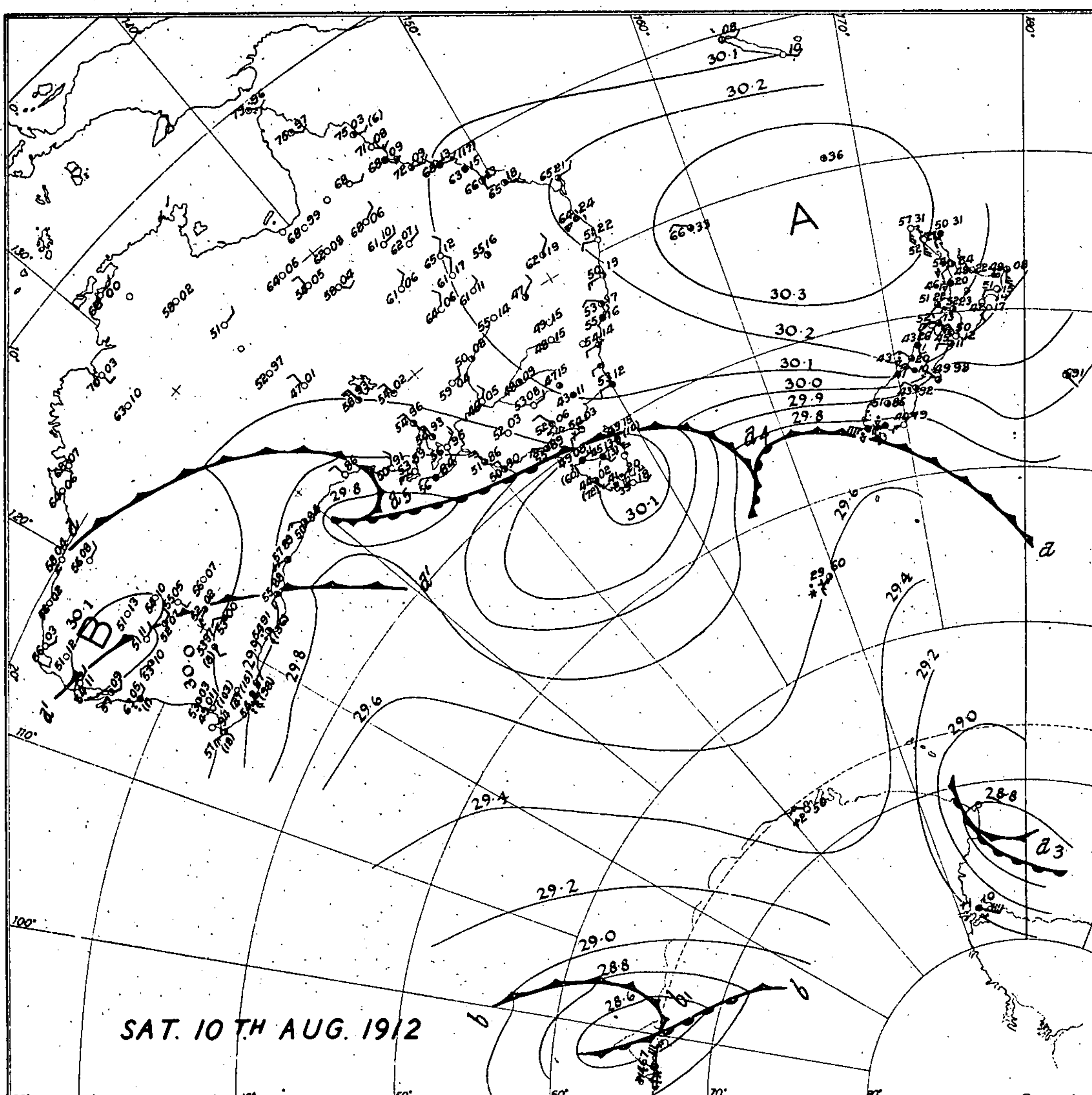
Front l^{IV} was a sharp front at Macquarie Island. There are deep depressions near both Cape Evans and Adélie Land. There is a series of very active secondary fronts crossing south-eastern Australia and the Tasman Sea area.



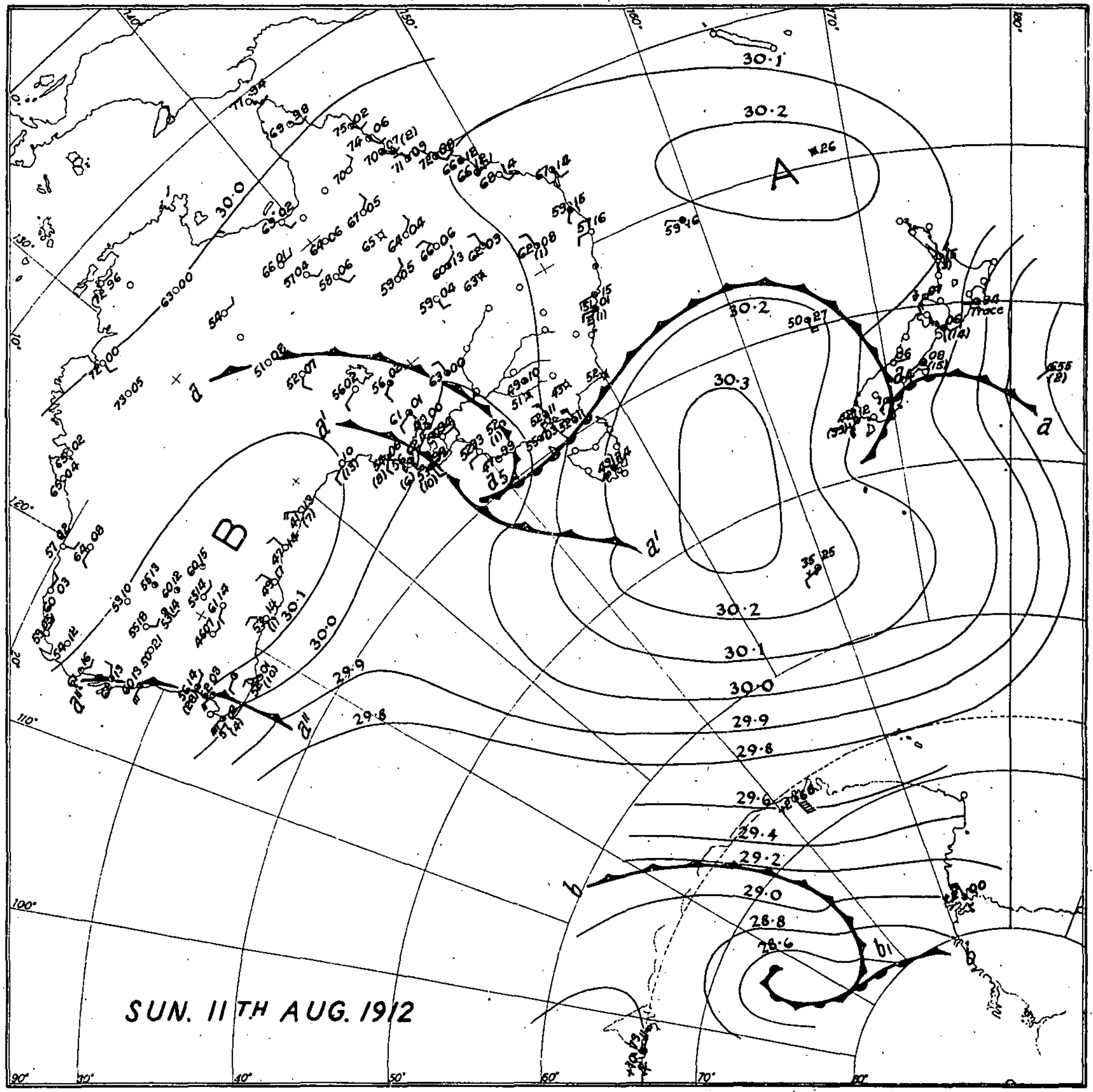
The northerly wind at Macquarie Island is surprising in view of the passage of a deep depression, the low temperatures, and the unstable conditions shown by the temperatures variations, hail squalls, etc. Waves a_3 and a_4 may be deeper than shown.



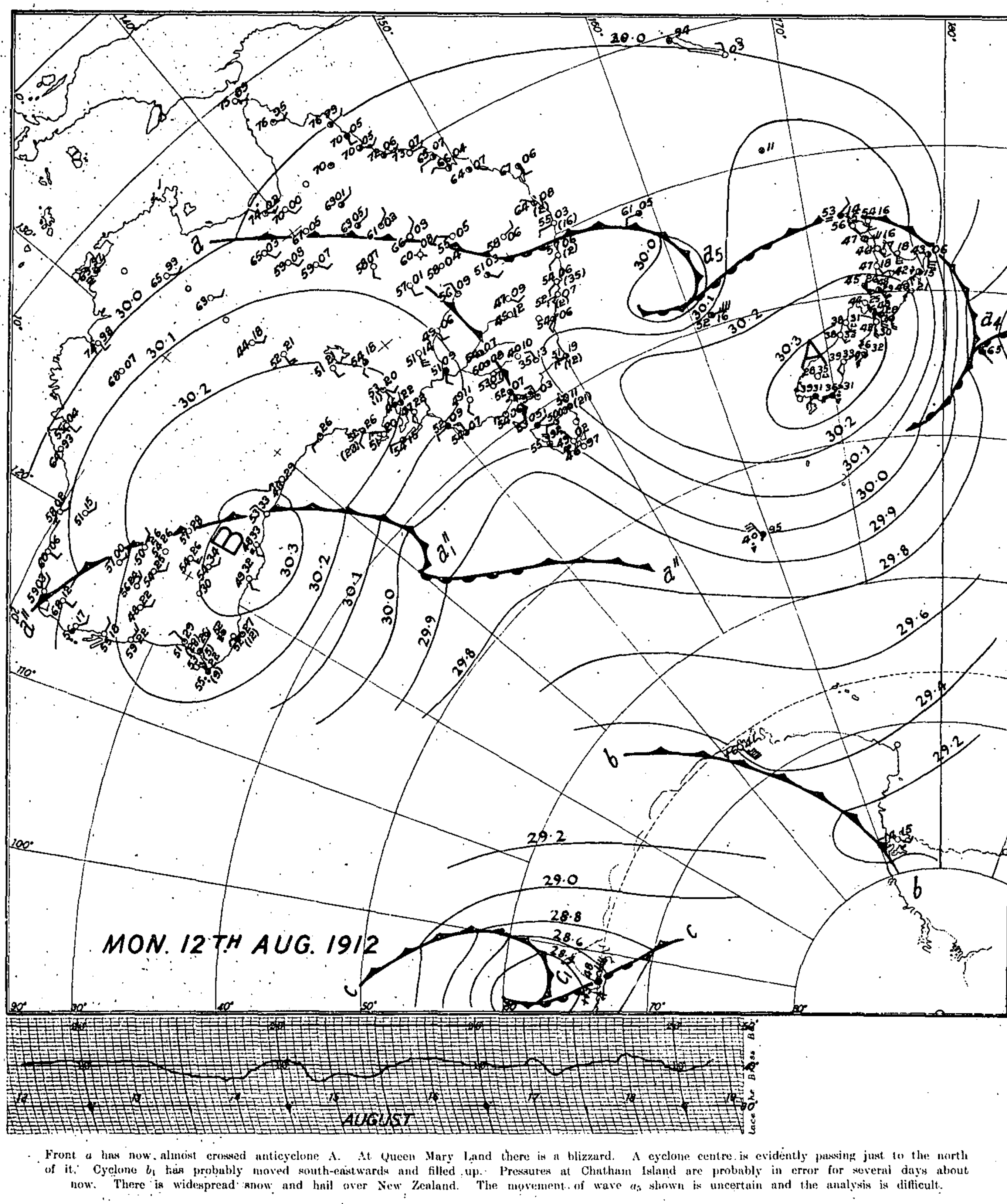
Conditions are becoming simpler in eastern areas. At Queen Mary Land there are indications of the approach of a depression.



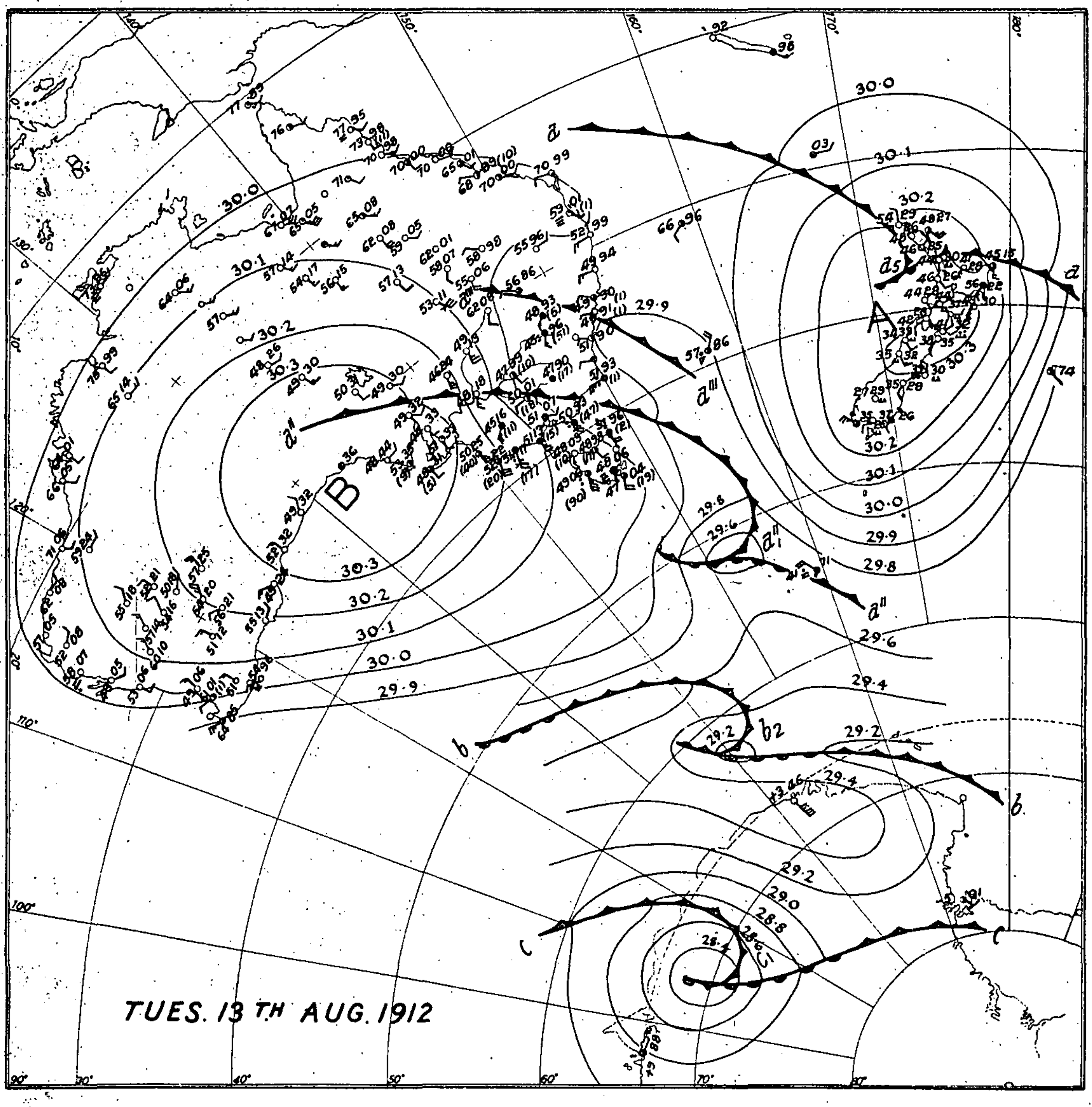
Front a is beginning to cross anticyclone A. There is a recrudescence of the blizzard at Cape Evans. This is assumed to be due to the approach of wave a_3. Wave b_1 has just passed Queen Mary Land.



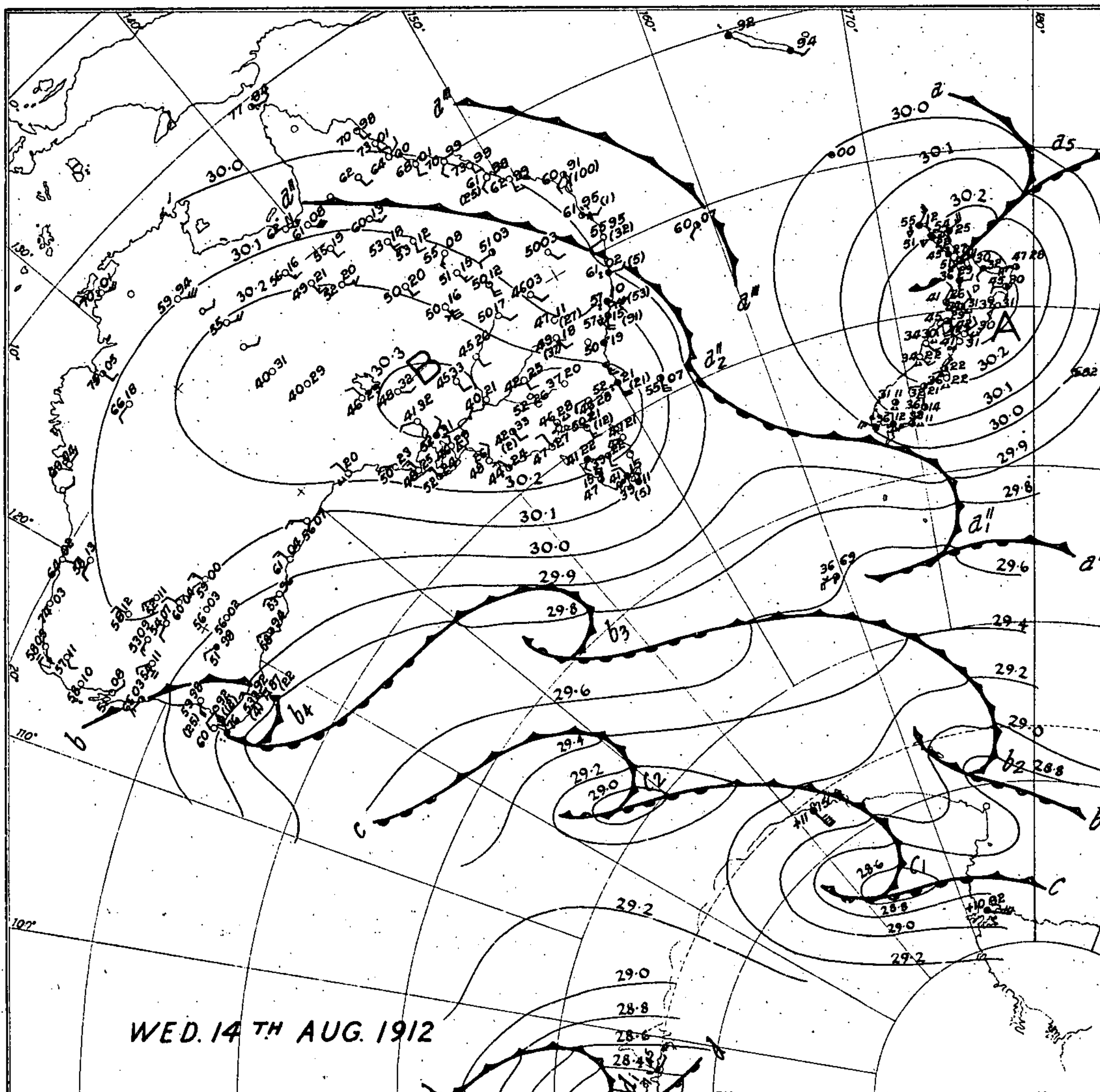
Note the northerly wind at Cape Evans in front of wave b_1. A fresh depression is approaching Queen Mary Land.



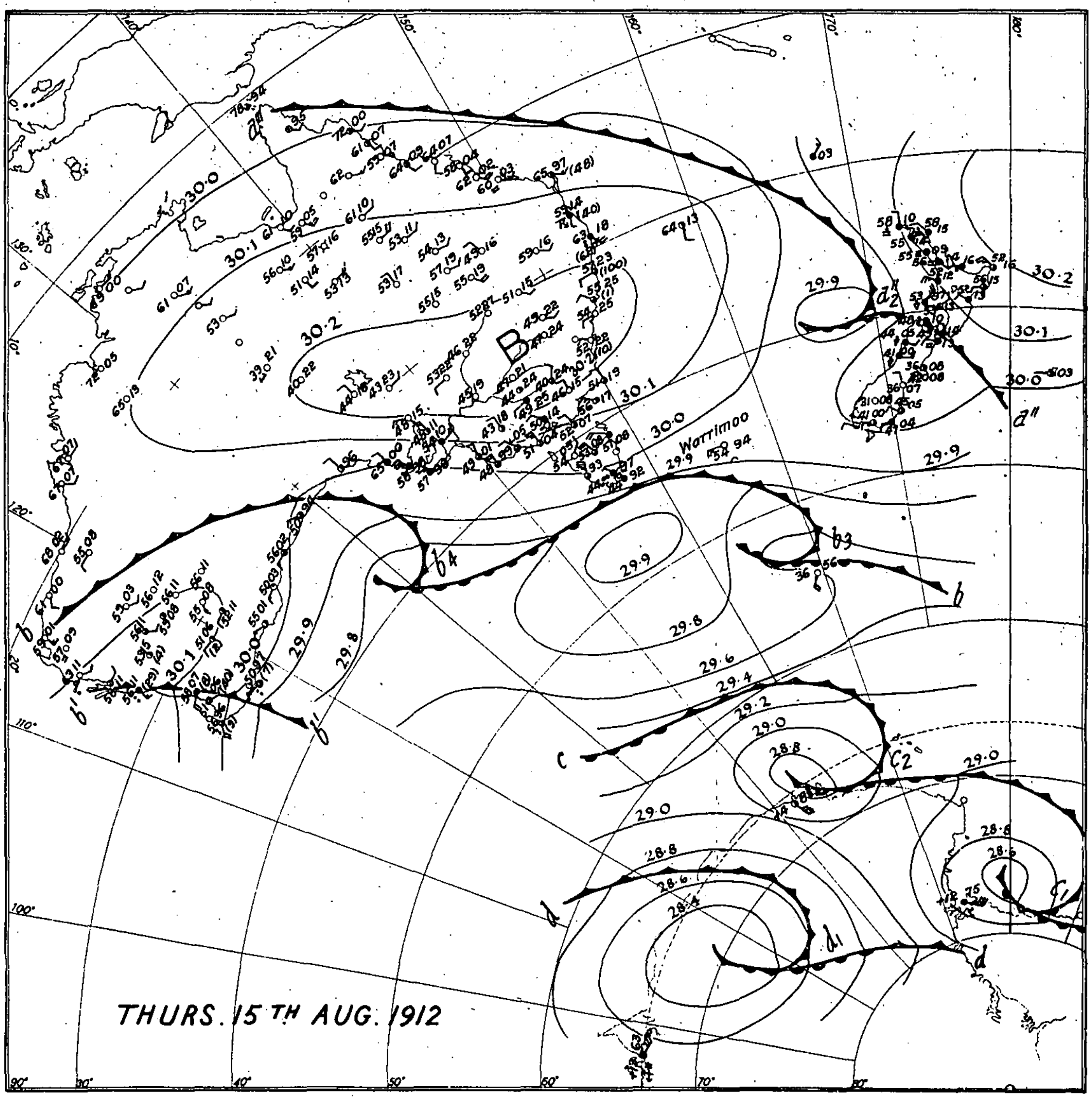
Front a has now almost crossed anticyclone A. At Queen Mary Land there is a blizzard. A cyclone centre is evidently passing just to the north of it. Cyclone b_1 has probably moved south-eastwards and filled up. Pressures at Chatham Island are probably in error for several days about now. There is widespread snow and hail over New Zealand. The movement of wave a_5 shown is uncertain and the analysis is difficult.



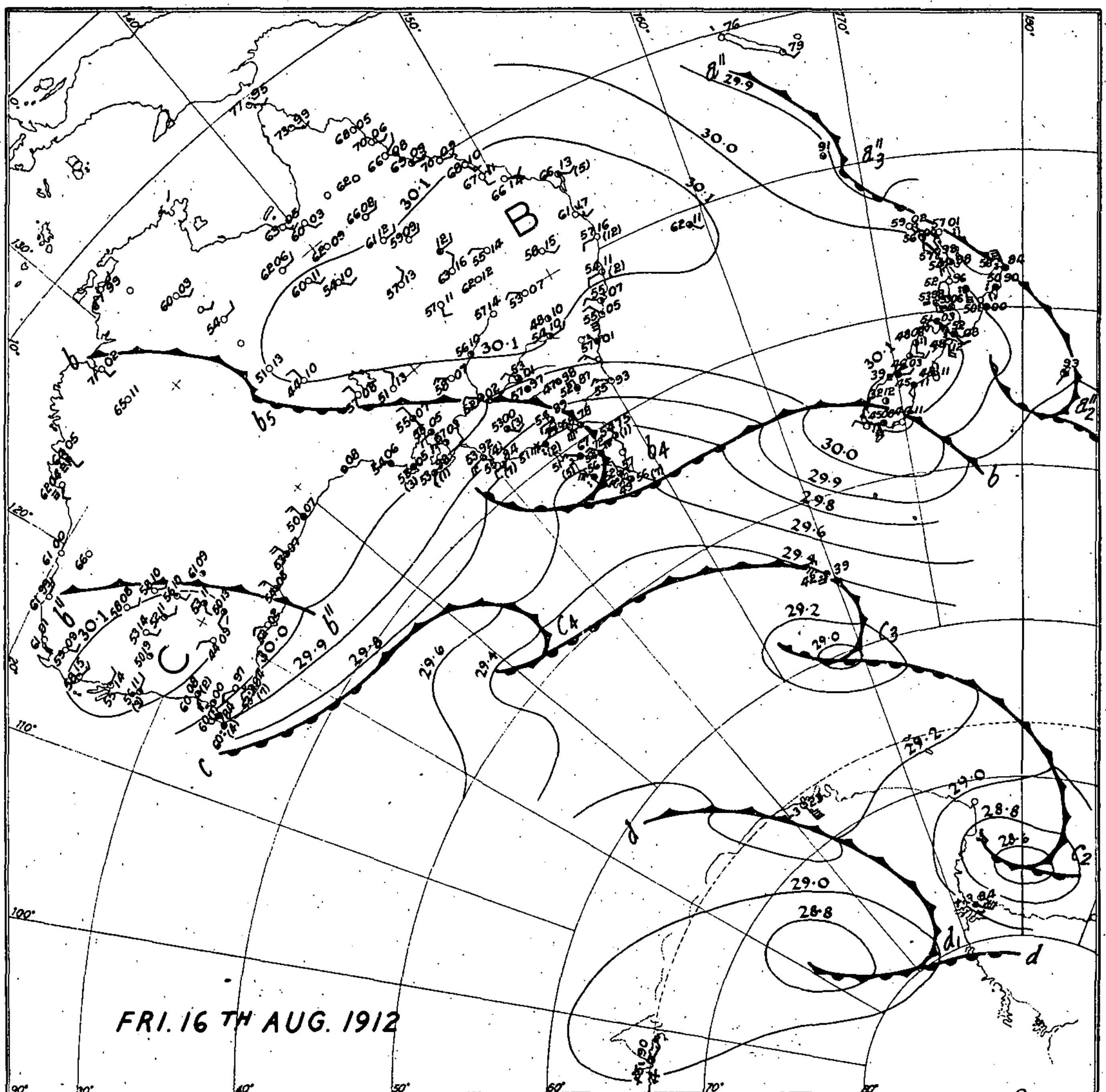
The secondary front a^{II} is well-marked at both Melbourne and Macquarie Island. There are interesting changes in Antarctica.



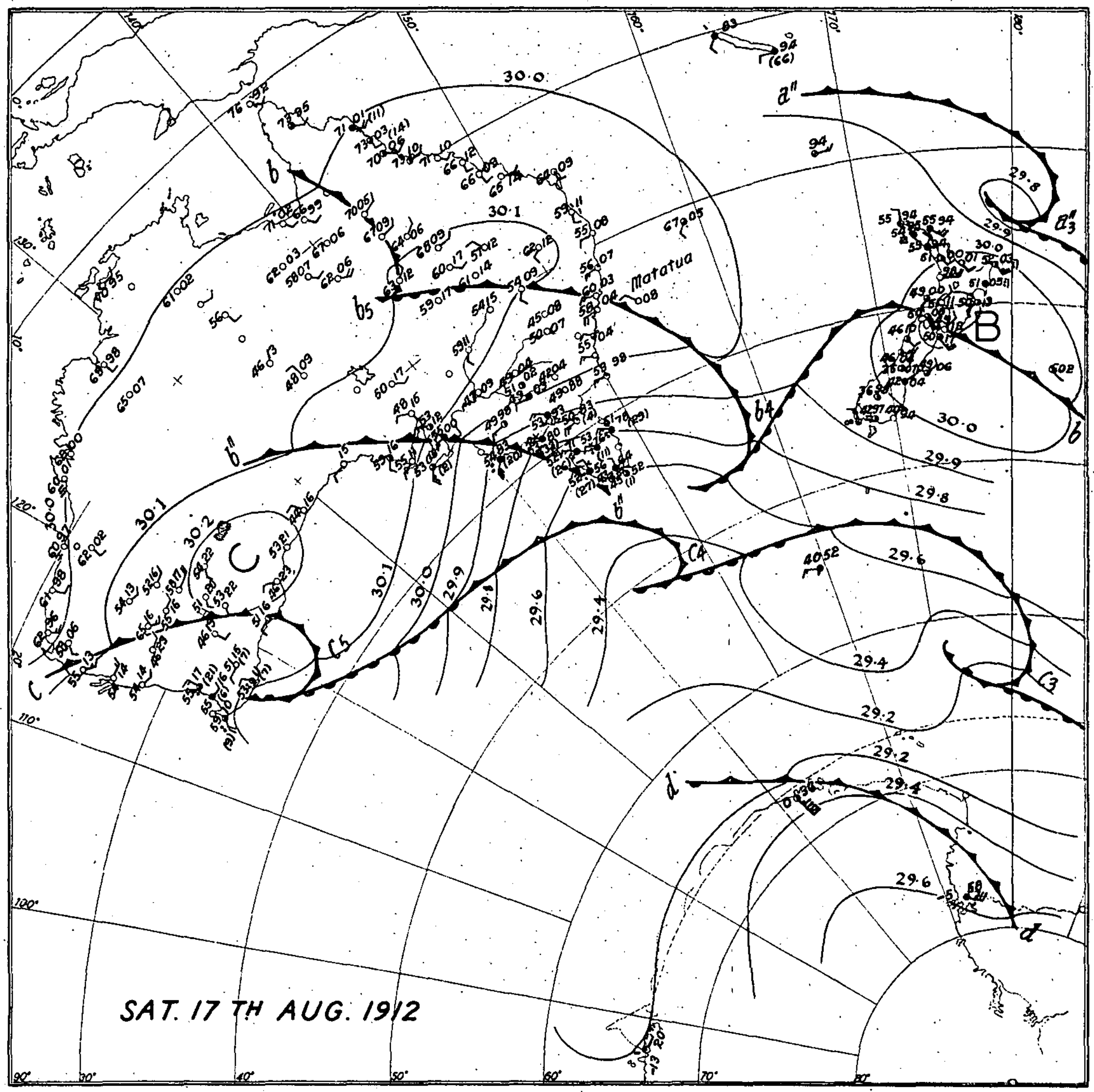
Note the rain in New Zealand and on the north coast of New South Wales. In Antarctica a blizzard follows the passage of front c at Cape Evans but pressure continues to fall with the nearer approach of cyclone c_1. The cold front and occlusion of d_1 later pass Queen Mary Land.



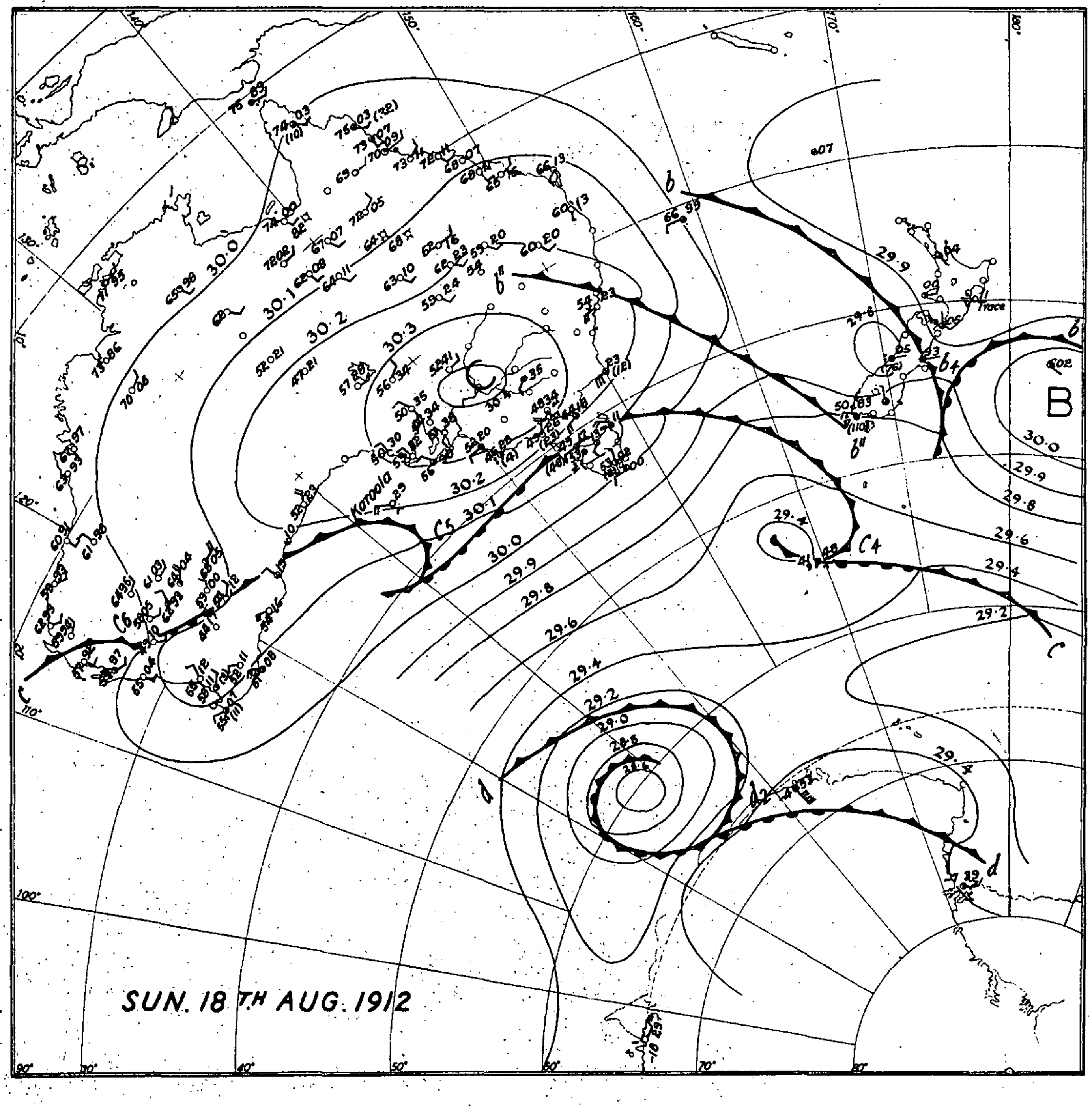
An interesting series of changes is still occurring in Antarctica.



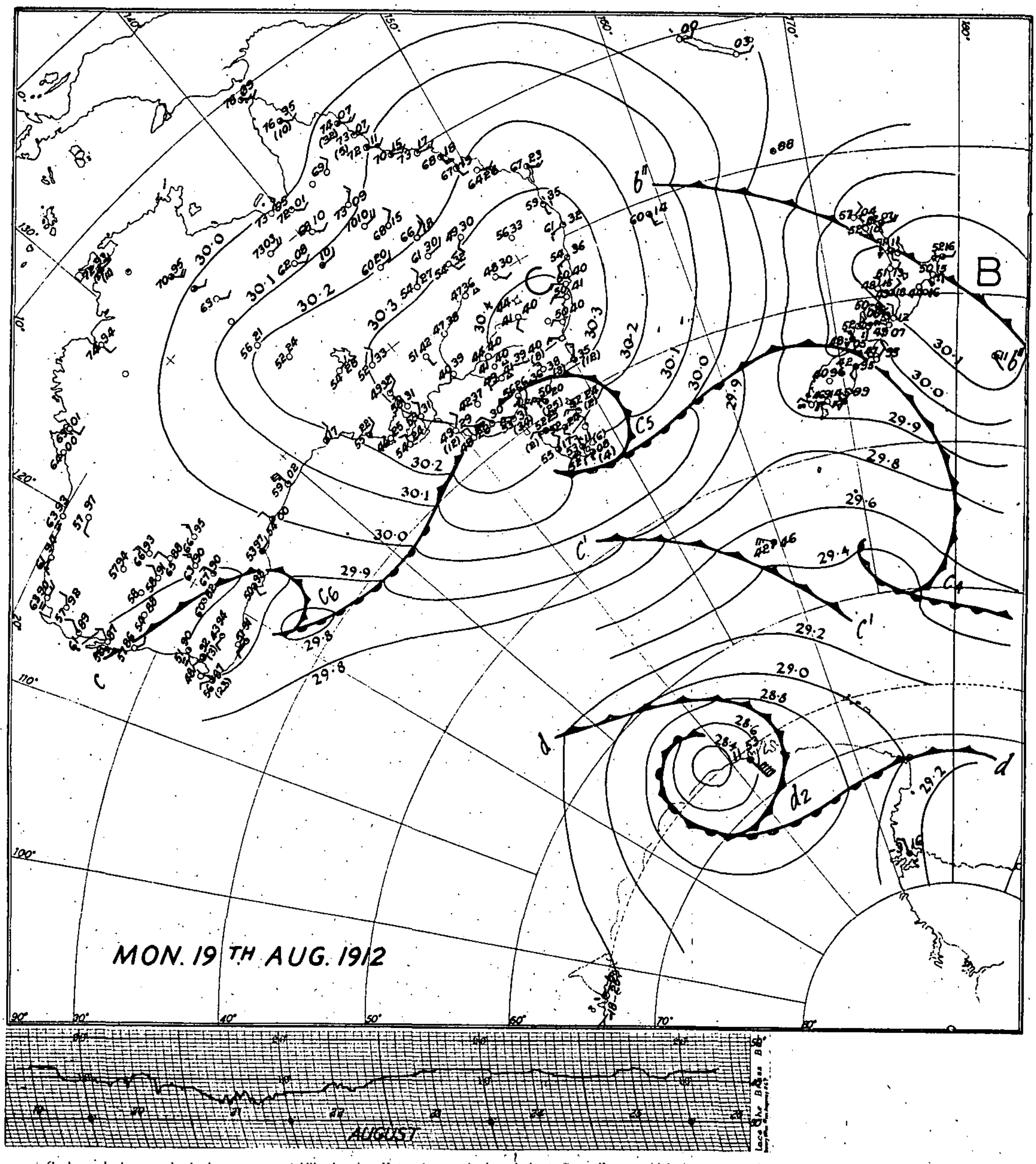
The passage of front c at Macquarie Island caused little change of temperature; the latest movement of the air behind it was continuously from the north of west. The blizzard at Cape Evans is taken to be due to the approach of cyclone c_2 while d_1 has been filling up and is taking a more southward course.



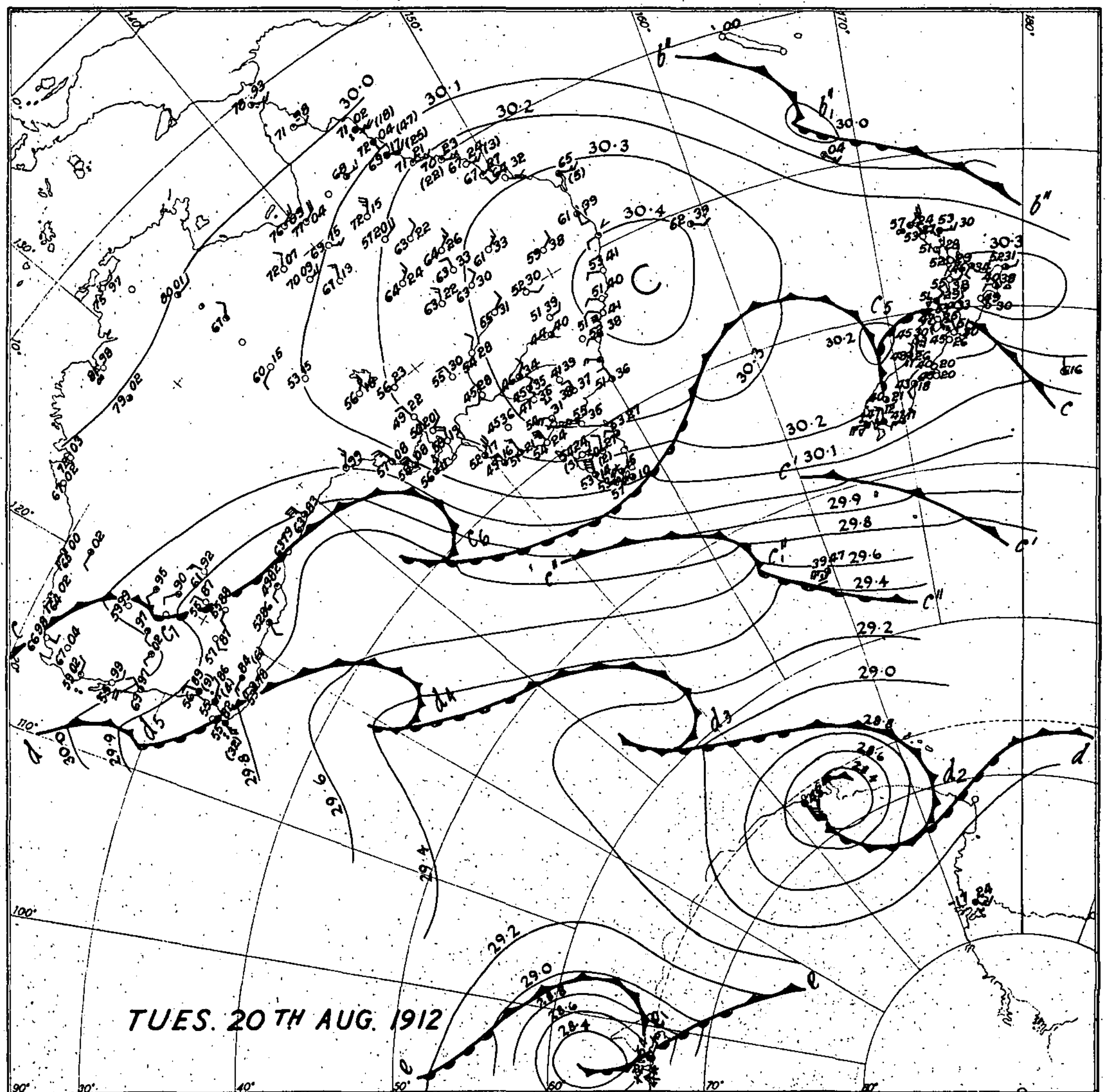
Front *d* has now passed both Cape Evans and Adélie Land.



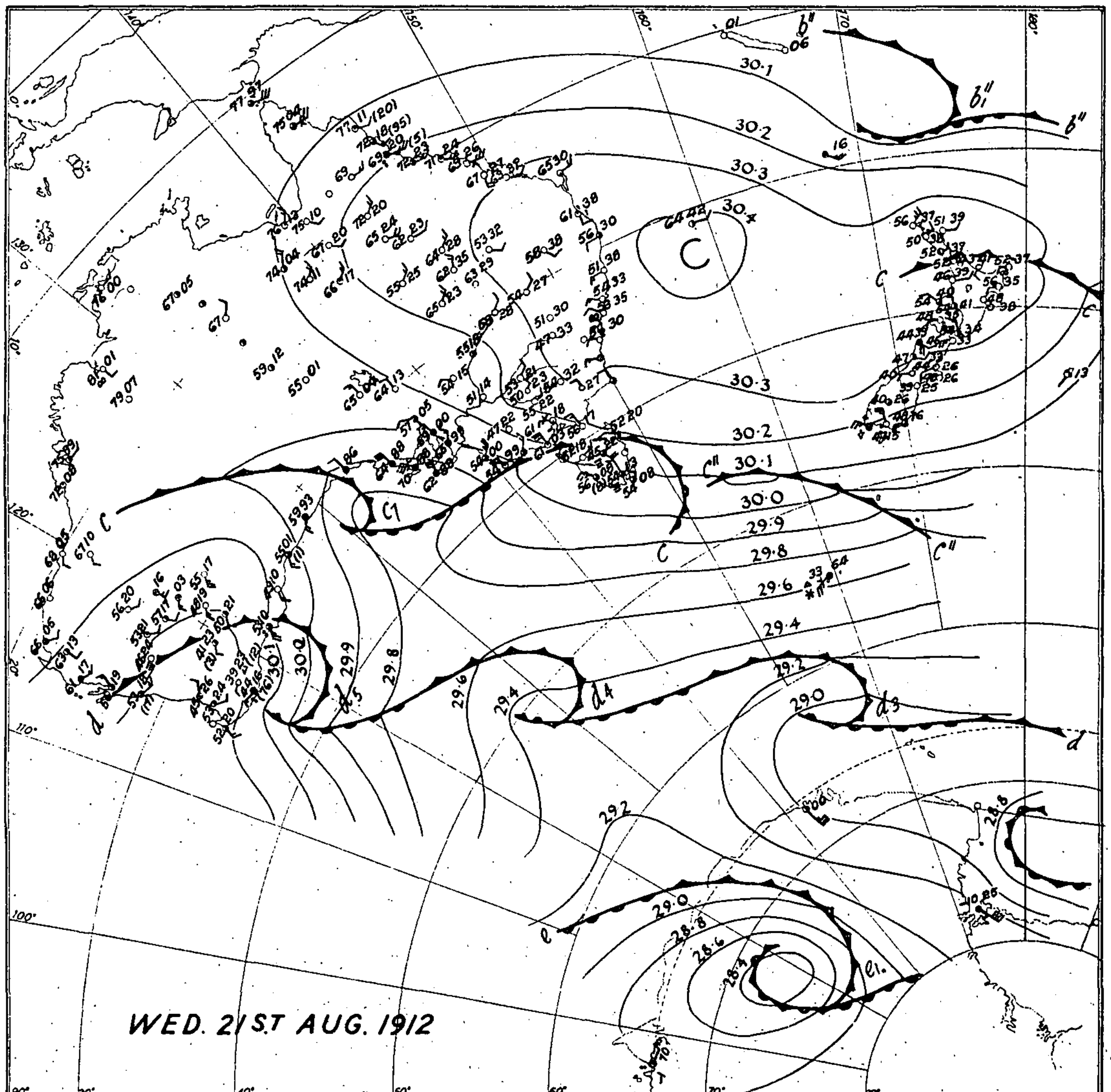
Note the east wind at Macquarie Island. A deep cyclone is approaching Adélie Land and front *d* has recrossed it as a warm front.



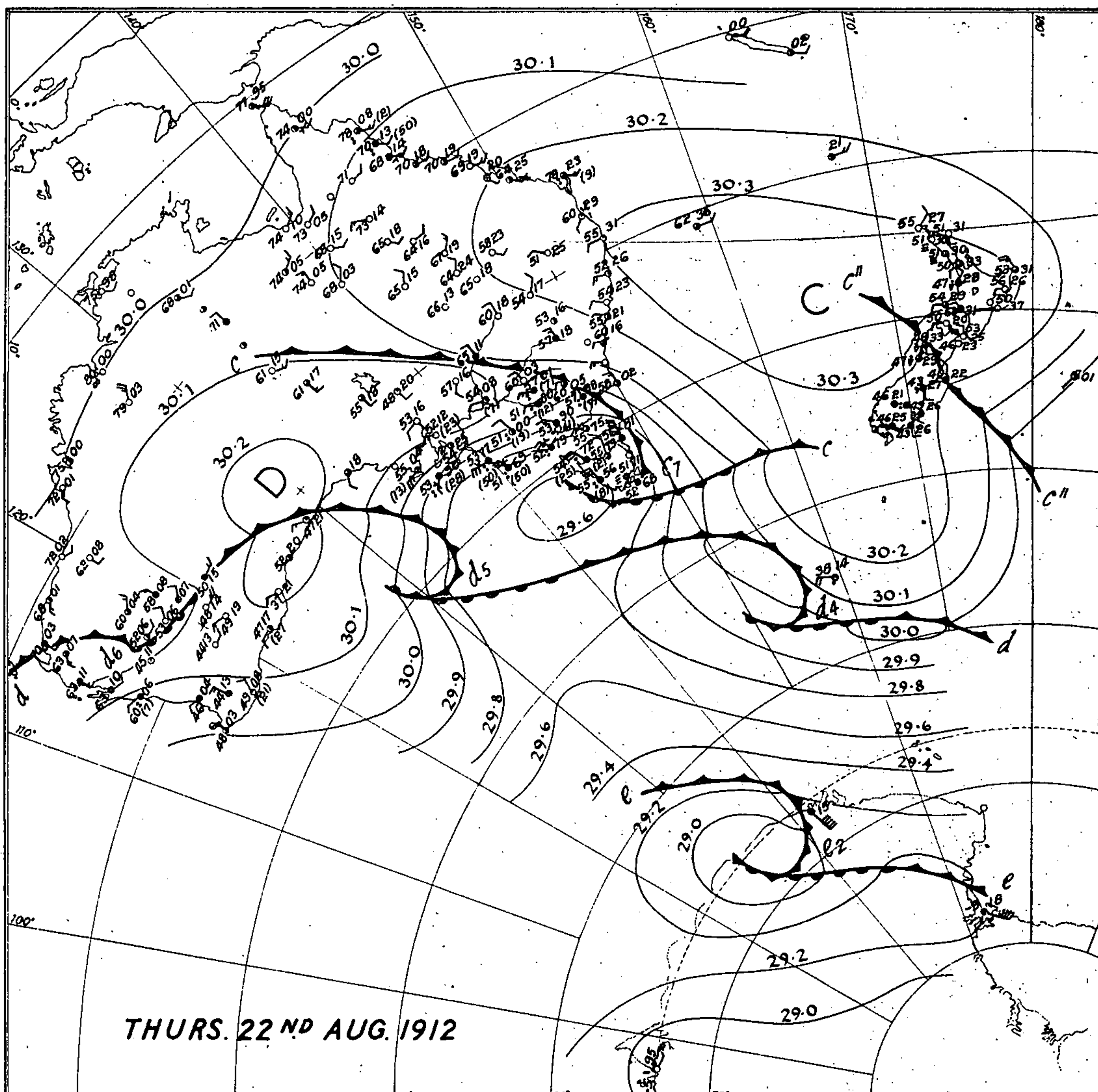
Cyclone d_2 is now beginning to pass Adélie Land. Note the northerly wind at Cape Evans which is not explained. A pronounced drift from the north in the upper air is indicated. Front c is assuming an east to west orientation.



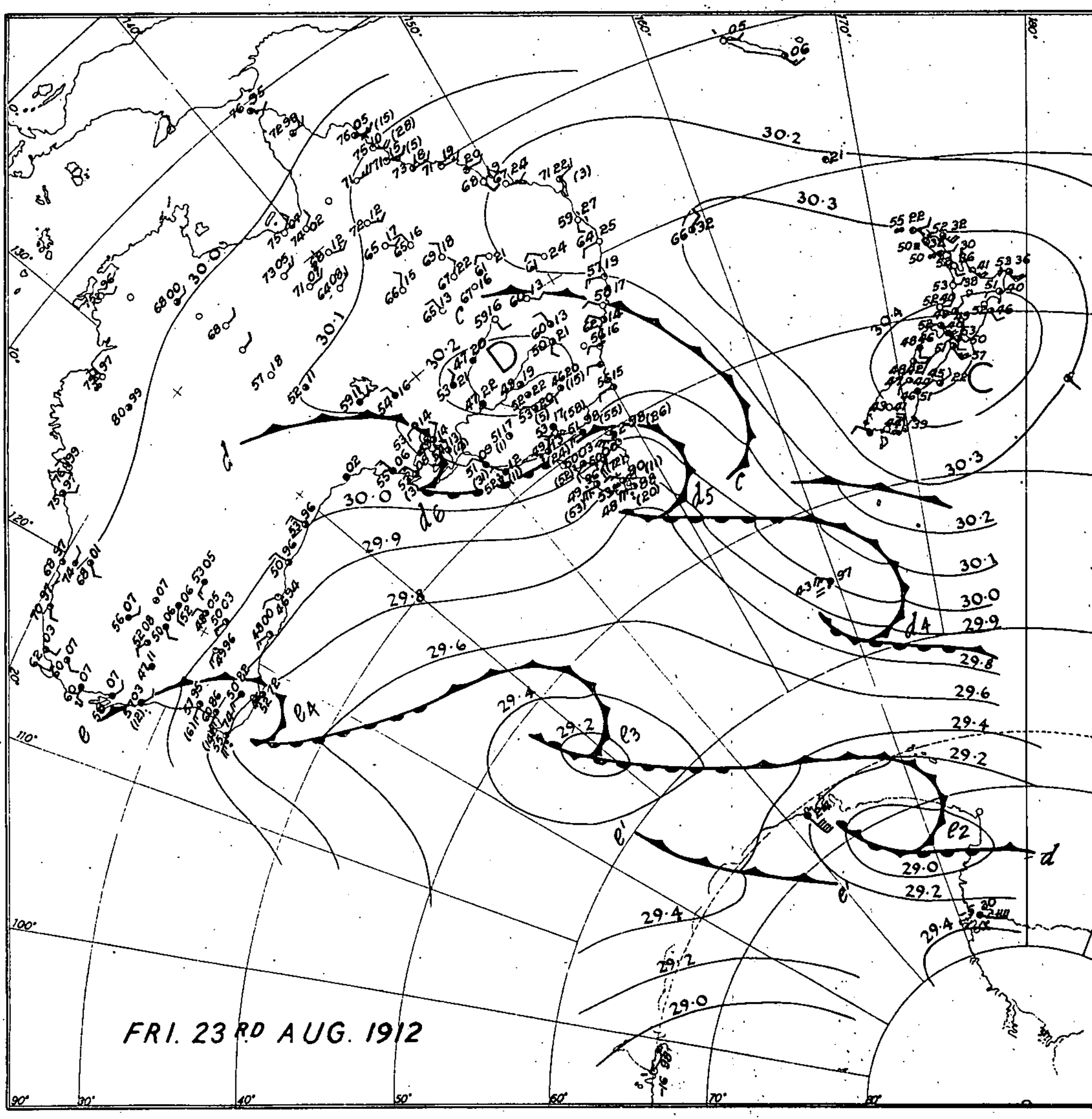
Cyclone d_2 is becoming completely occluded. A fresh one is passing Queen Mary Land.



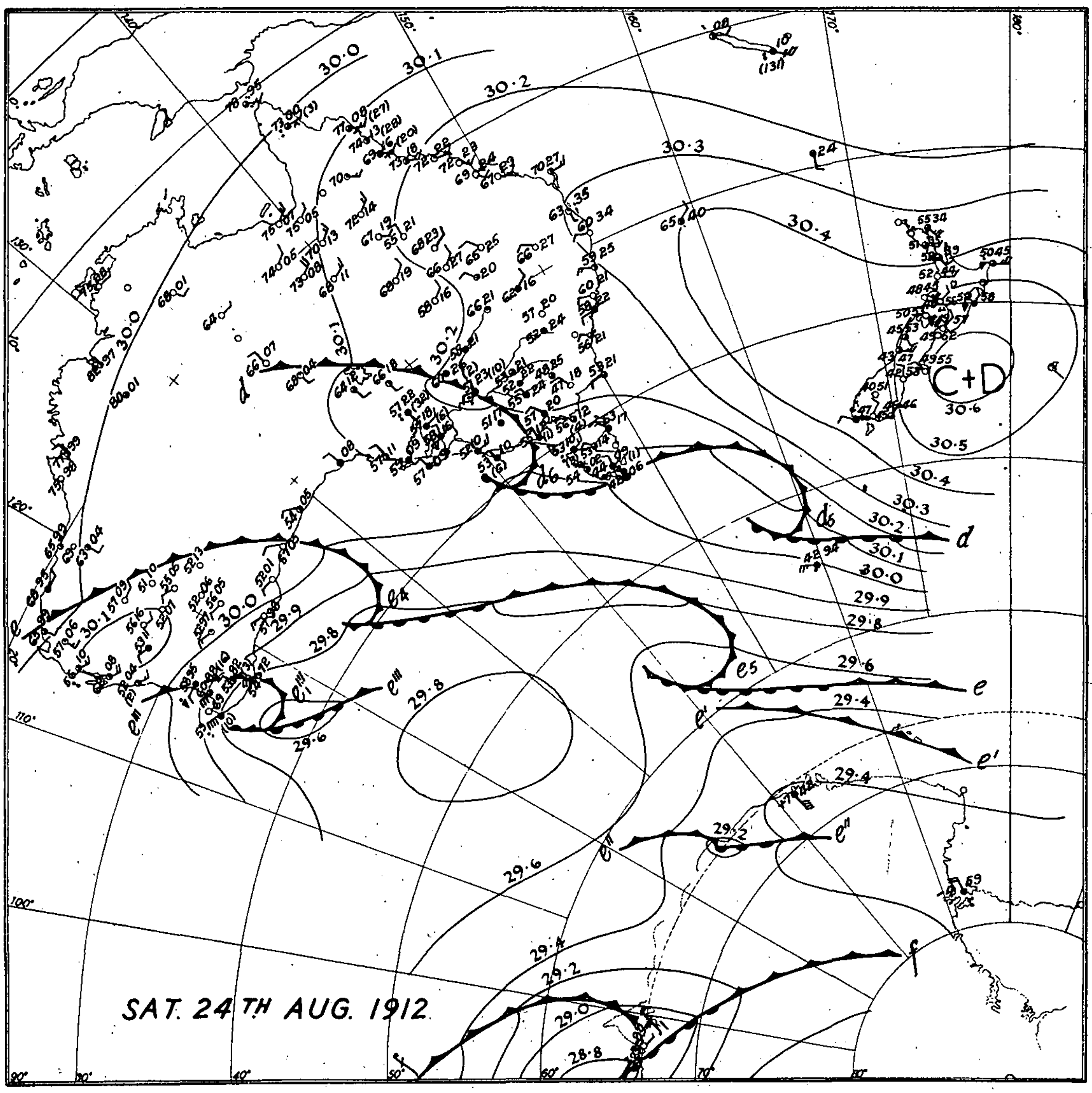
Note the wide and definite flow of air from the north over eastern Australia. Front c has become broken but the western part appears to be junctioning with the secondary c''. A blizzard is now blowing at Cape Evans and cyclone e_1 does not approach near enough to affect it.



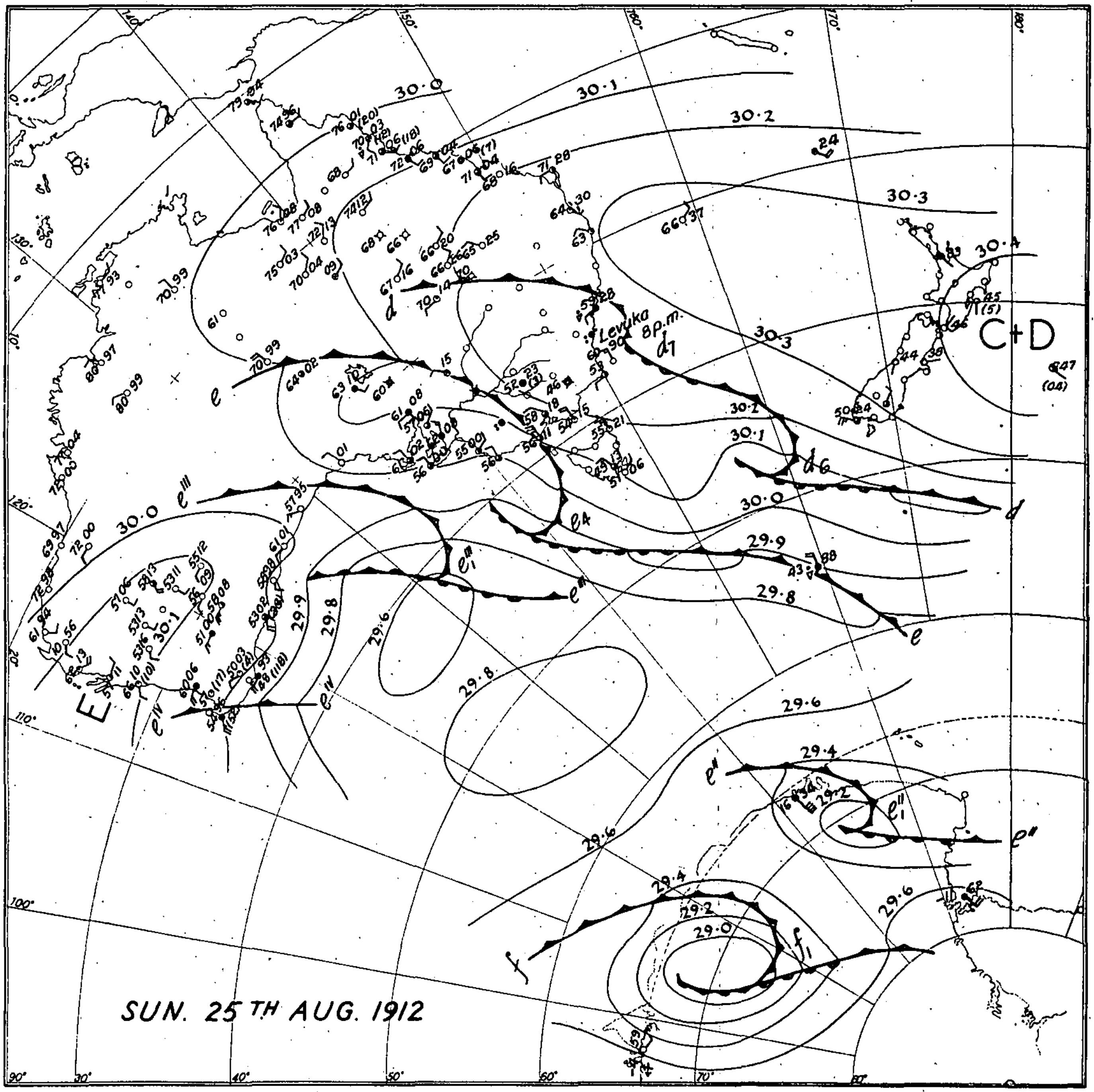
Wave e_7 has developed into an active depression over south-eastern Australia. A blizzard is still blowing at Cape Evans. Conditions have been unstable at Macquarie Island during the preceding ten days as shown by the thermogram.



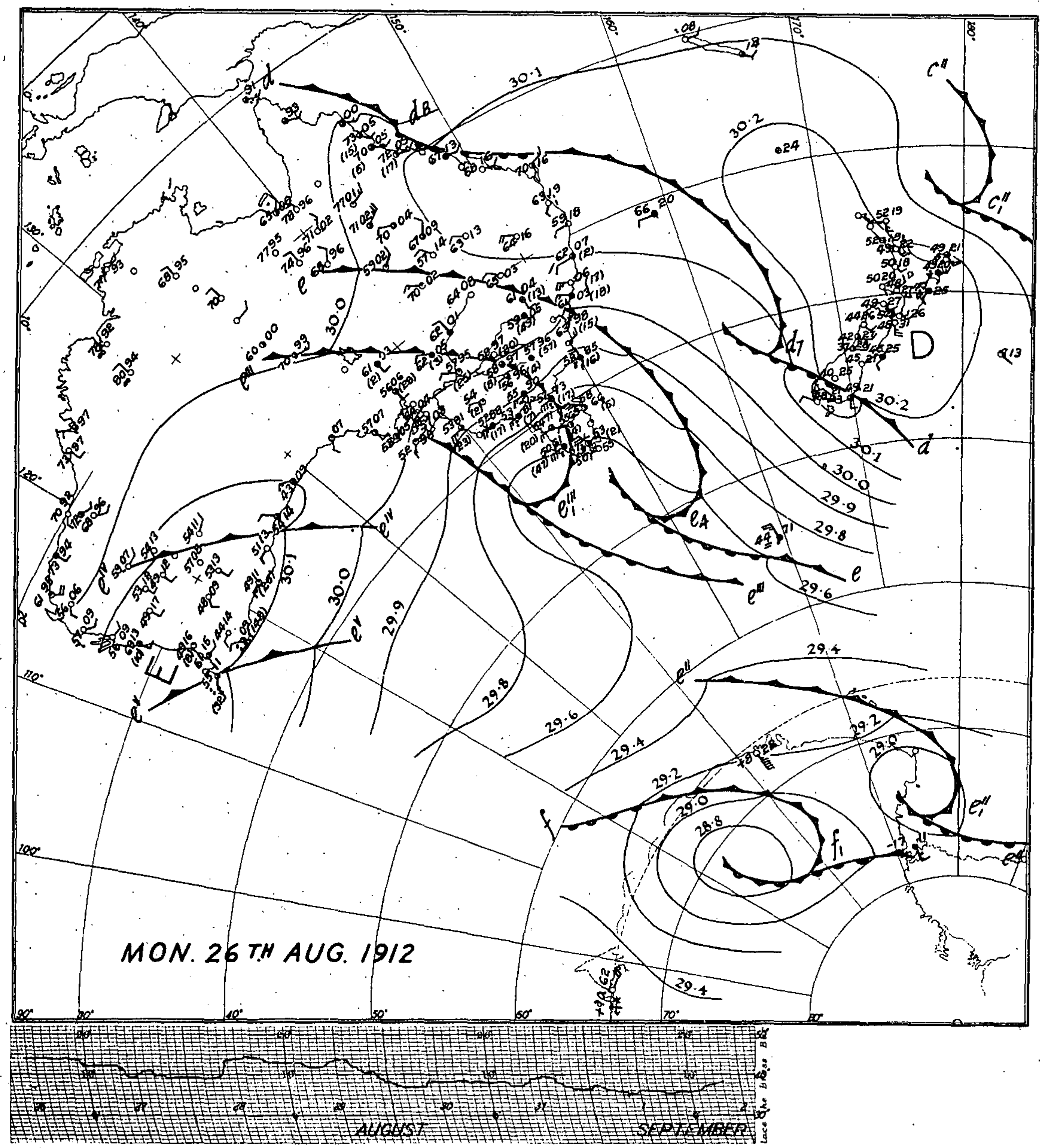
Front c has almost disappeared but wave d_5 is active in the region previously occupied by c_7. There is still a blizzard at Cape Evans.



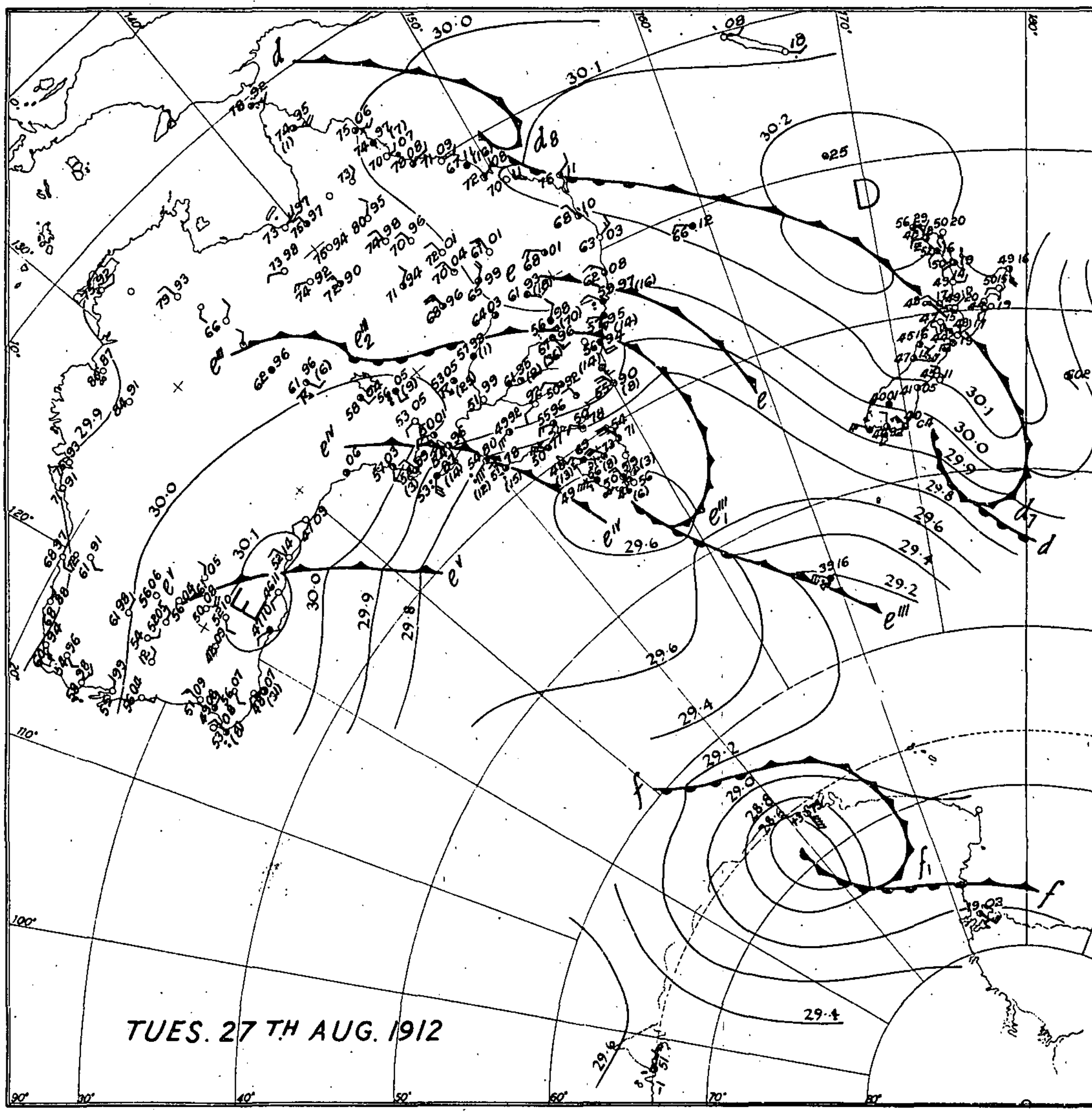
Anticyclone D has joined with C. There was probably a division again later. The cold front and occlusion of a new wave are passing Queen Mary Land. Note the northerly wind at Cape Evans.



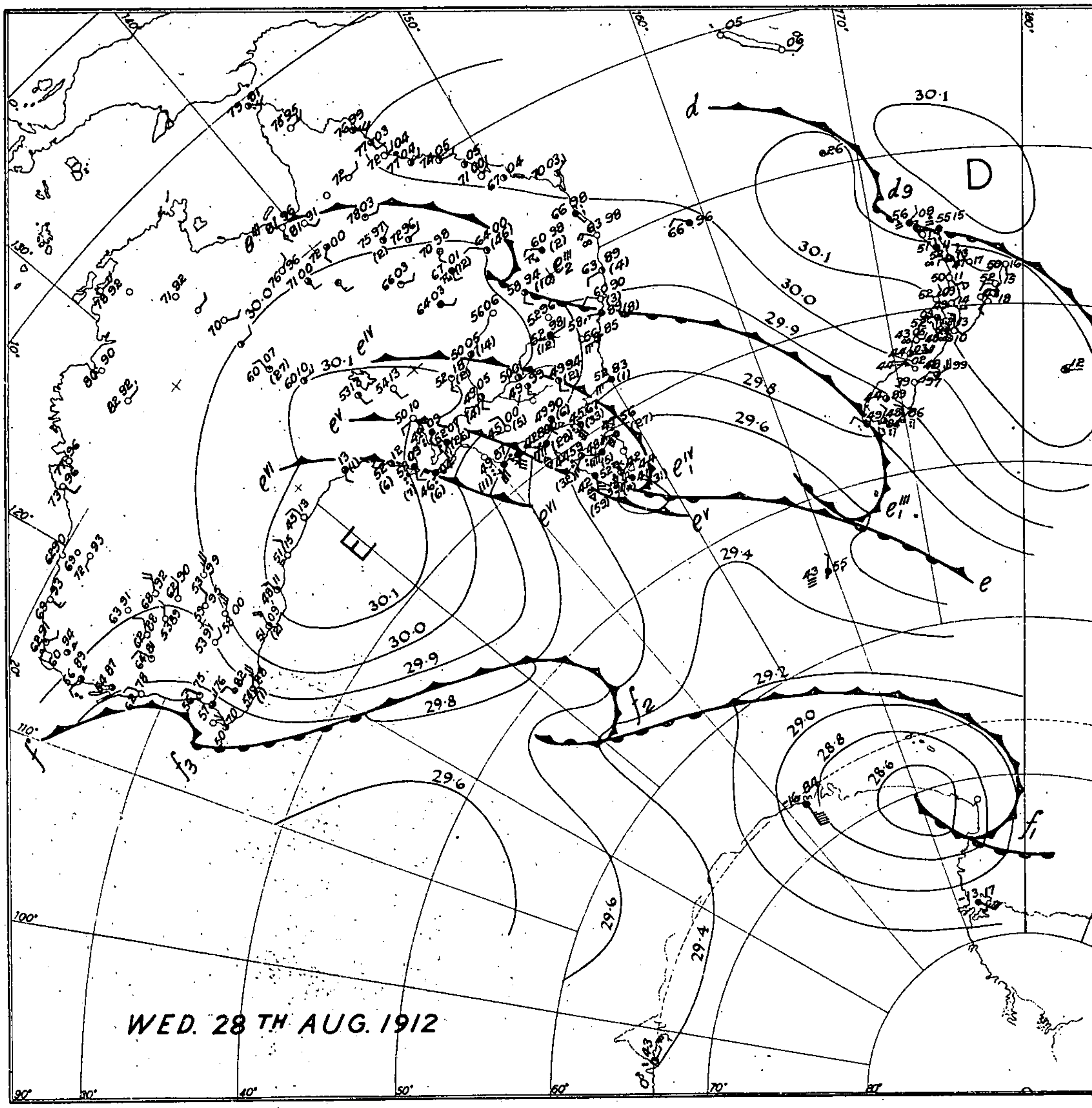
The secondary front e^{II} is inserted to account for the changes of pressure at Adélie Land and of wind at Cape Evans. Pressure is very high at the latter station.



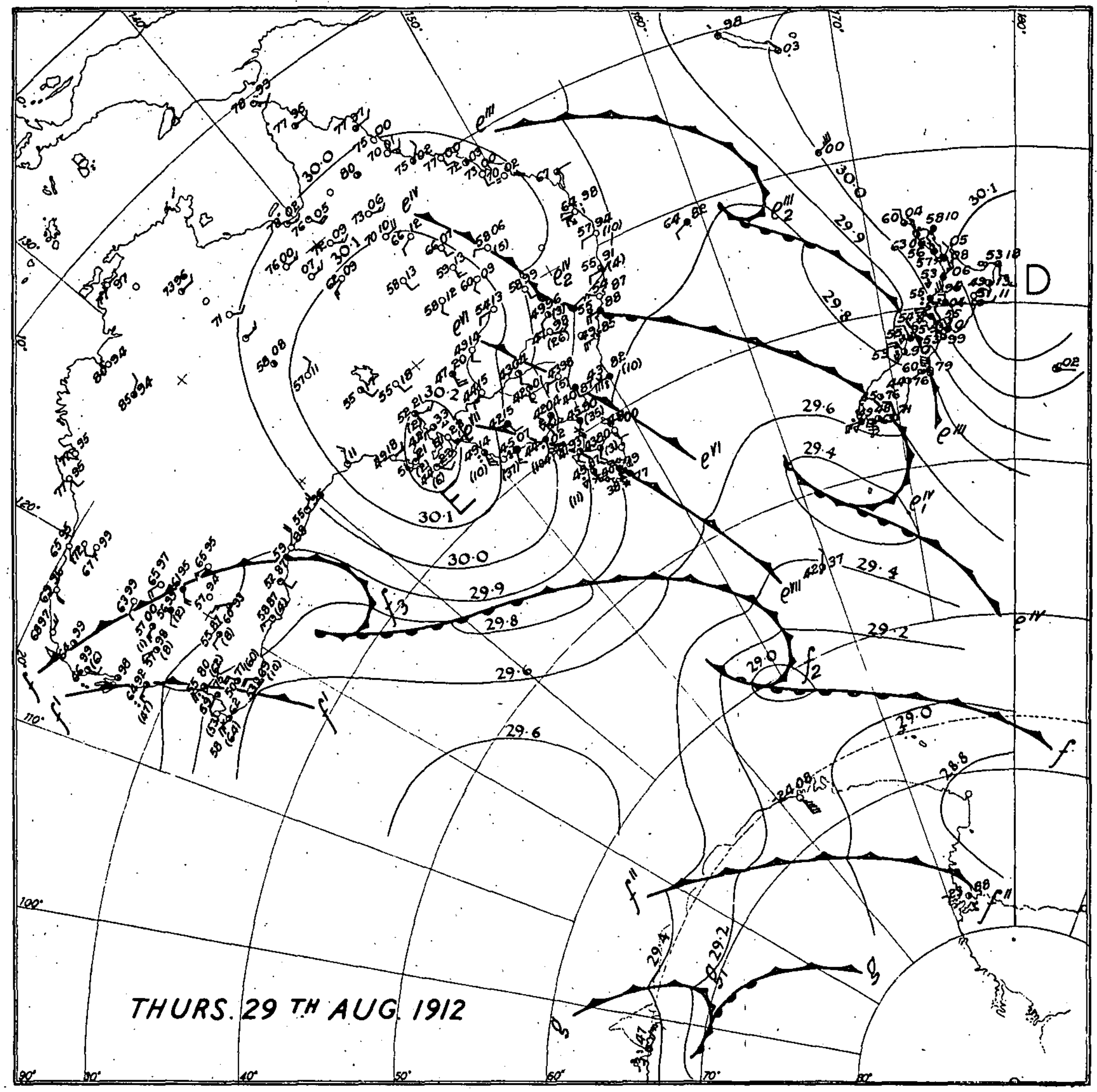
Cyclone f_1 apparently moves nearly due east and the centre passes nearer to Adélie Land than to Cape Evans. The passage of the front is well-marked at the latter station. The wind and snow at Queen Mary Land are not accounted for.



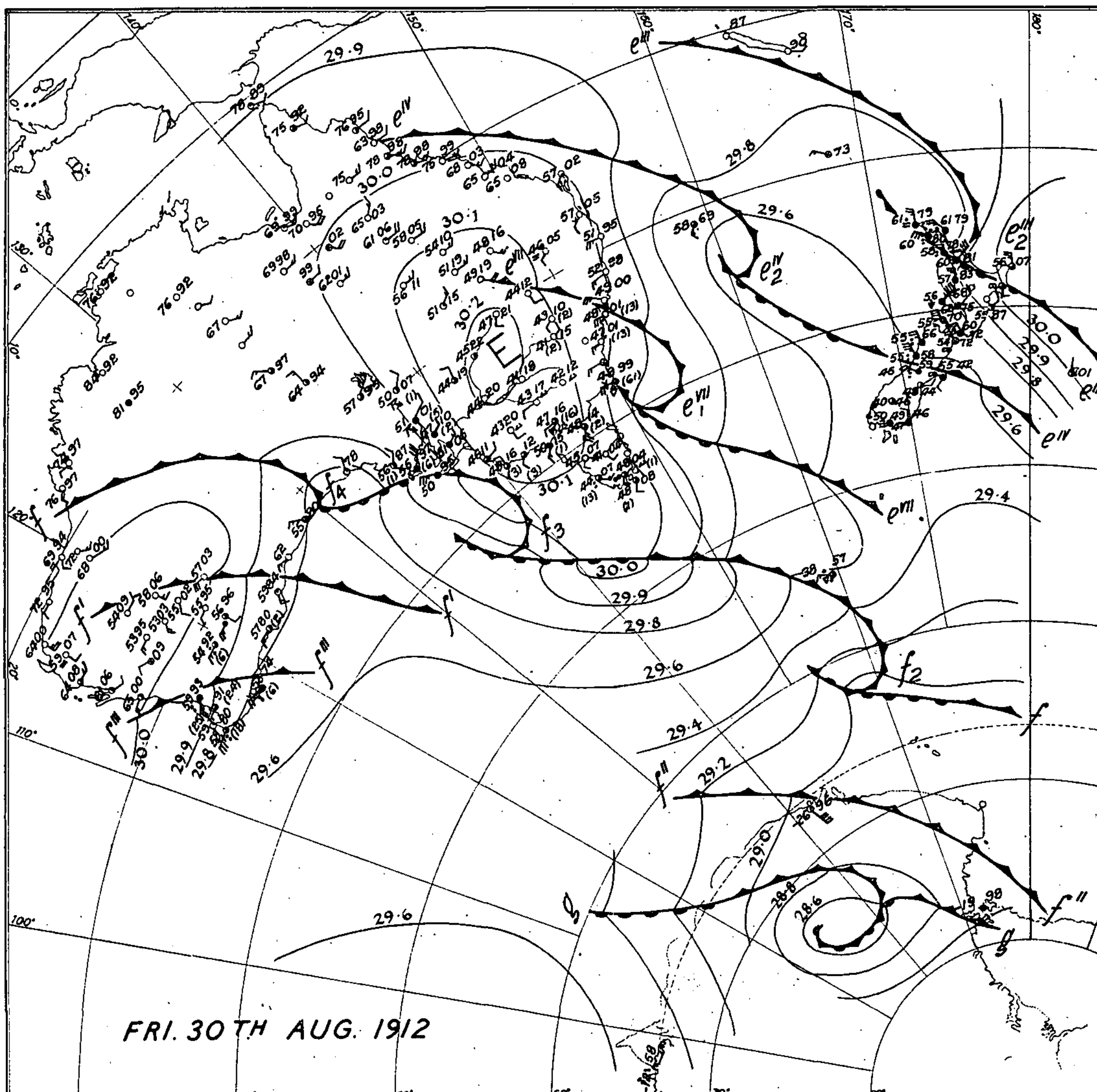
Cyclone f_1 is now passing south of Adélie Land. Unstable conditions with some thunder prevail over south-central Australia.



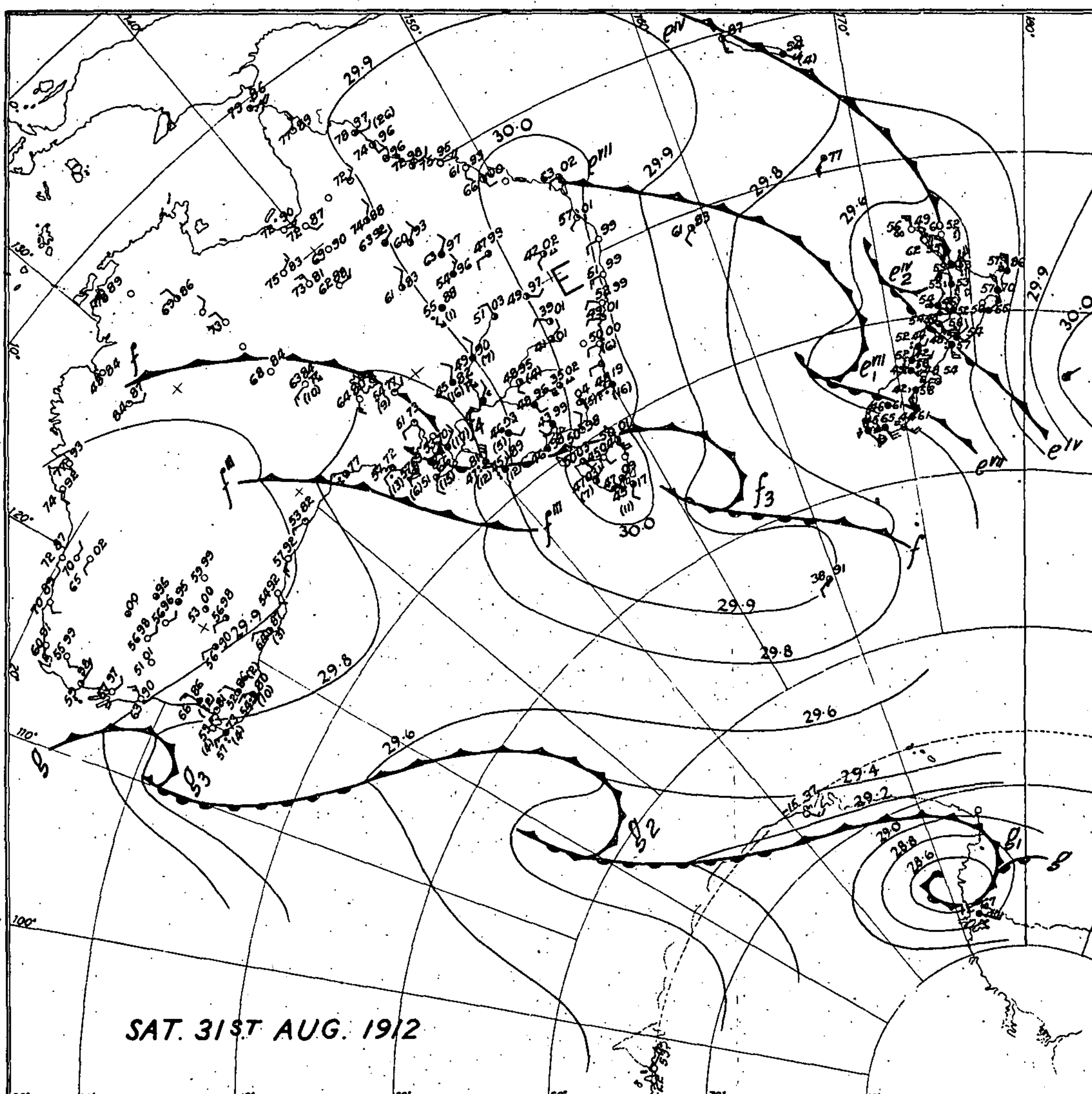
Numerous secondary fronts have formed behind *e*. A blizzard is now blowing at Cape Evans. At Macquarie Island there has been a marked rise of temperature. There are numbers of hailstorms in Victoria and Tasmania.



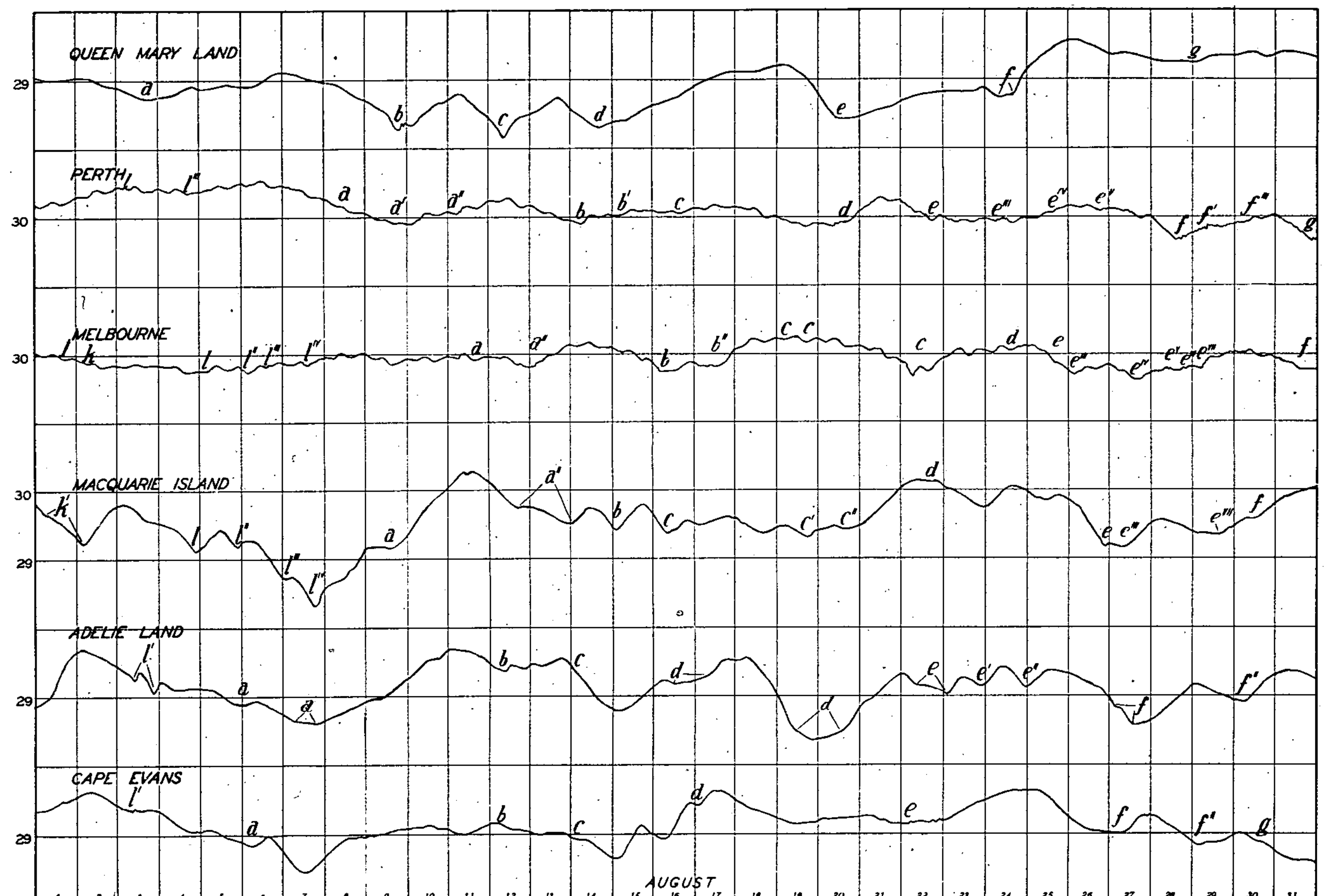
Considerable activity prevails in the Tasman Sea area. There are cold southerly winds, snow and hail in south-eastern Australia while at Norfolk Island and over most of New Zealand there is a marked flow from the north.



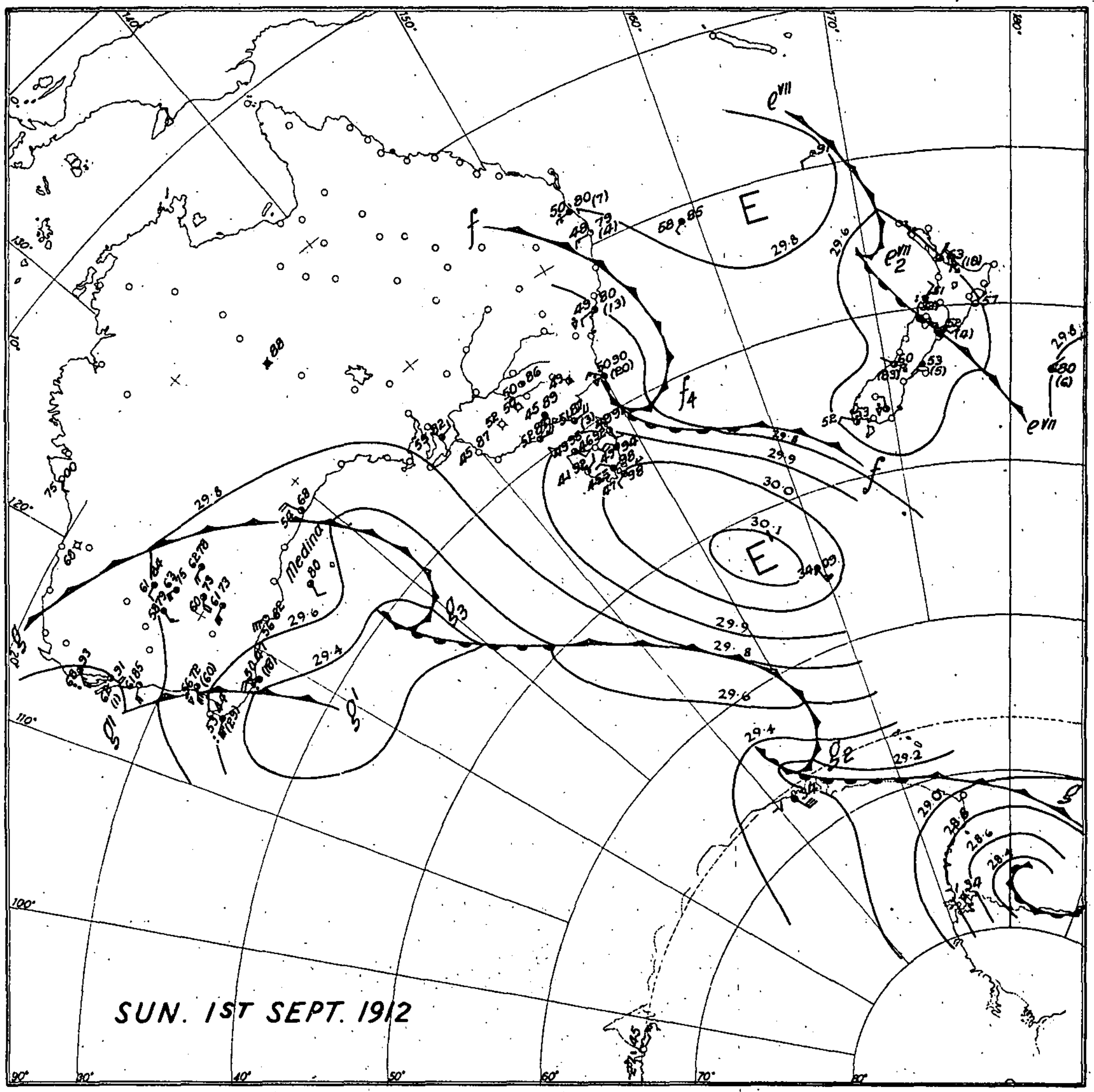
The sequence of changes indicates that a cyclone on front *g* passes north of Cape Evans, but south of Queen Mary Land and Adélie Land. The disturbed conditions are now moving from the Tasman Sea on to New Zealand where rain is widespread.



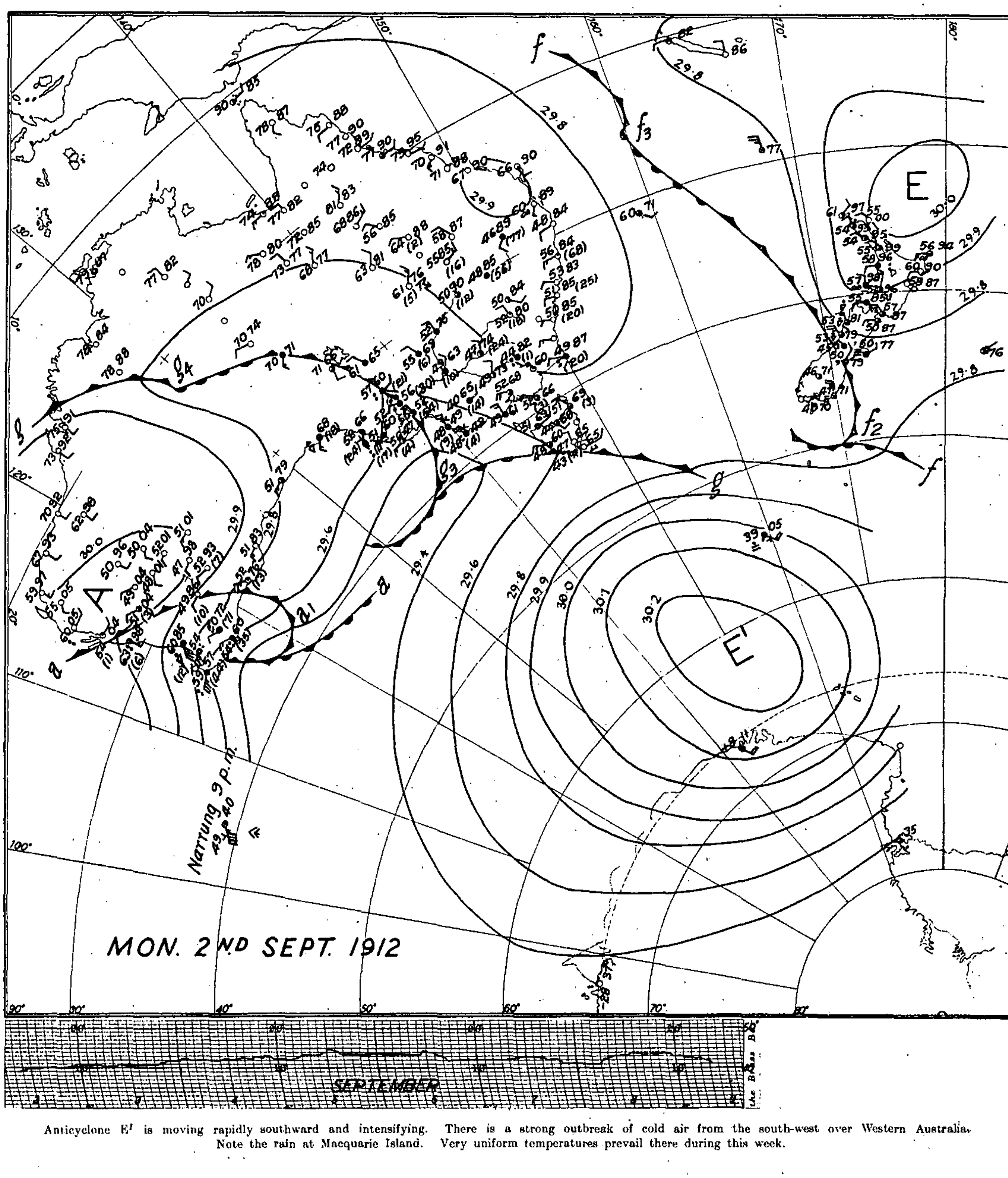
Cyclone g_1 has now passed Cape Evans where a blizzard is blowing. Conditions are still very disturbed over New Zealand.



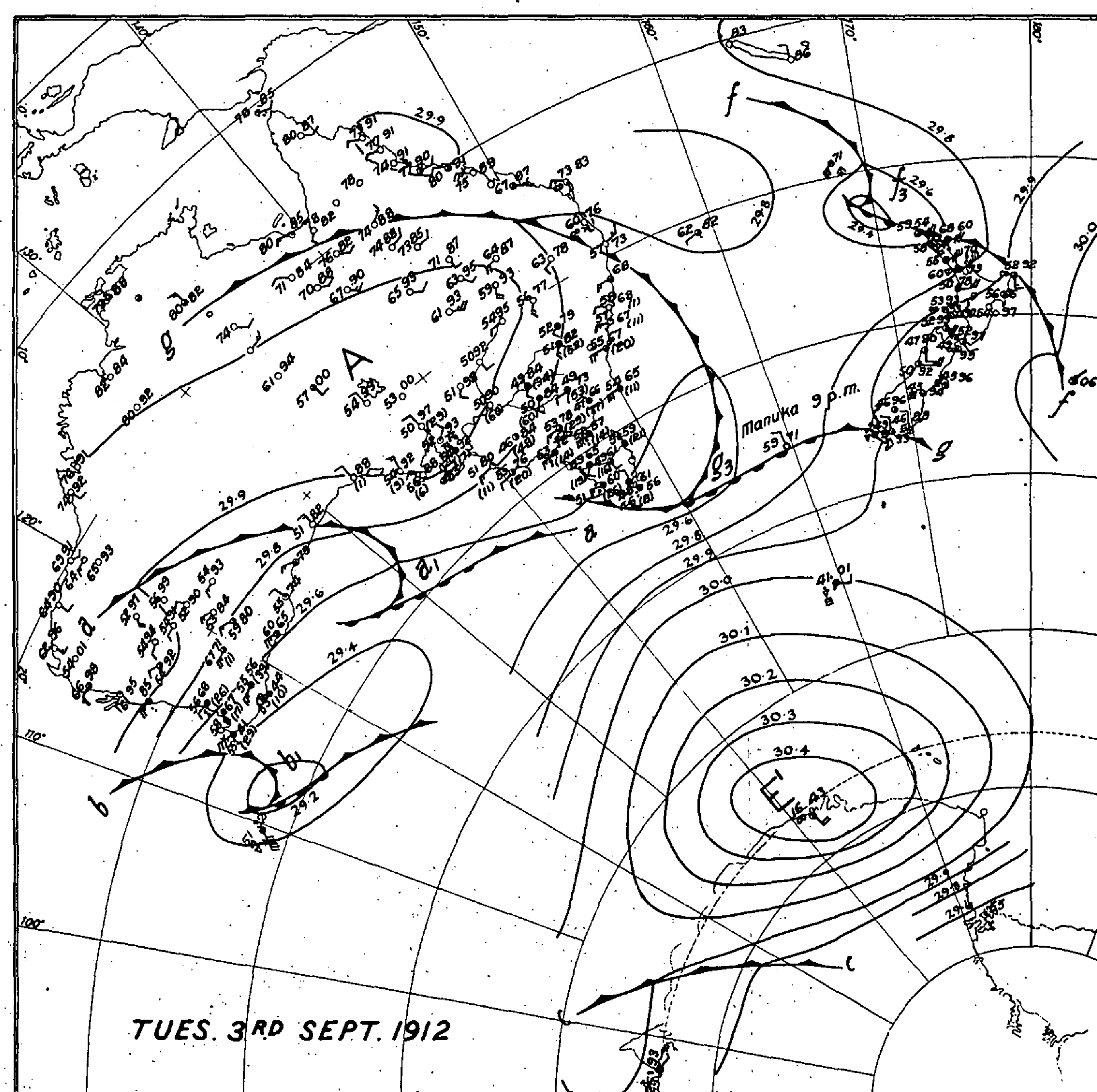
QUEEN MARY LAND
PERTH
MELBOURNE
MACQUARIE ISLAND
ADELIE LAND
CAPE EVANS
AUGUST



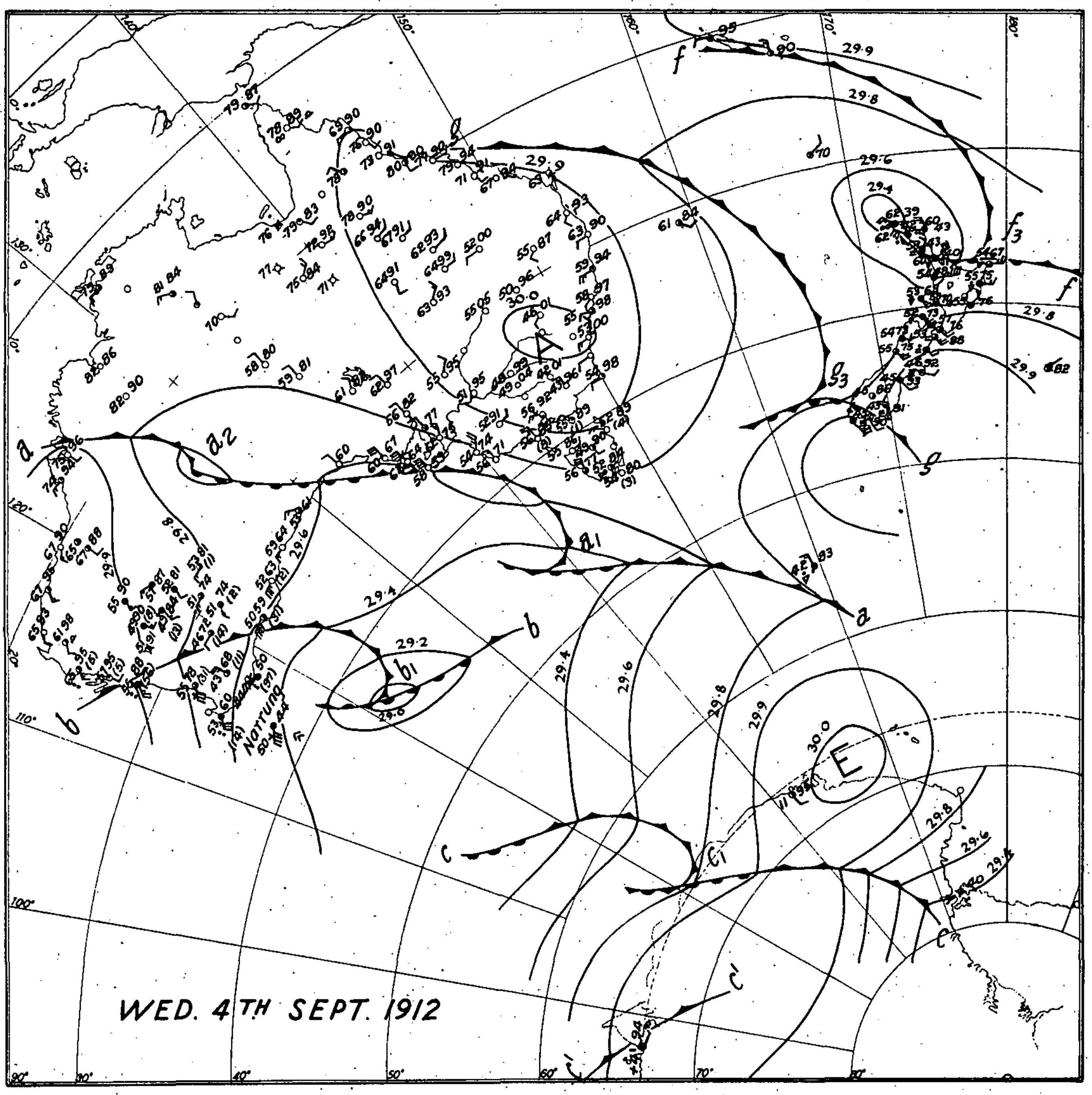
Anticyclone E has been divided by front *f*, the northern portion has moved into very high latitudes. The temperature is low at Macquarie Island.



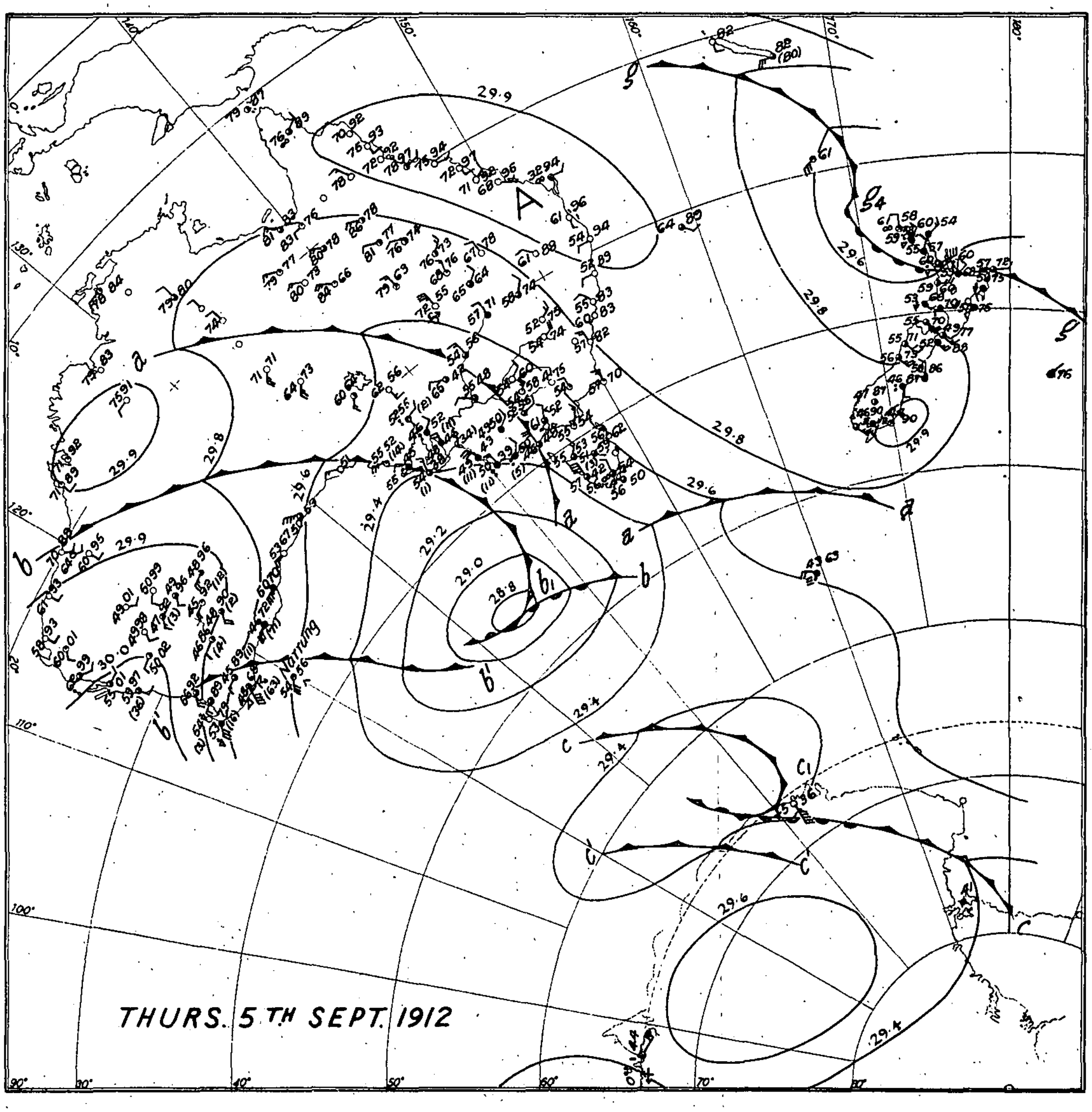
Anticyclone E' is moving rapidly southward and intensifying. There is a strong outbreak of cold air from the south-west over Western Australia. Note the rain at Macquarie Island. Very uniform temperatures prevail there during this week.



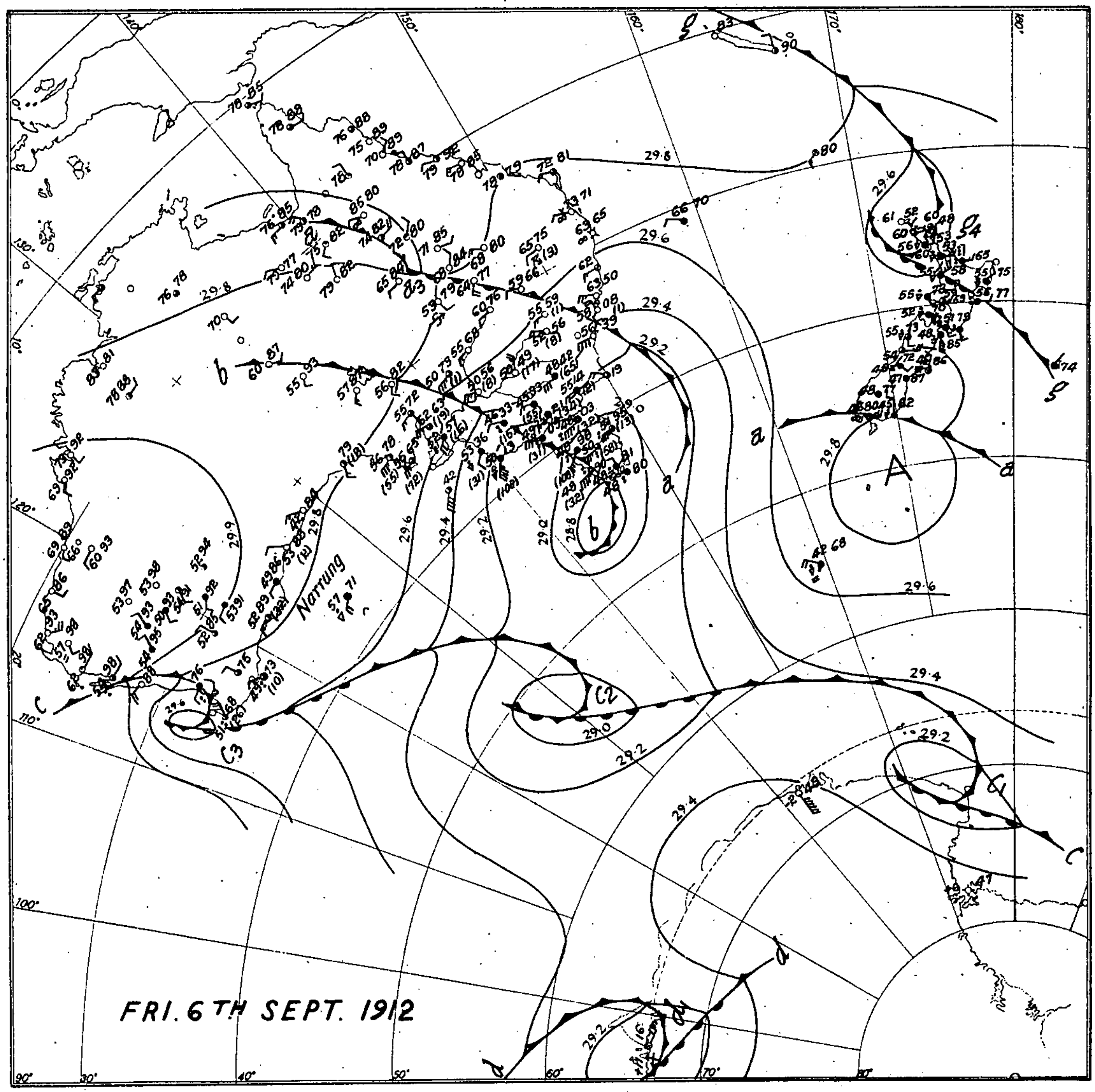
A very remarkable anticyclone is now centred near Adélie Land. A second outbreak of cold air is approaching Western Australia. A small cyclone is developing near northern New Zealand. There was a very large increase of pressure at Queen Mary Land following the passage of front *c*.



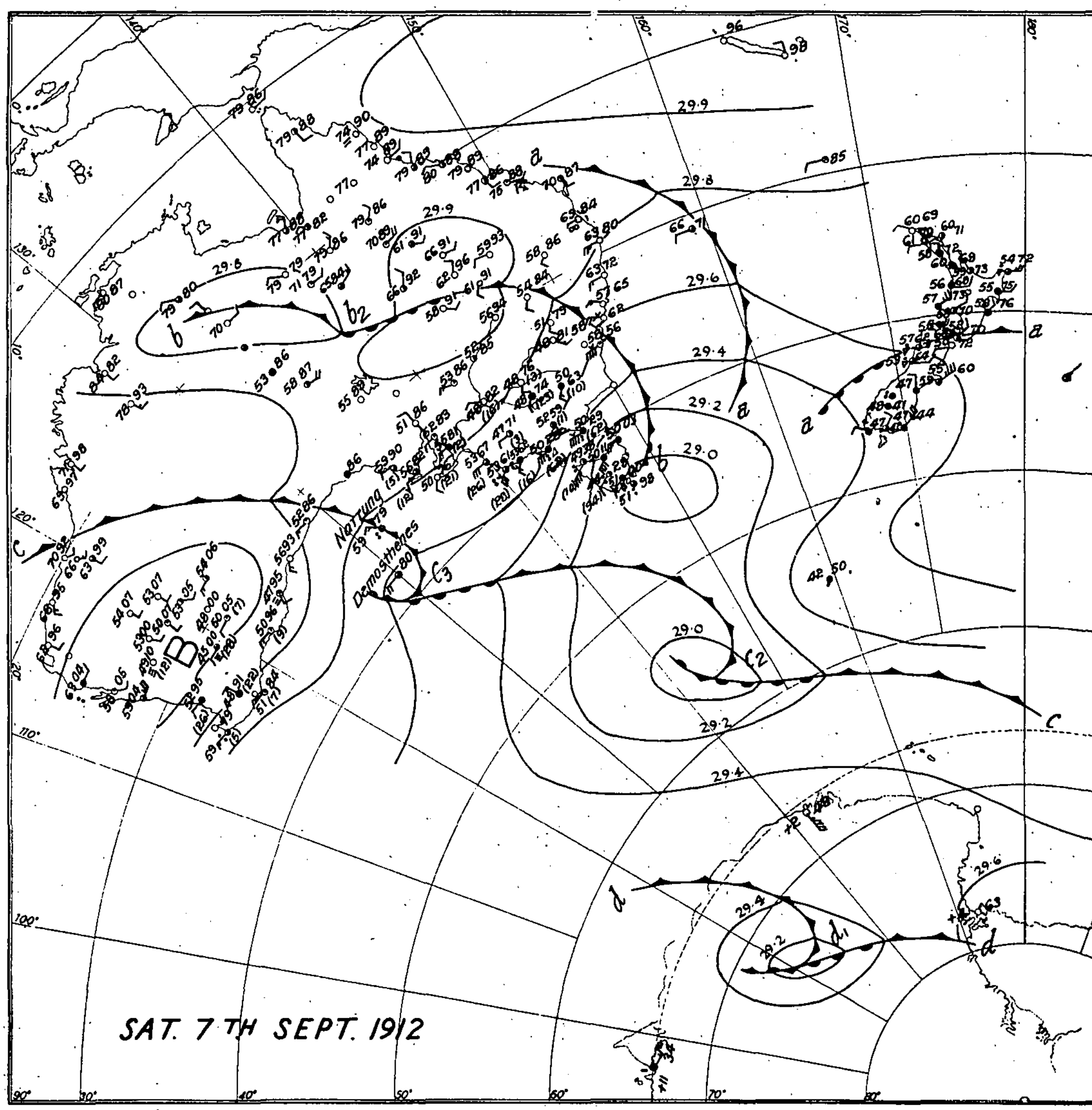
The anticyclone off the Antarctic coast is losing intensity. A series of interesting changes was propagated eastward over Australia from the 1st to the 7th September. The question of their relation to Antarctic conditions also is very interesting.



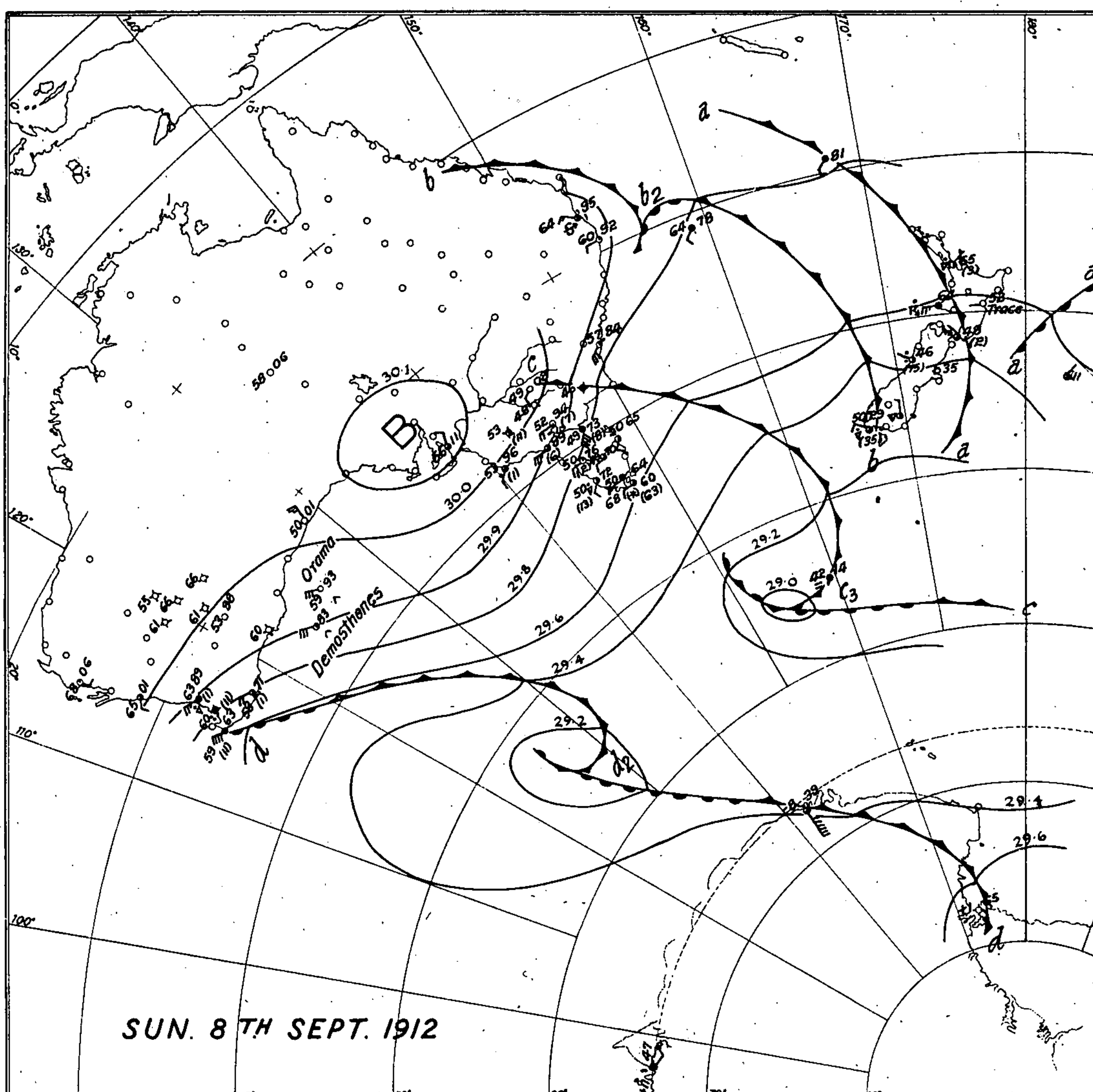
Note the wide northerly current over eastern Australia with a strong flow from west or south-west in rear of it and a deep cyclone to the south. Another cyclone is developing over northern New Zealand, this time on front *g*. Pressure has fallen in Antarctica.



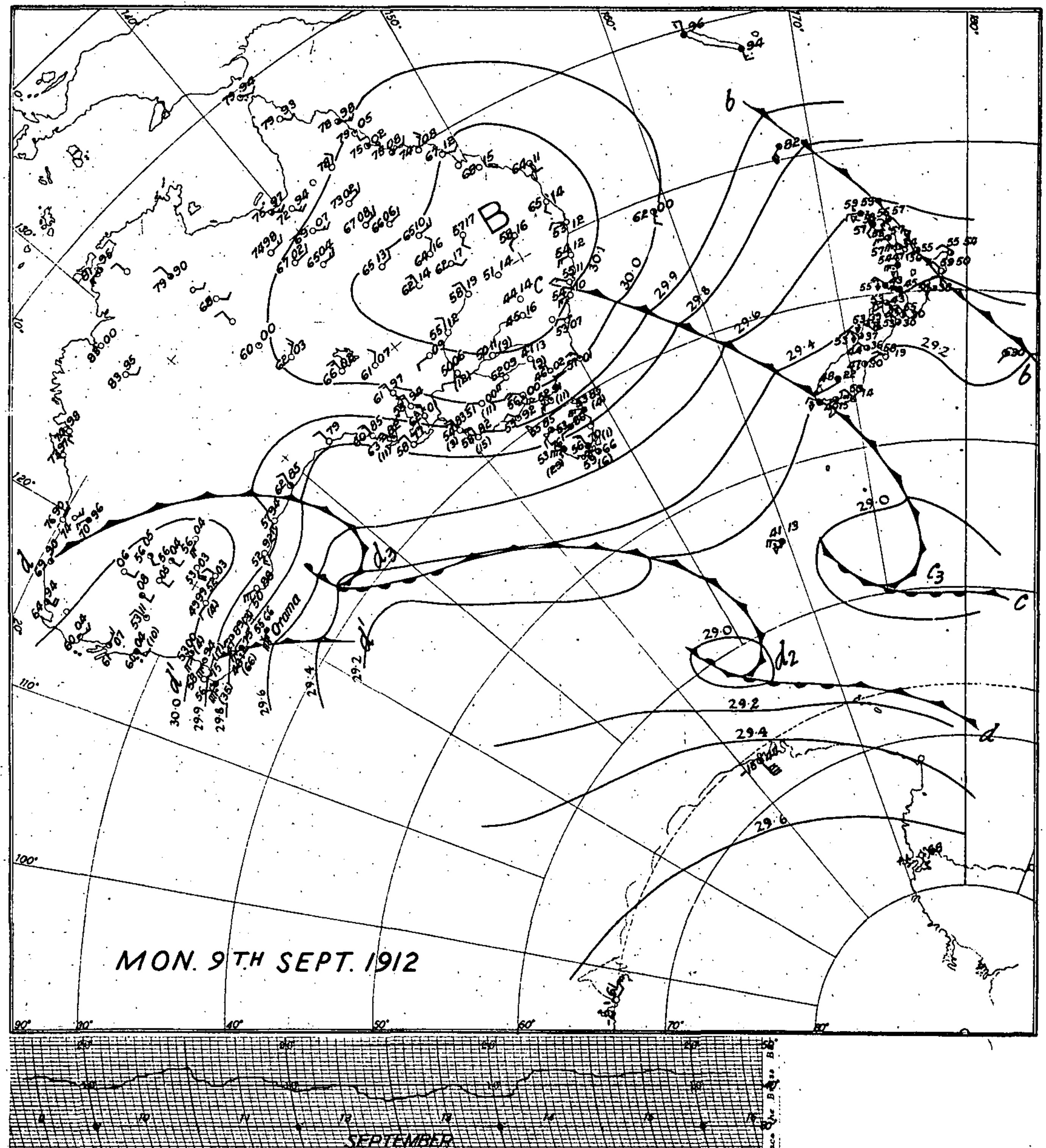
A strong wind circulation is still in evidence over south-eastern Australia and a deep cyclone is centred near Tasmania. The cyclone in northern New Zealand is becoming occluded.



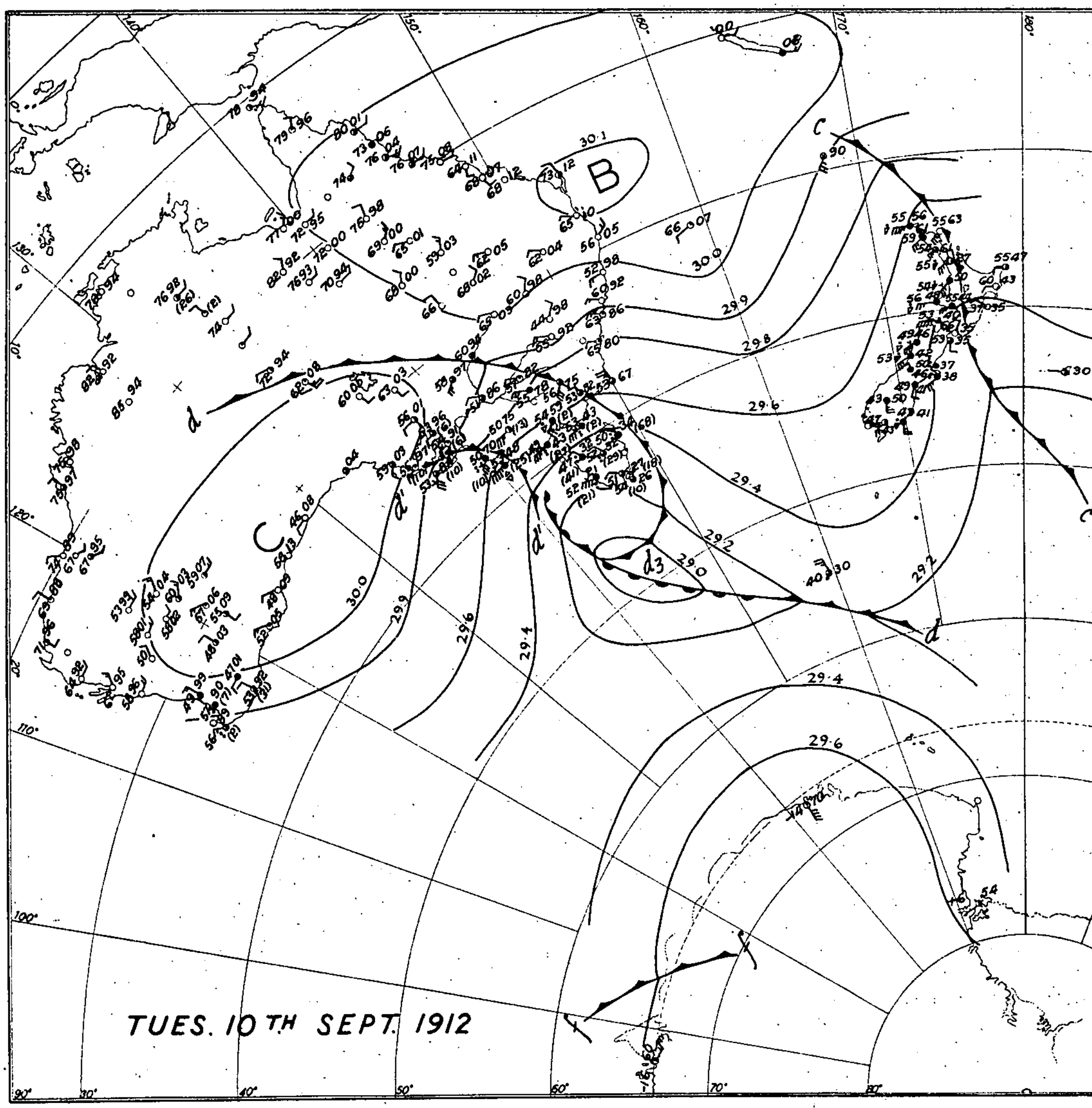
The circulation is still strong in south-eastern Australia but conditions are becoming more normal. Pressure is high in Antarctica, especially at Cape Evans. Front d has little effect on the latter and wave d_1 is therefore assumed to move southward.



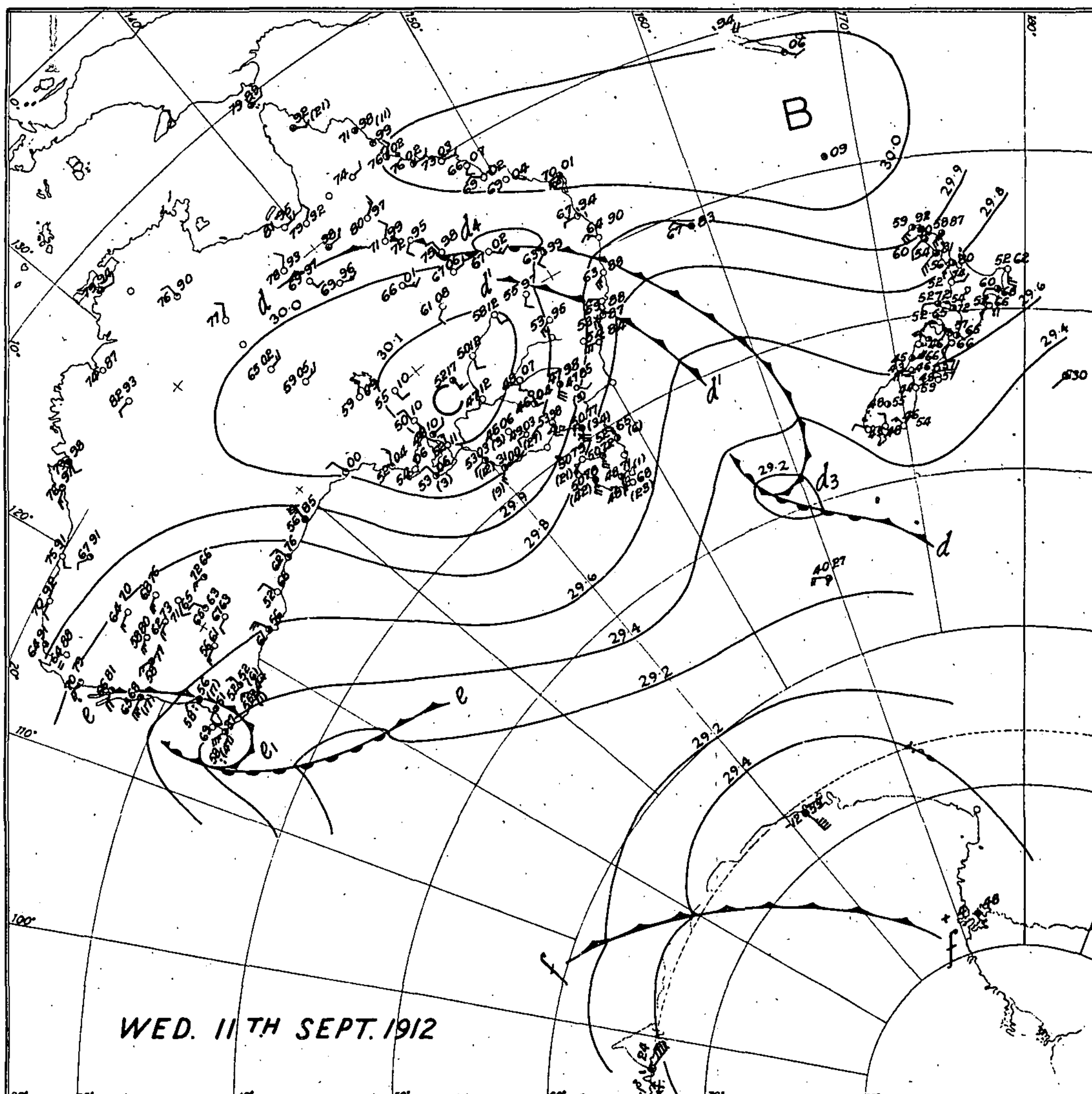
There are strong winds south of Australia. A cyclone is passing just south of Macquarie Island.



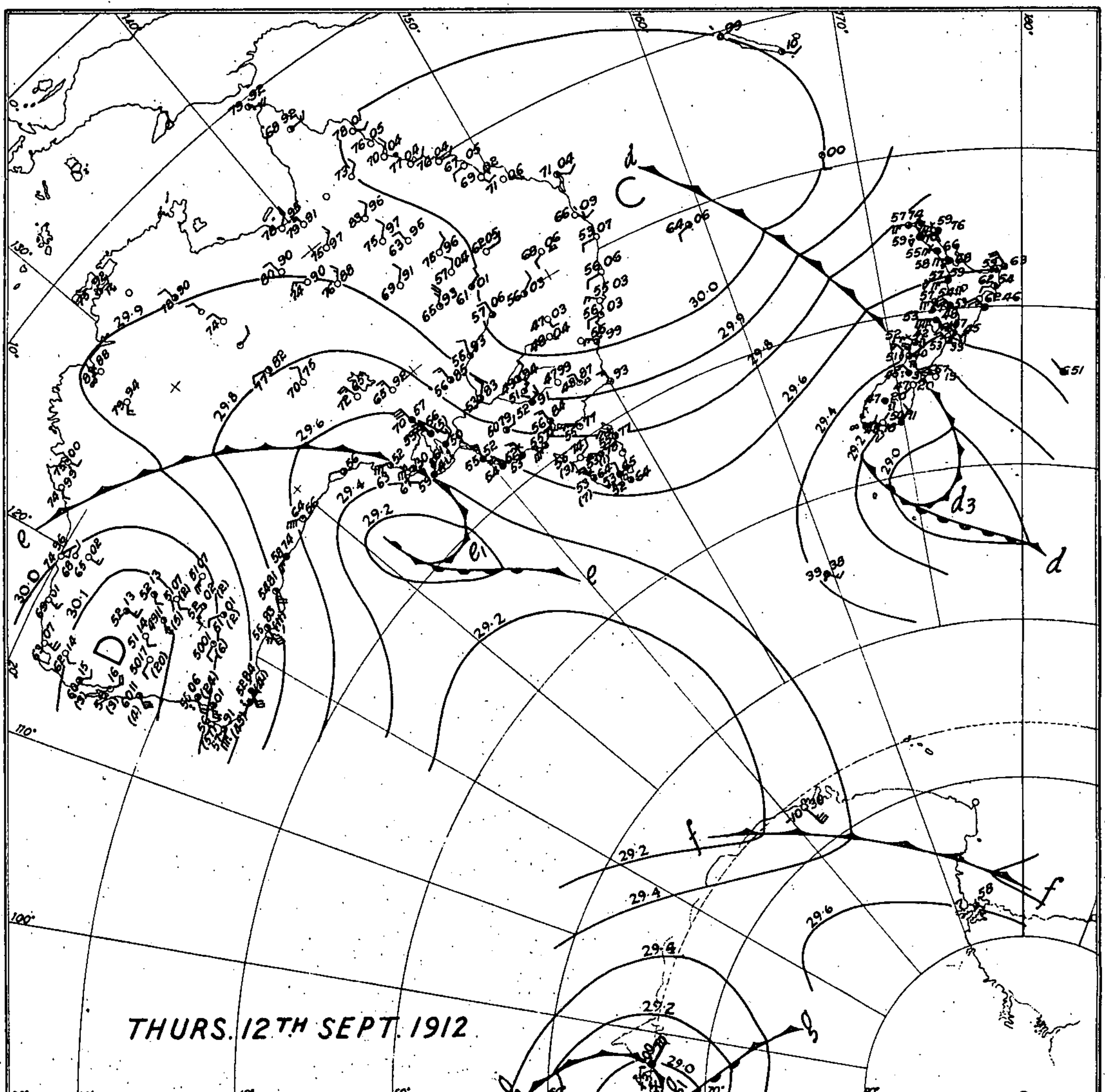
Winds are still strong south of Australia. There has been little change of temperature at Macquarie Island where northerly winds still prevail.



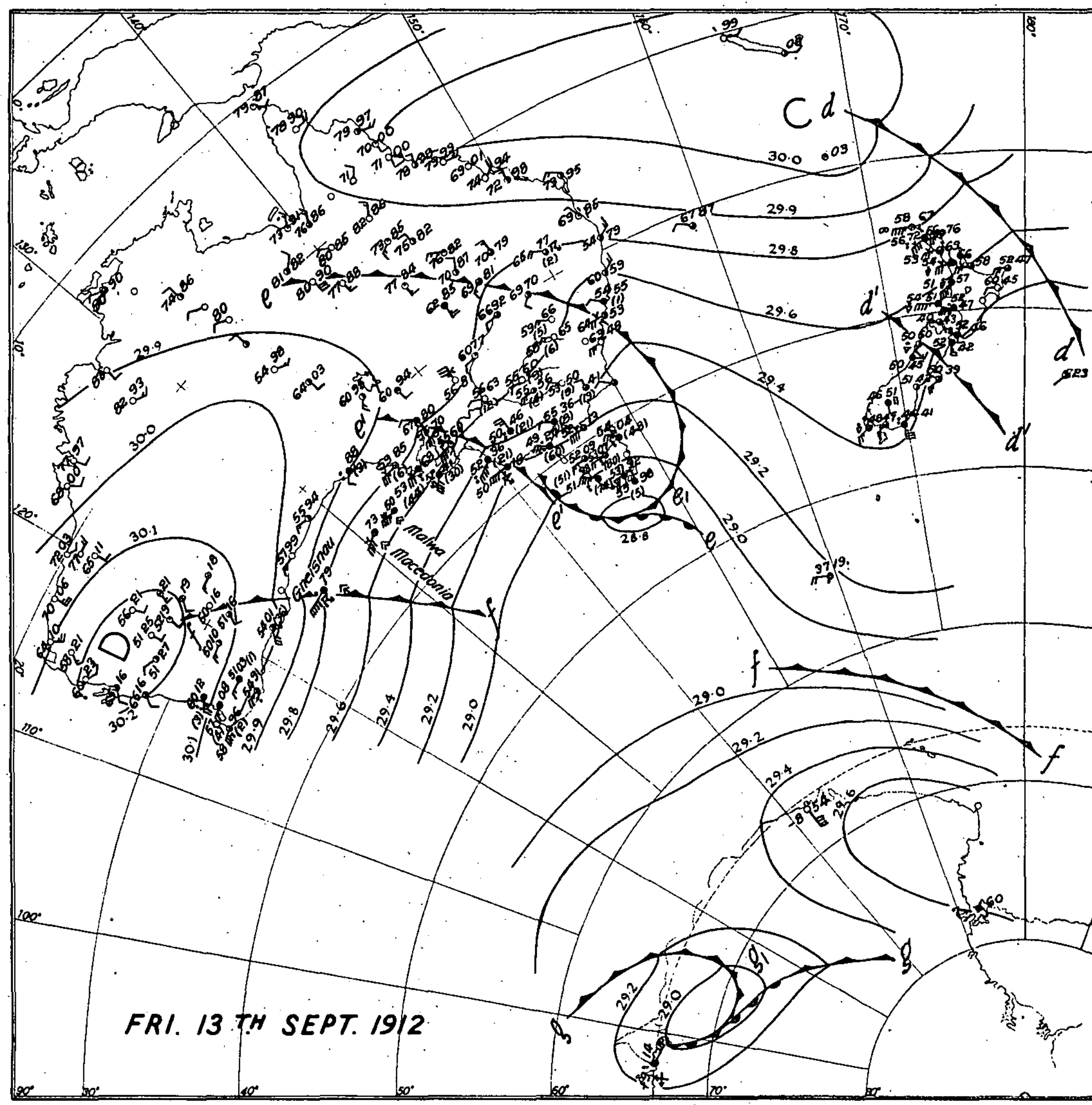
Pressure is still very high in Antarctica, especially at Adélie Land, but low south of Tasmania. There is widespread rain in New Zealand.



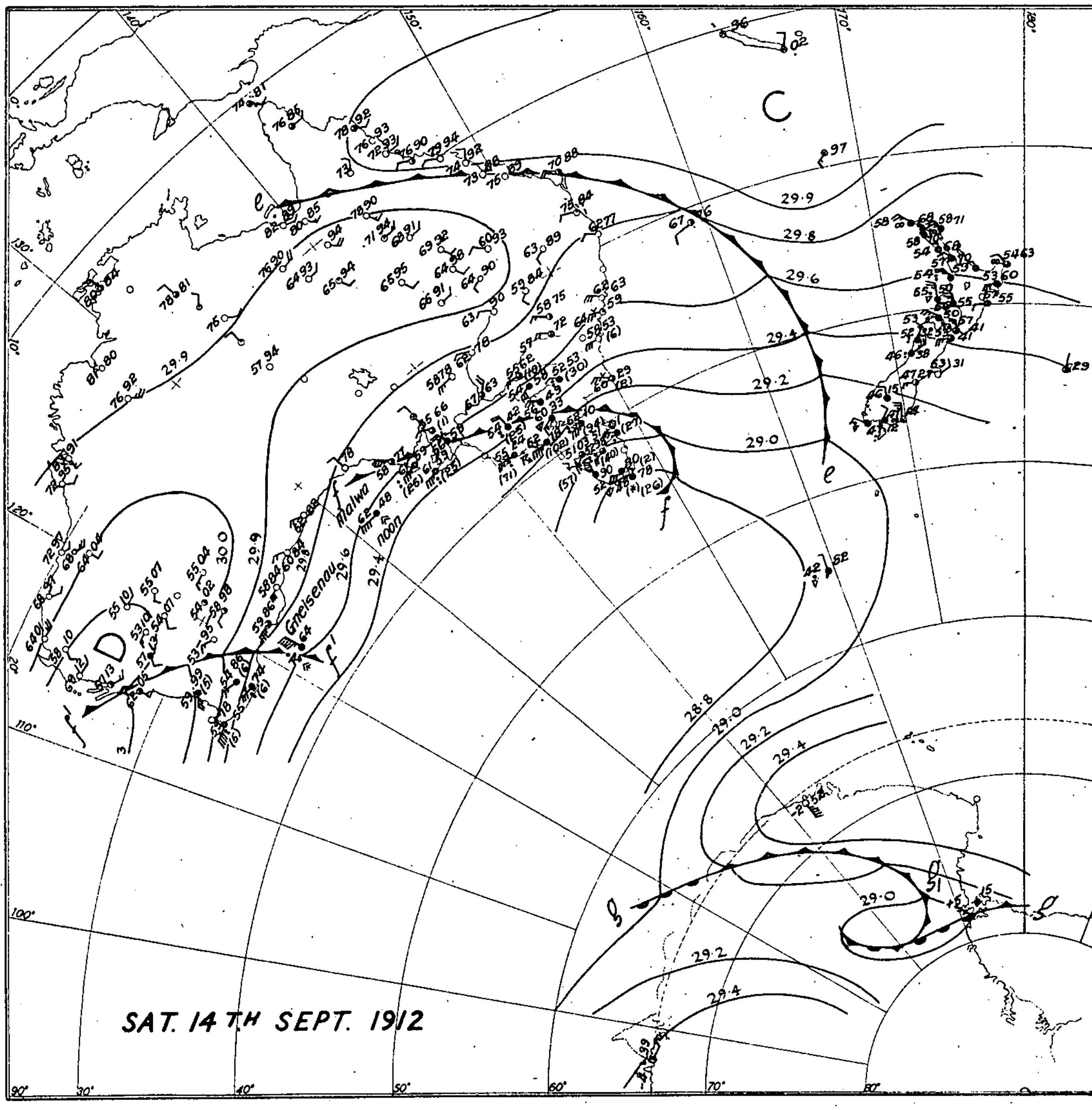
A blizzard is blowing at Queen Mary Land, and a cyclone approaching. The circulation over southern Australia is still vigorous.



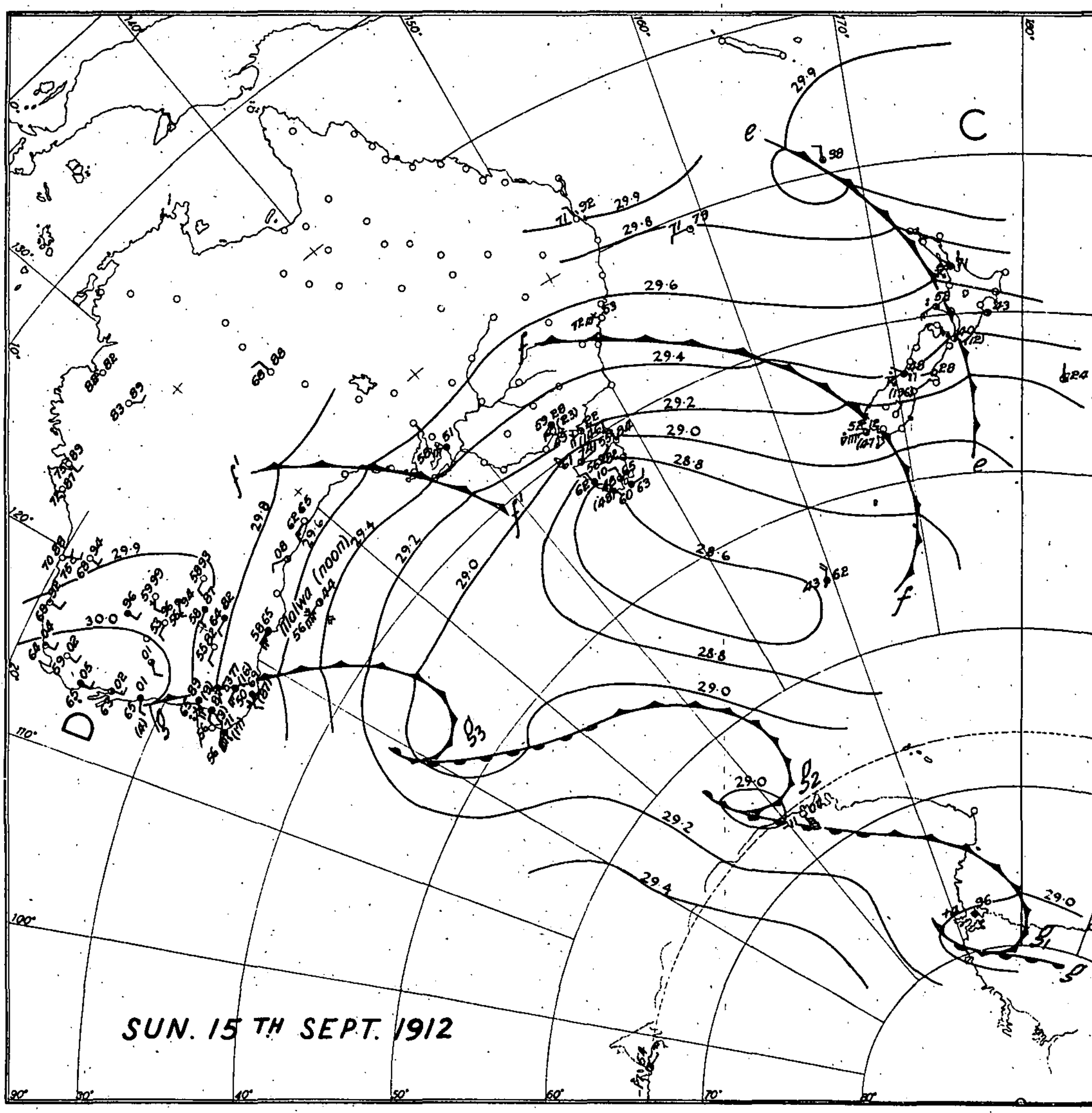
A cyclone is crossing Queen Mary Land which experiences both cold front and occlusion. The westerly type of weather is well-marked over Australia and New Zealand. Note the converging flow into the cyclone centred south of the Great Australian Bight. In New Zealand rain is remarkably widespread in advance of the front.



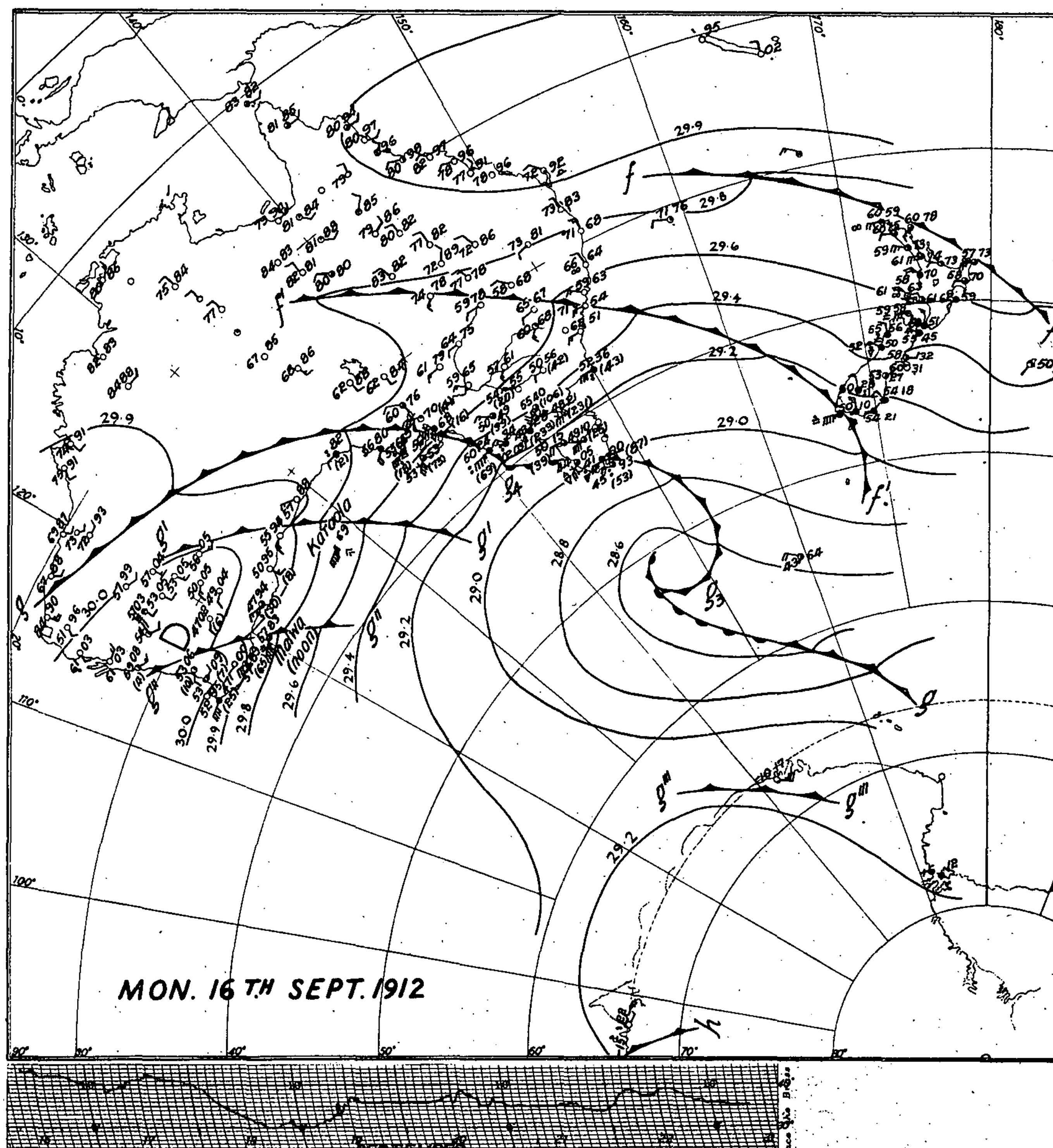
The westerly type of weather is still more pronounced over the Australia-New Zealand area. Pressure is very low over Tasmania. There are strong gales in the Great Australian Bight. Pressure is still high over eastern Antarctica.



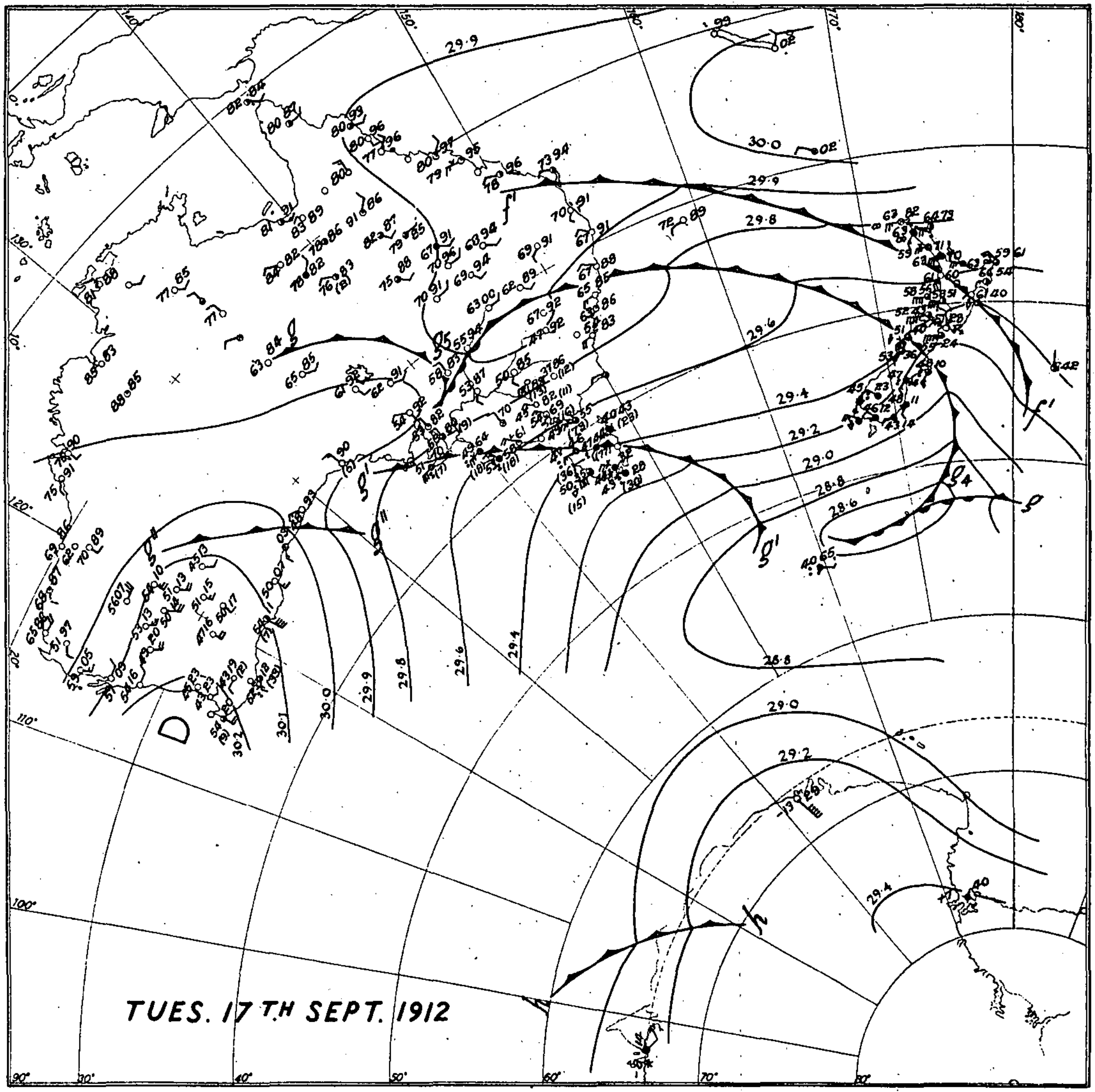
The westerly type of weather is still most pronounced over southern Australia. There is little sign of fronts passing Macquarie Island. Wave g_1 is now approaching Cape Evans but pressure is still high at Adélie Land.



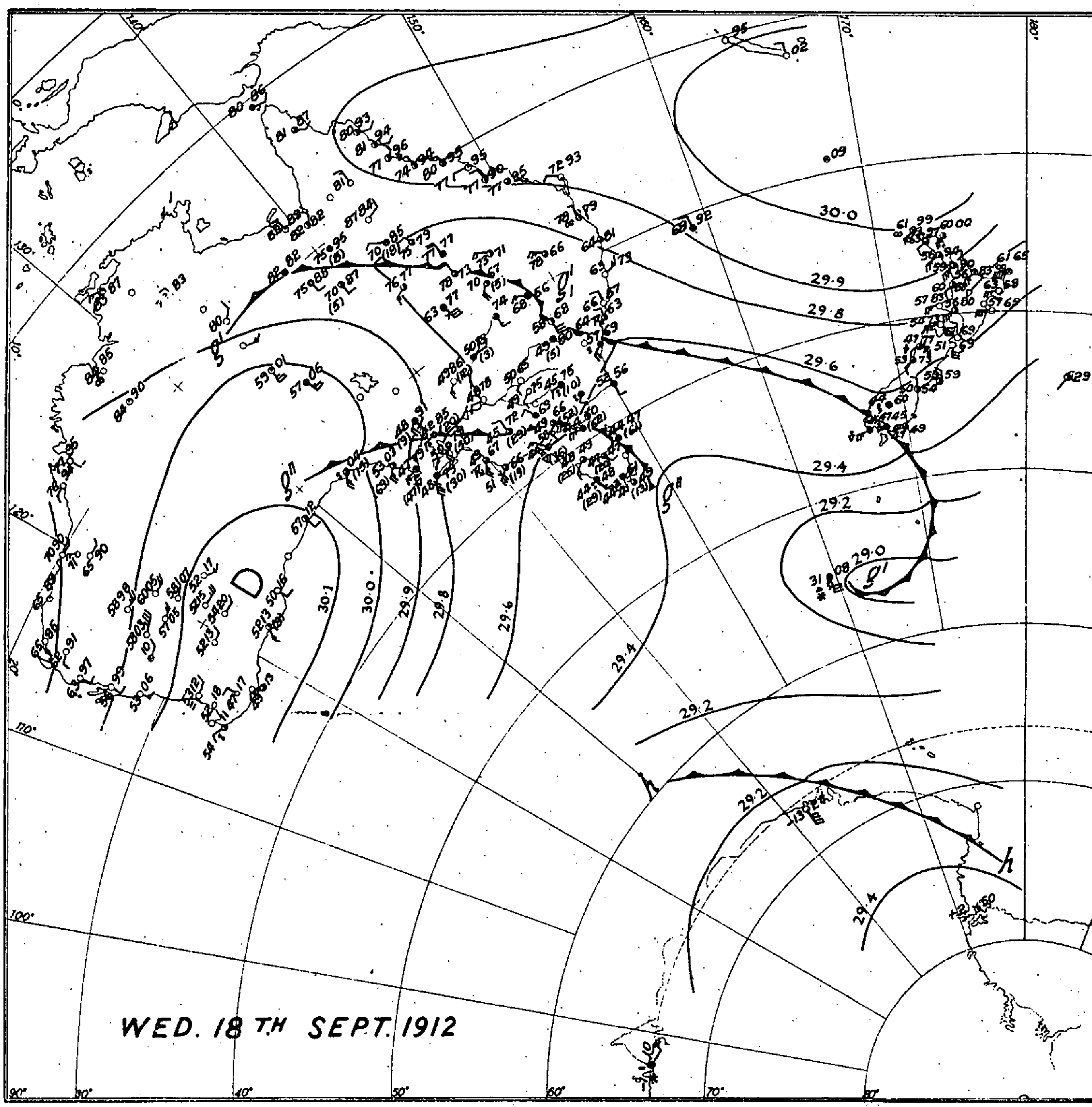
The westerly type of weather still persists over Australia and New Zealand. Pressure is very low at Macquarie Island. Light winds (direction not recorded) at Cape Evans suggest that the occlusion of wave g_1 is passing to the south. Pressure has fallen in east Antarctica, but is high again at Queen Mary Land.



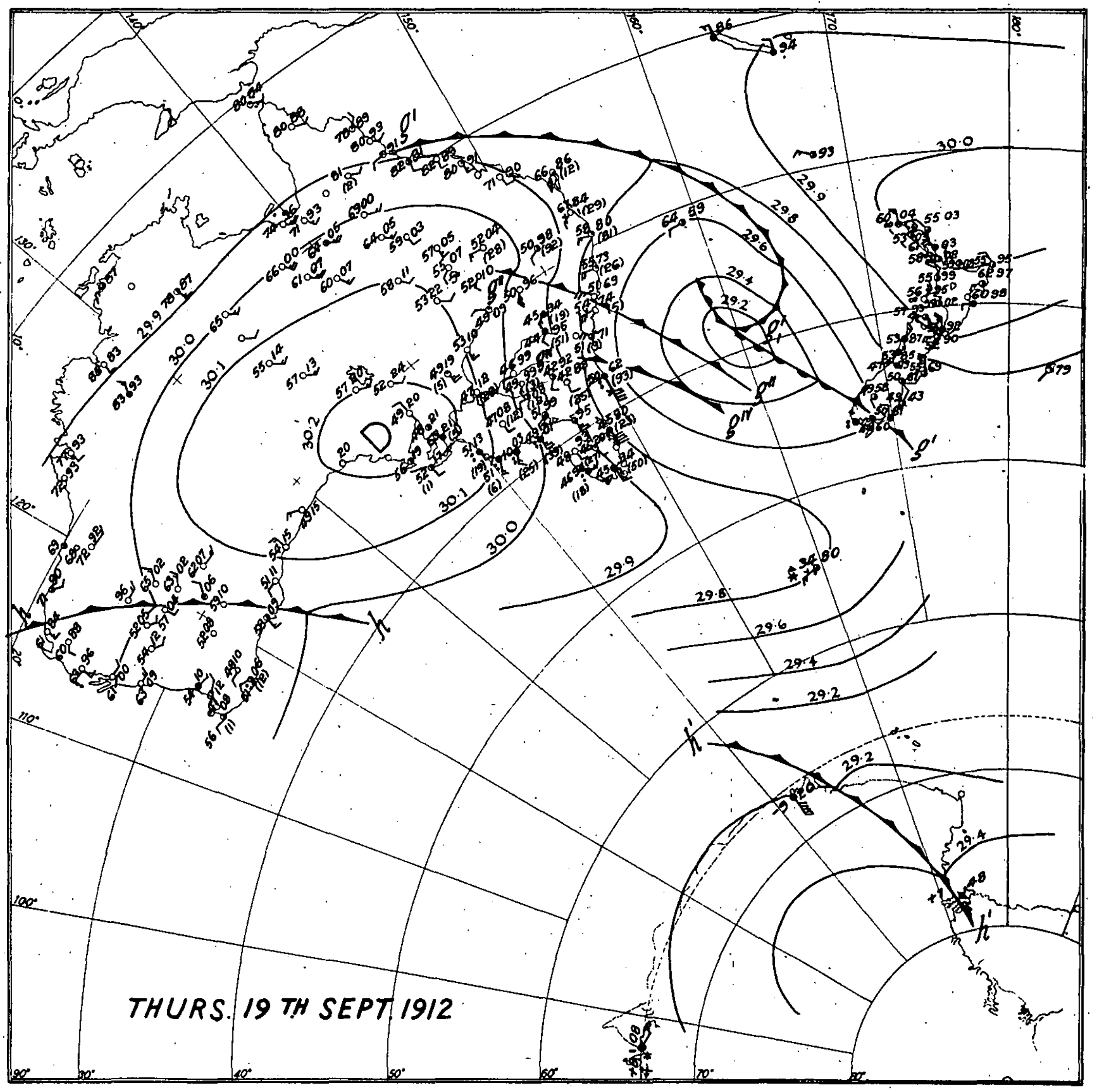
A similar situtation to that of the previous day persists. There are strong westerly gales over southern Australia and very low pressure at Macquarie Island. Pressure in Antarctica is more normal.



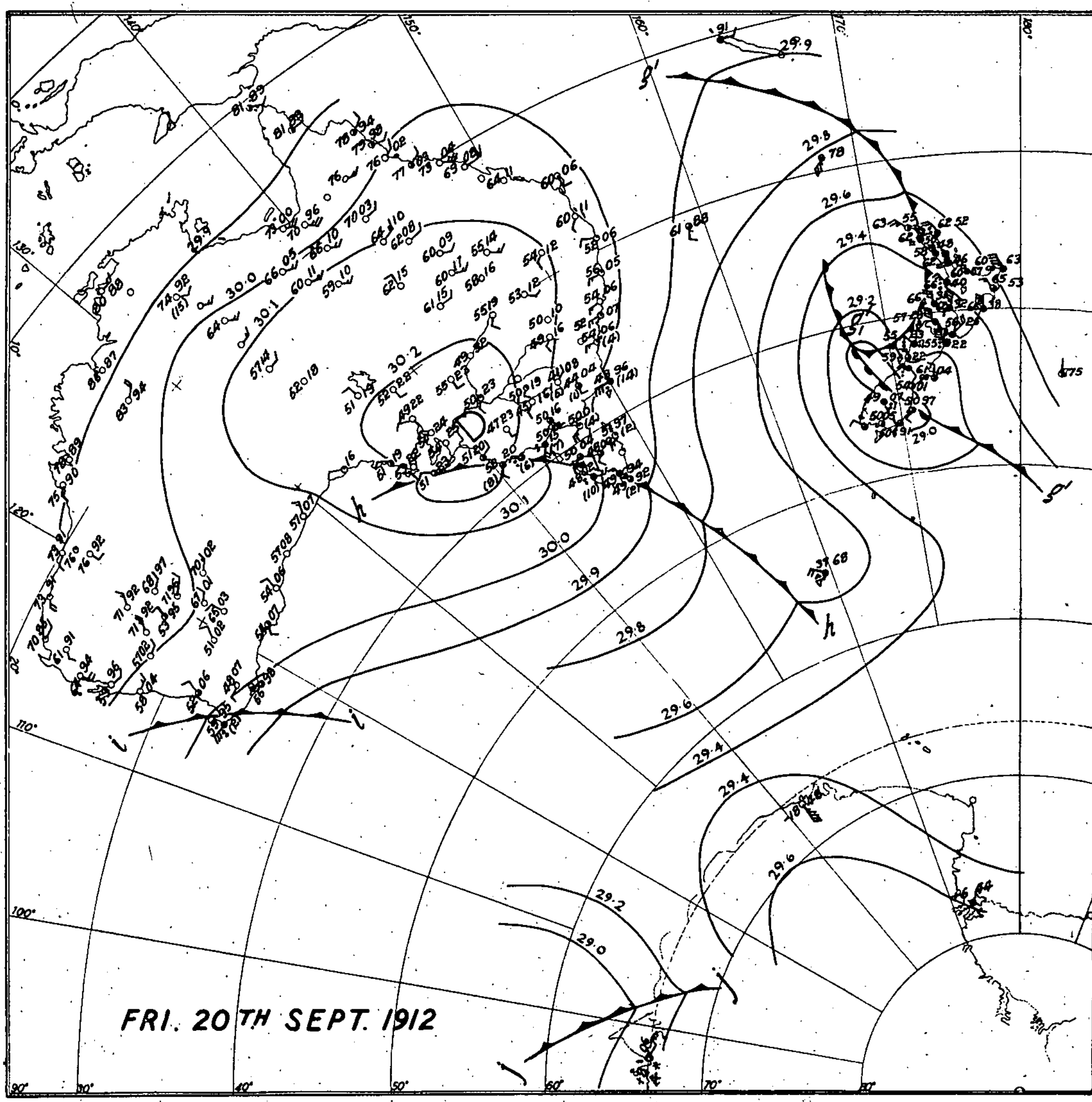
The spell of westerly weather is coming to an end in Western Australia. Note the evidences of unstable conditions in westerly weather; heavy showers, hail and snow. There is a light easterly wind at Macquarie Island.



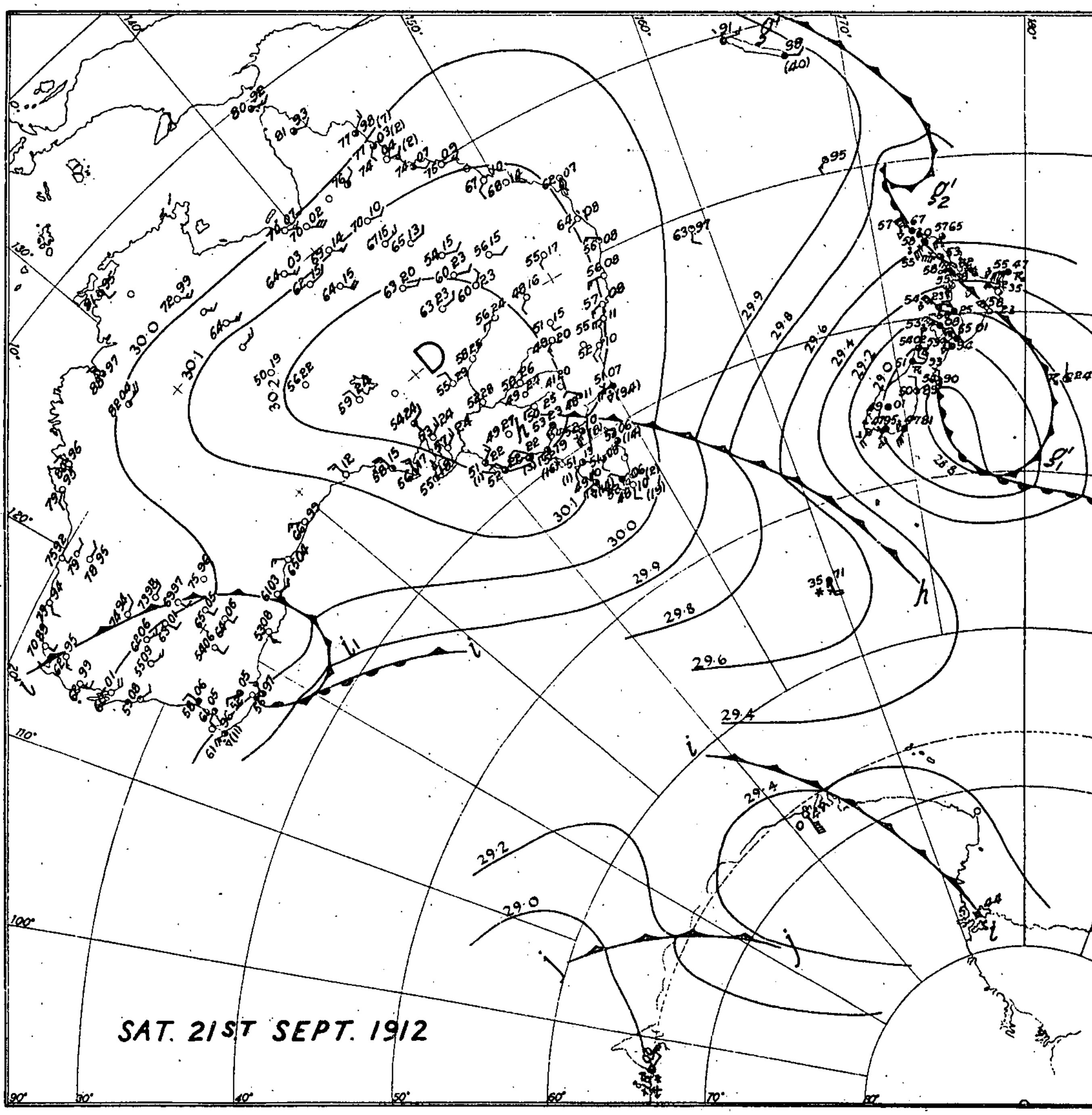
The westerly weather is gradually passing away. Temperature falls to a very low value at Macquarie Island on this day.



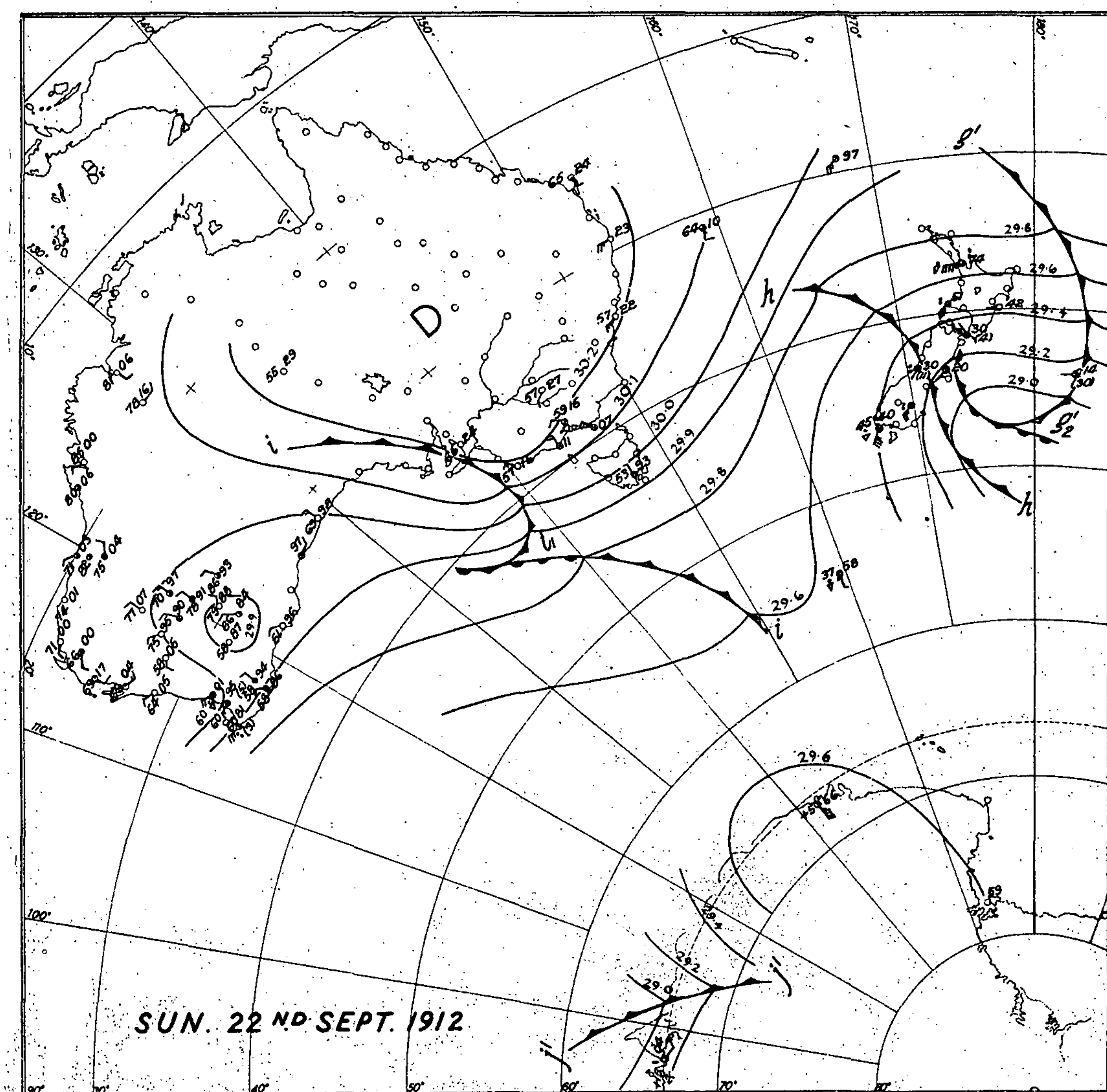
There is a strong outbreak of cold air over eastern Australia, while to the east there is a pronounced flow from the north extending over a wide range of latitude and a cyclone is developing over the Tasman Sea.



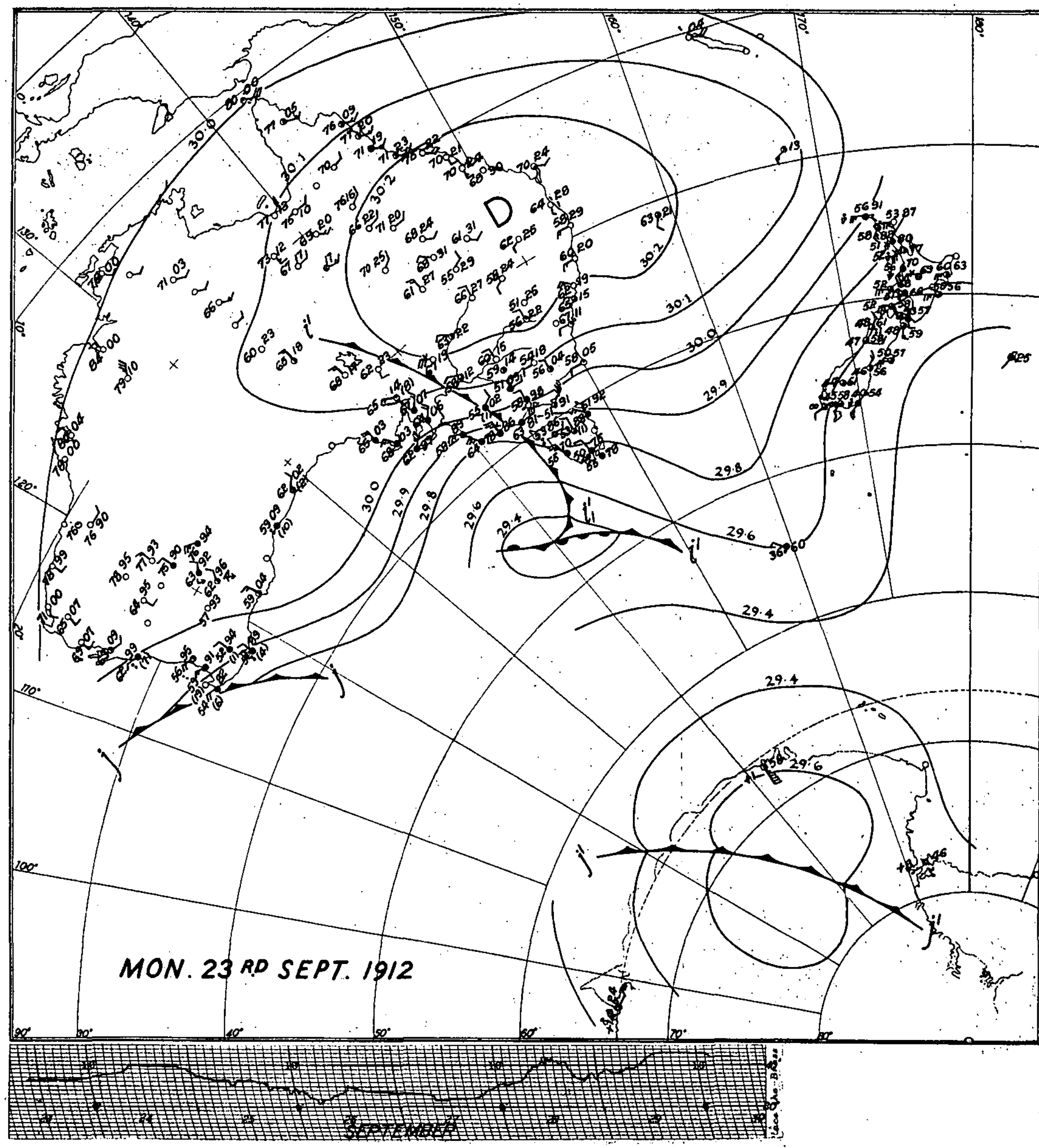
There is very widespread rain in New Zealand in the warm sector of the cyclone.



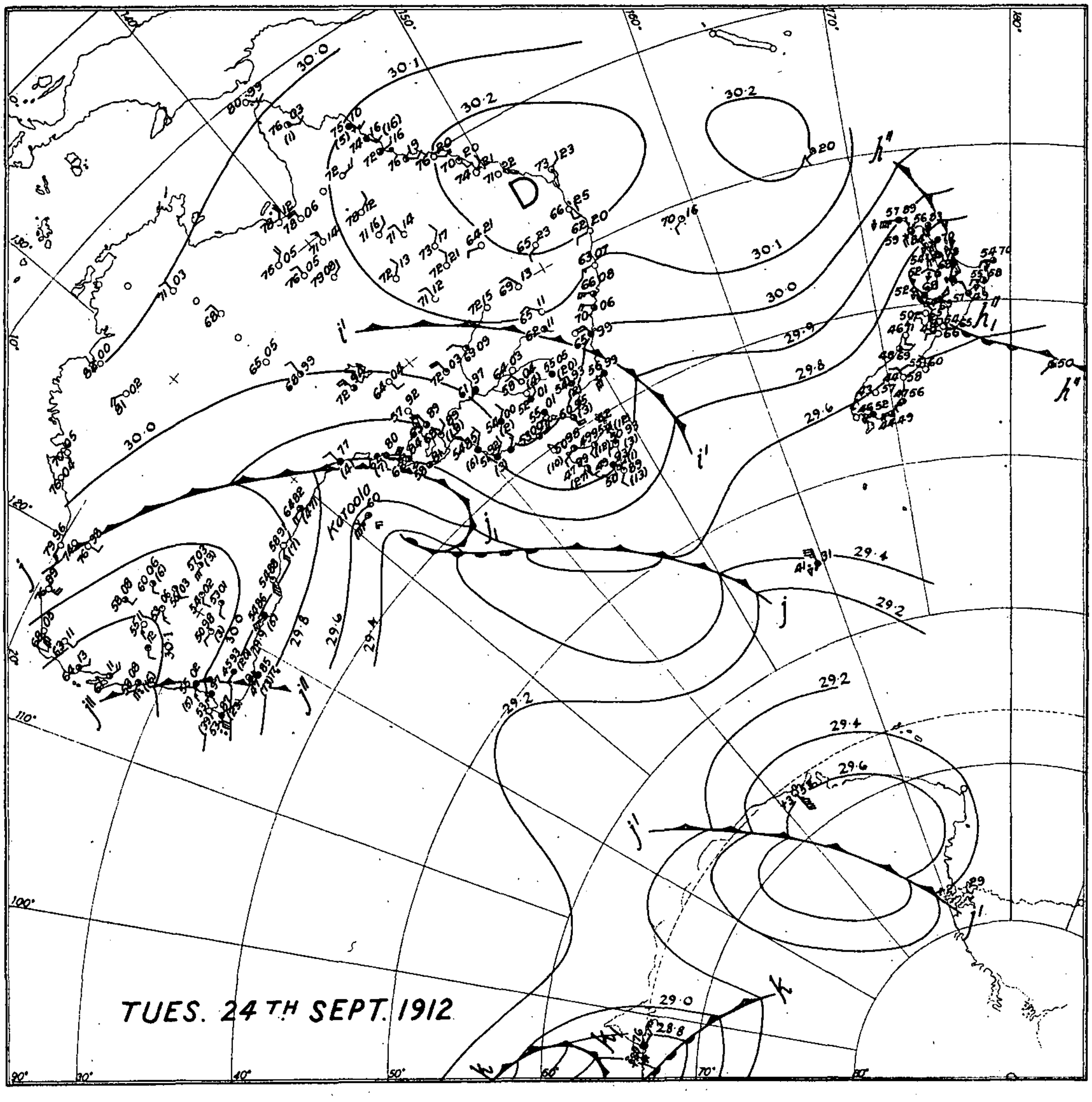
The cyclone is now passing New Zealand where there has been some flooding. Some thunderstorms have occurred and snow is falling on the high levels. In Antarctica there is little activity.



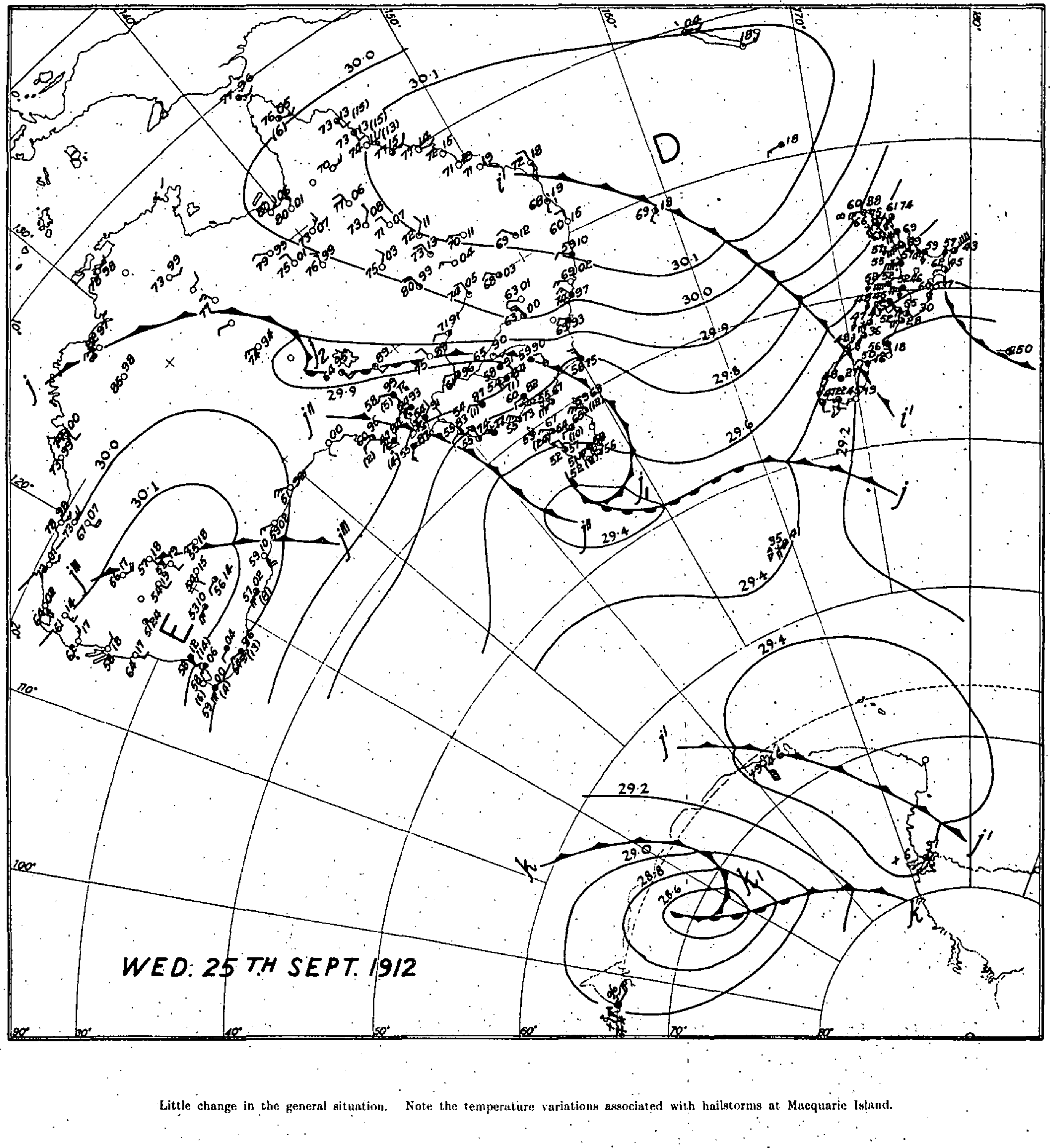
Pressure is very high again in eastern Antarctica and there is some recrudescence of westerly weather over southern Australia.



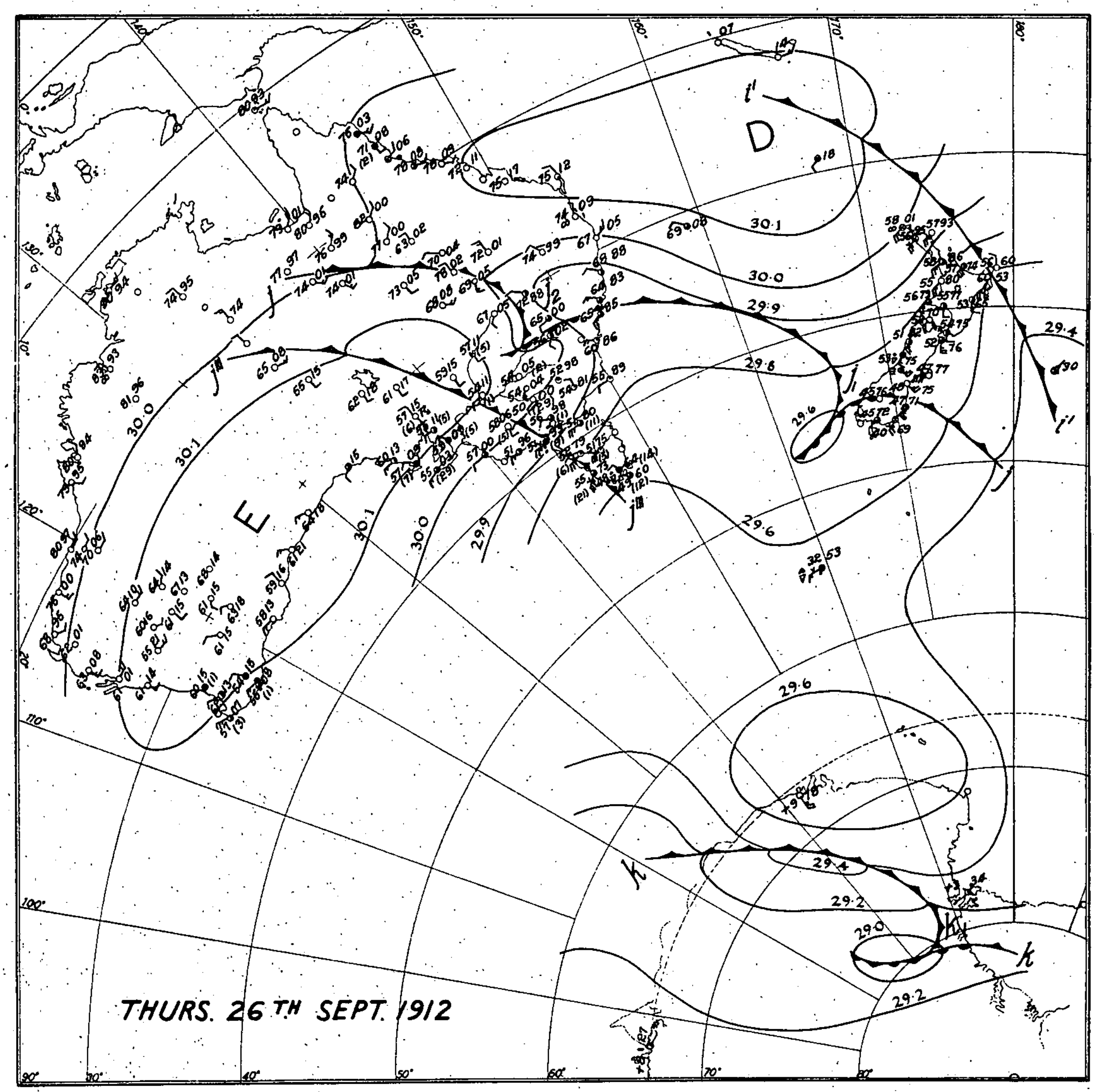
The westerly type of weather is moderately developed in Australia and New Zealand. Pressure is high and activity slight in Antarctica.



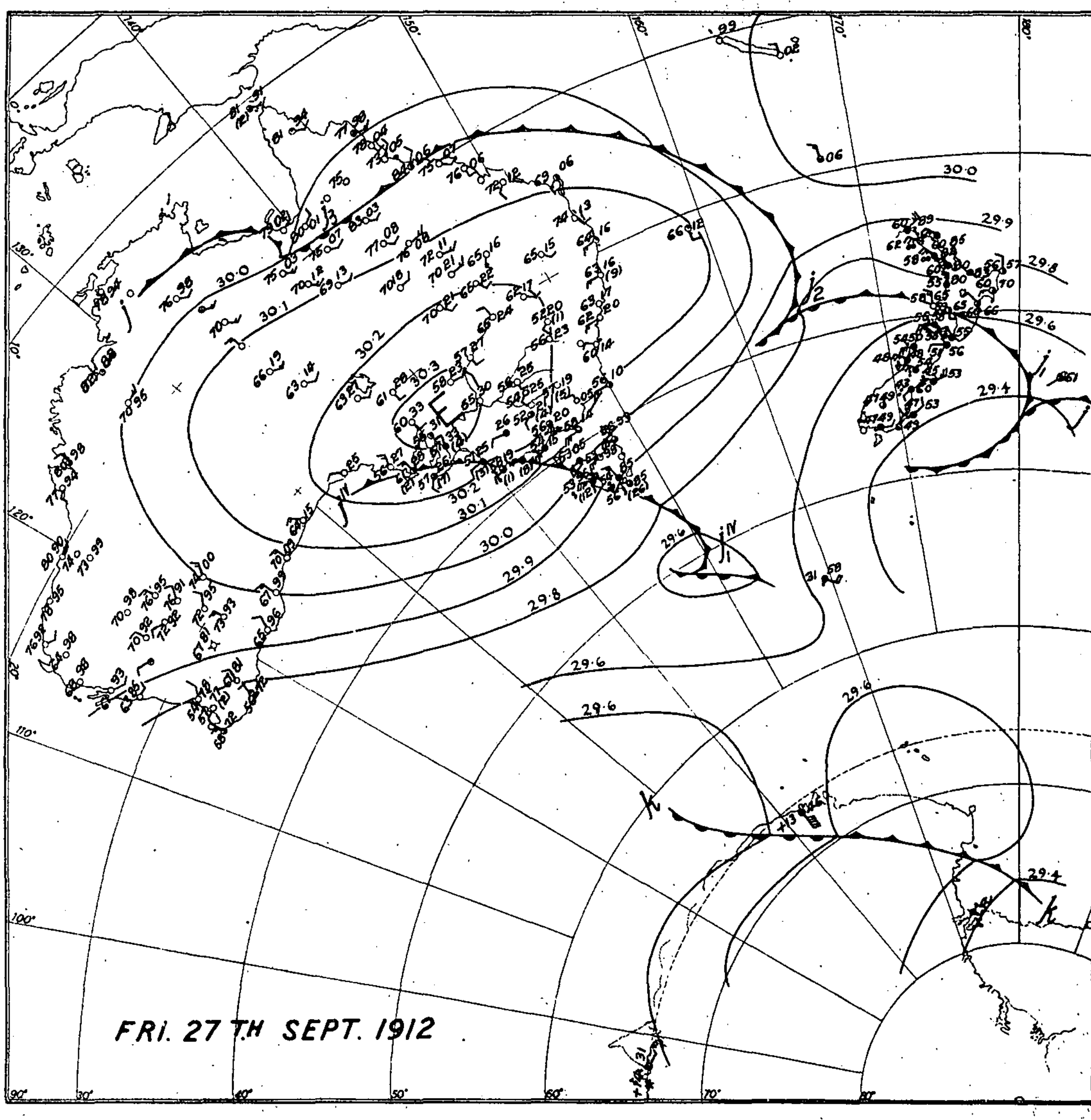
Westerly weather still prevails over southern Australia. A new front with a wave on it has appeared over New Zealand. Pressure remains high at Adélie Land but a depression is approaching Queen Mary Land.



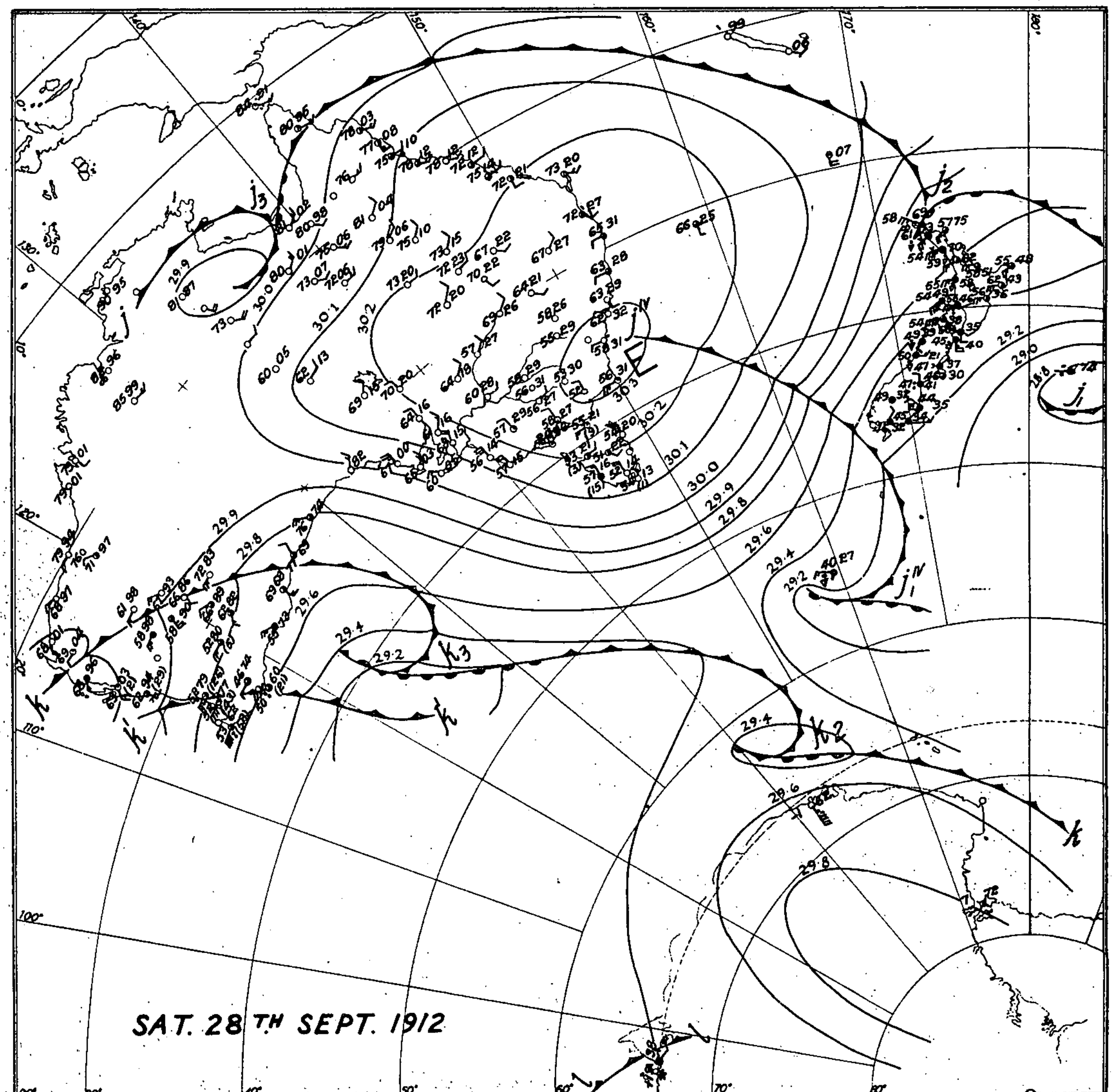
Little change in the general situation. Note the temperature variations associated with hailstorms at Macquarie Island.



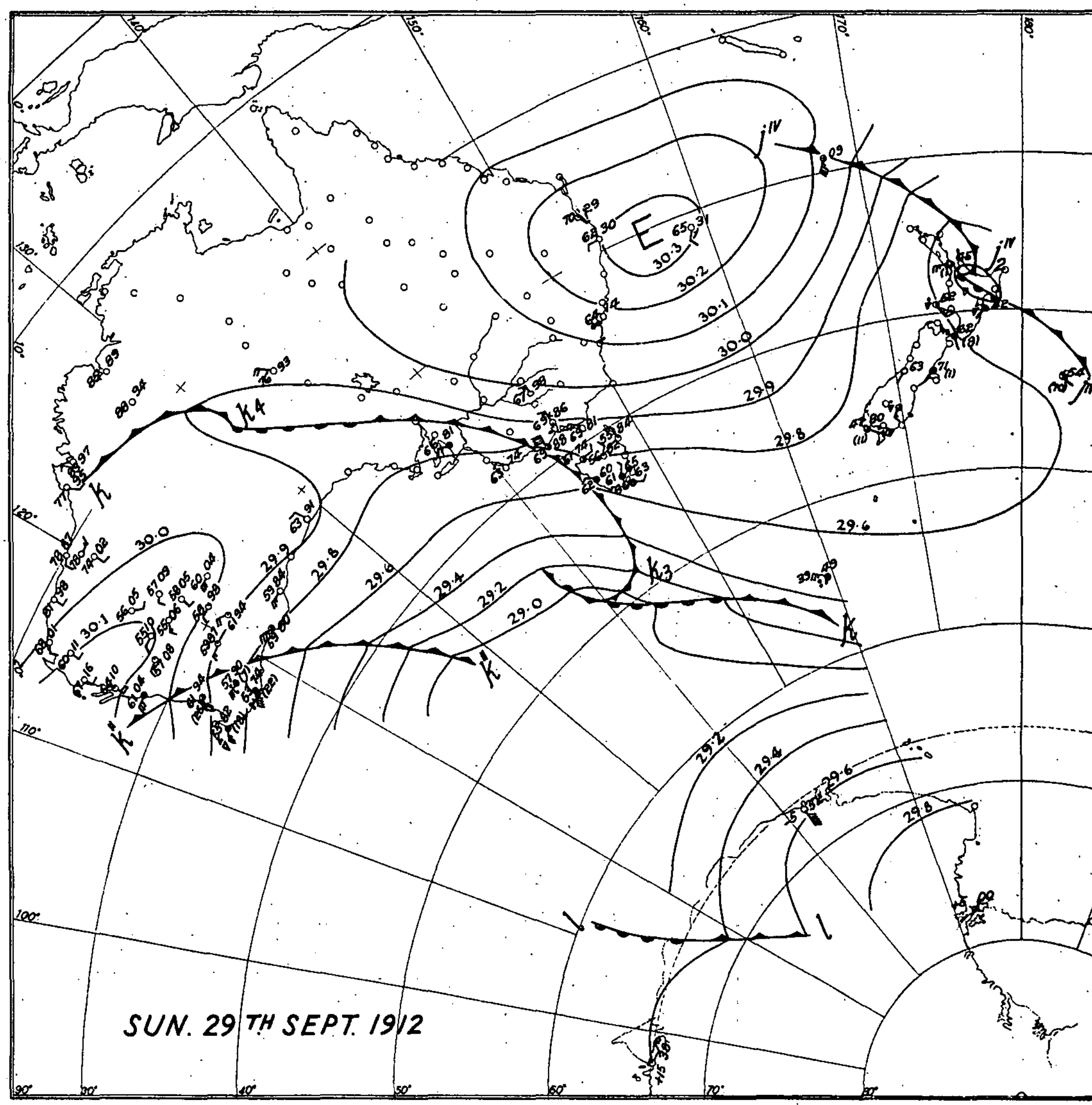
Wave k_1 apparently passes to the south of Cape Evans where winds remain light. Moderate westerly type of weather prevails in New Zealand.



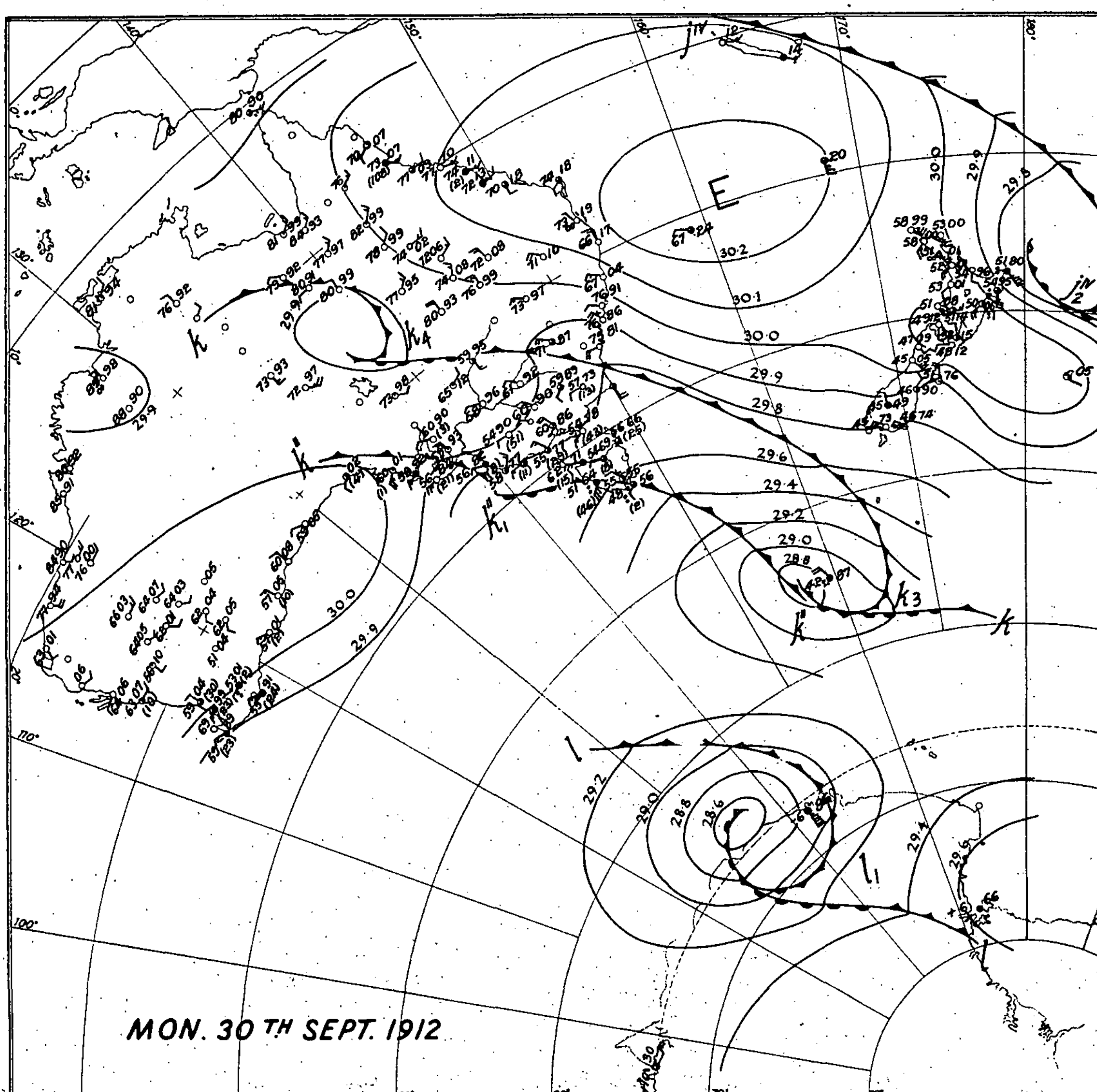
Note the weather over New Zealand and the form of the fronts shown. There is still a persistent tendency for high pressure over Antarctica.

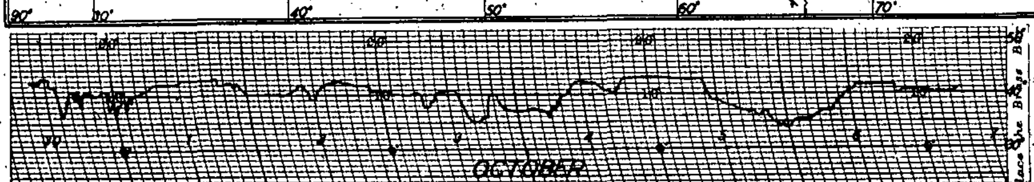


Note movement of front *j* and its waves in the New Zealand area. The waves are not moving southward along the front as is common but the whole system is being carried towards the north-east. A wave has just passed Macquarie Island.



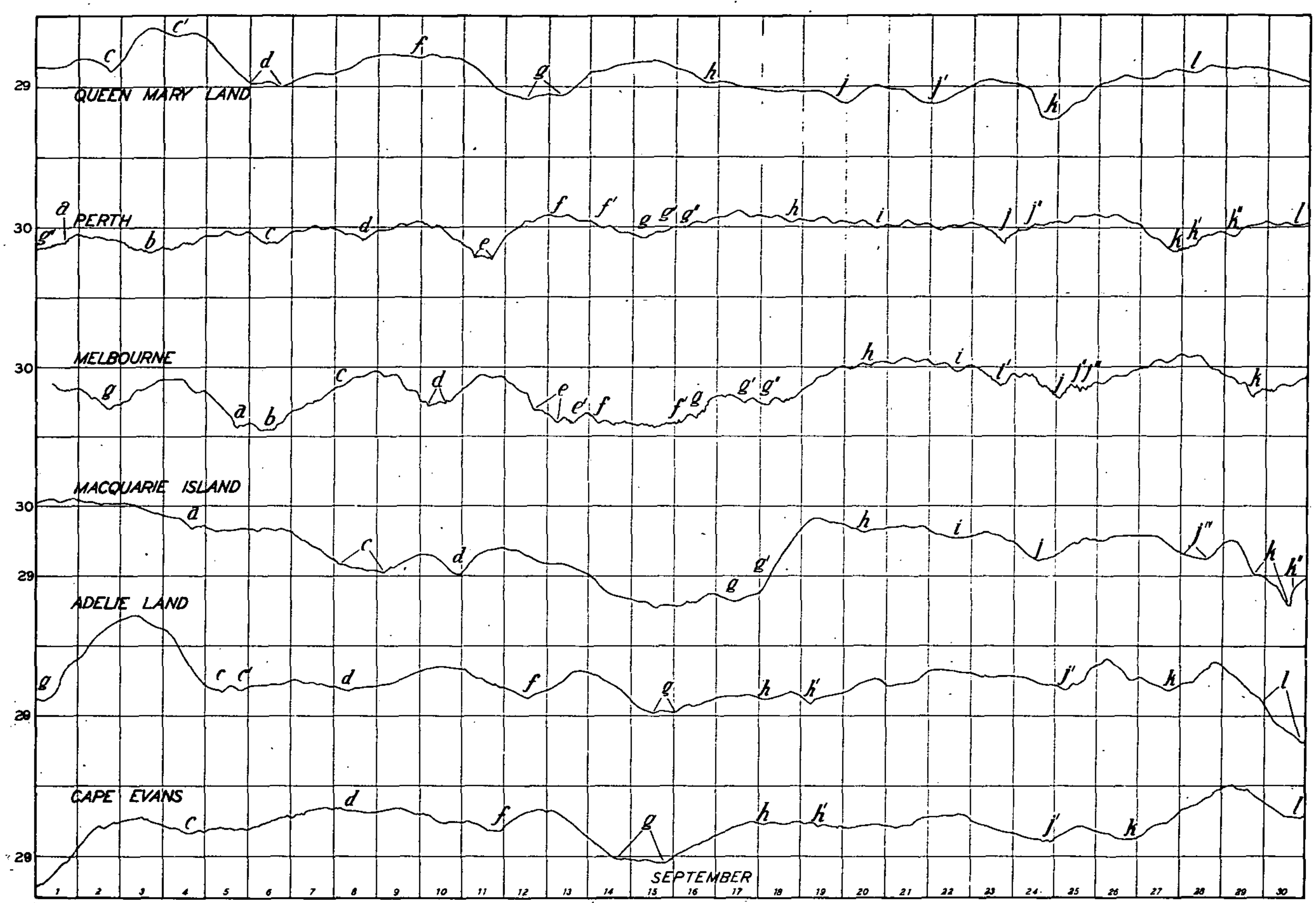
There are pronounced westerlies again in Western Australia. Pressure is exceptionally high at Cape Evans.





A deep cyclone passes Adélie Land during the day. The analysis over Antarctica when high pressure is prevailing, as during the past few days, is somewhat uncertain. A rather deep wave is passing Macquarie Island.

*35314—SEPTEMBER, 1912



QUEEN MARY LAND
PERTH
MELBOURNE
MACQUARIE ISLAND
ADELIE LAND
CAPE EVANS
SEPTEMBER
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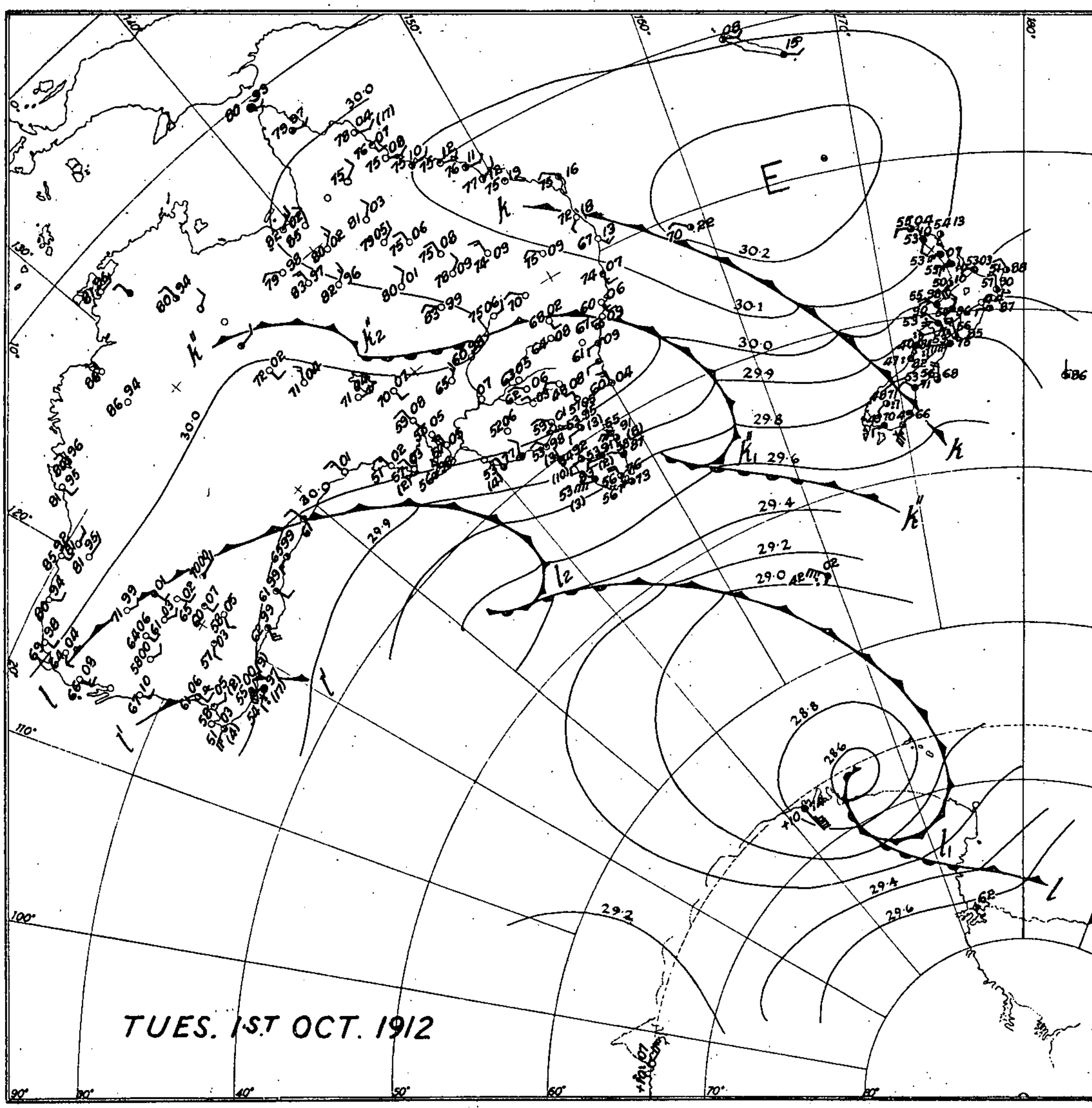
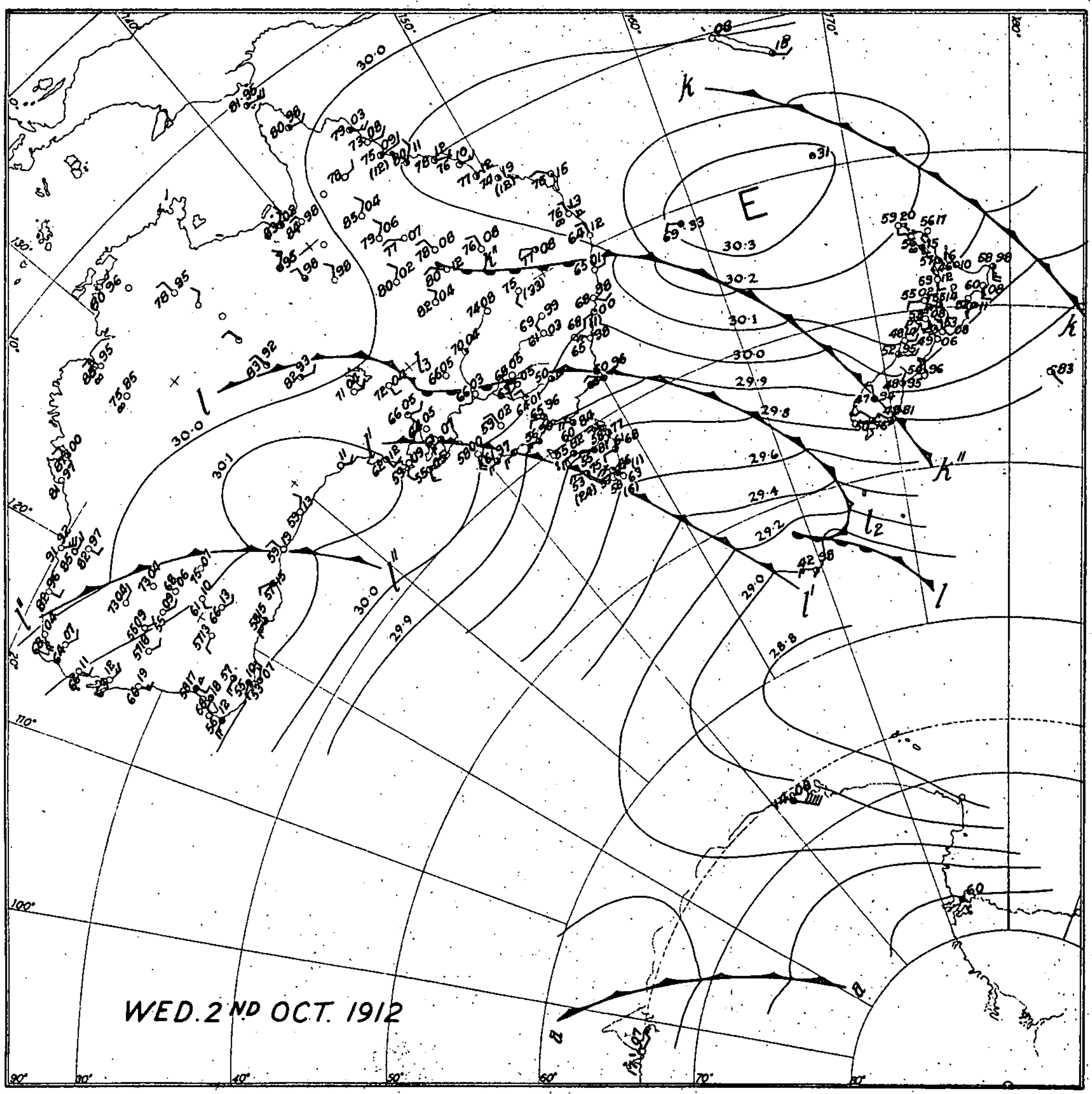
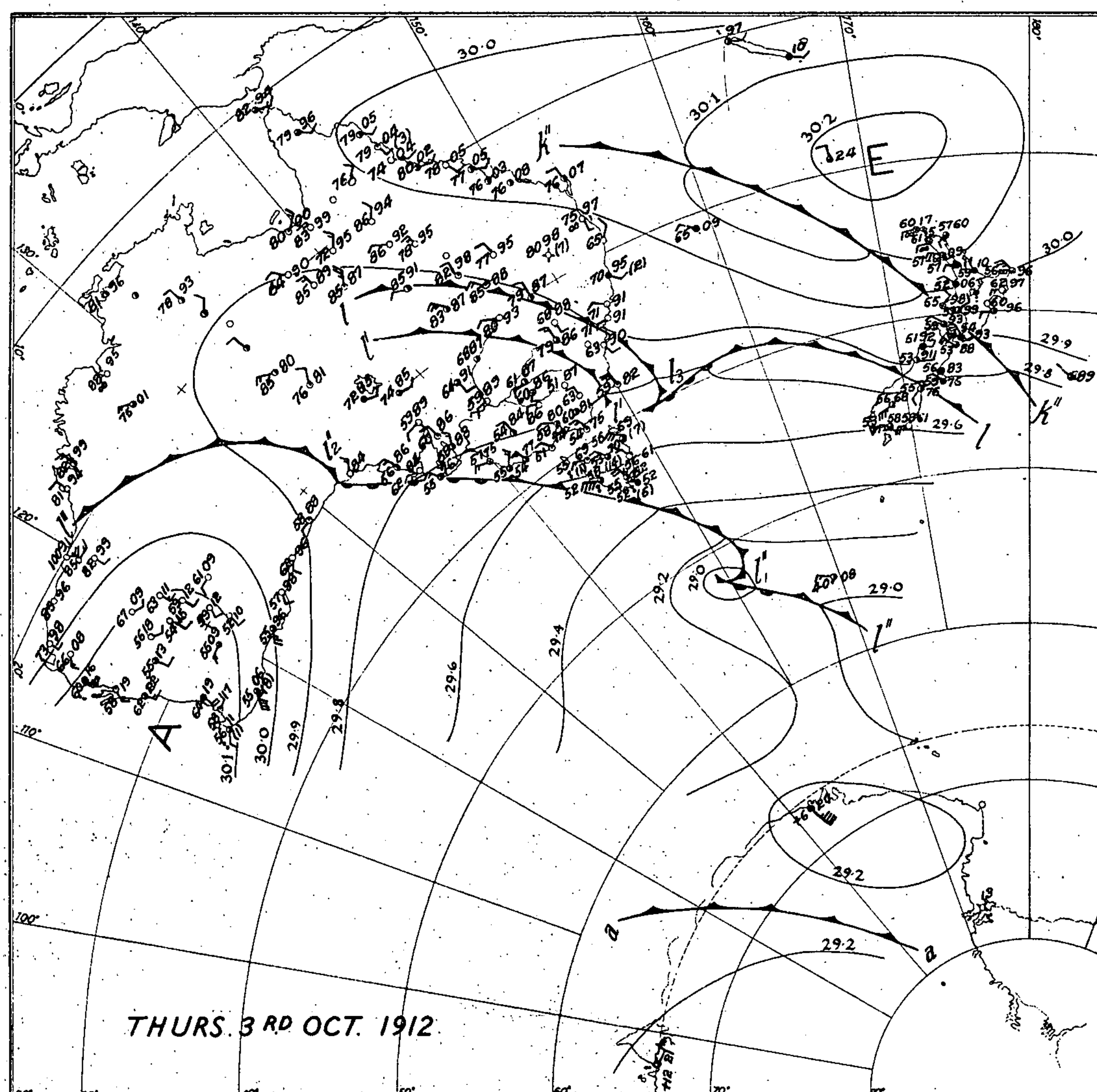


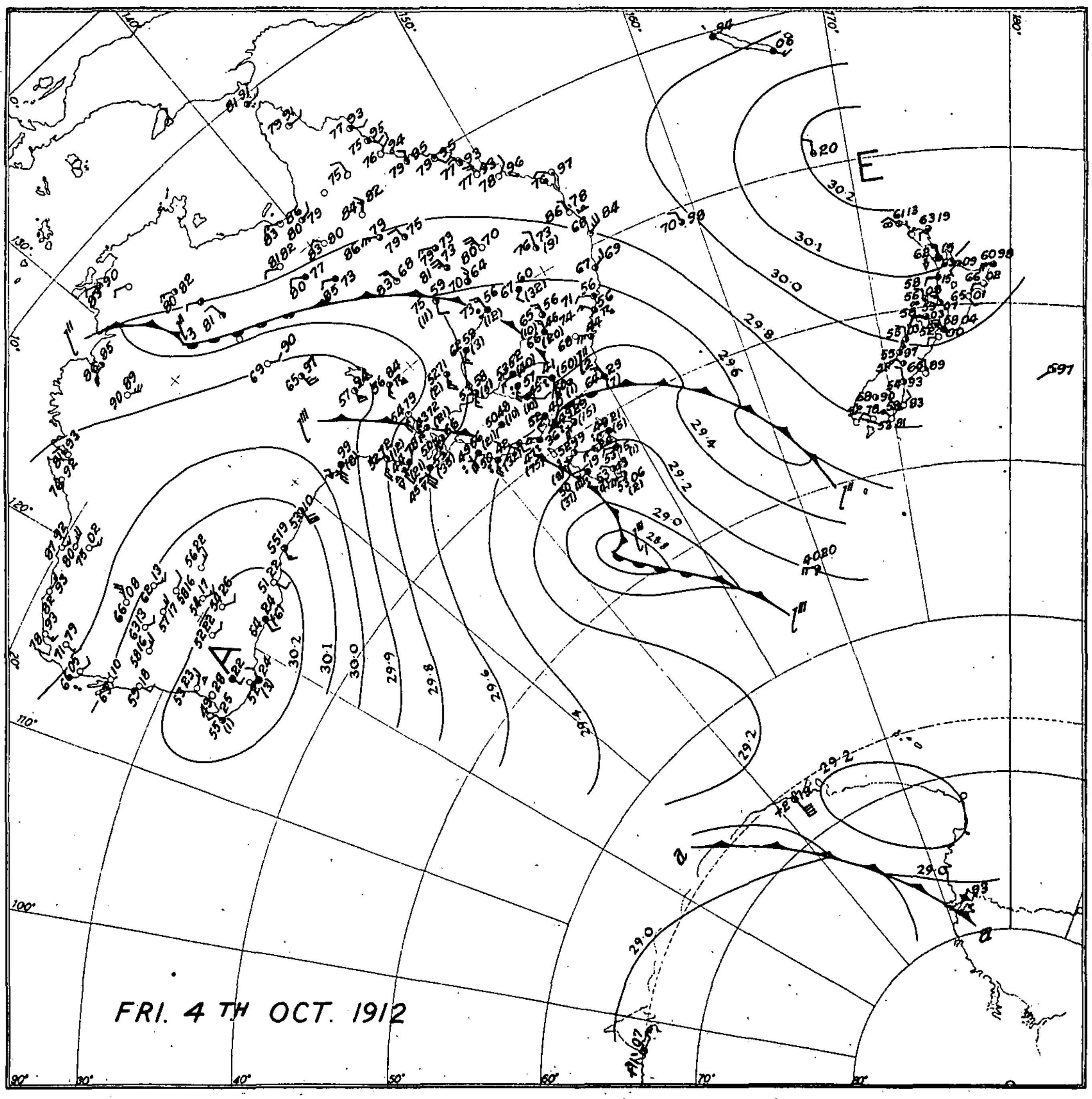
Analysis difficult. A front has probably passed Cape Evans where the record indicates that a blizzard is blowing. Regular wind observations now cease, however, at that station.



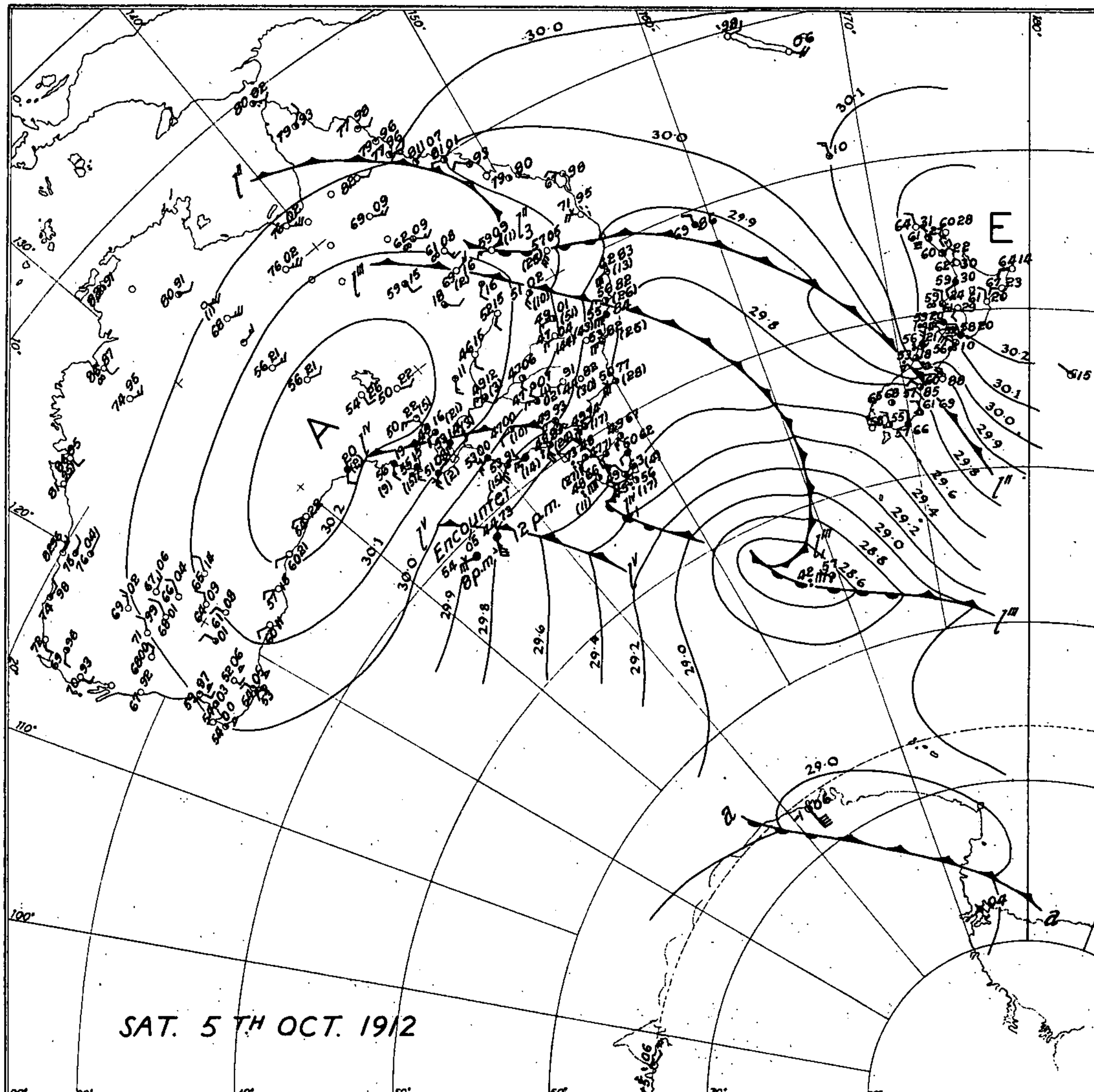
The westerly type of weather still prevails in temperate latitudes but high pressure in the extreme south.



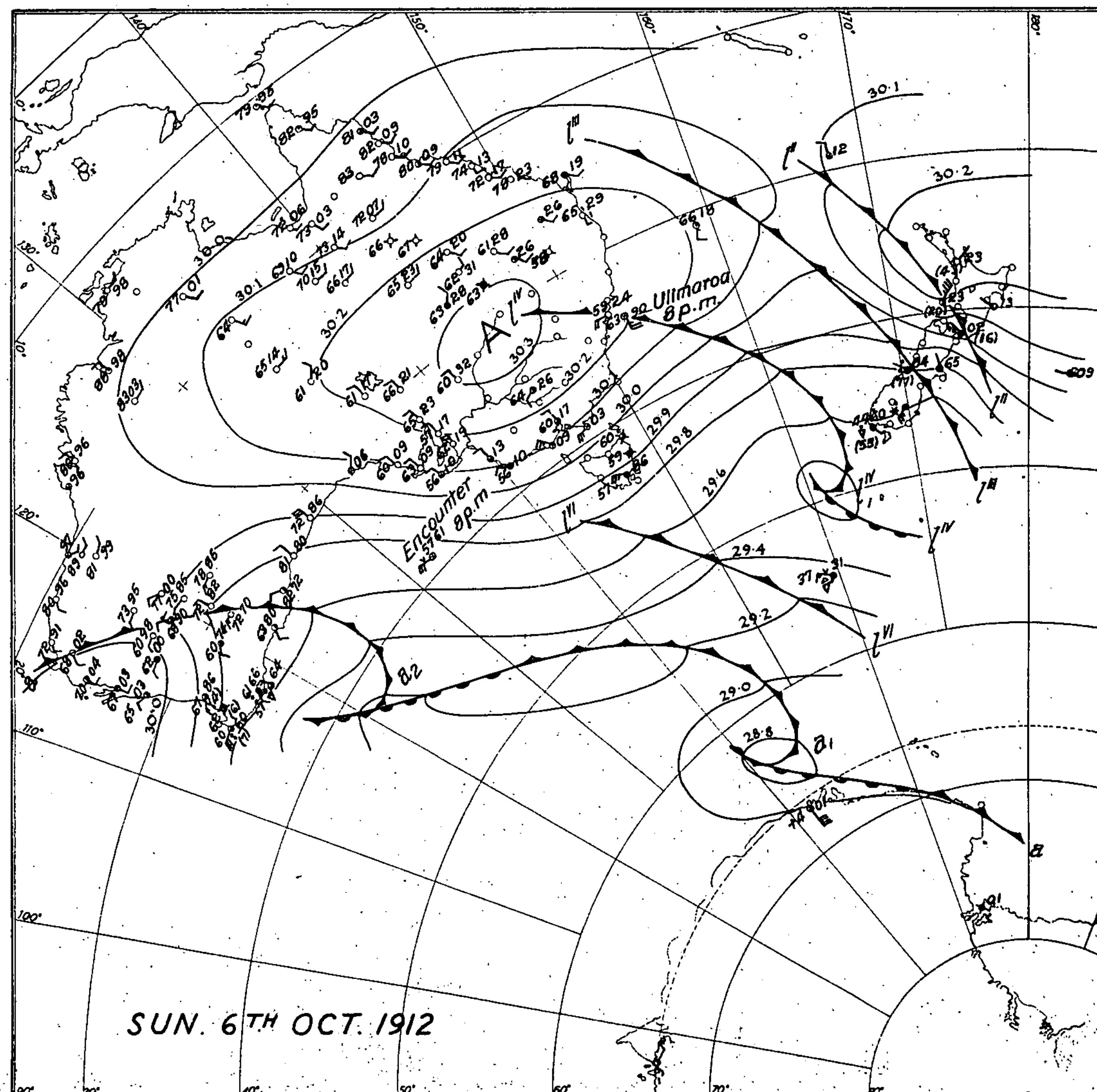
Analysis still difficult. A series of secondary fronts is beginning to form behind front *l*. Pressure has now fallen at Cape Evans.



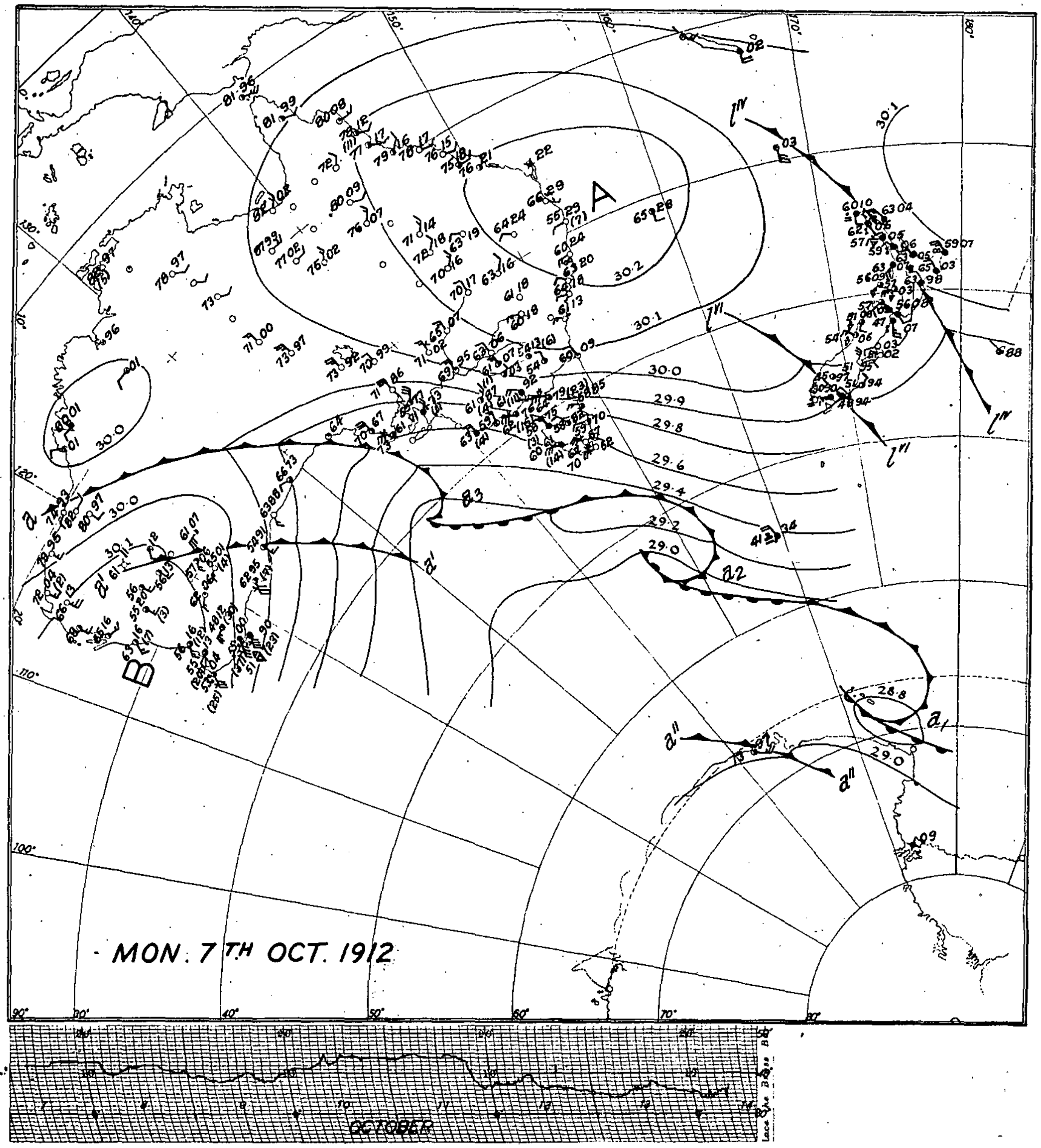
The situation is now more normal. A deep cyclone is forming south of Tasmania. There has been a remarkable series of temperature changes at Macquarie Island during the preceding few days.



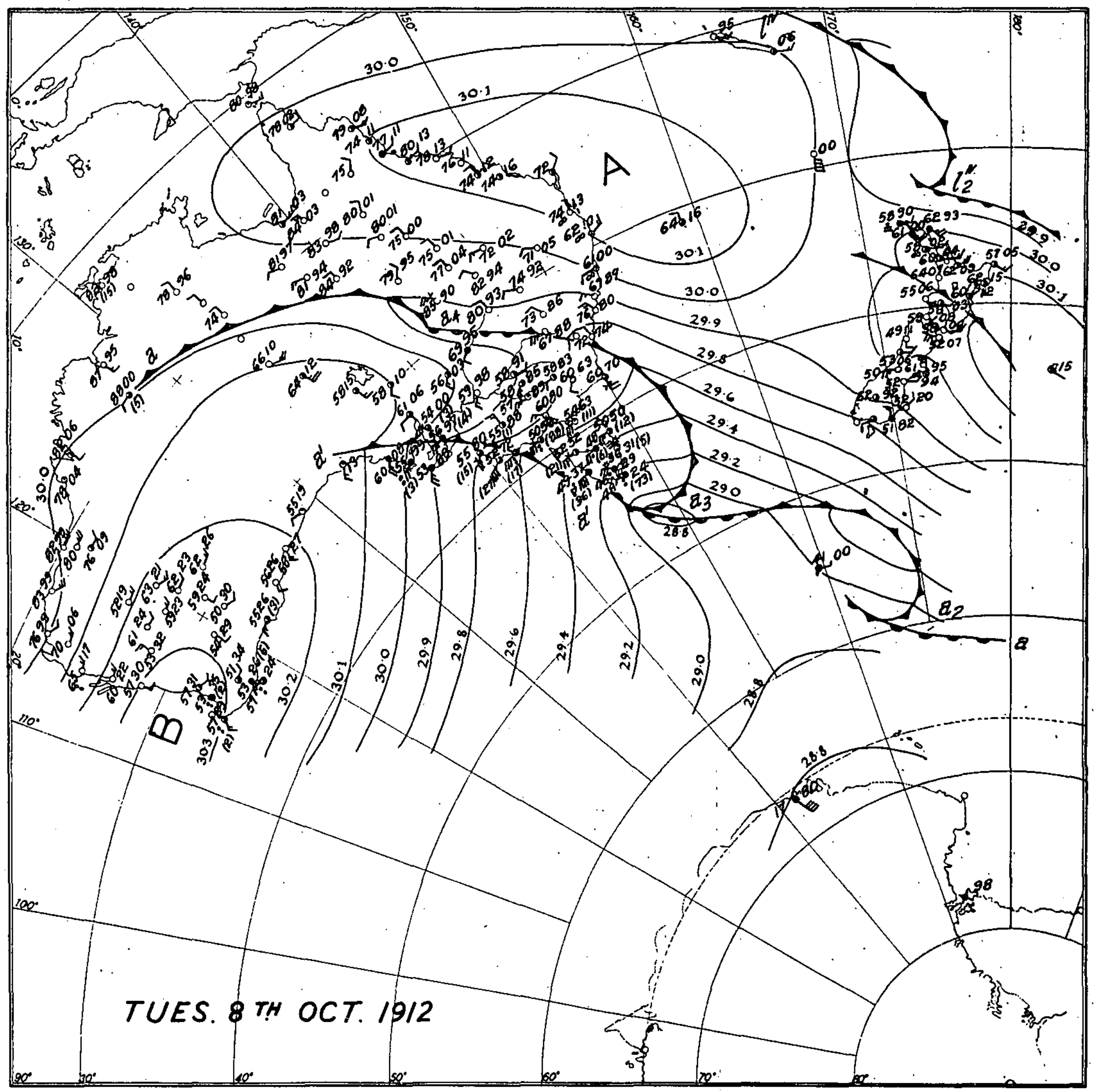
Wave l_1^{III} has become very deep and passes Macquarie Island during the day. The temperature was high in the warm sector and a marked fall followed the passage of the front.



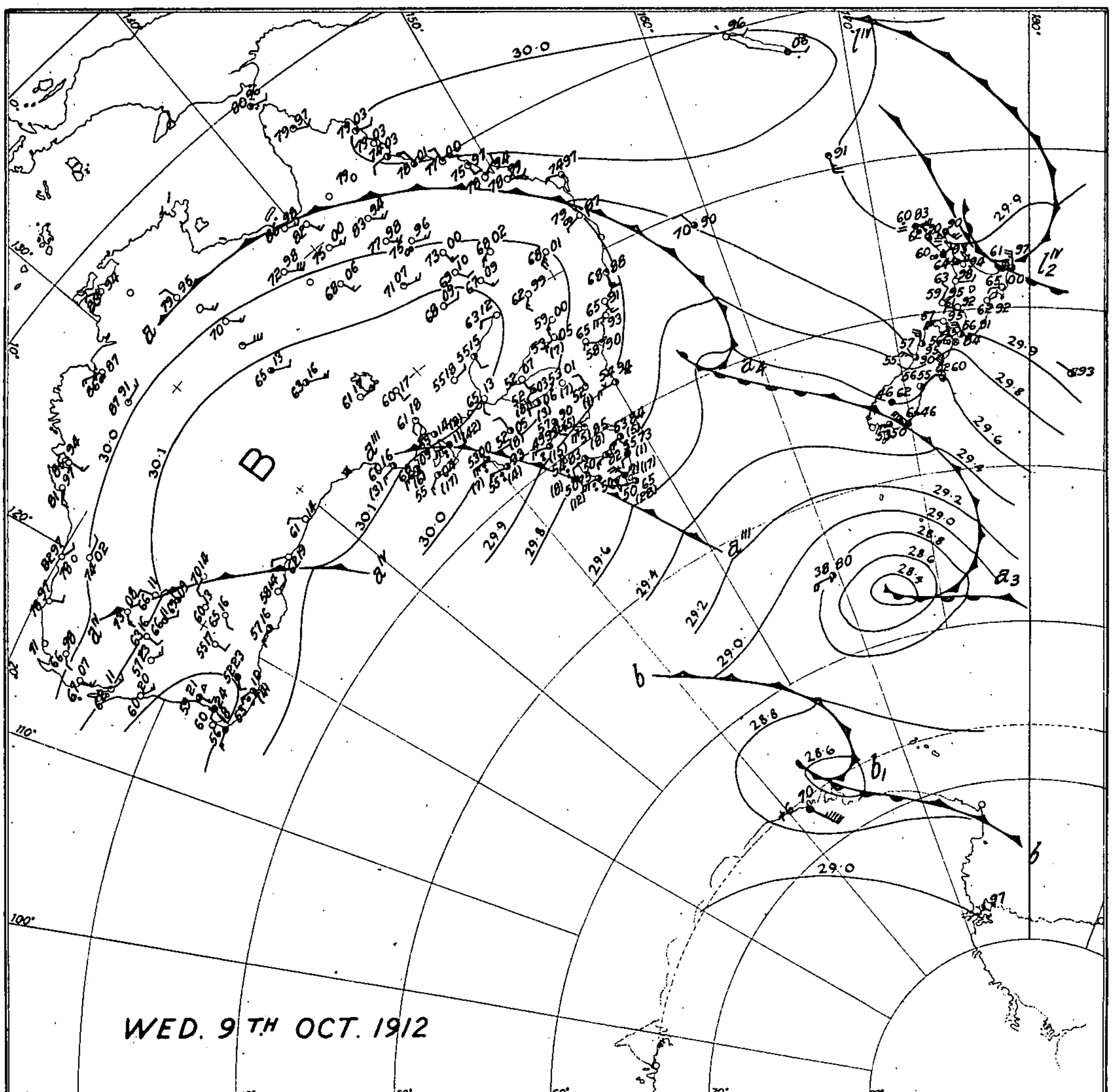
The westerly type of weather again prevails in temperate latitudes.



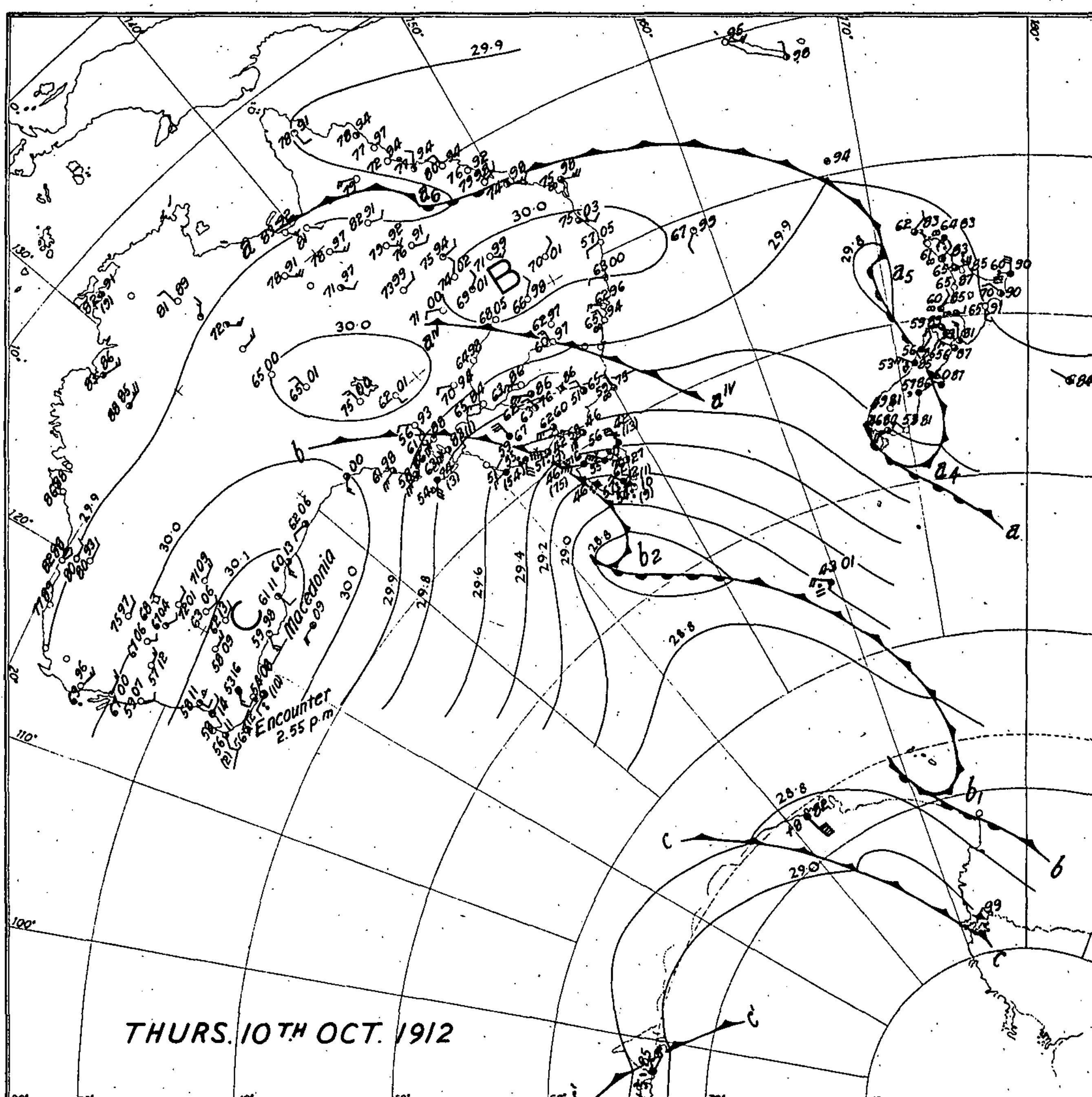
Front *a* is now a pronounced and active one. Weather changes later at Macquarie Island indicate the passage of a cold front and an occlusion. The movements shown for the northern part of front l^{IV} and l^{VI} are very rapid and the structure is uncertain.



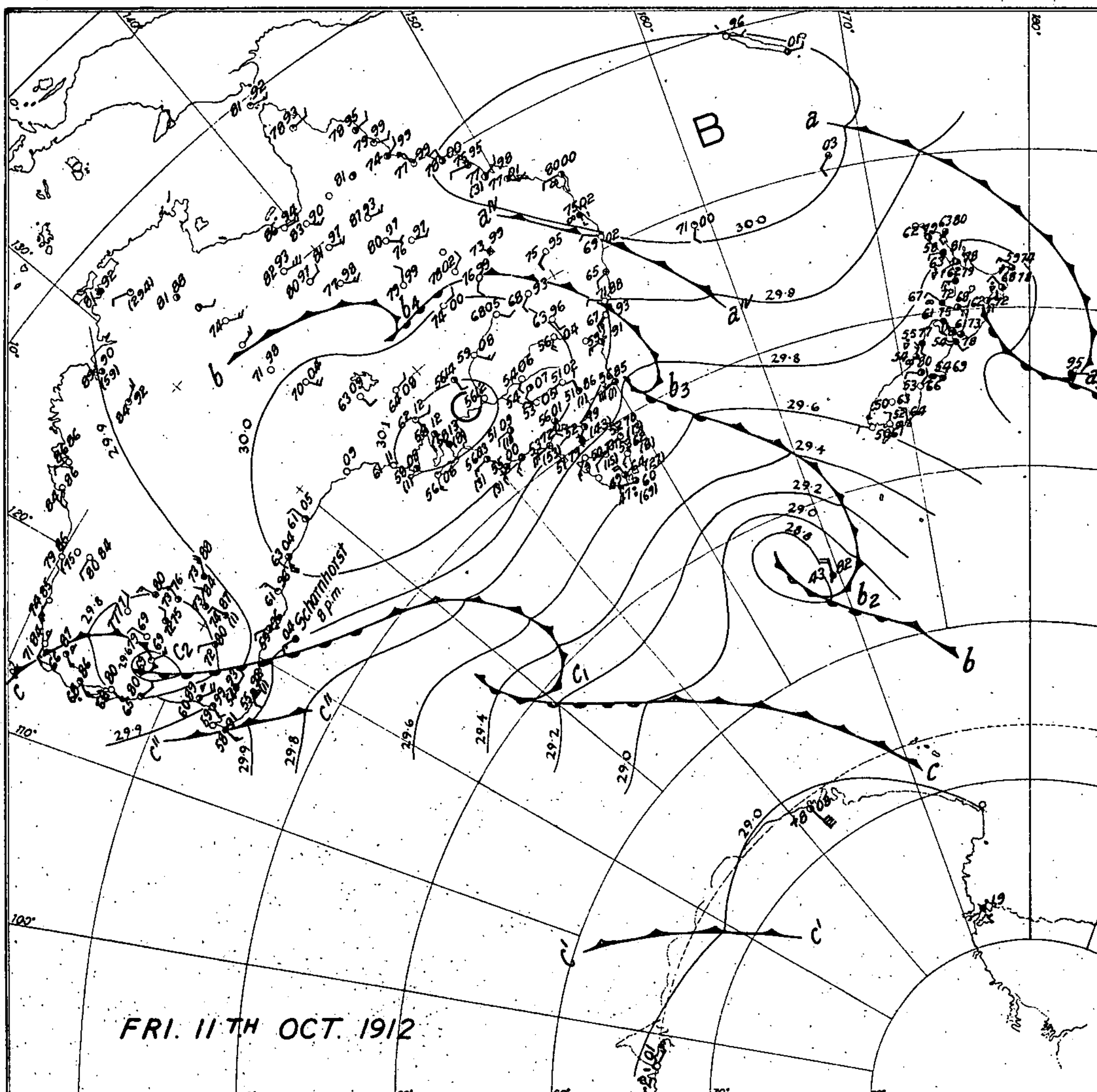
Note the easterly wind at Macquarie Island due to the deepening of wave a_3 to the north. A wave appears to be forming on a front to the north of New Zealand.



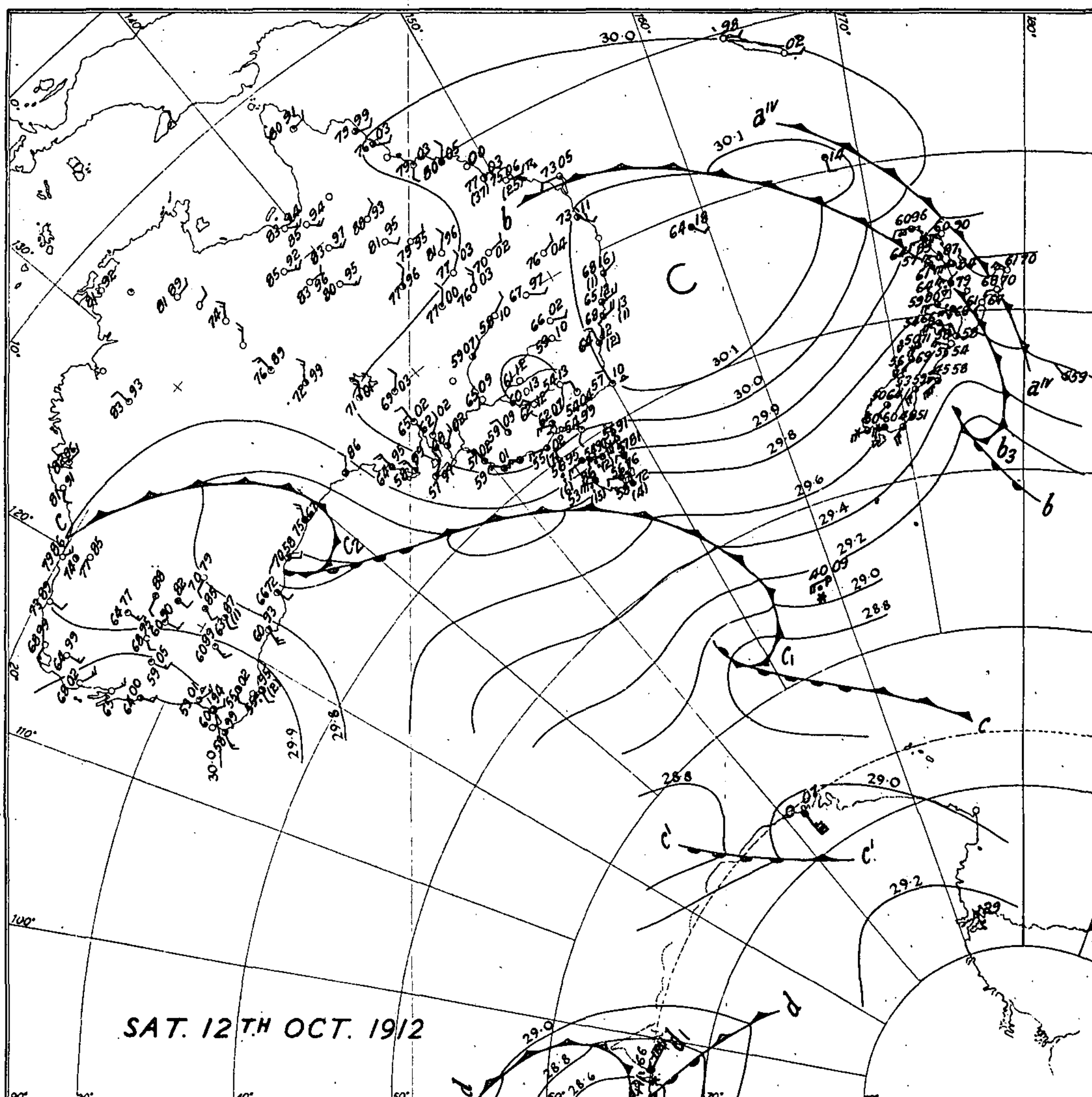
Cyclone a_3 has moved rapidly past Macquarie Island. A wave is passing north-eastern New Zealand.



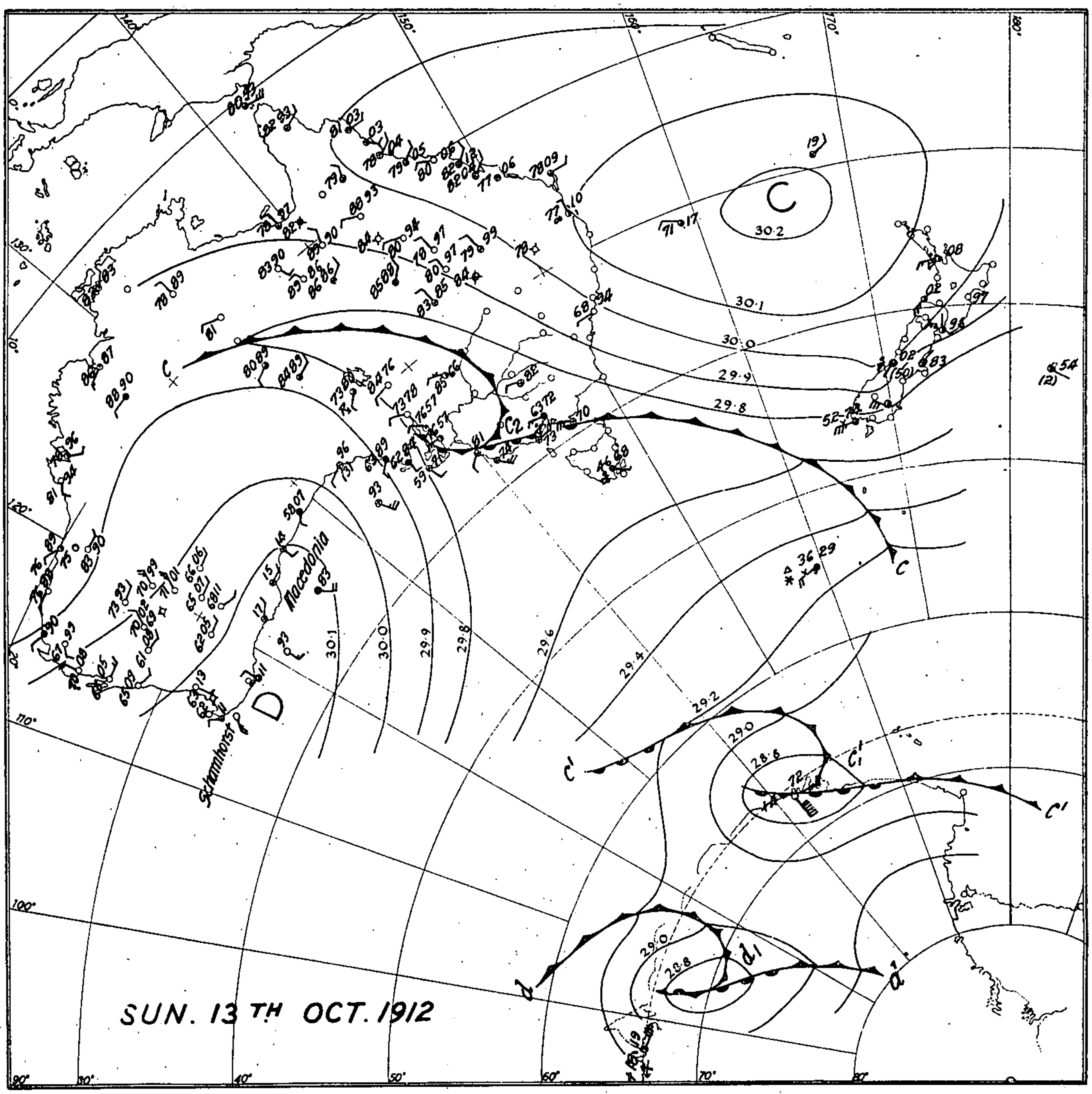
A pronounced front has developed in south-eastern Australia and this is taken to be *b*. This front probably crossed and recrossed Macquarie Island. Pressure has been low in Antarctica but activity is slight.



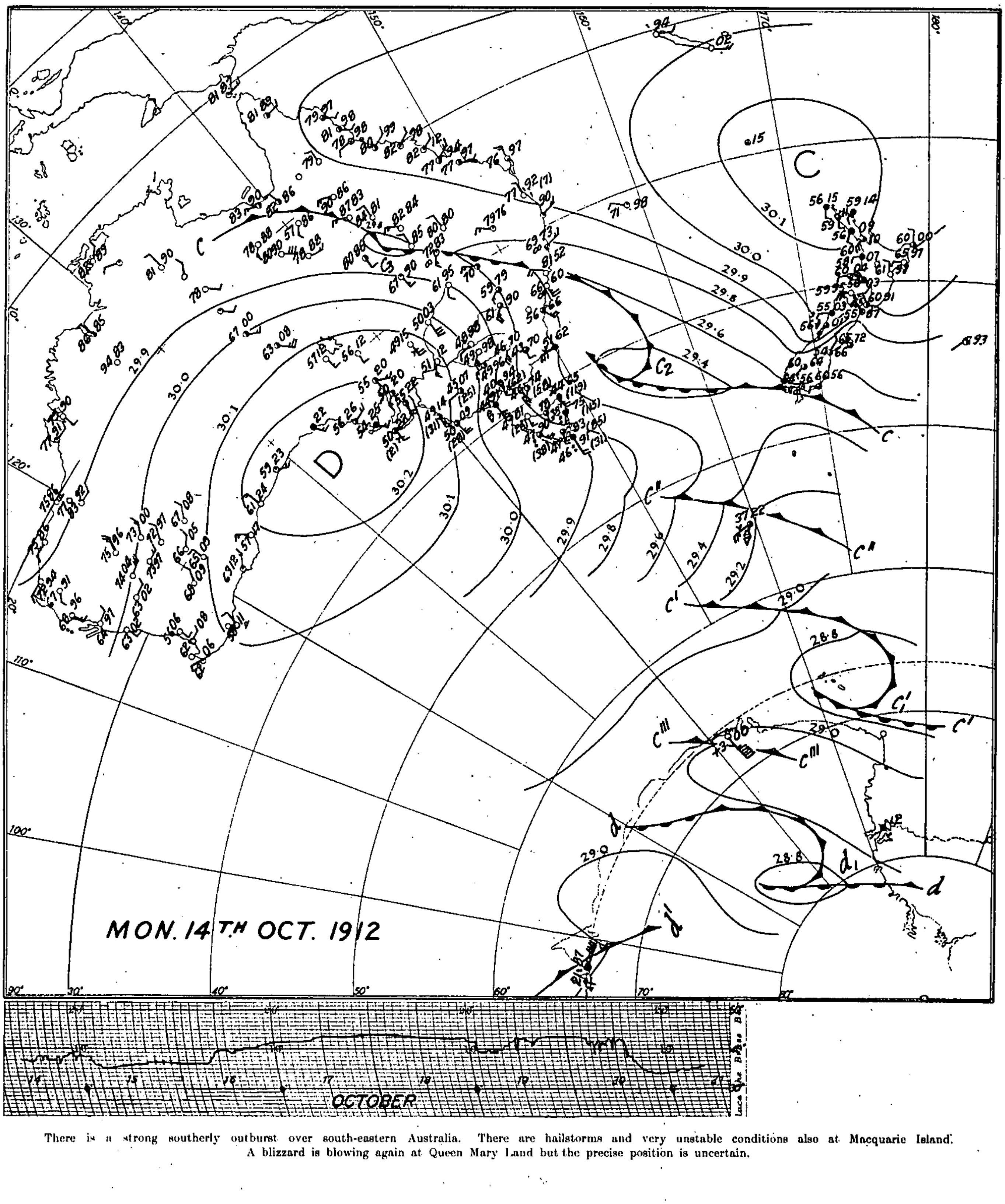
A cyclone passes Macquarie Island during the day, both cold front and occlusion being shown in the records.



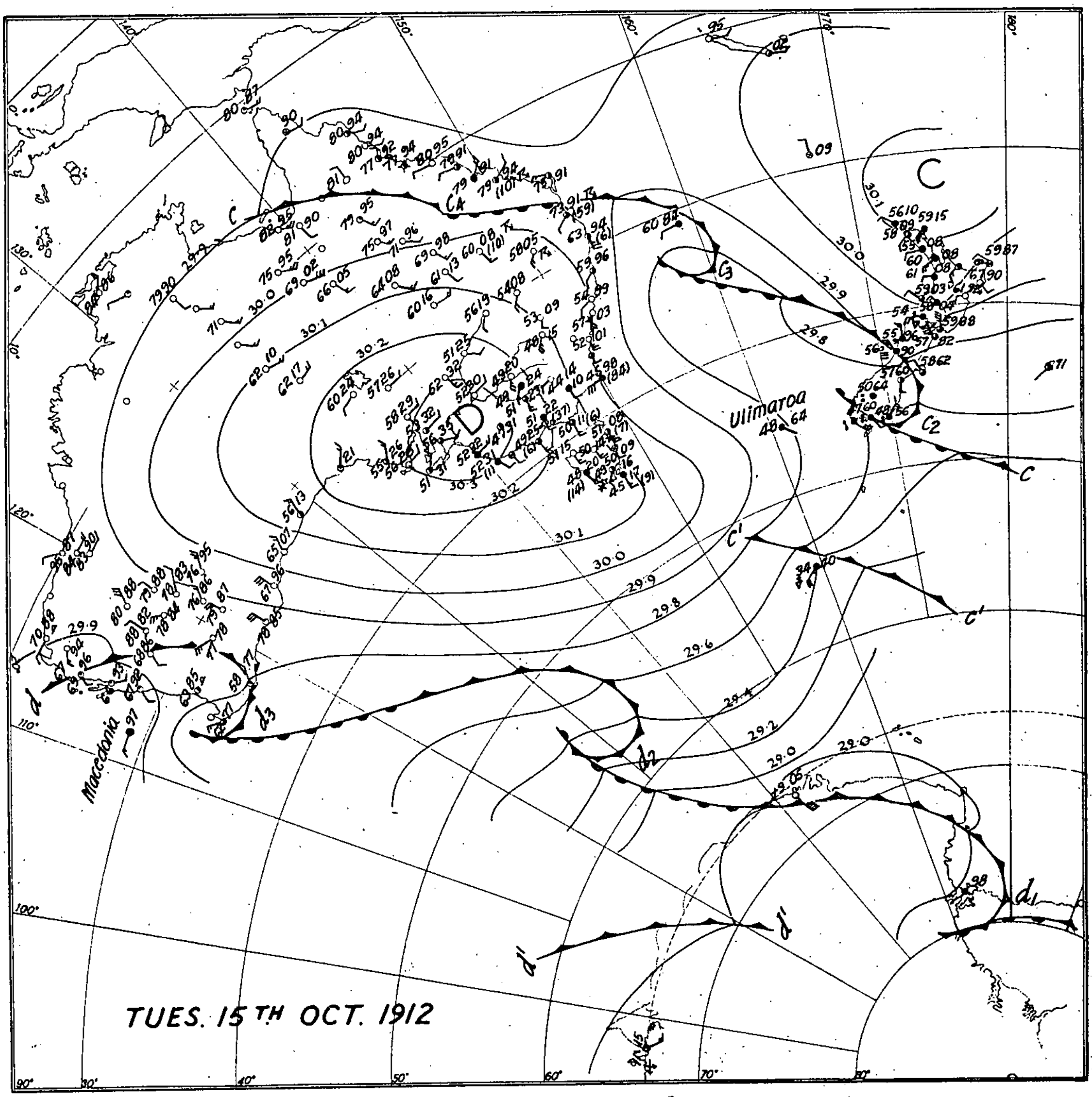
A deep cyclone is approaching Queen Mary Land, where a fierce blizzard is blowing. Pressure changes at Cape Evans are difficult to correlate with the weather during this period.



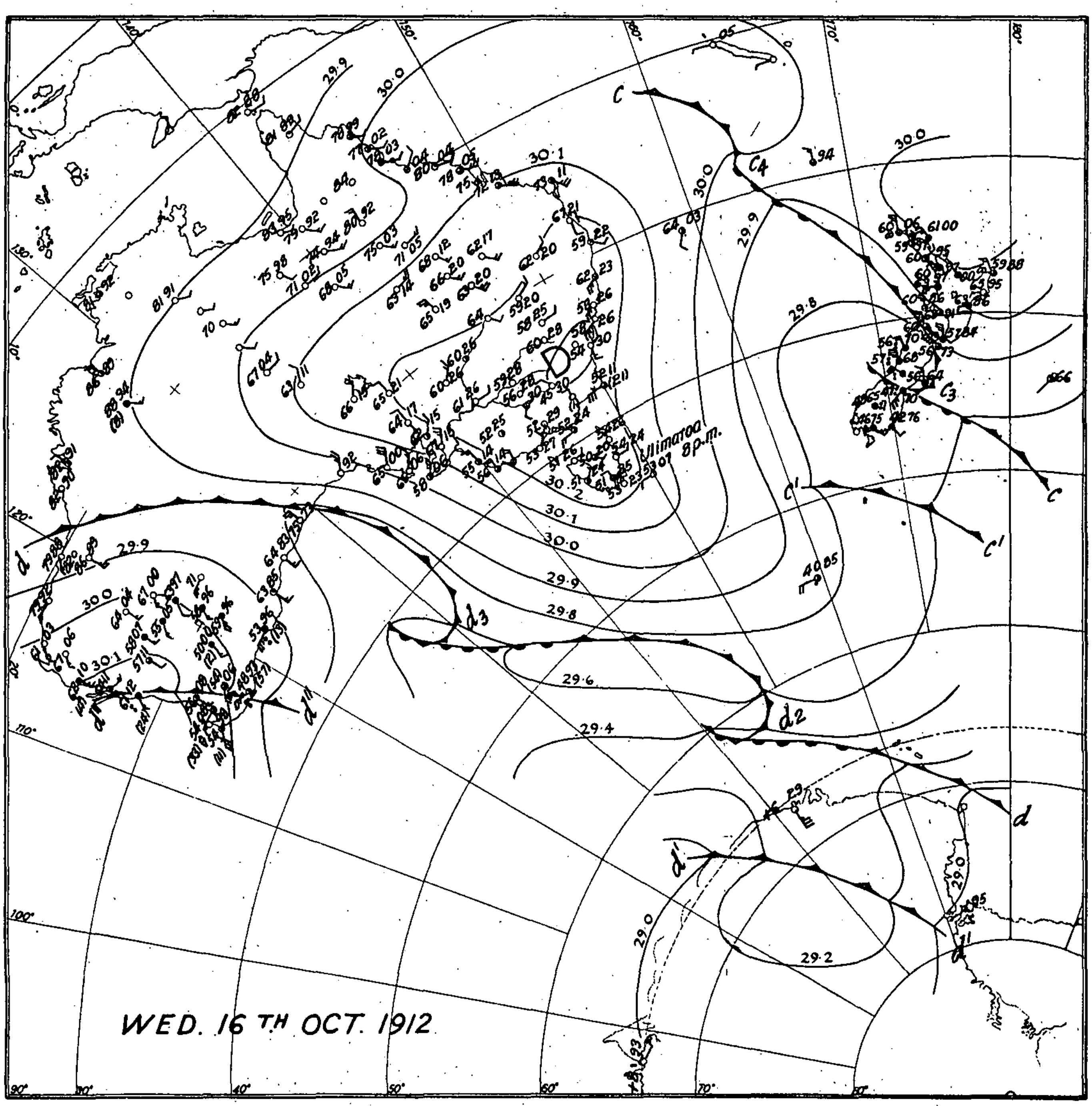
A cyclone has passed Queen Mary Land but this can scarcely be the one which is now crossing Adélie Land.



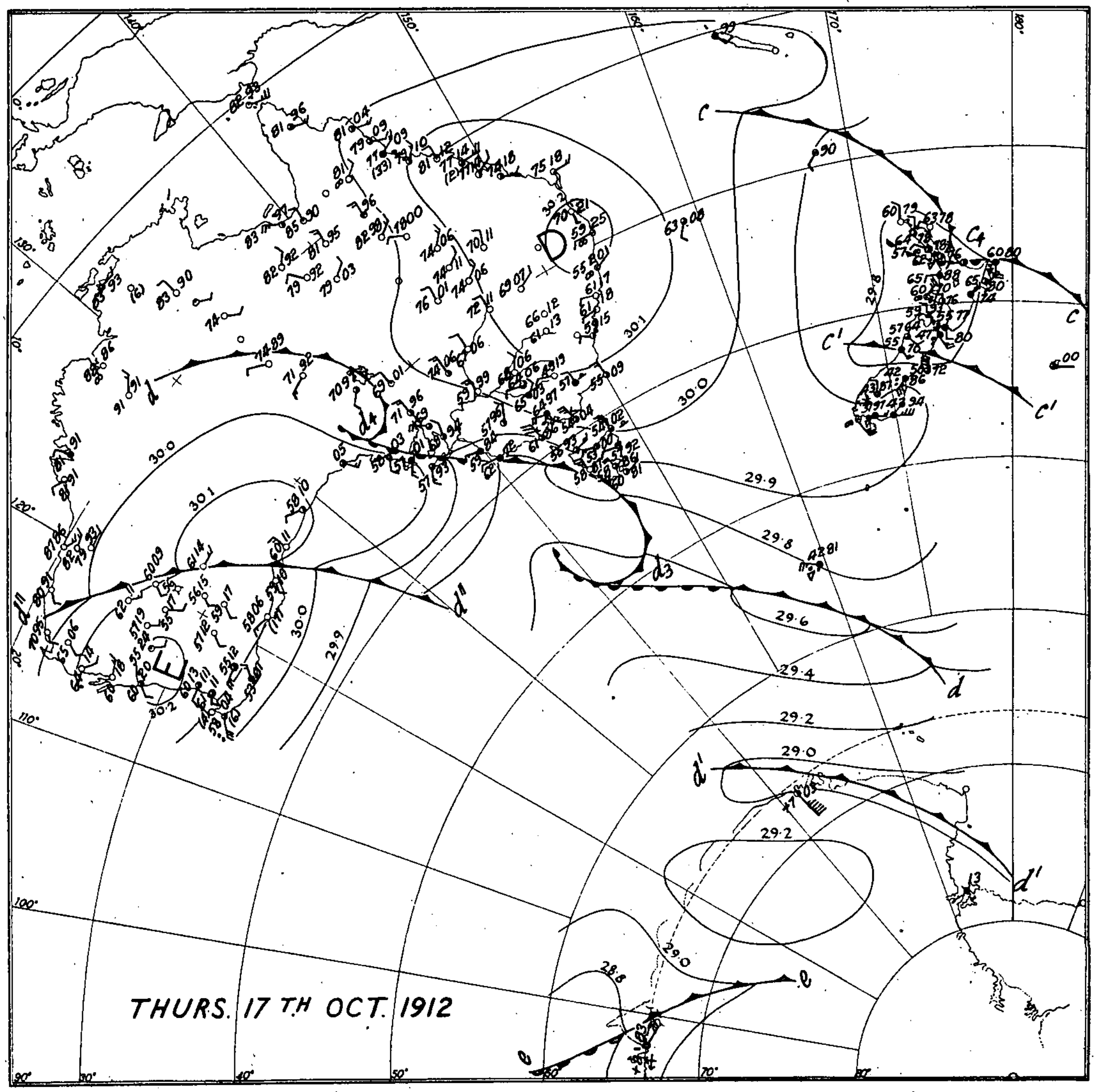
There is a strong southerly outburst over south-eastern Australia. There are hailstorms and very unstable conditions also at Macquarie Island. A blizzard is blowing again at Queen Mary Land but the precise position is uncertain.



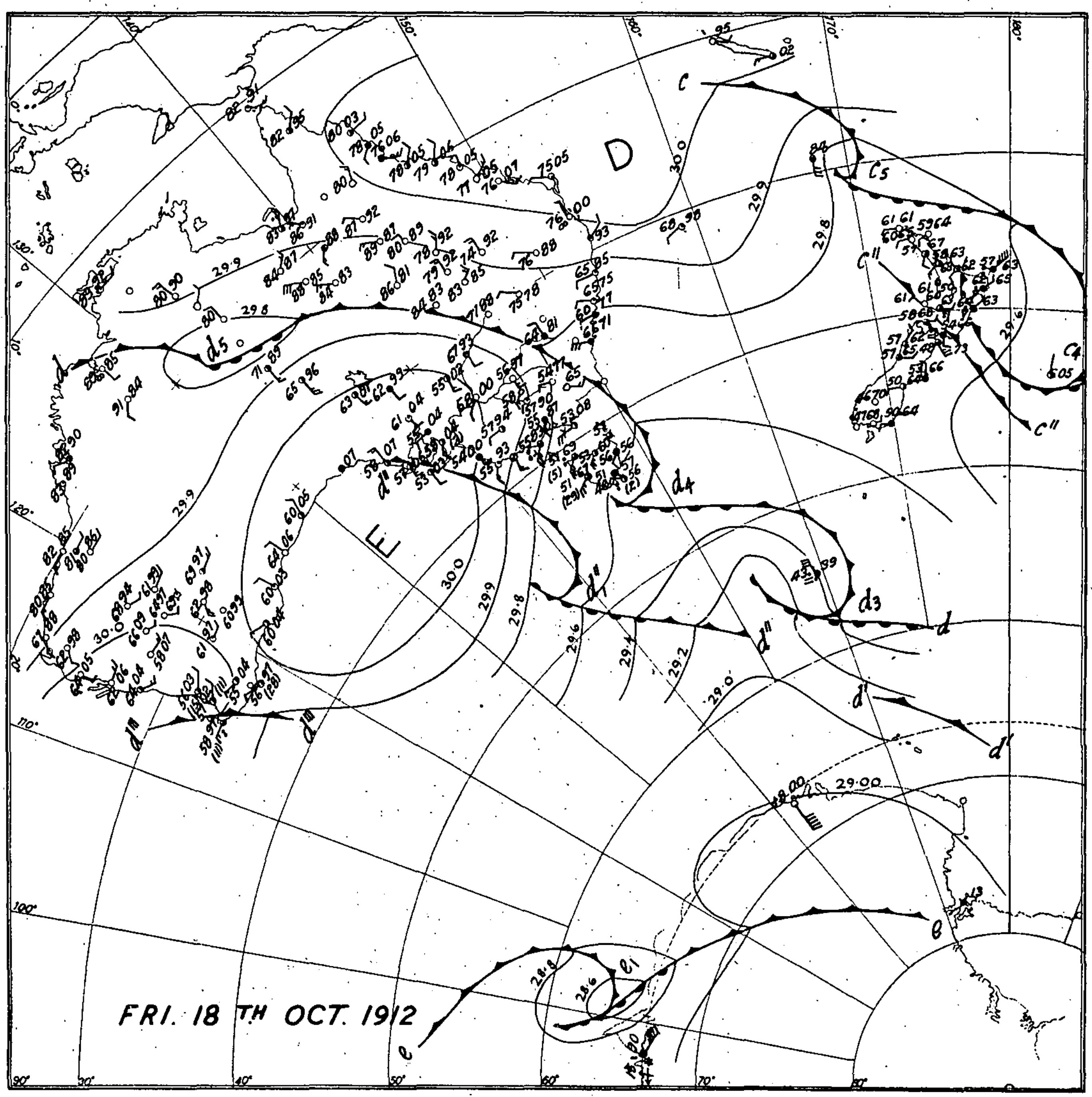
There is a strong flow from the north over Western Australia.



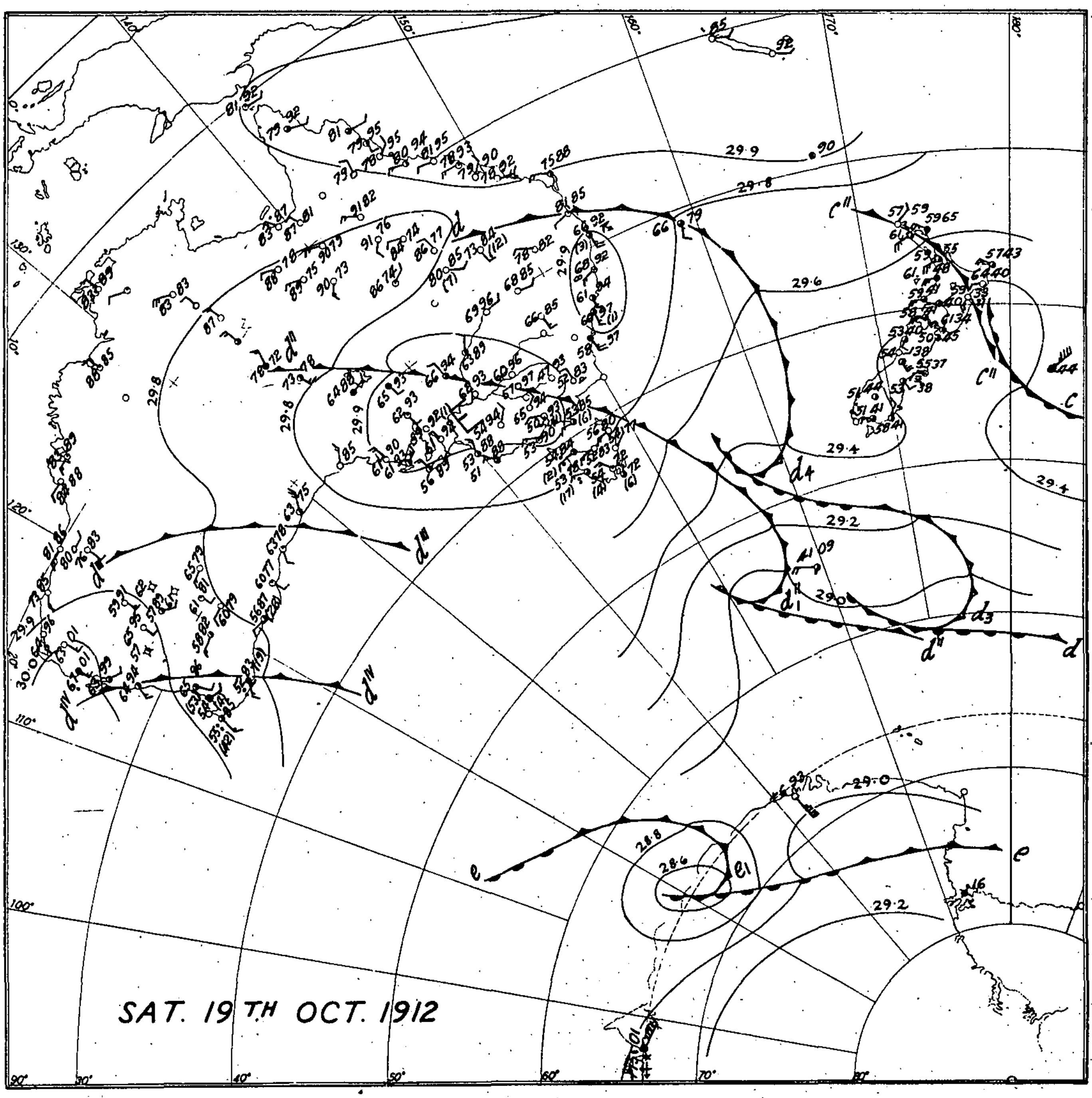
There is great activity about front *d*. *c* also is a well-marked front.



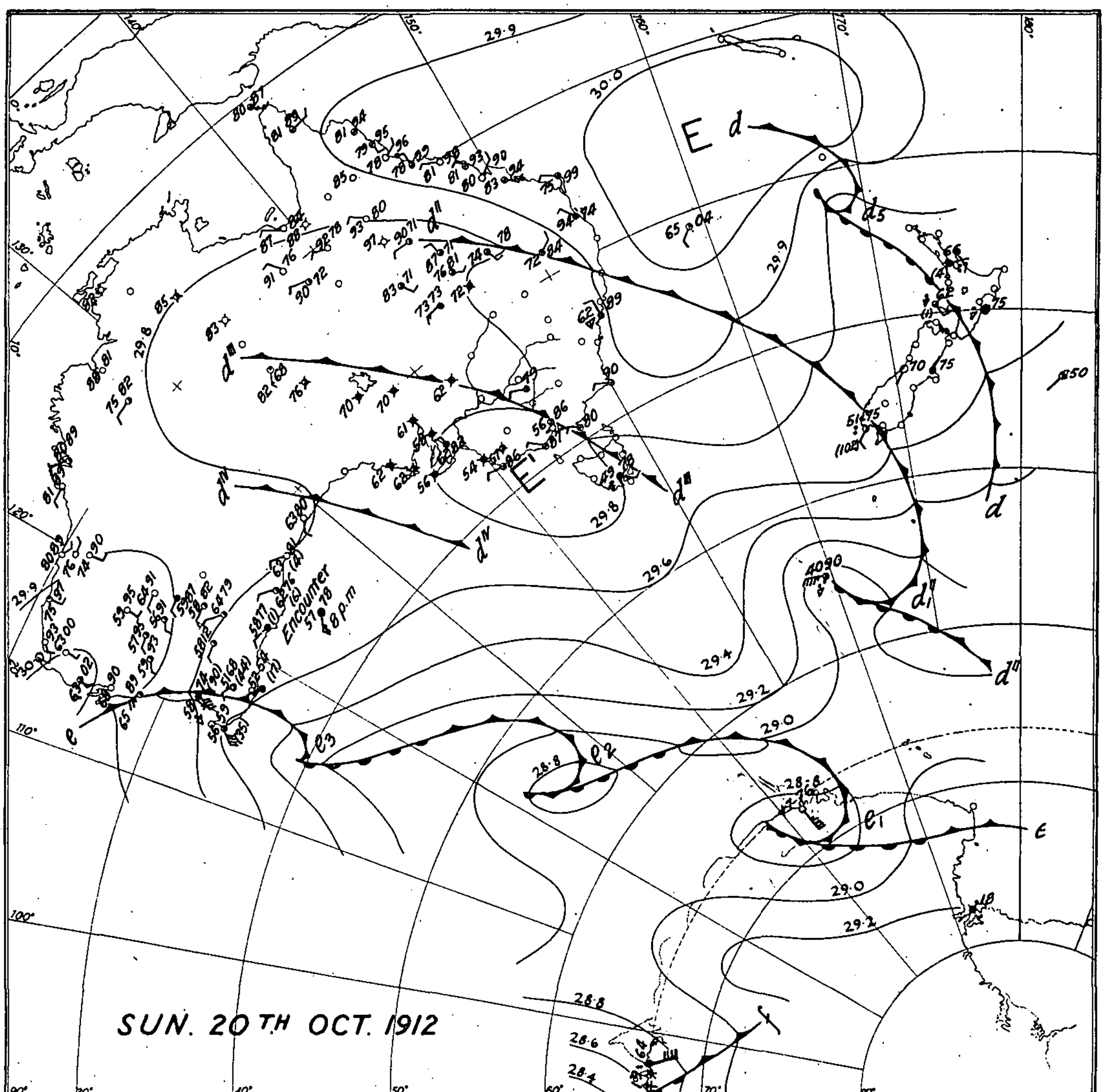
There is still a strong flow from the north in front of front *d*. Snow is falling on the high levels of southern New Zealand.



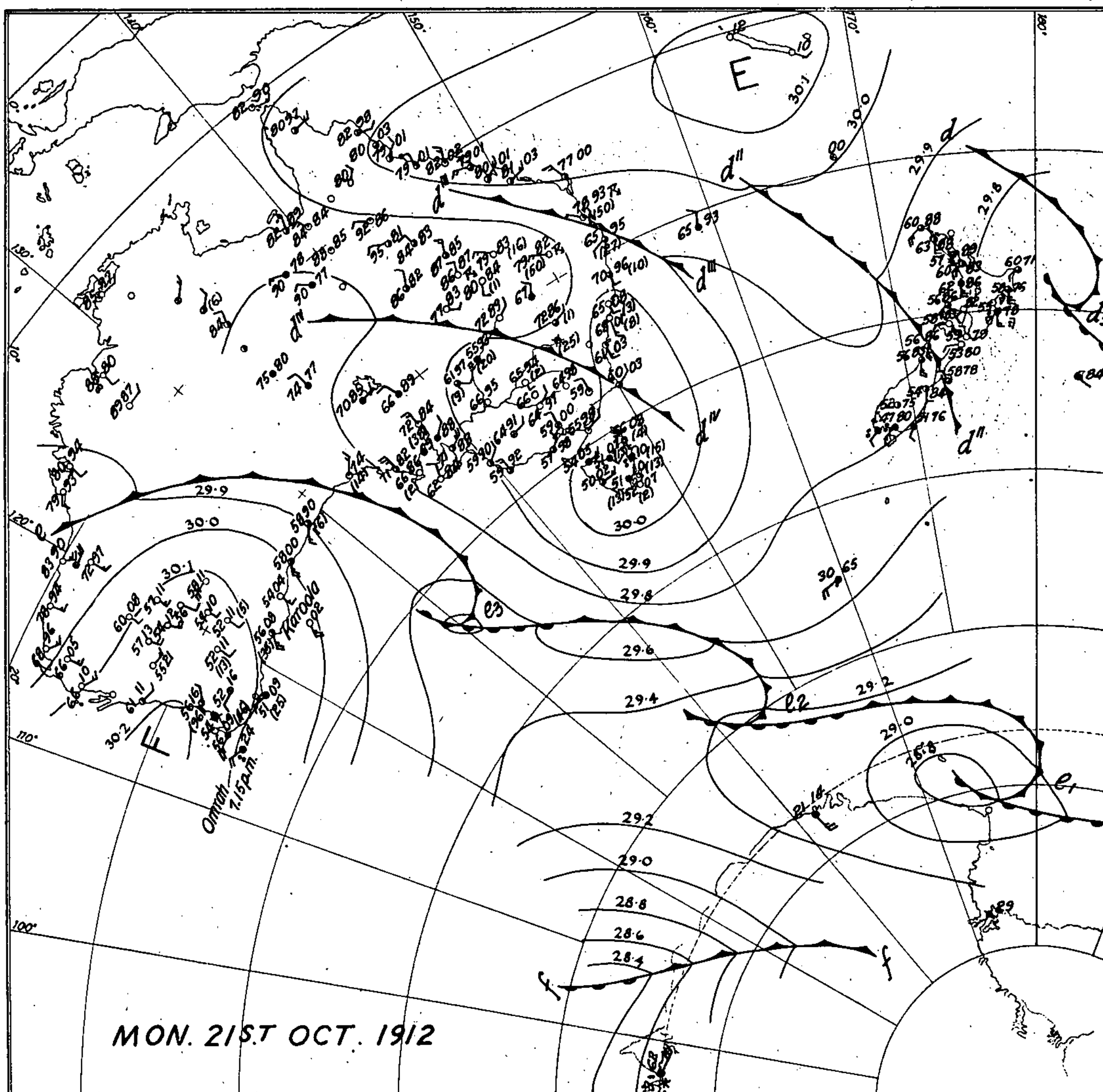
The temperature at Macquarie Island is steady until front *d* passes. Anticyclone D moved northward and disappeared. There is another strong blizzard at Queen Mary Land following the passage of a cyclone to the north.

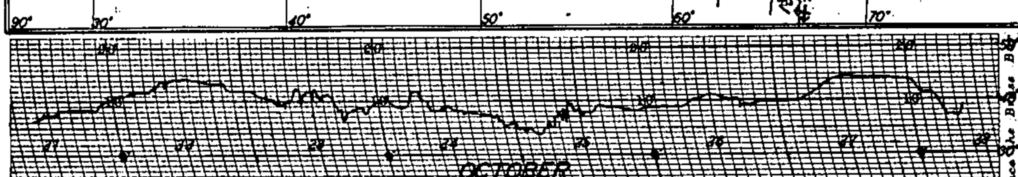


After being very variable following the passage of wave d_3 the temperature at Macquarie Island becomes steady again in the warm sector of d_1^{II}. After the passage of the cold front of the latter, unstable conditions again set in until the occlusion passes when the temperature falls sharply. A strong blizzard is blowing at Queen Mary Land.

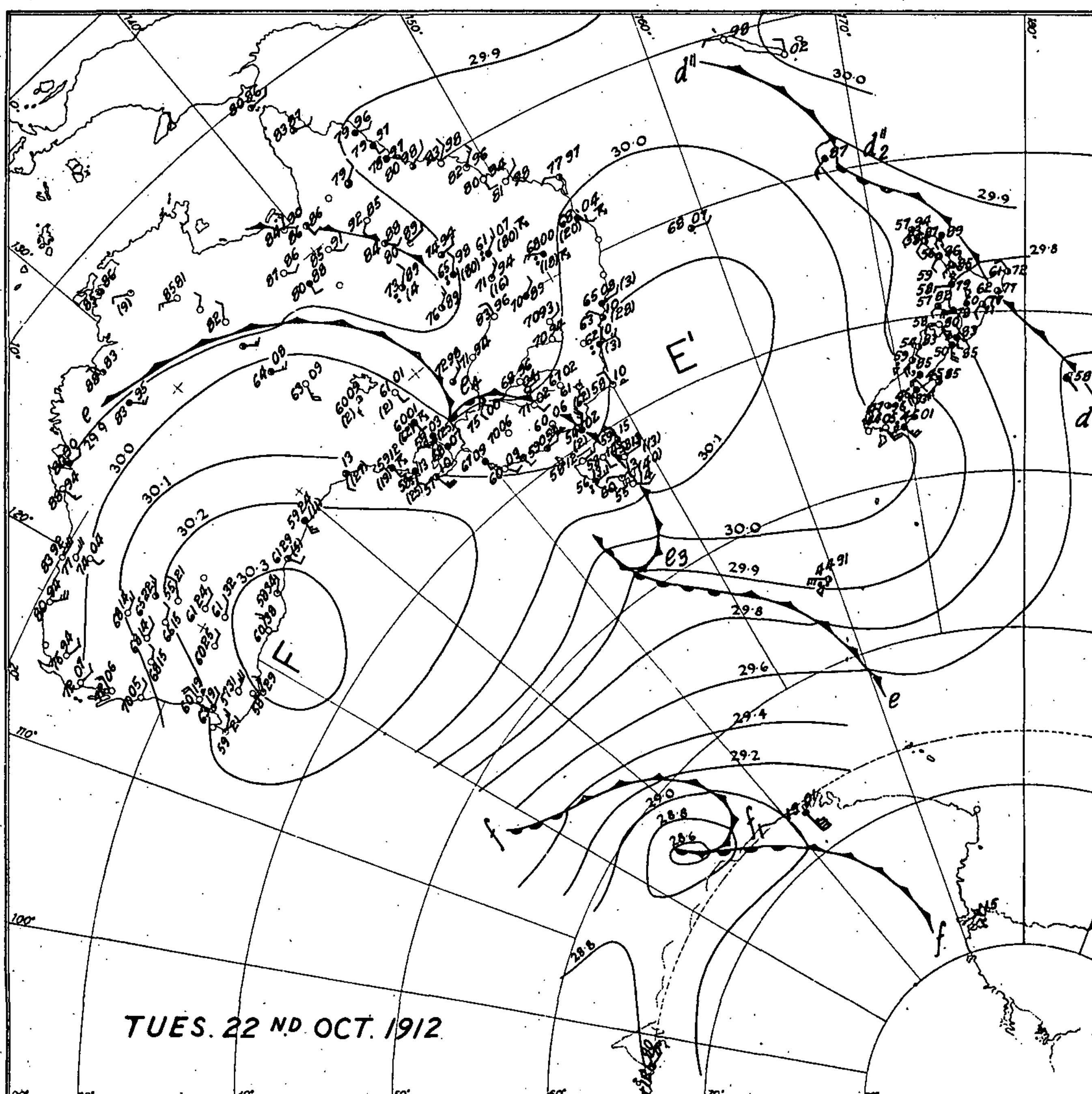


There is a strong gale at Macquarie Island near the top of the occlusion of wave d_1^{II}. The southerly gale at Queen Mary Land is unusual and difficult to reconcile with a falling barometer. Anticyclone E is feeble and fronts repeatedly lay across it.

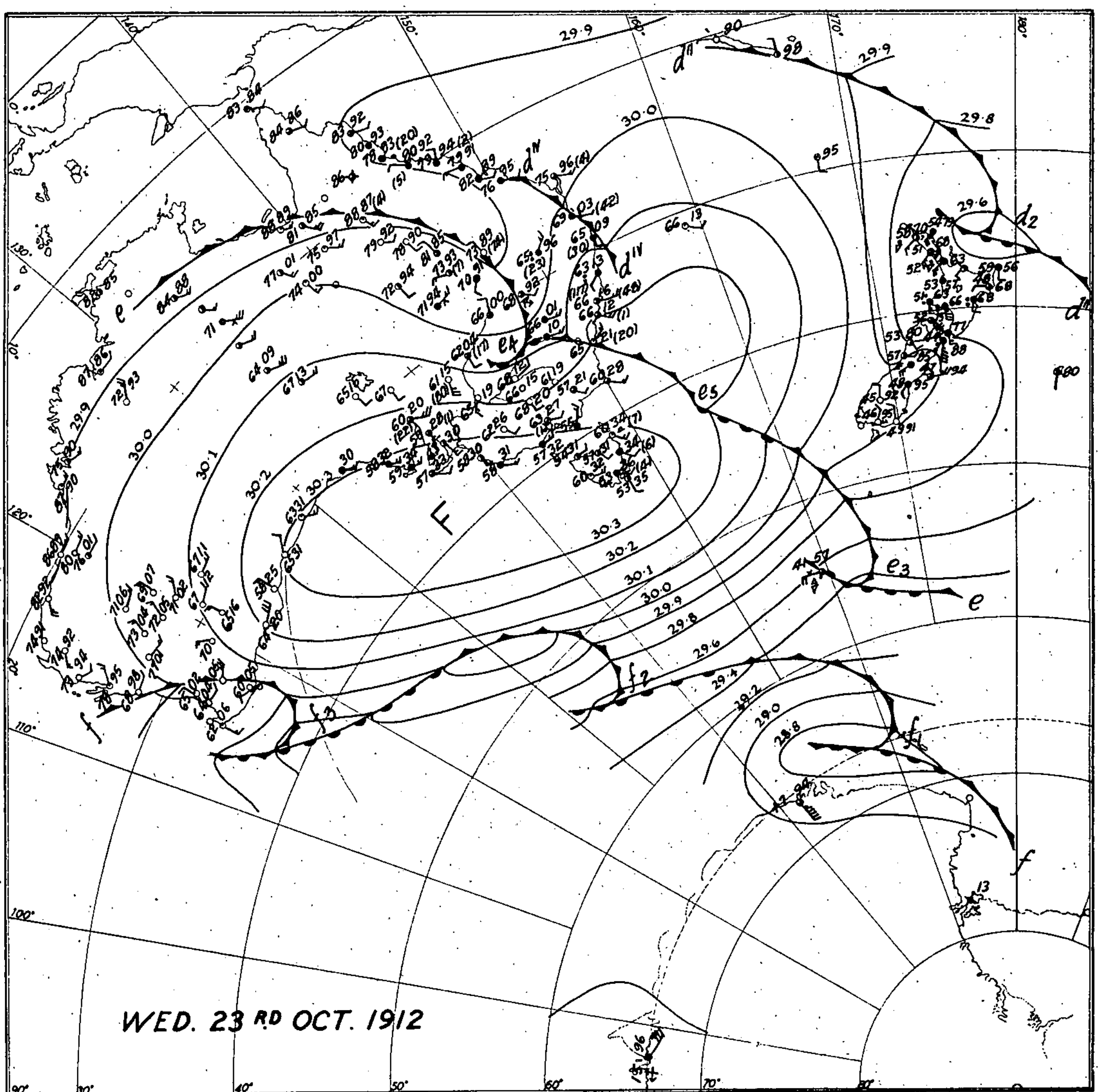




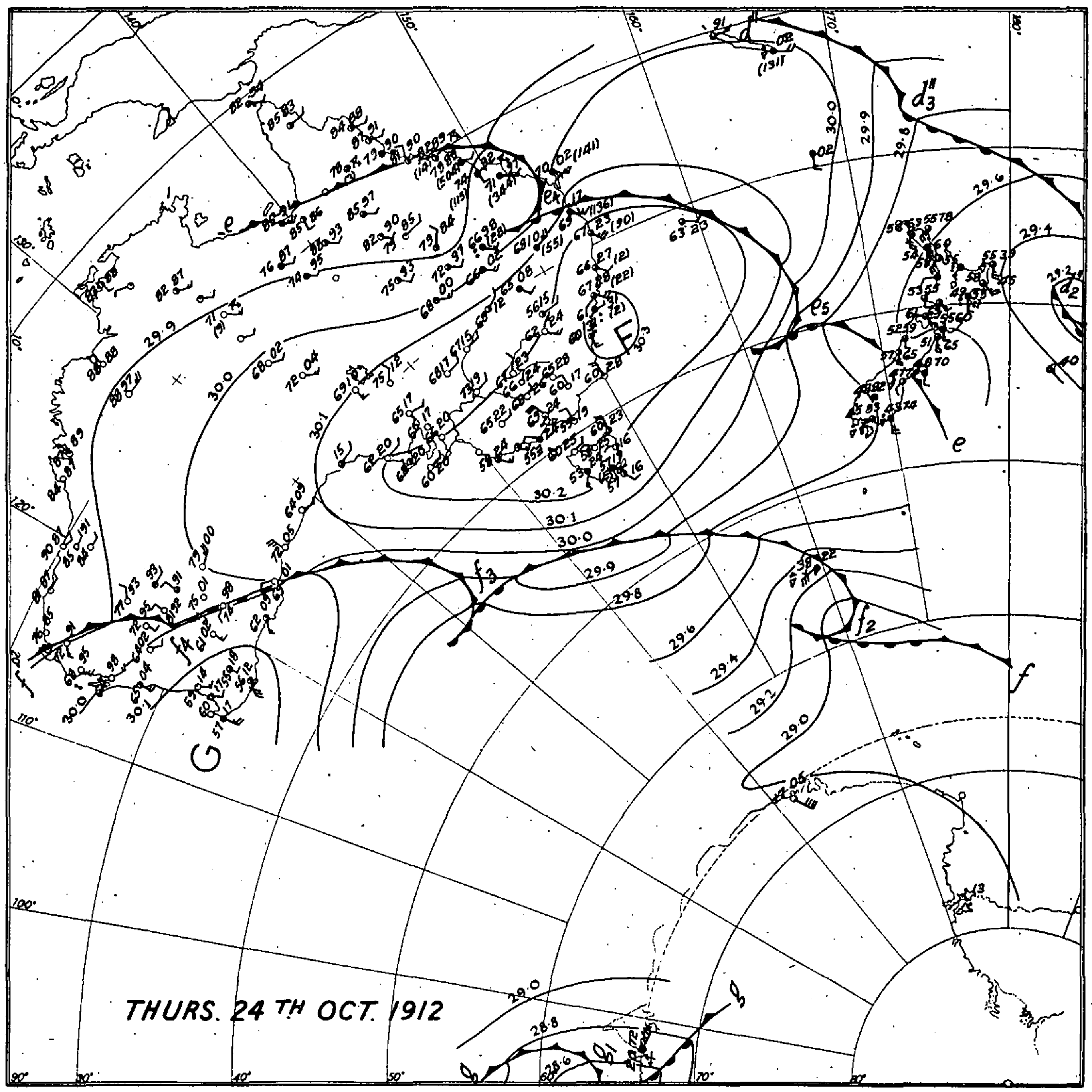
Front *e* is well marked over Australia. The wind is decreasing at Queen Mary Land.



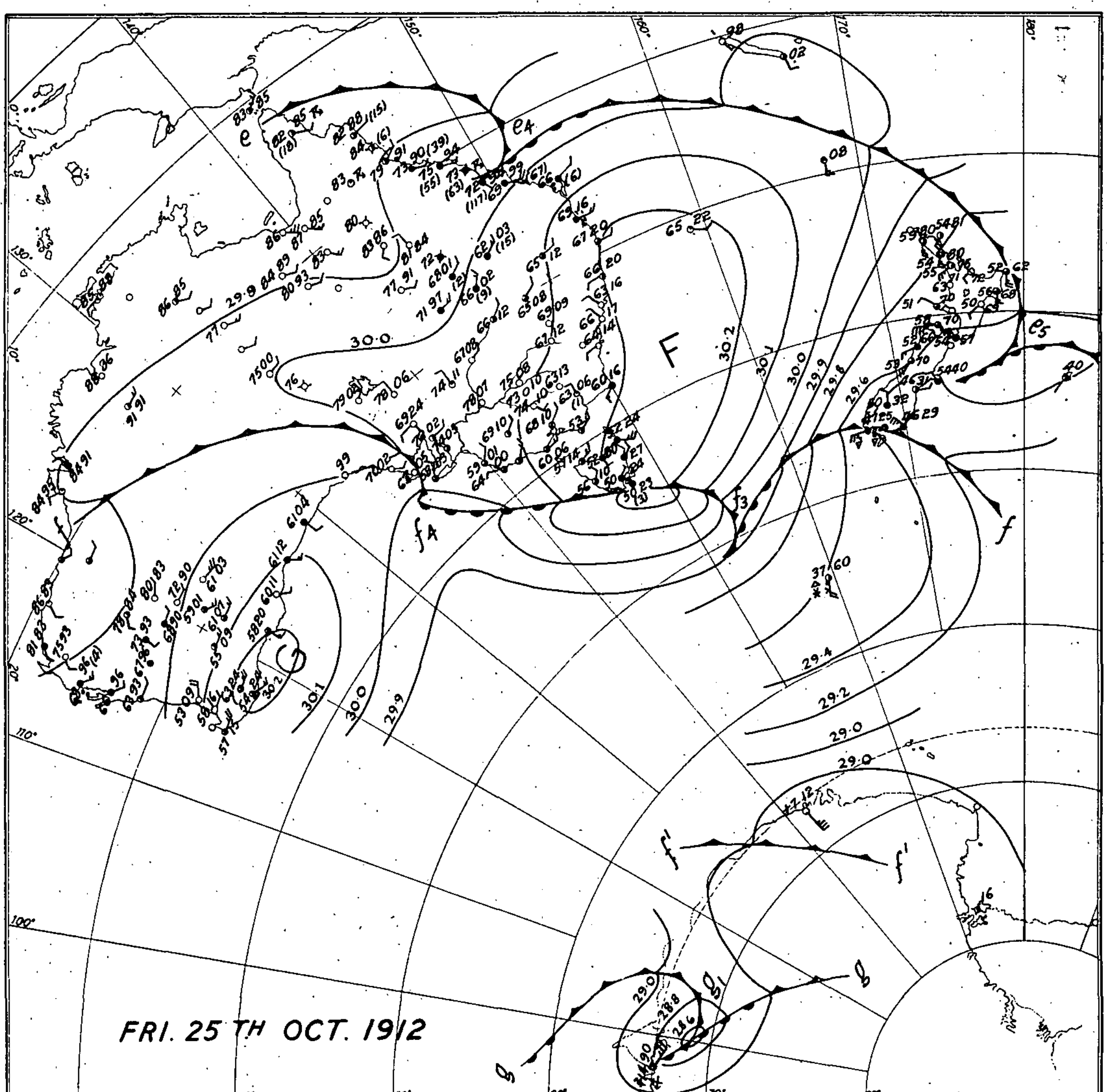
Note the convergence and the development of rain in the interior of Queensland.



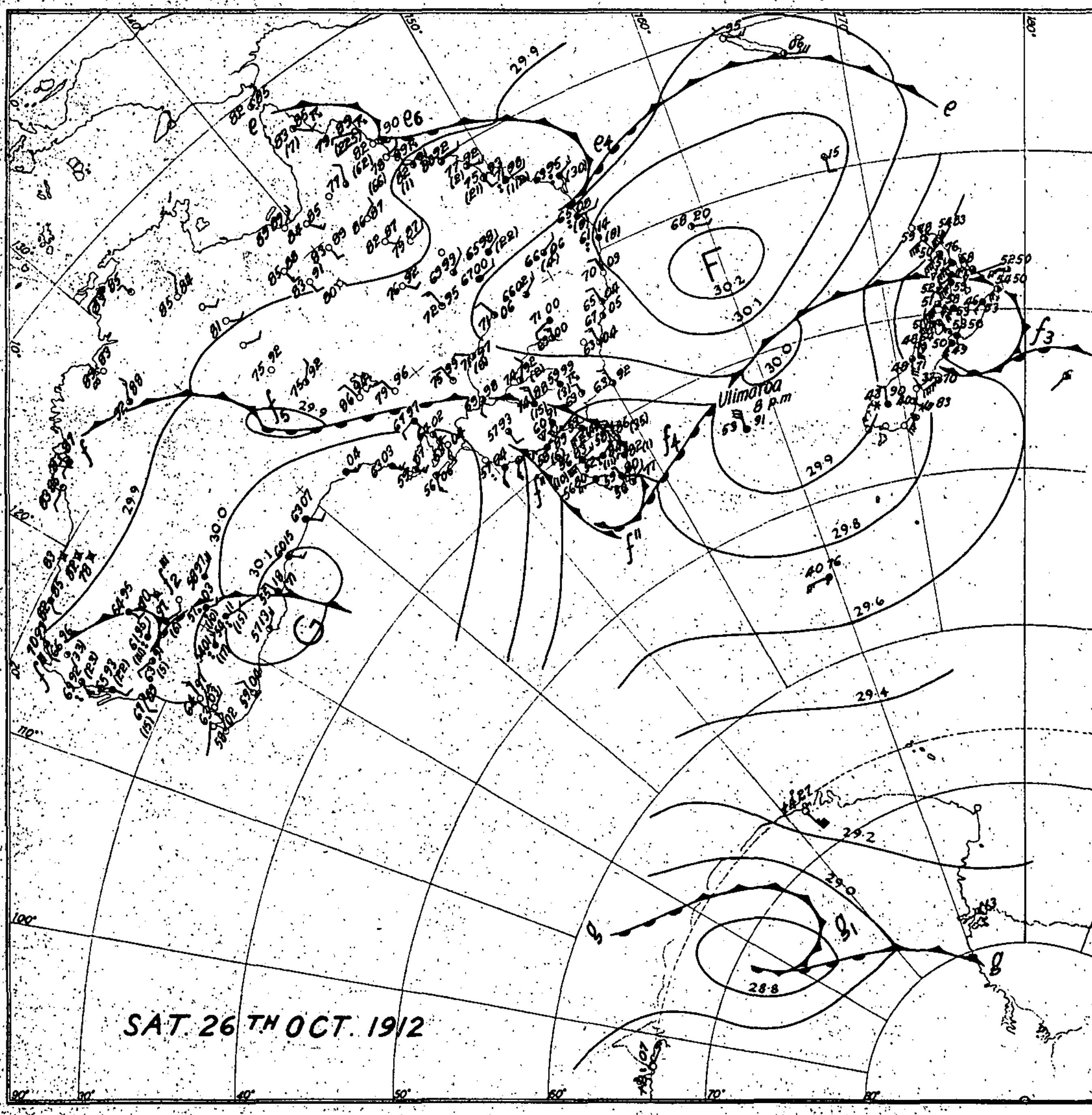
Anticyclone F is centred unusually far south and there is a steep gradient on its southern side. In New Zealand there is a cold southerly outbreak.



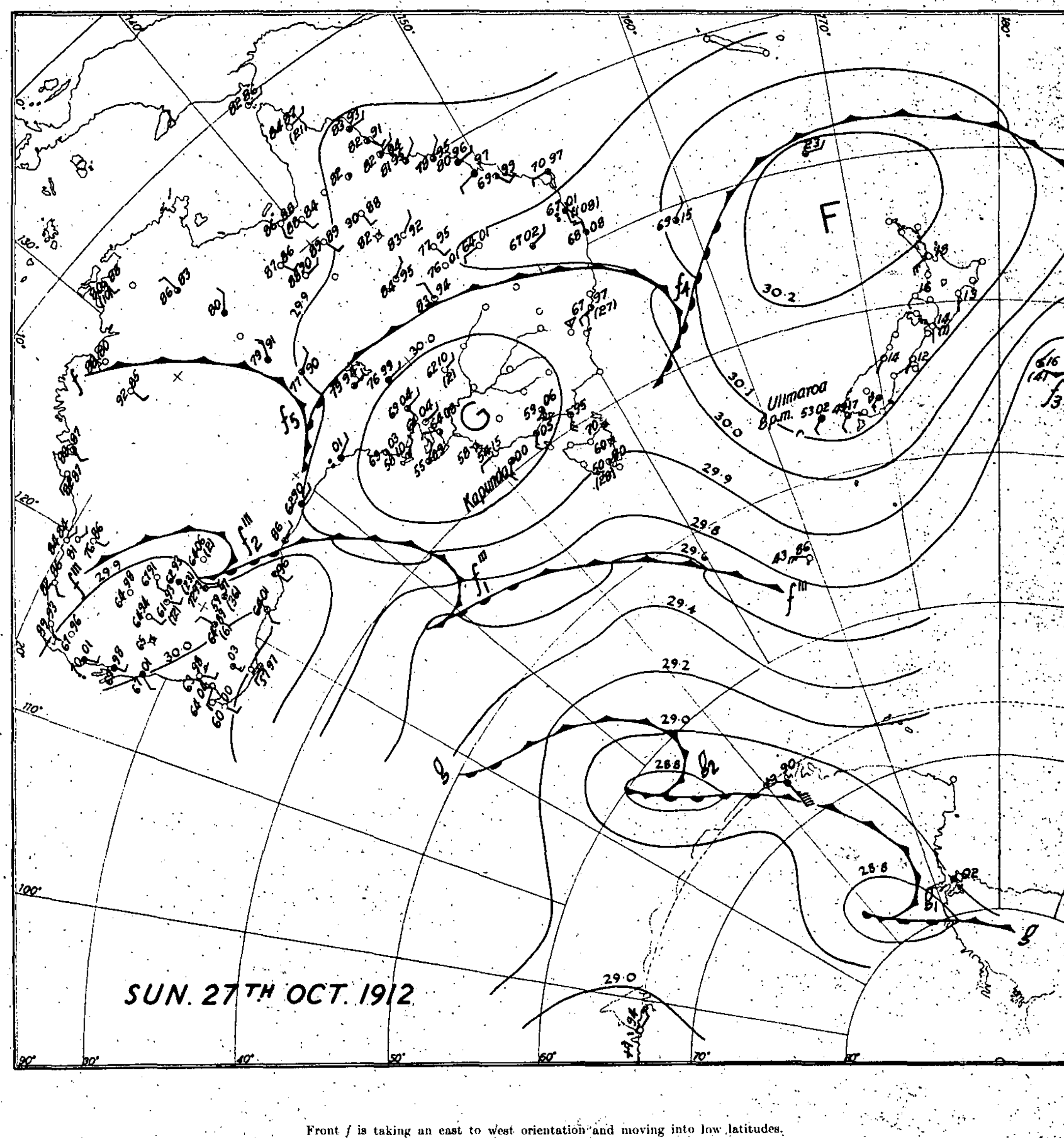
Anticyclone F has moved northward again. Another blizzard is blowing at Queen Mary Land.



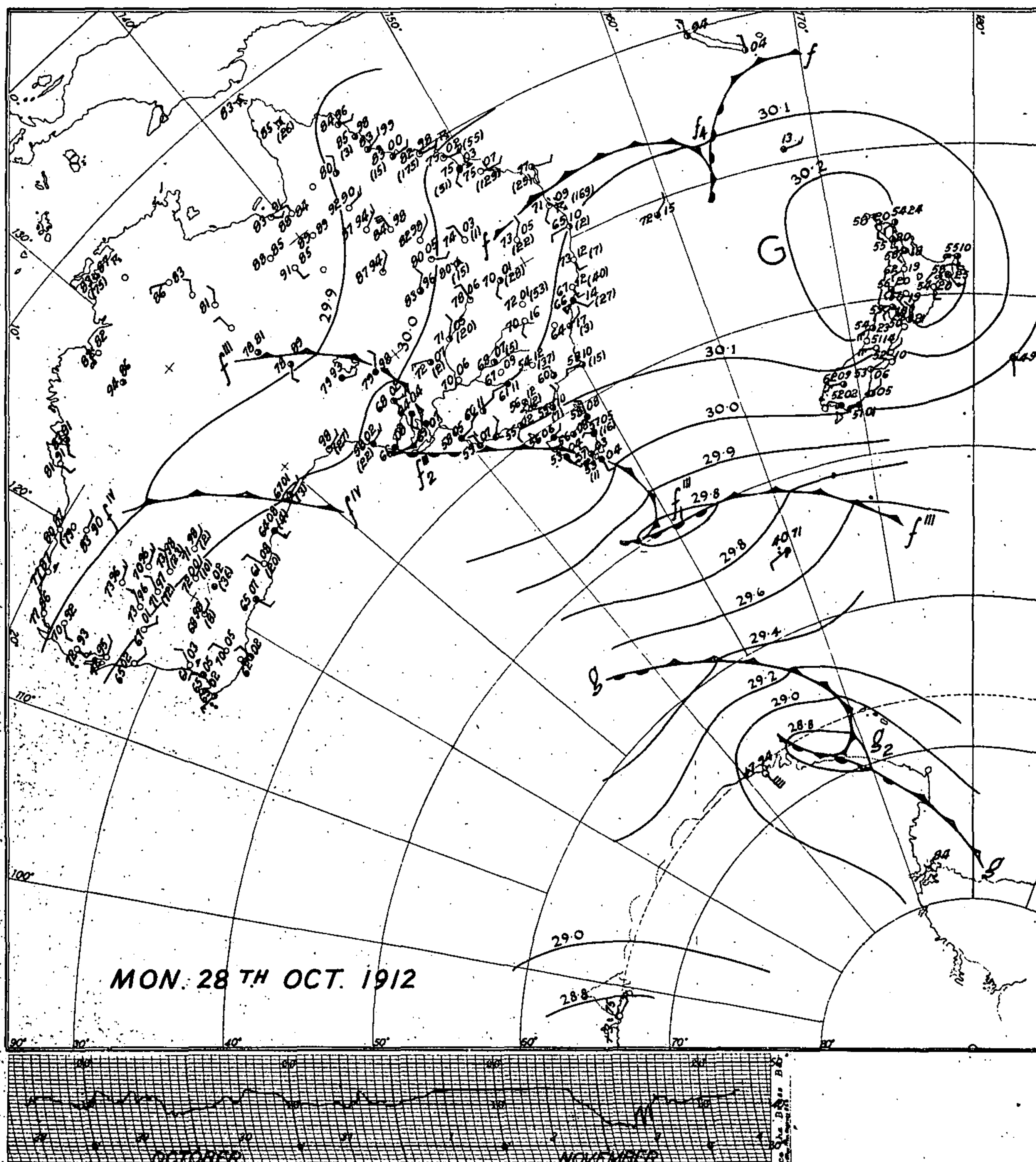
Front *f* is beginning to move northwards over anticyclone F. The temperature has been very variable at Macquarie Island in unstable air. A cyclone is now passing Queen Mary Land and the wind decreasing. There has been a very disturbed period at this station.



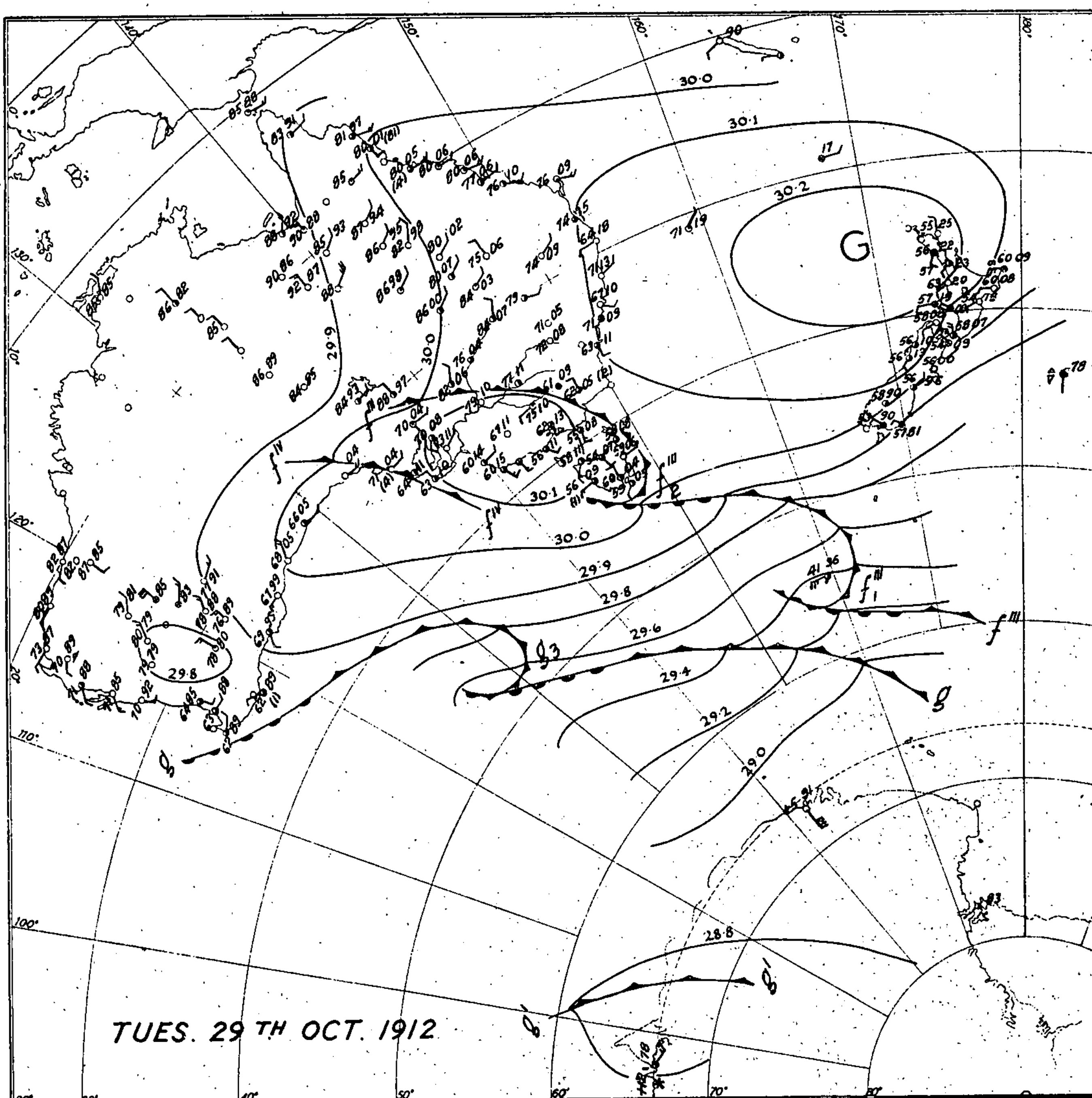
Note the series of waves which has developed in the tropics on front *e*. There is a strong southerly outbreak over New Zealand with widespread snow over the South Island.



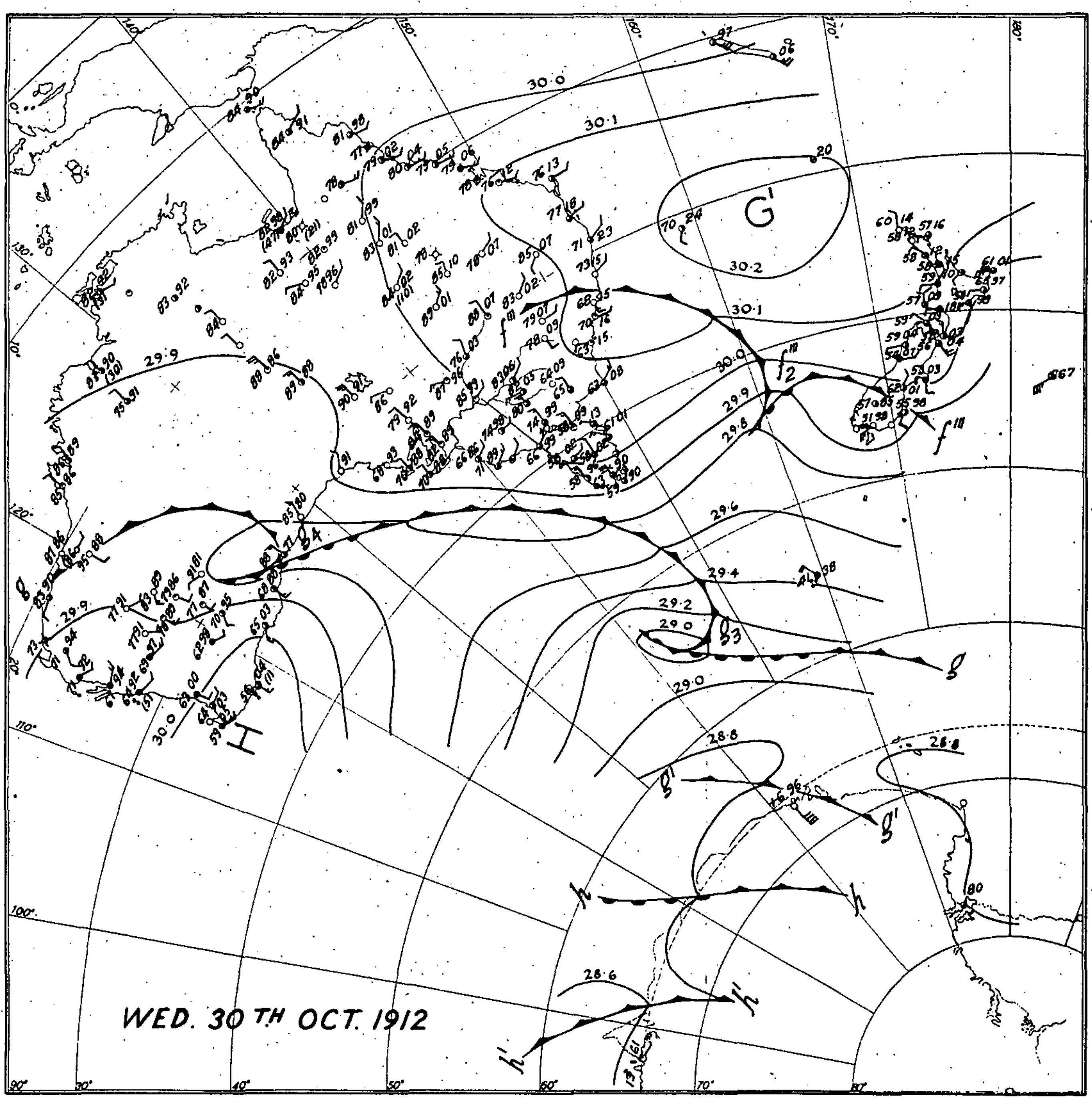
Front f is taking an east to west orientation and moving into low latitudes.



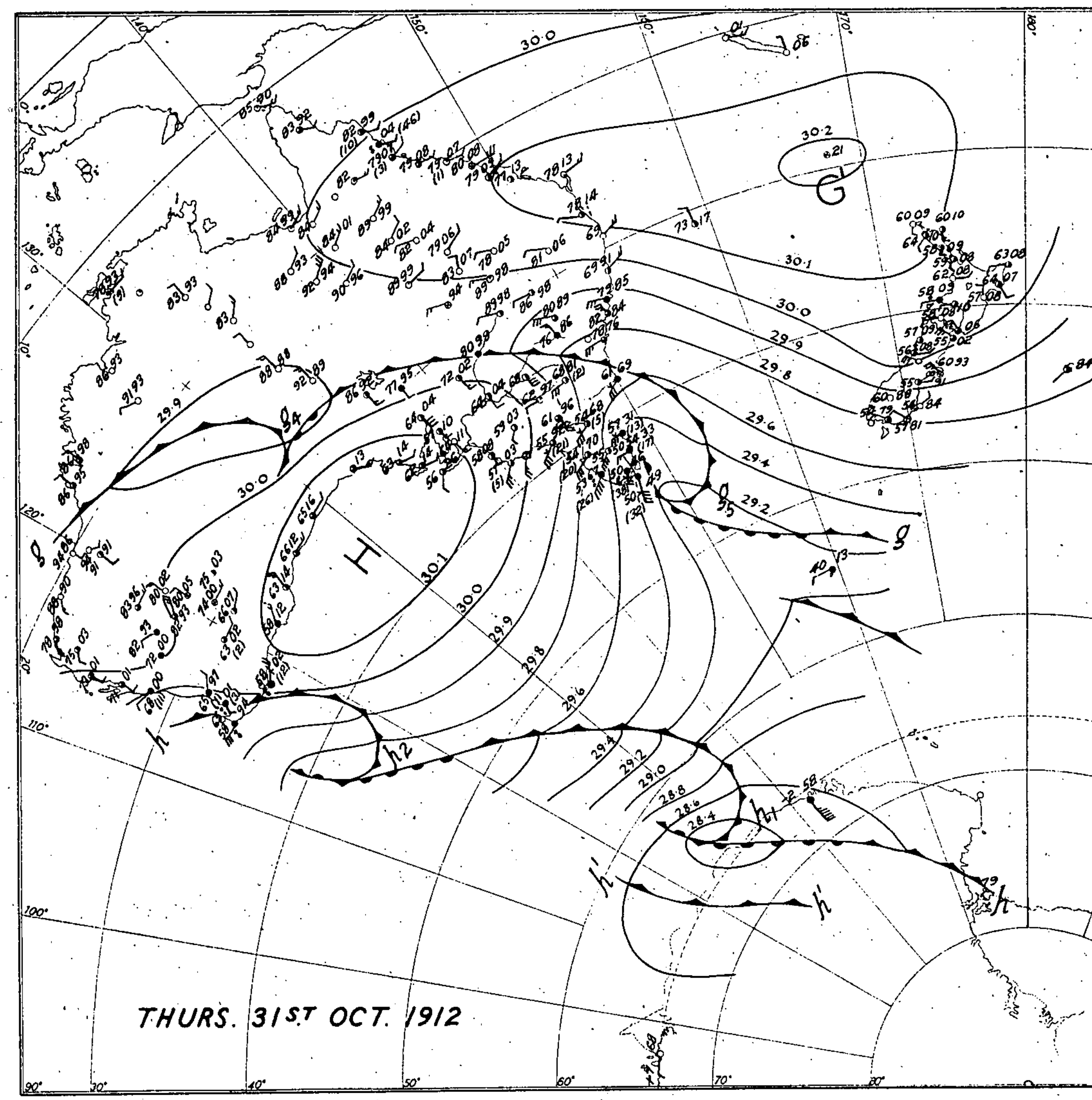
Conditions are quiet and the analysis is difficult.



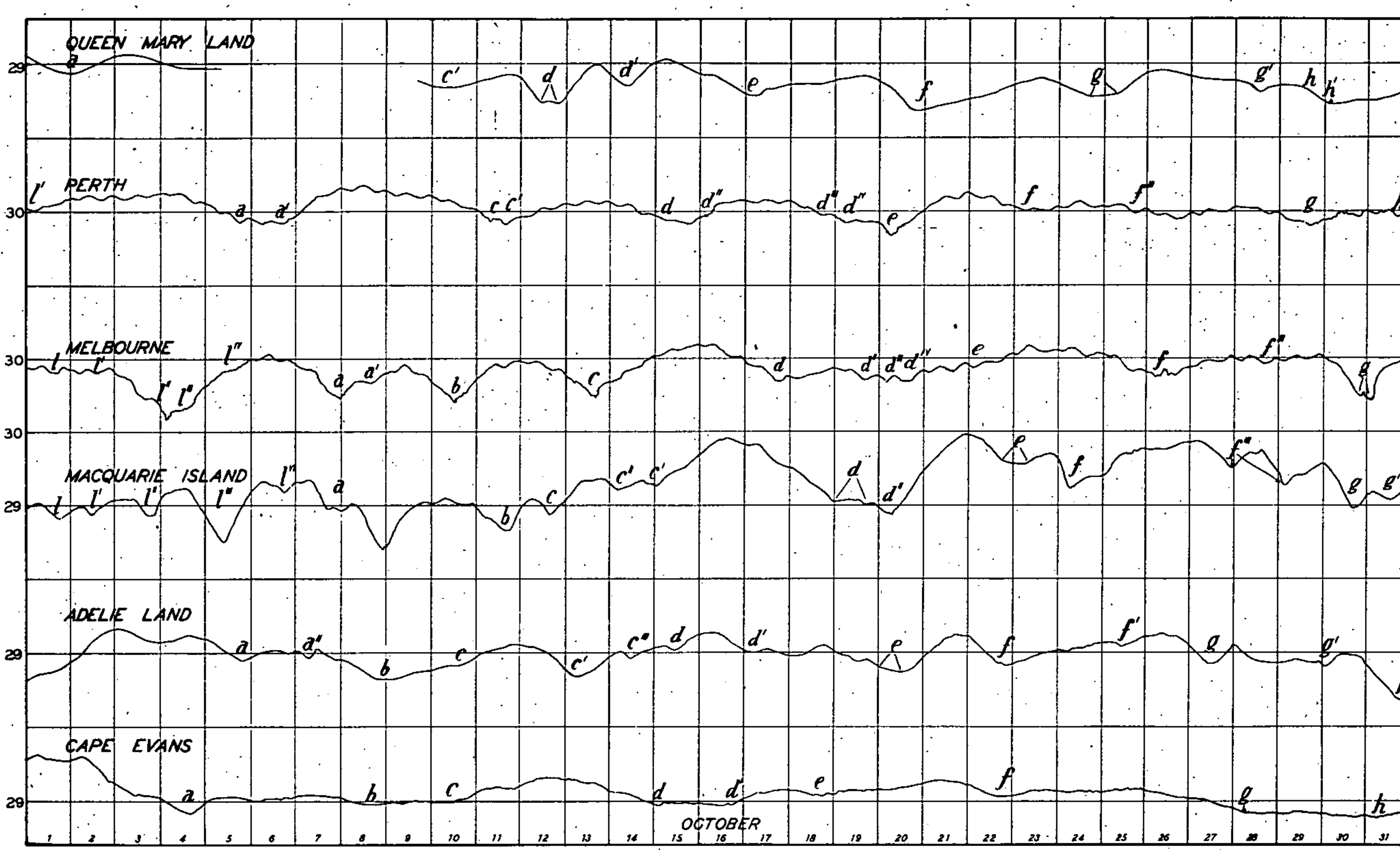
Little of note. Temperatures are very variable at Macquarie Island for several days.

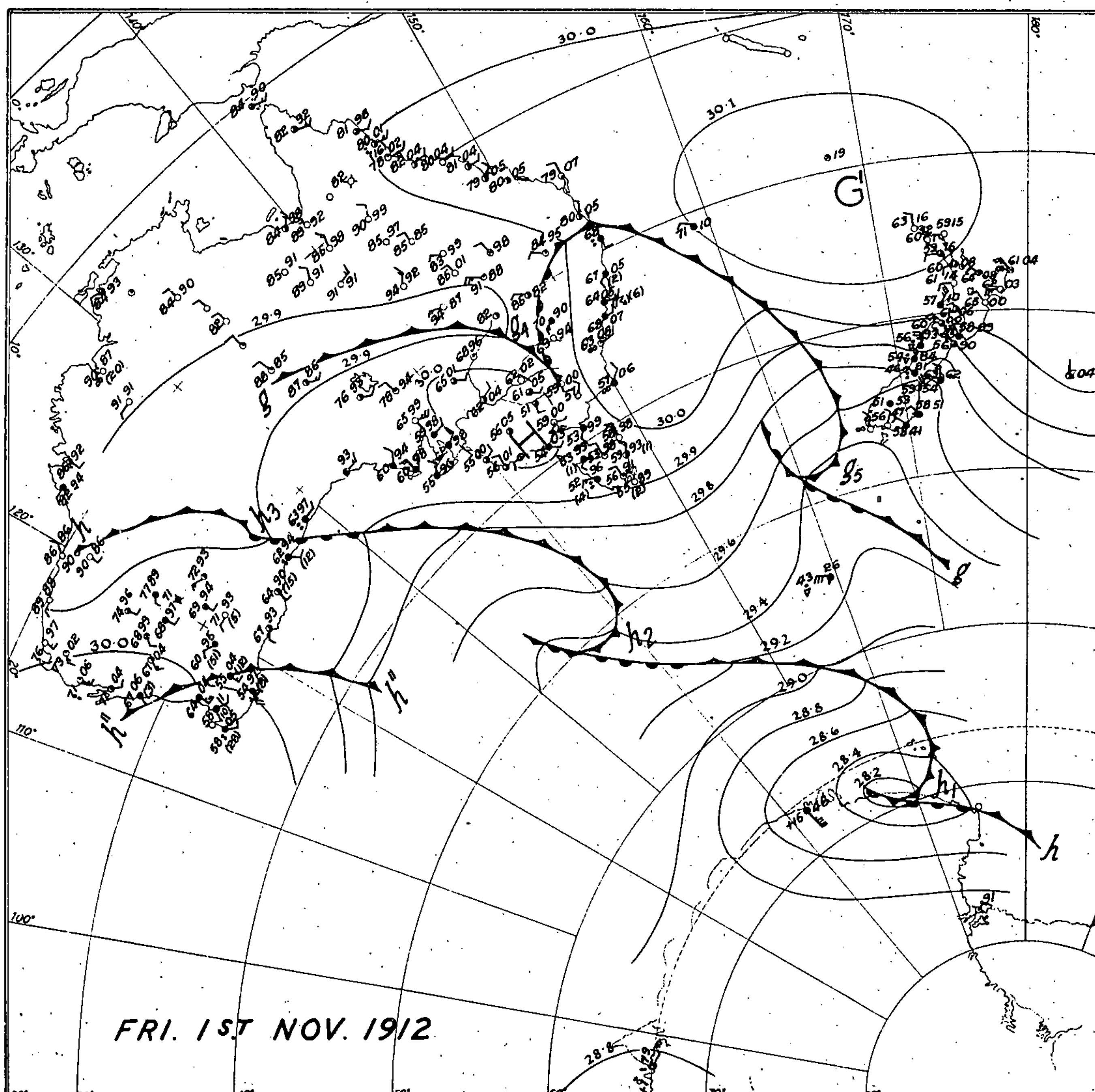


Conditions are still quiet, especially in Antarctica, and the analysis is difficult.

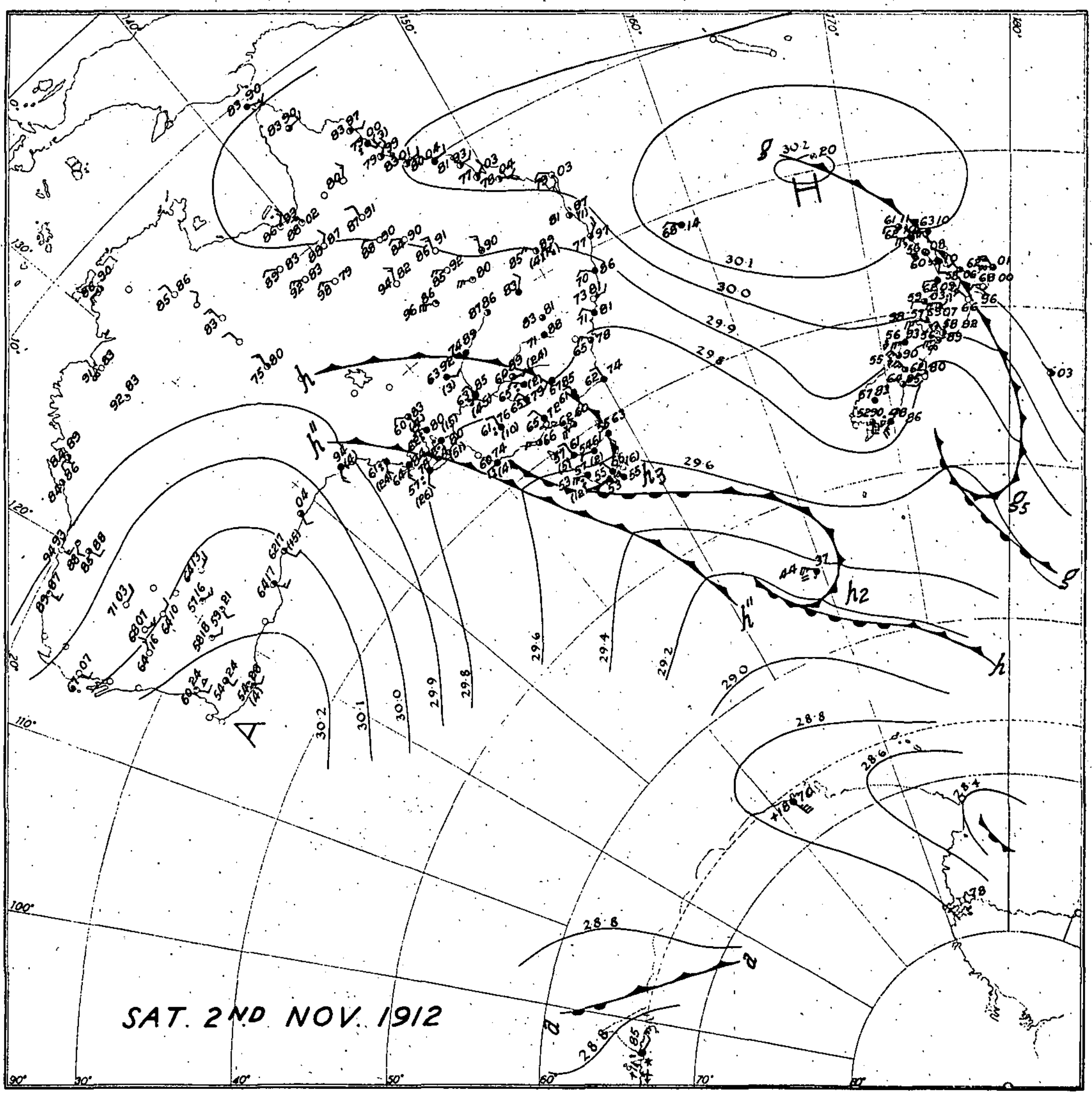


There has been a remarkable development in southern Australia where front g has moved very fast and g_5 has developed into a vigorous wave. A depression is approaching Adélie Land.

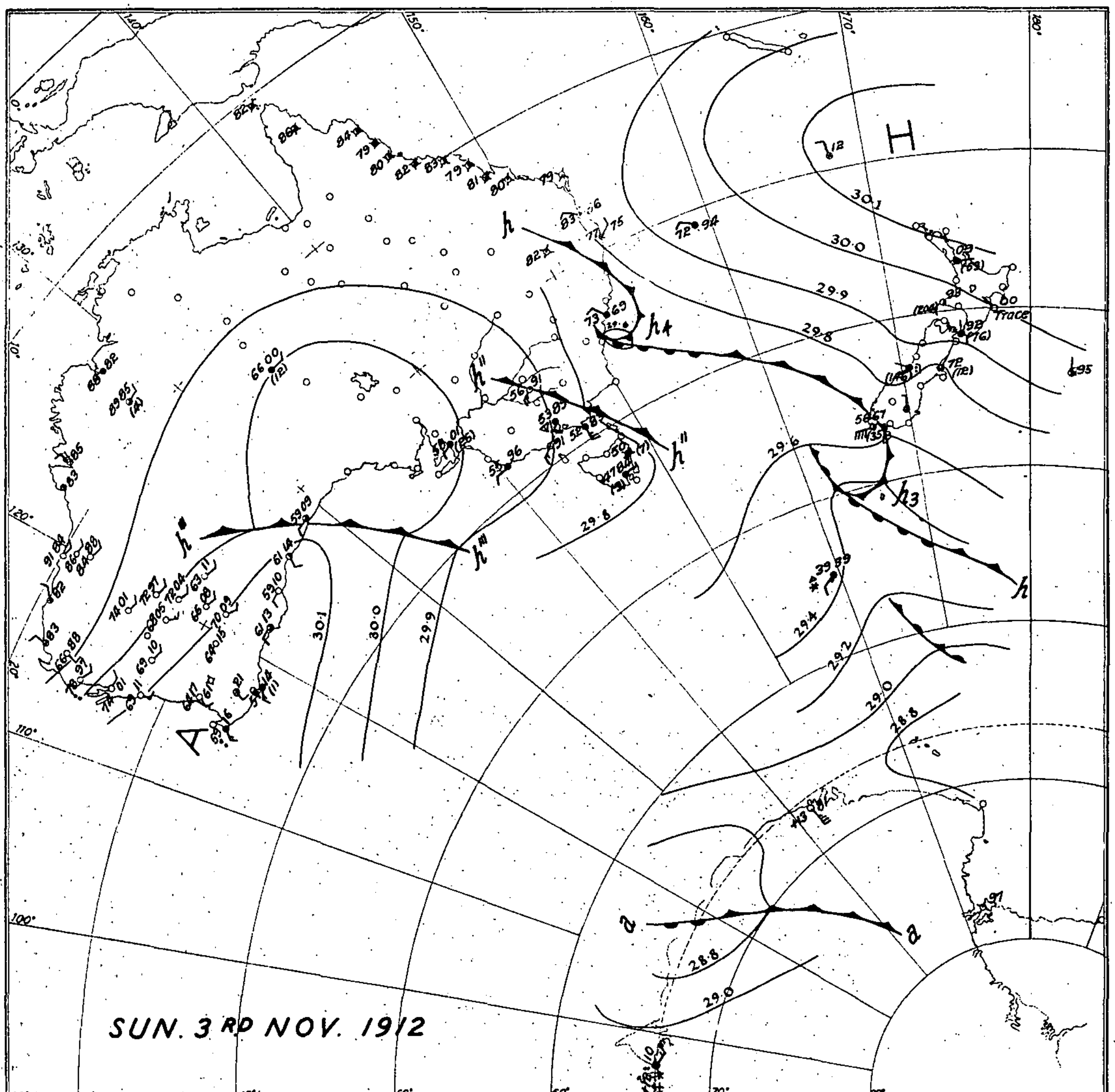

QUEEN MARY LAND
PERTH
MELBOURNE
MACQUARIE ISLAND
ADELIE LAND
CAPE EVANS
OCTOBER



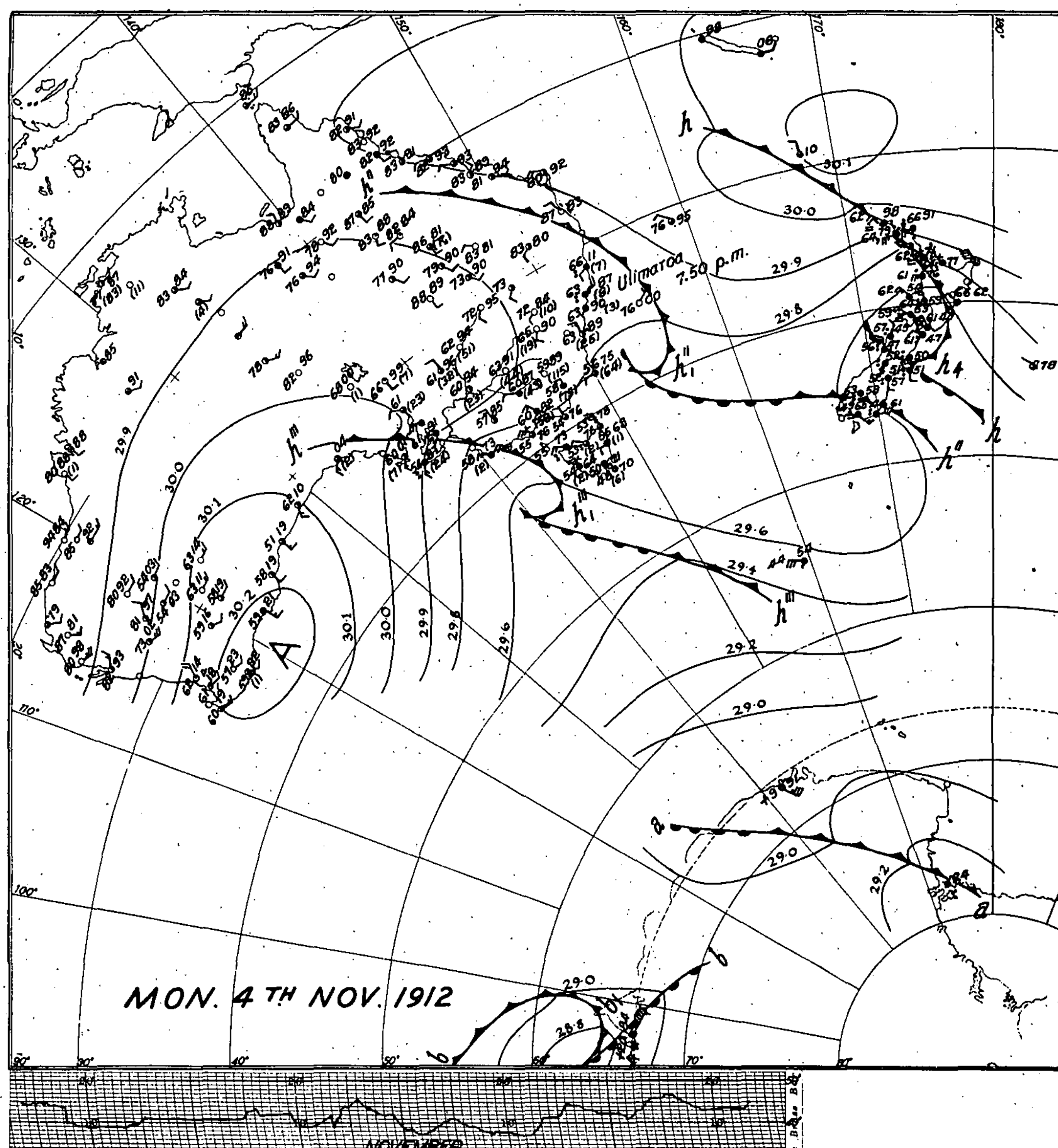
Little of note. The depression h_1 is now east of Adélie Land, where pressure is still low.



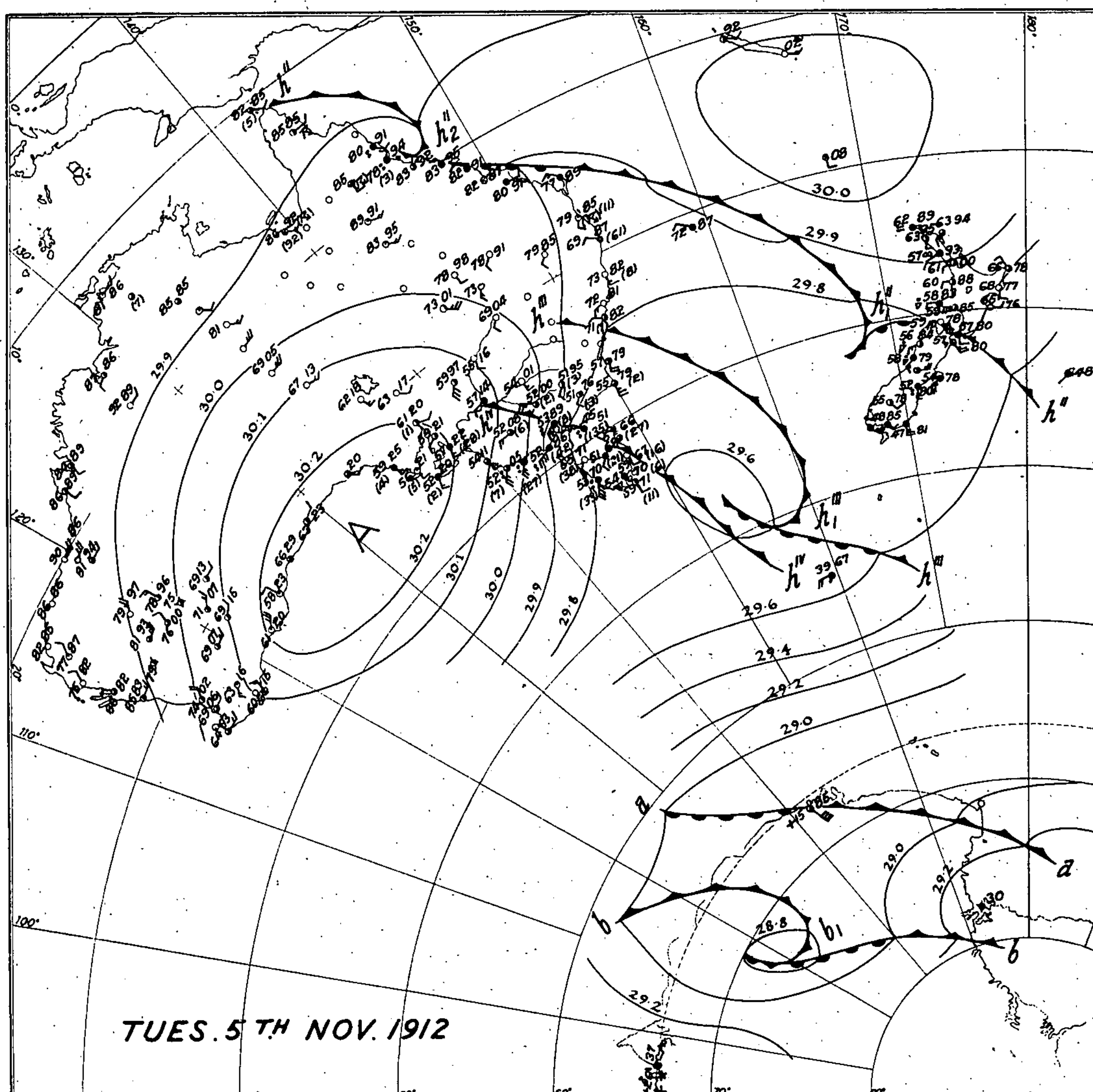
Front h has moved rapidly and widespread rain is associated with wave h_3.



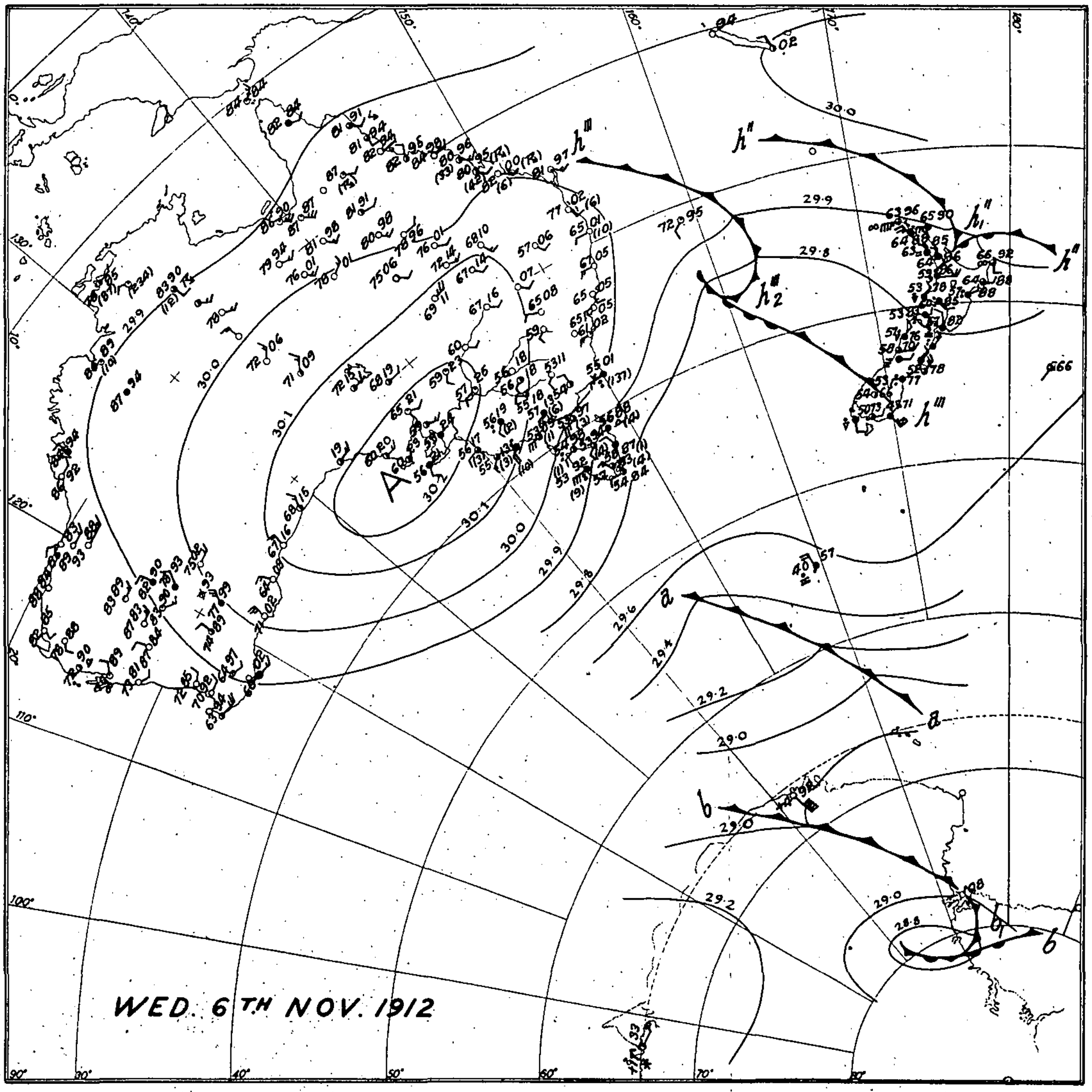
Little of note. Snow and hail at Macquarie Island.



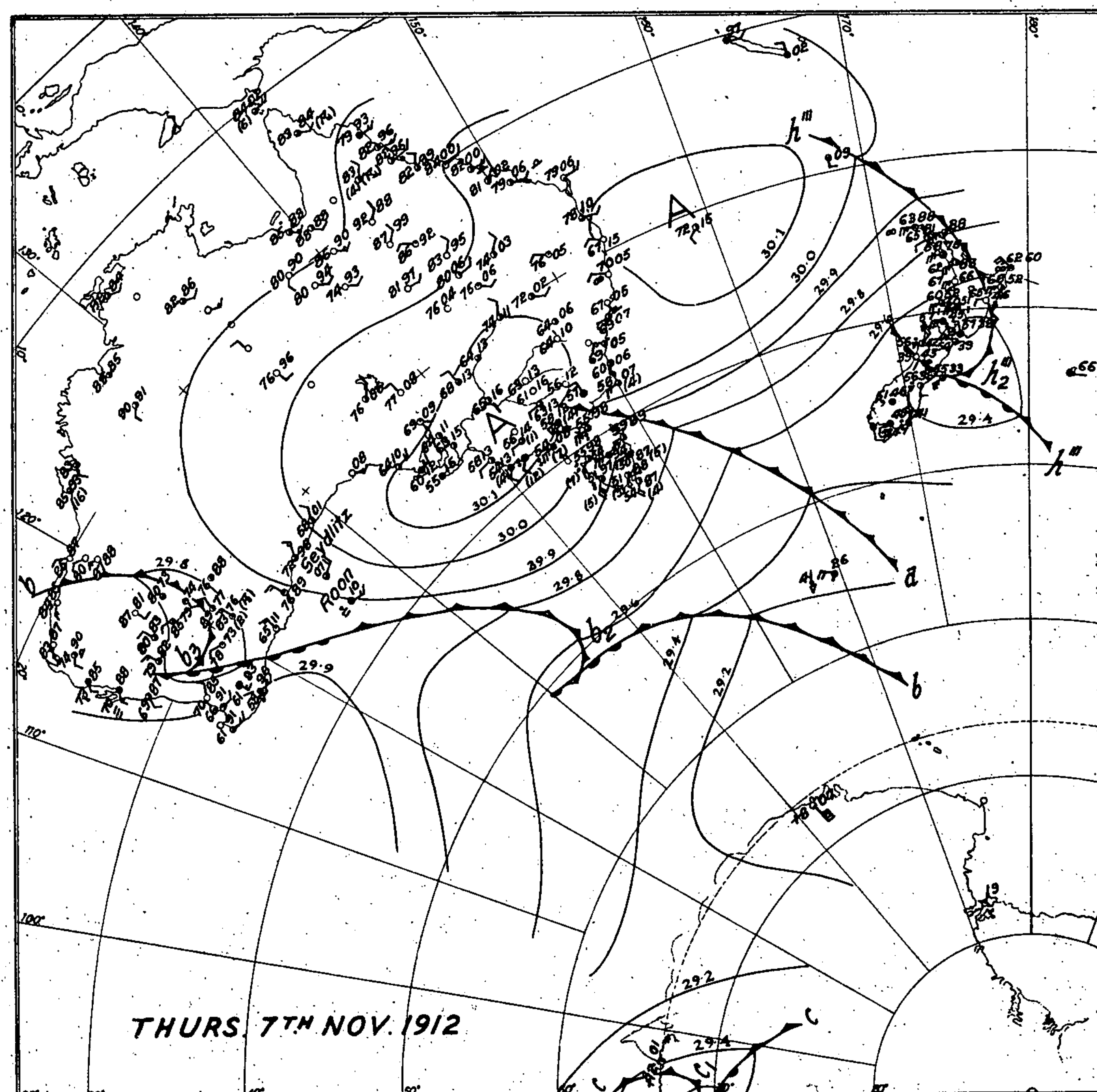
There are strong winds and remarkably widespread rain over New Zealand about wave h_4 which has moved very rapidly. Waves are developing on secondary fronts also. A blizzard is blowing at Queen Mary Land, the centre of a cyclone apparently passing just north of it.



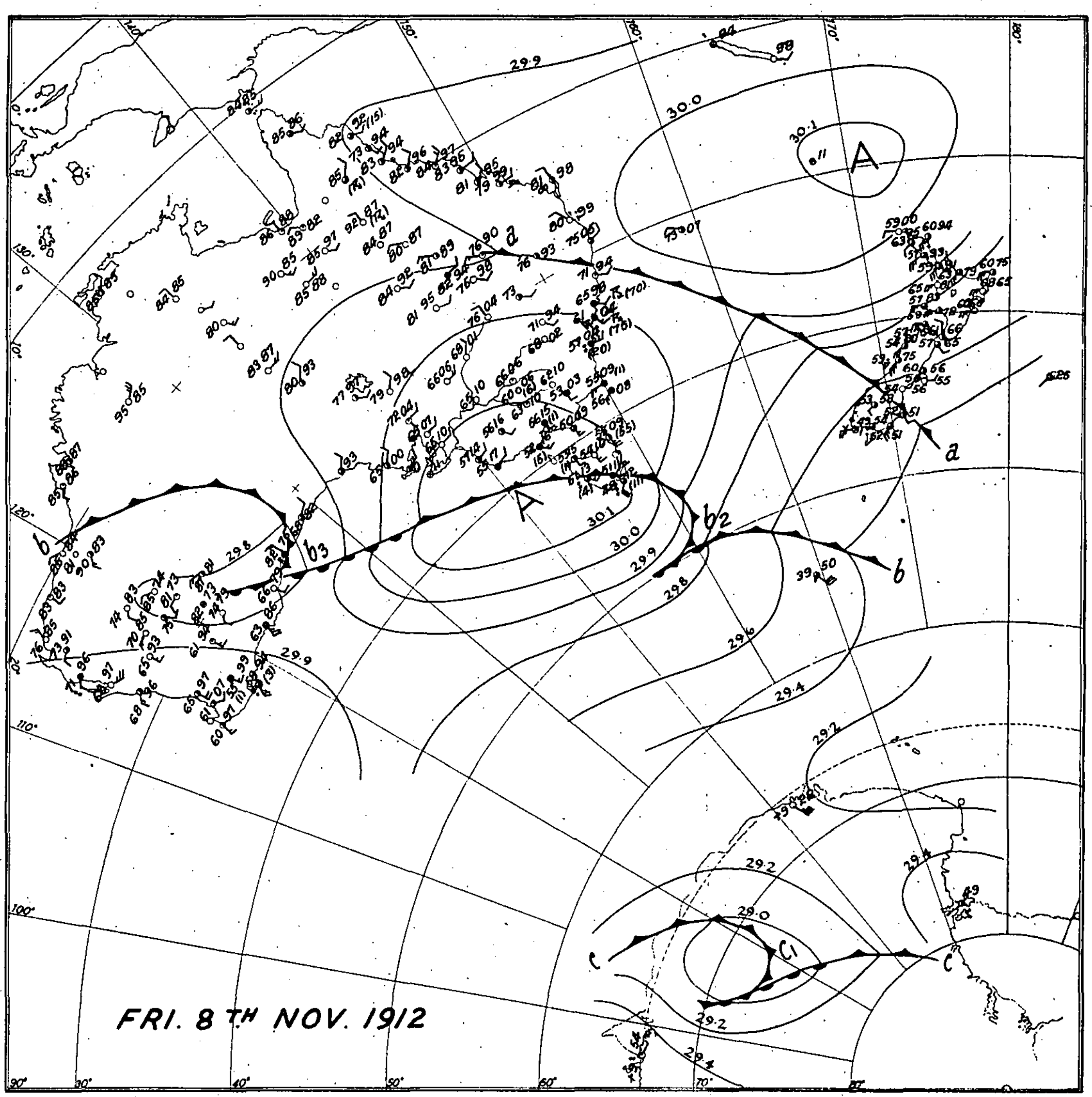
A very abrupt fall of temperature took place at Macquarie Island with the passage of h^{III}.



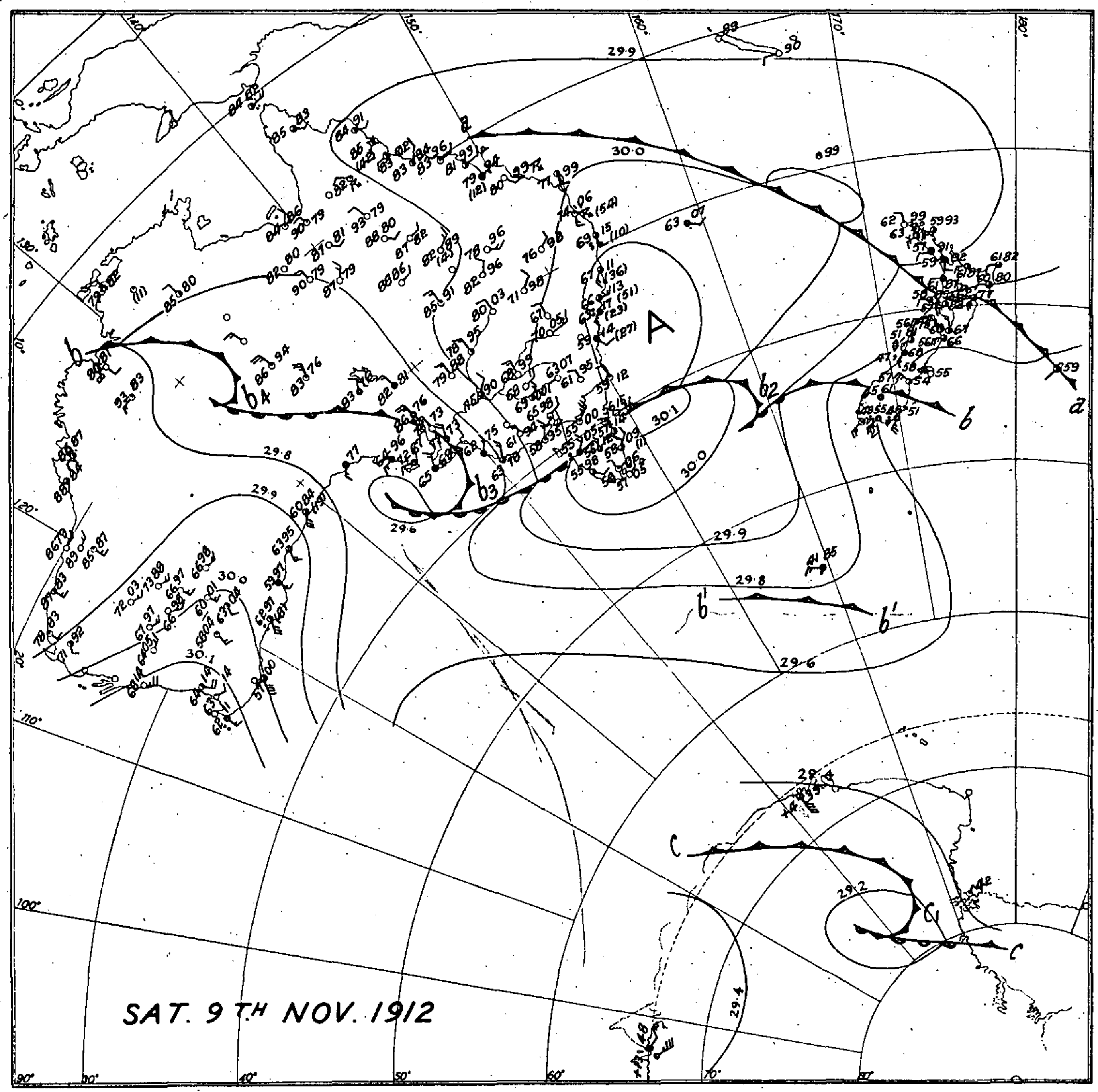
Wave b_1 appears to be passing to the south of Cape Evans which is little affected except for the fall of pressure. There is much rain over New Zealand.



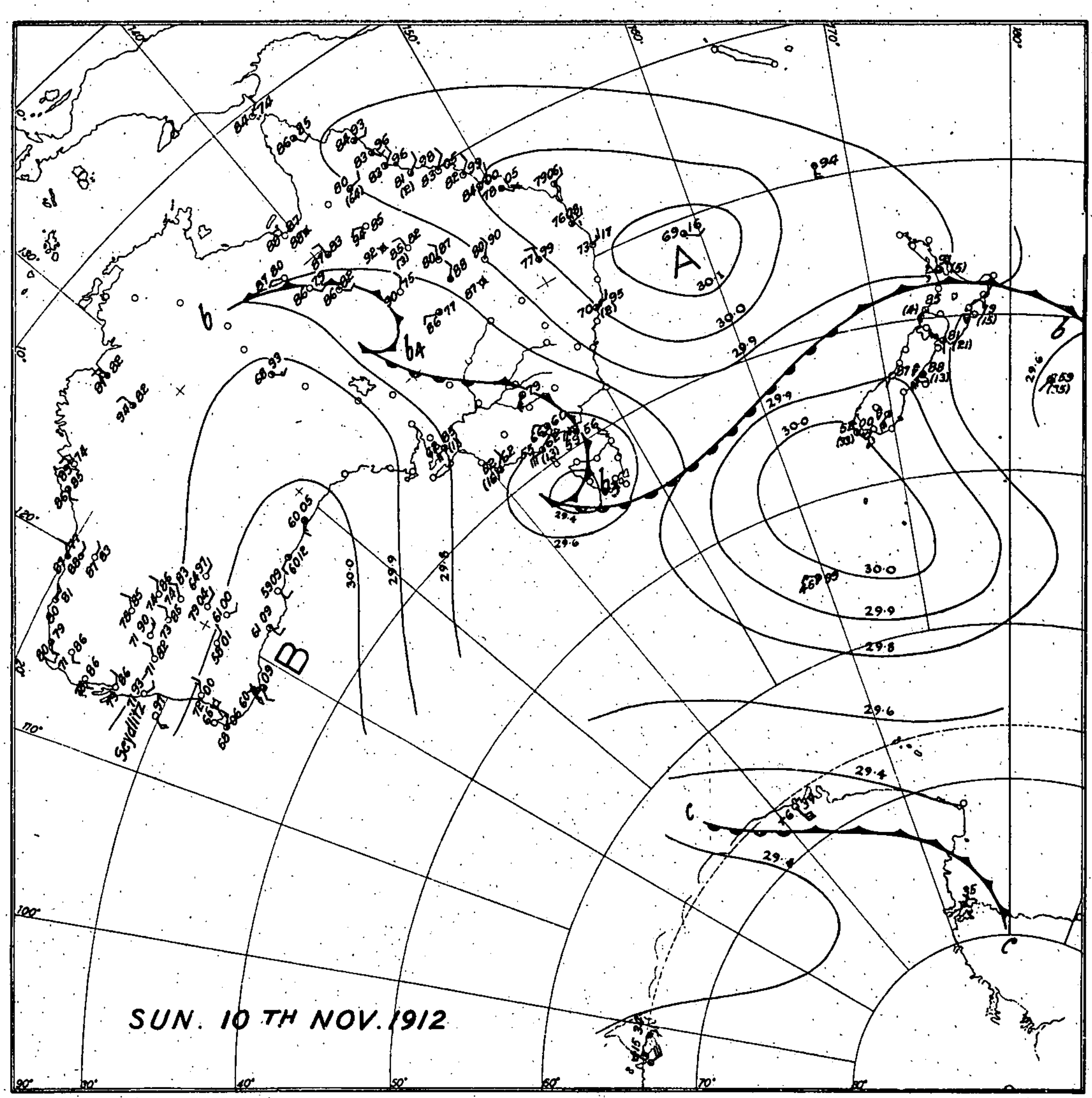
A depression is crossing Queen Mary Land but the absence of wind and of any marked effect later at Adélie Land or Cape Evans suggest that the centre is passing to the south.



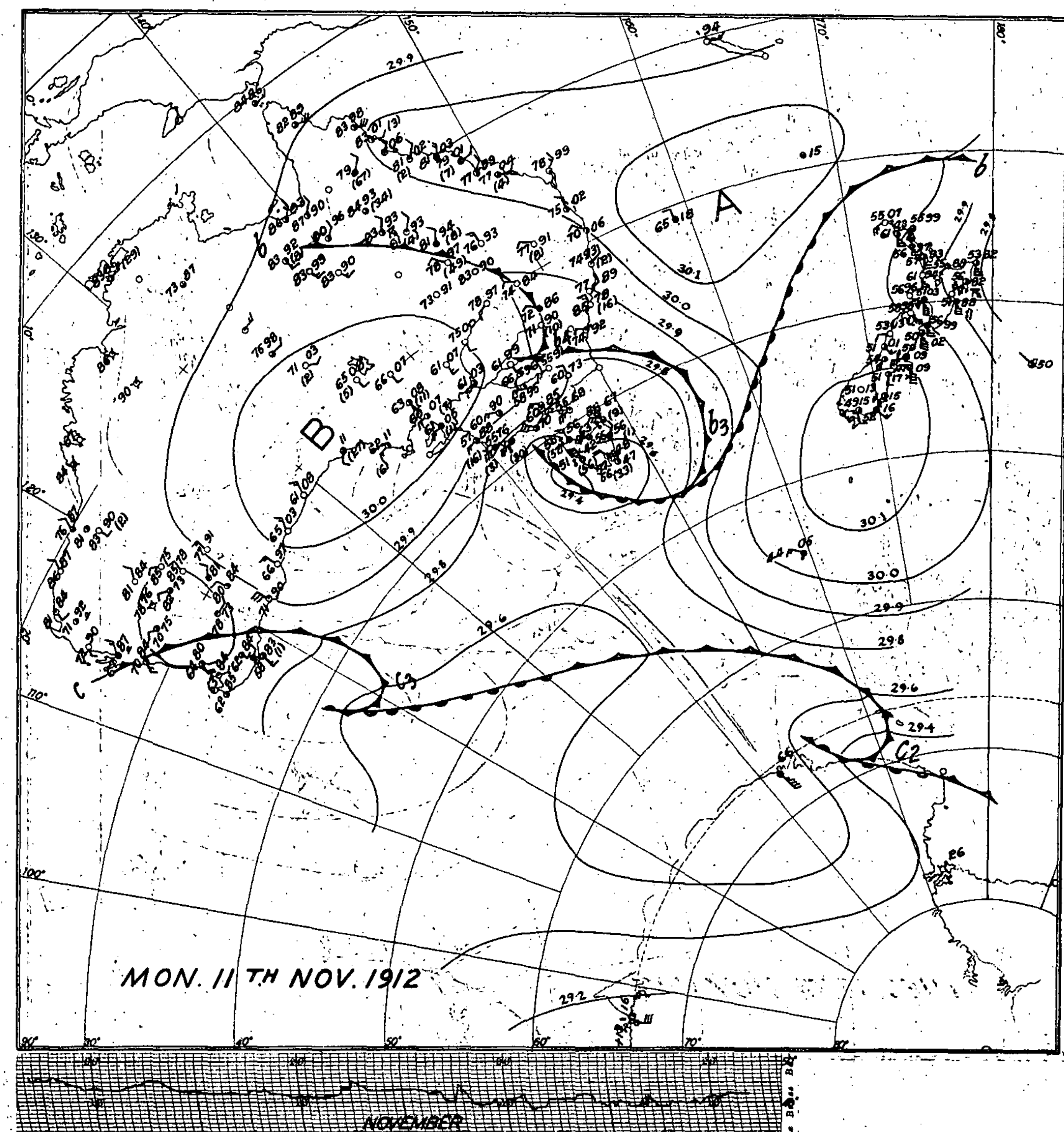
Pressure is high in Antarctica.



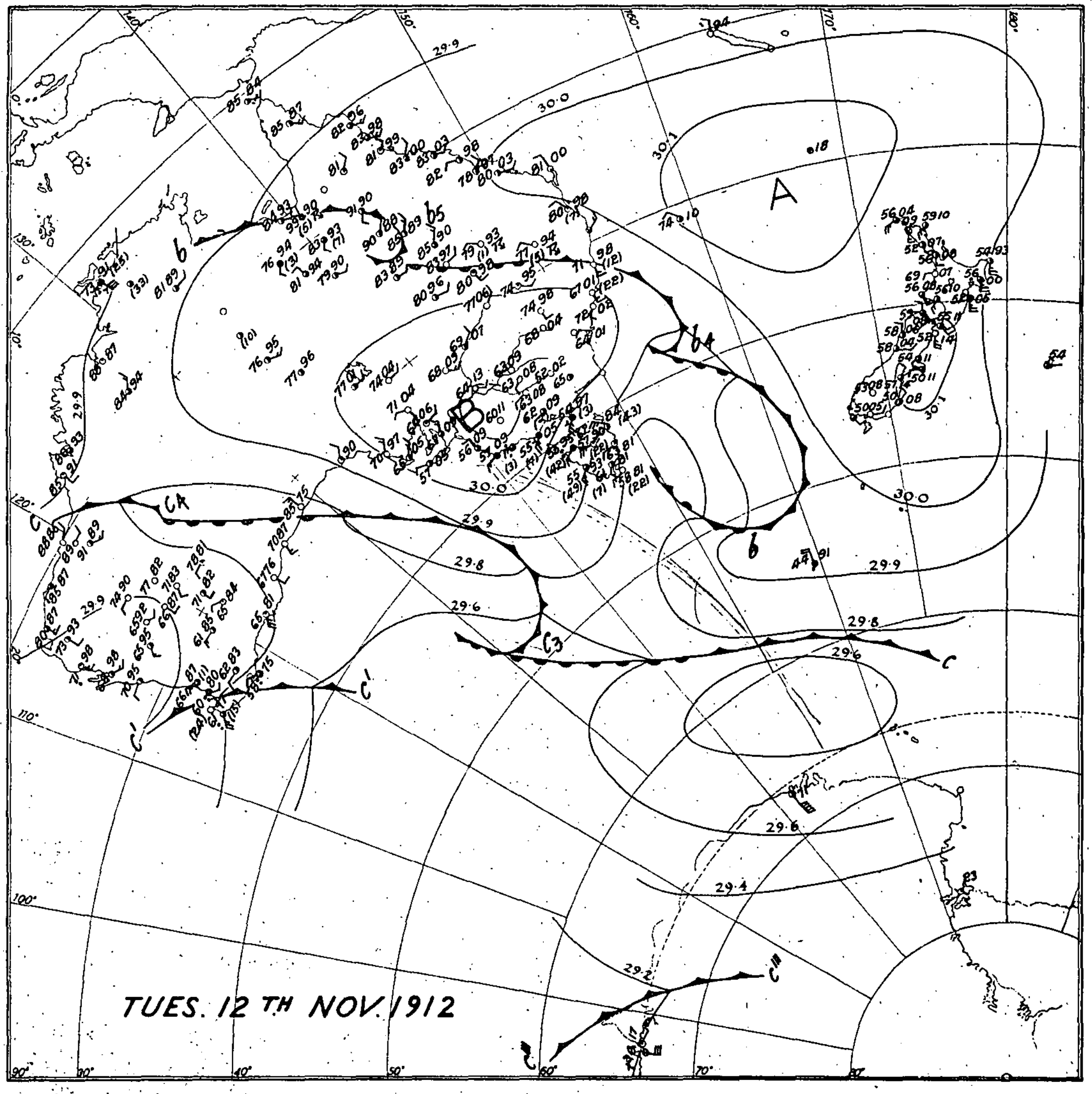
There is a wide current from the north over eastern Australia and a strong southerly outbreak in the west. Front *b* is pronounced. The second wind arrow appearing near the Queen Mary Land station represents a sledging party's observations. Such observations will appear at times near both the Antarctic Stations.



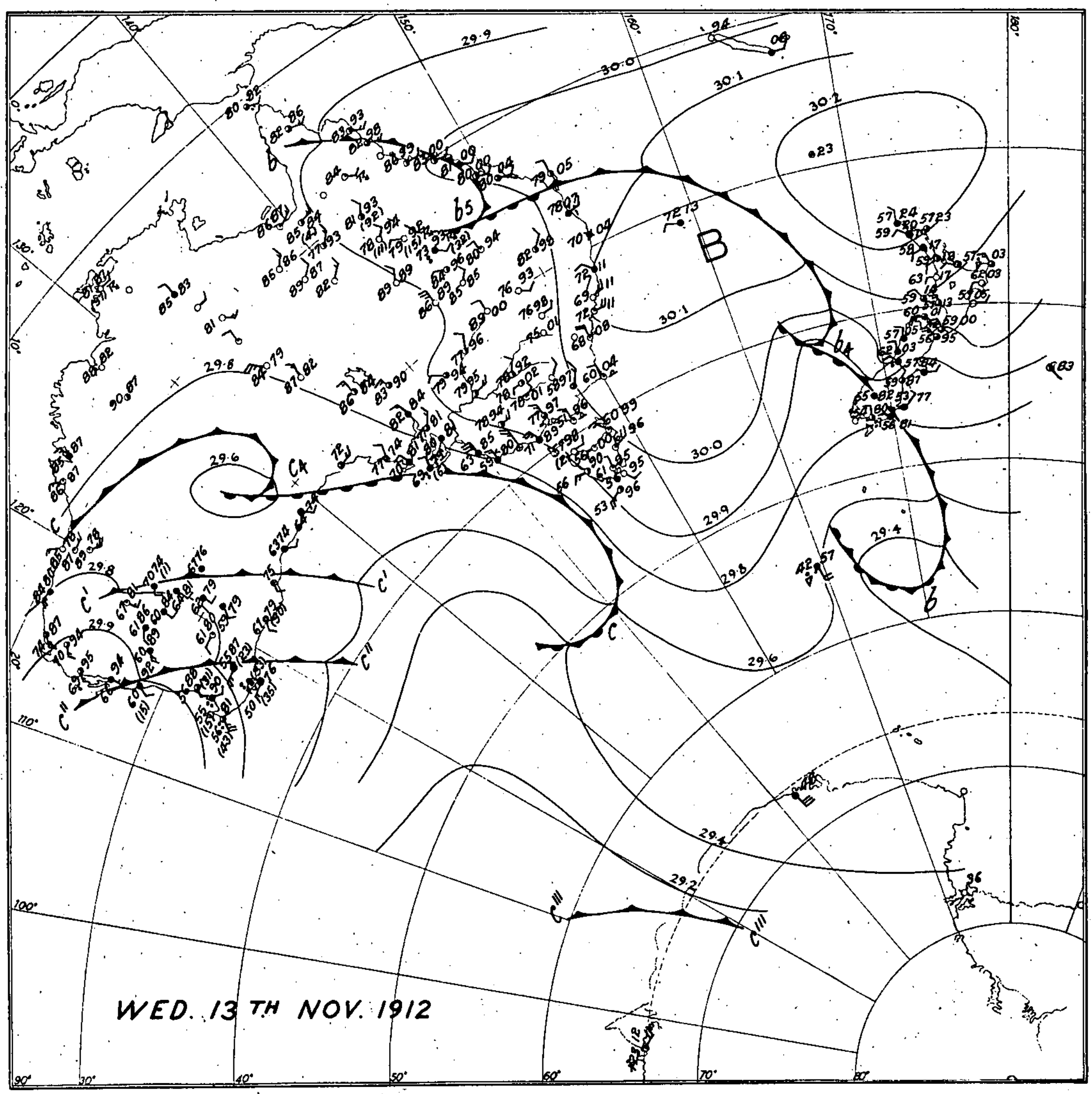
A shallow cyclone has formed over Tasmania but the eastern part of front *b* is moving northward across anticyclone A. Over New Zealand there is a cold southerly outbreak with hail.



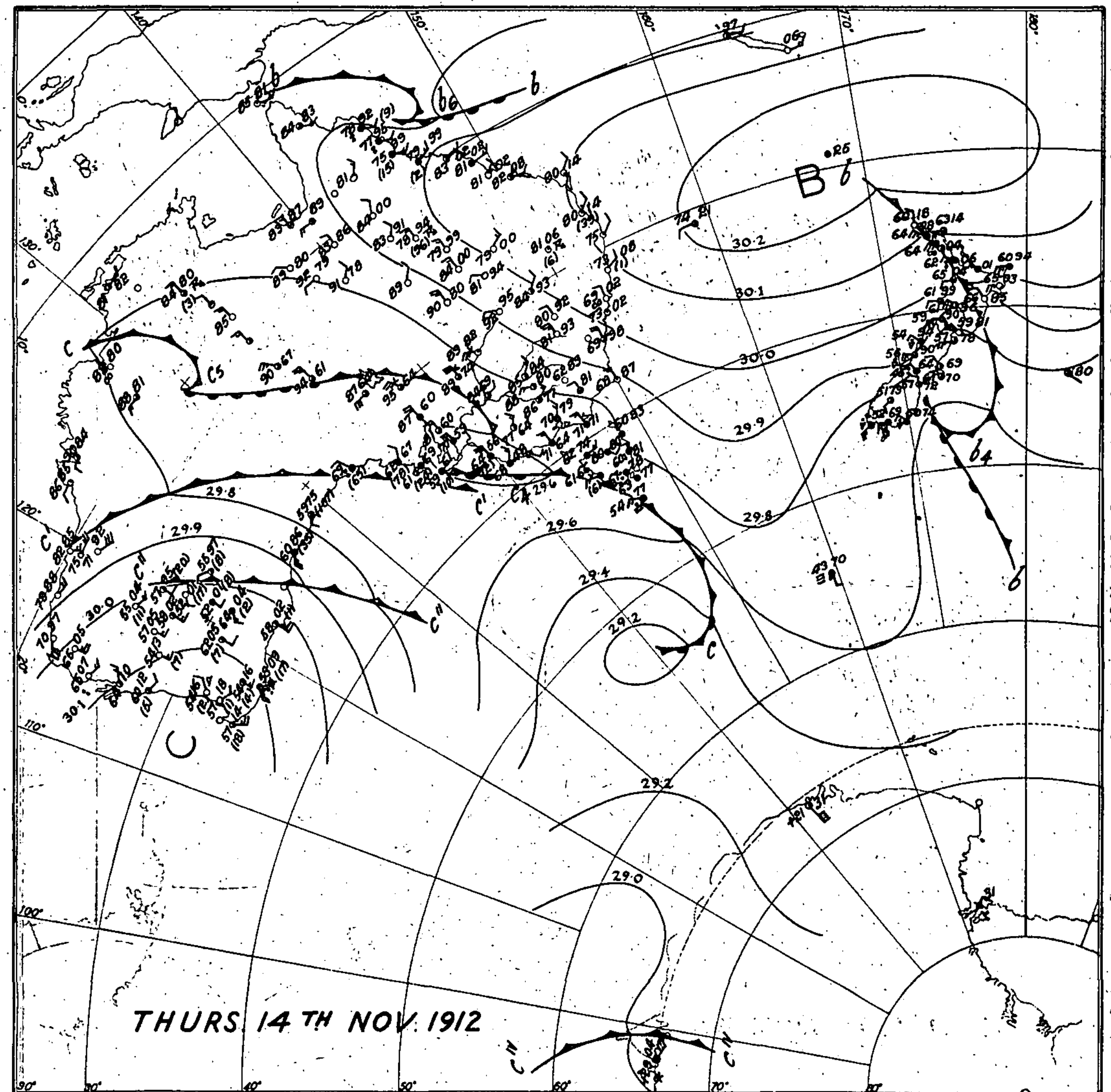
The centre of the cyclone has remained almost stationary west of Tasmania on the occlusion of wave b_3. There are strong southerly winds in New Zealand.



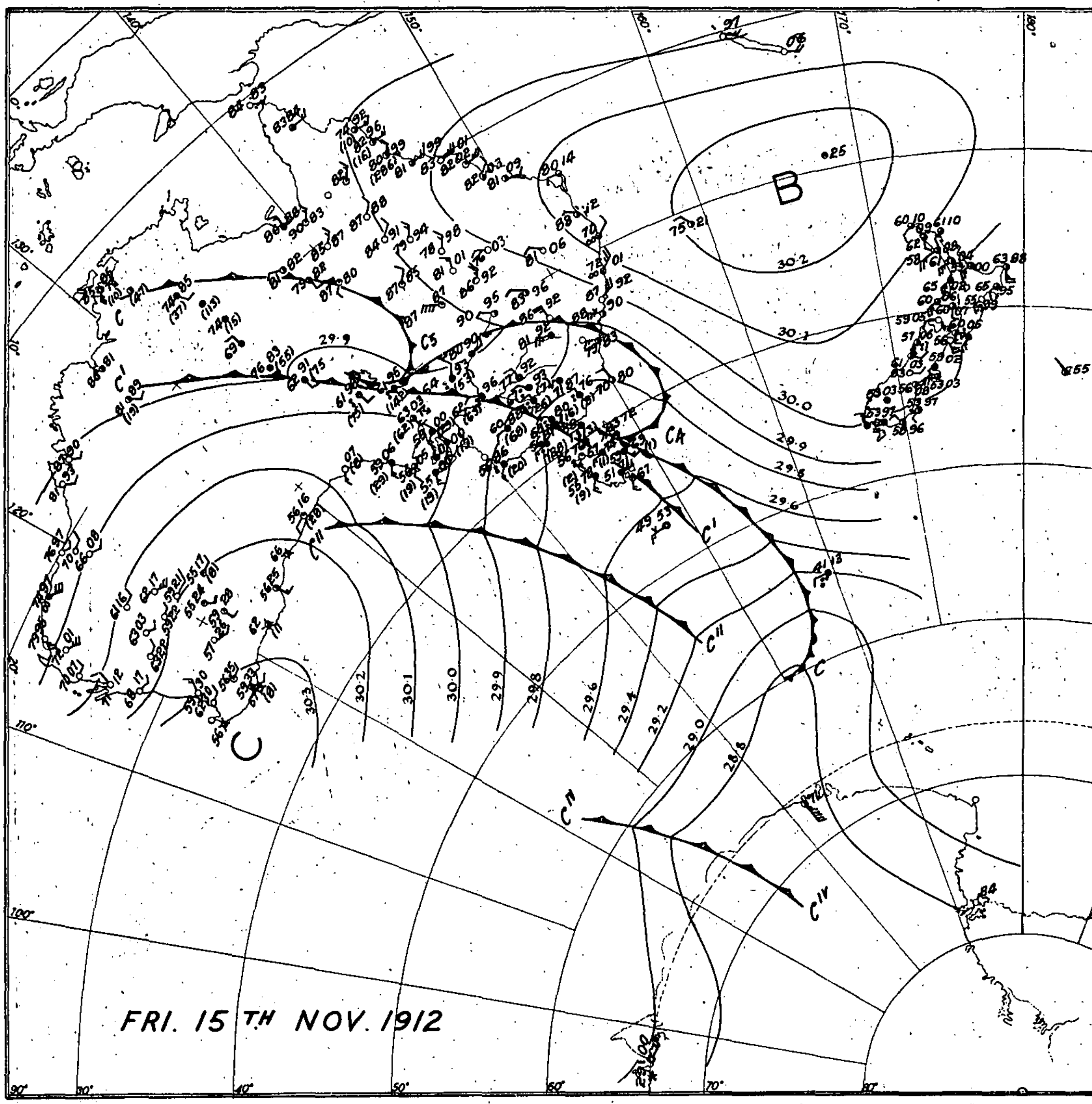
The western part of front *b* becomes separated from the eastern part.



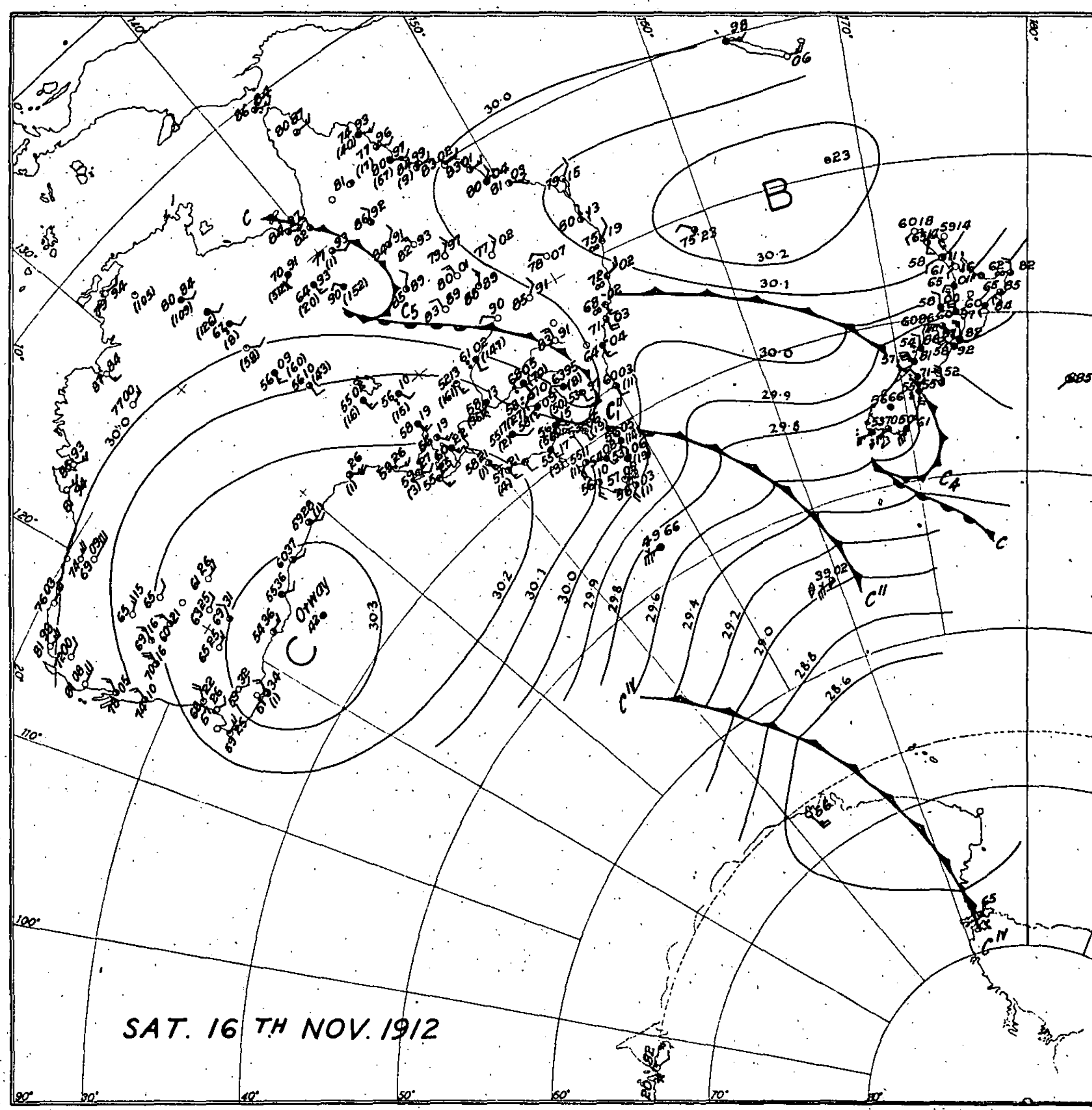
The weather changes at Macquarie Island suggest that the southern part of front *c* becomes diffuse while the northern part, which is well marked, moves slowly eastward.



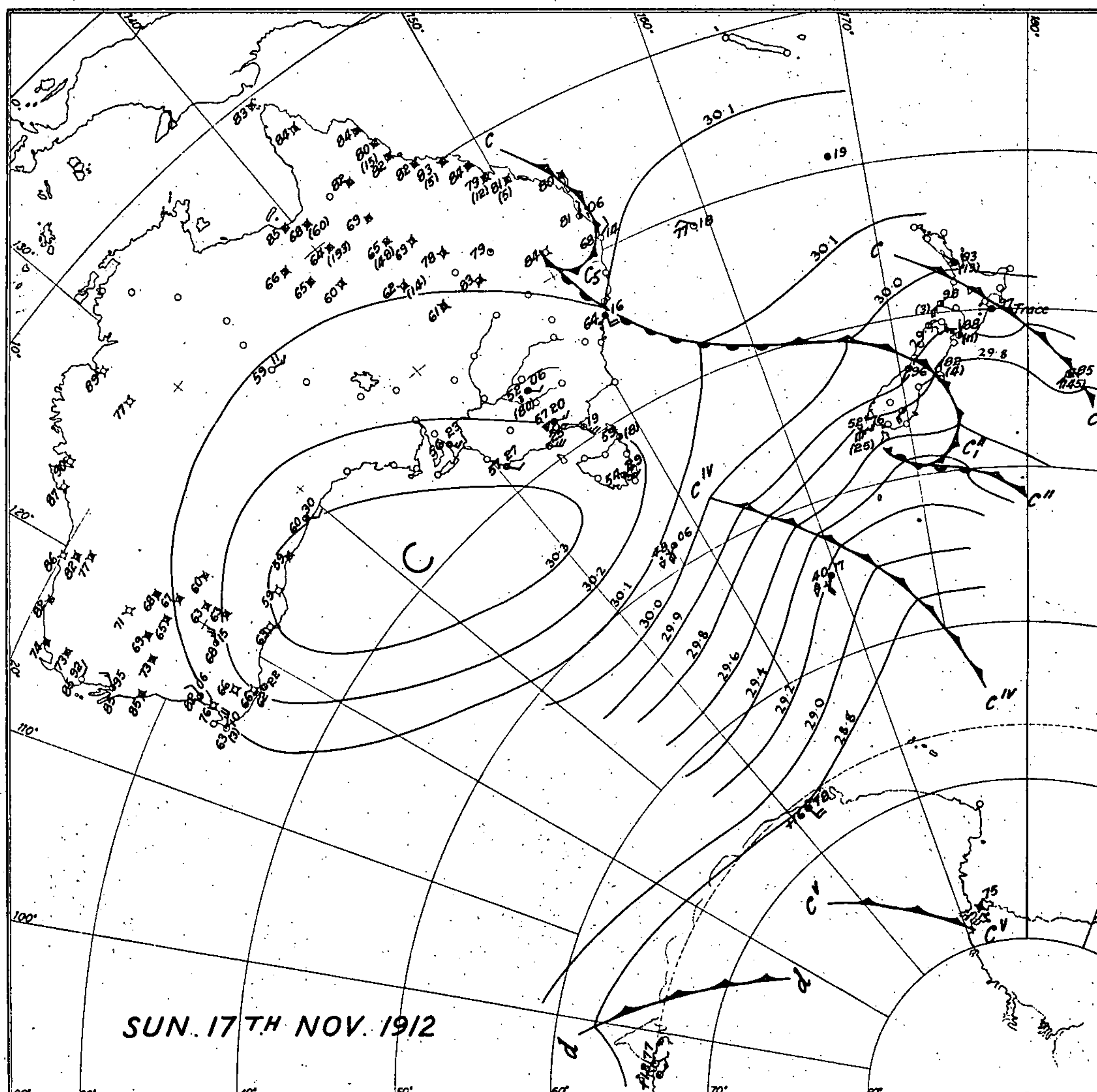
Front c is still well marked over Australia. Pressure is still high and activity slight in Antarctica.



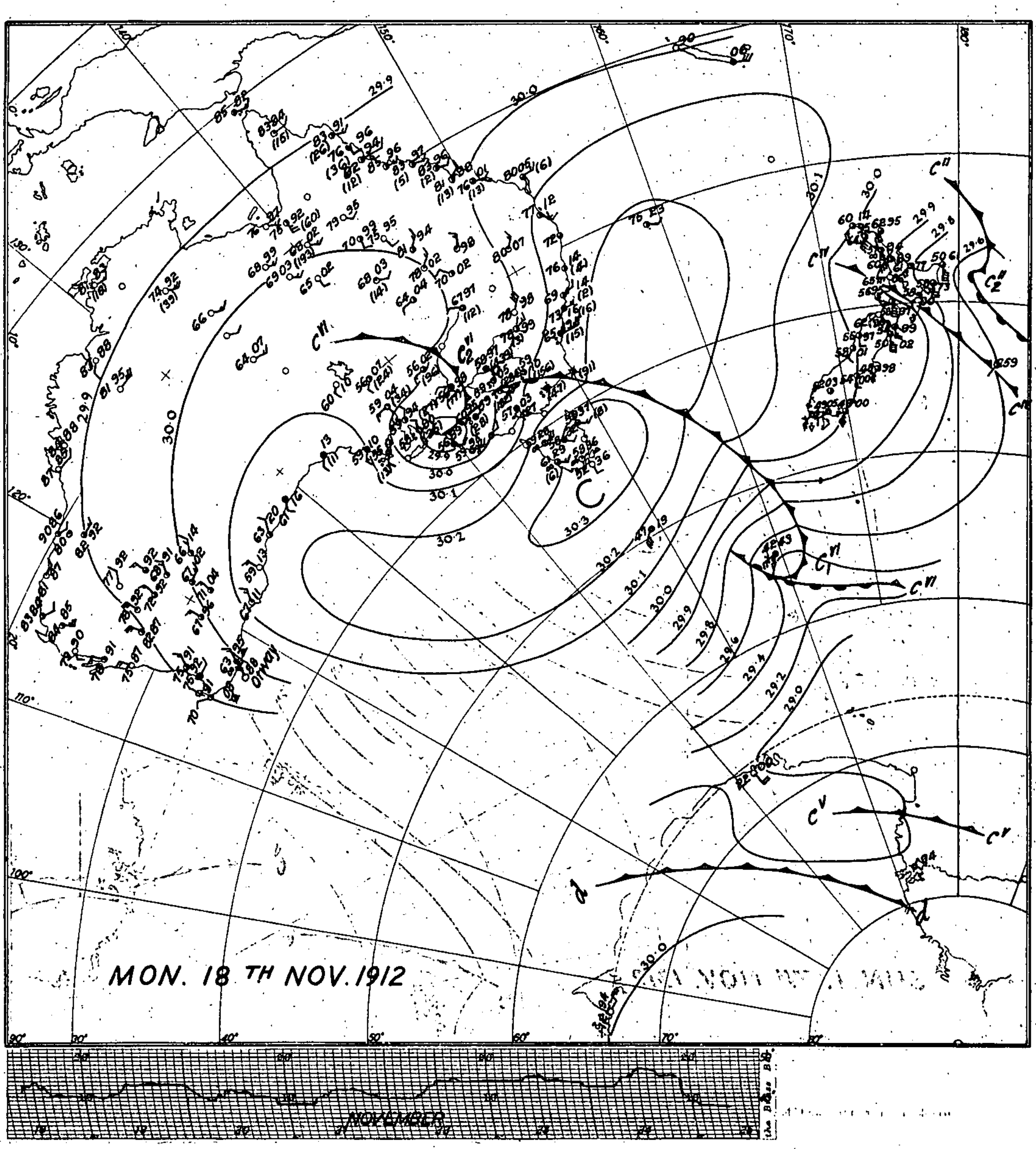
Fronts pass Macquarie Island but cause little change of temperature. There is little movement of air from the south behind them. Pressure has now fallen over Antarctica.



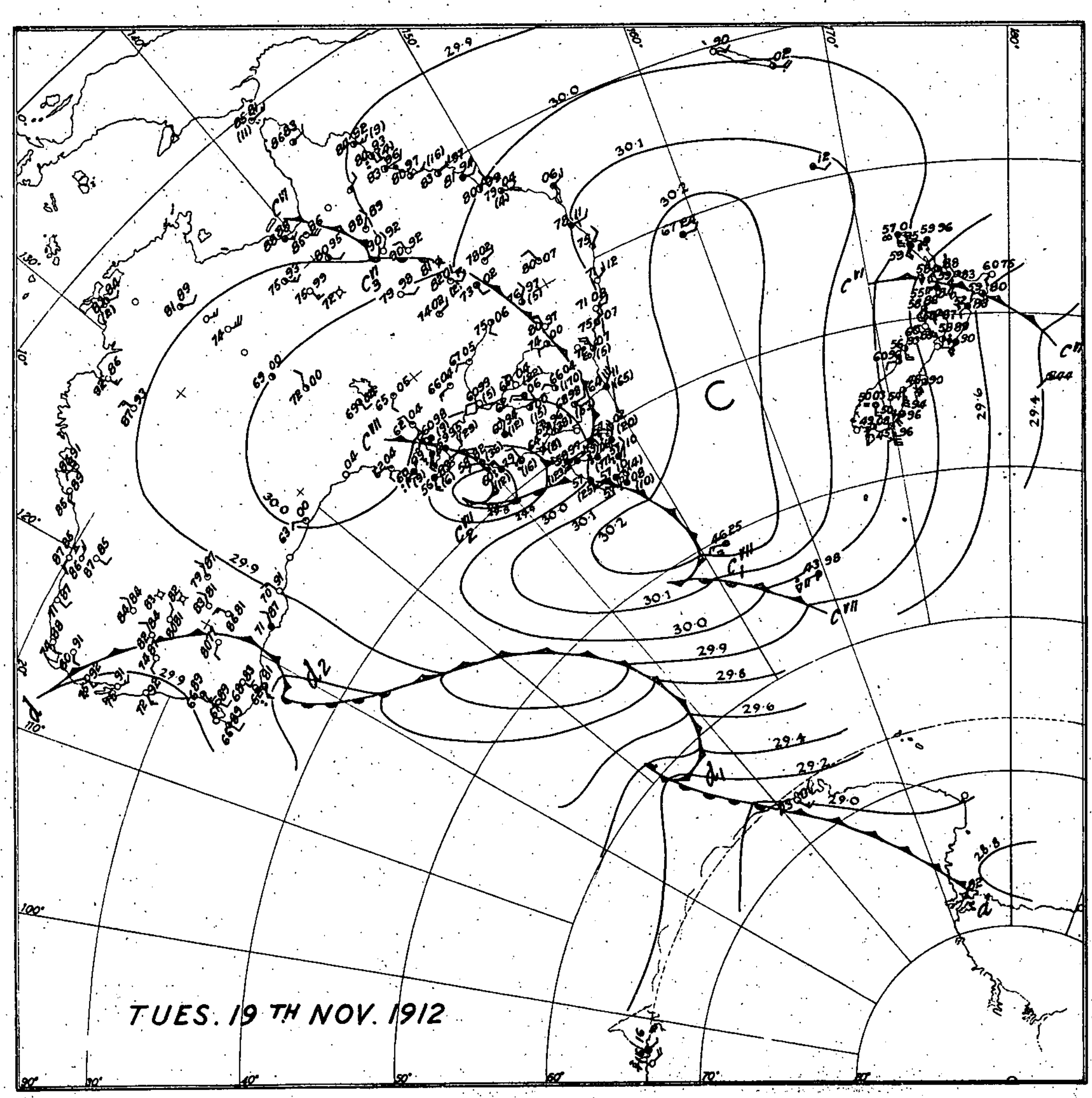
Analysis difficult. Little frontal activity in high latitudes.



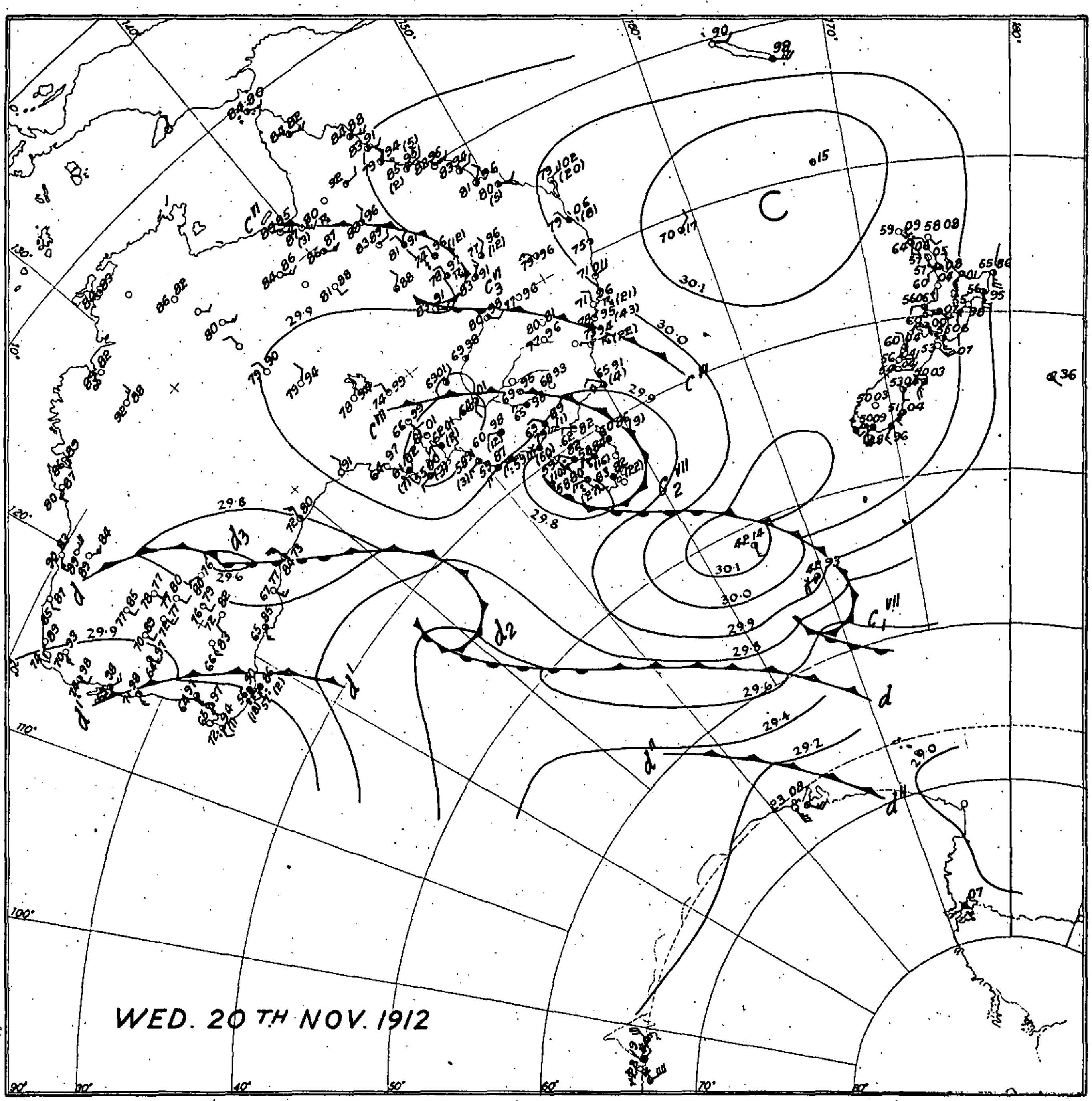
Variable temperatures and hail at Macquarie Island. A front has passed both it and the "Aurora" which is located to the north-west.



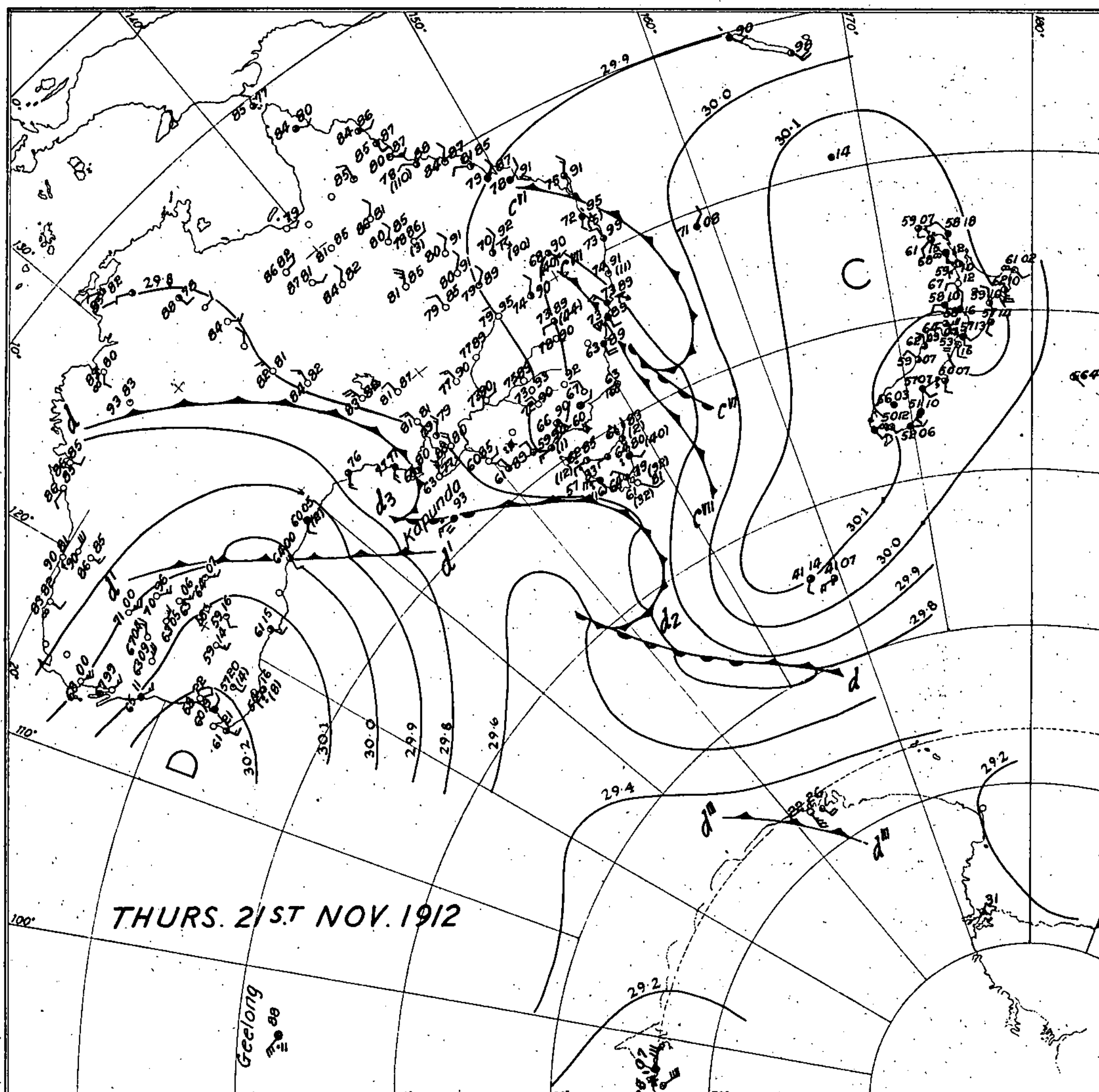
Note the large number of secondary fronts to c and the development on the north side of anticyclone C. There is a strong southerly outbreak over New Zealand.



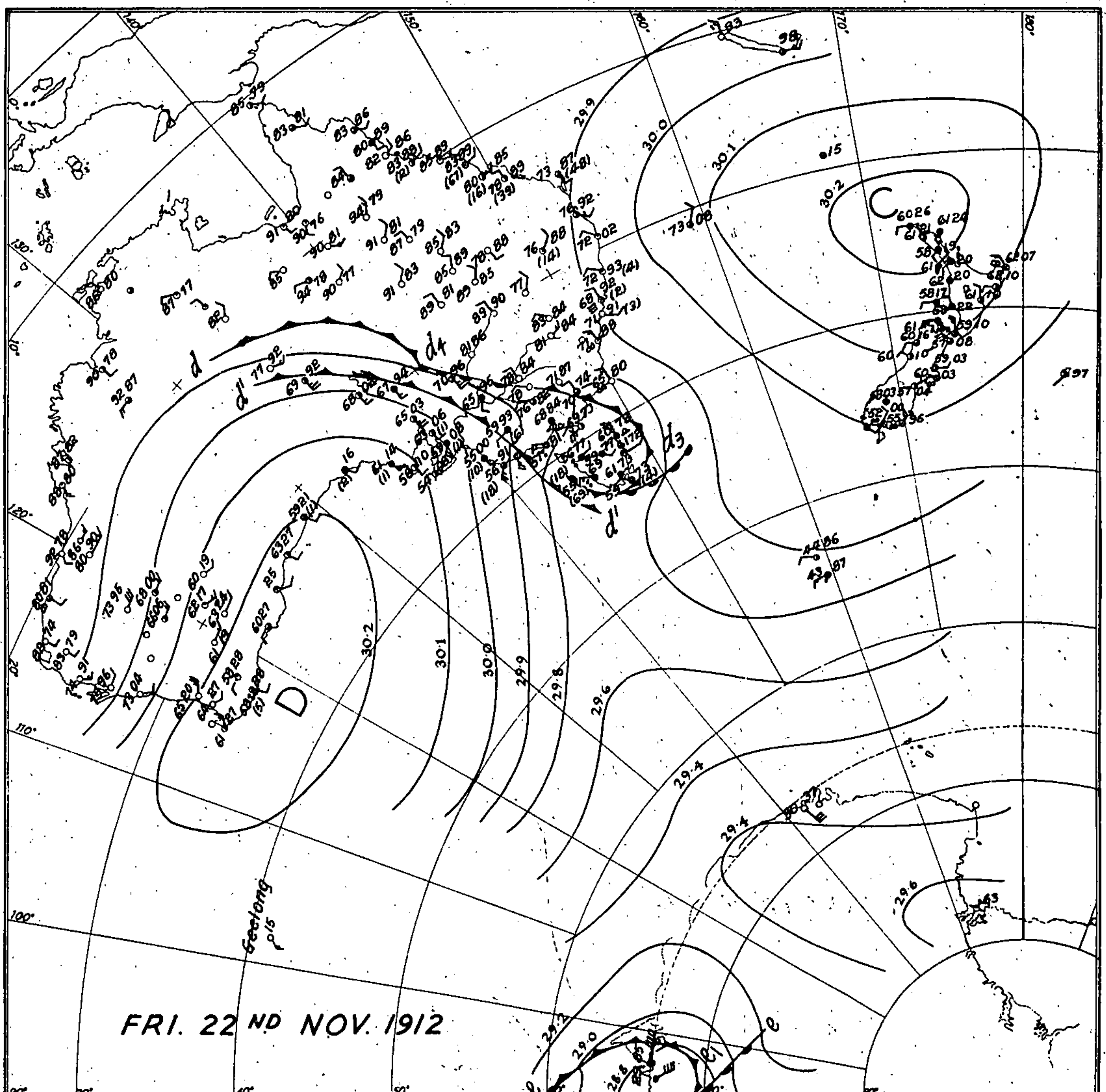
There is considerable activity over south-eastern Australia where a shallow cyclone is centred. Anticyclone C is extending northwards over the Tasman Sea. The movements of this anticyclone are characteristic and an effect of the monsoonal conditions over Australia. Pressure is unusually high at the "Aurora's" position but a front passes both it and Macquaric Island.



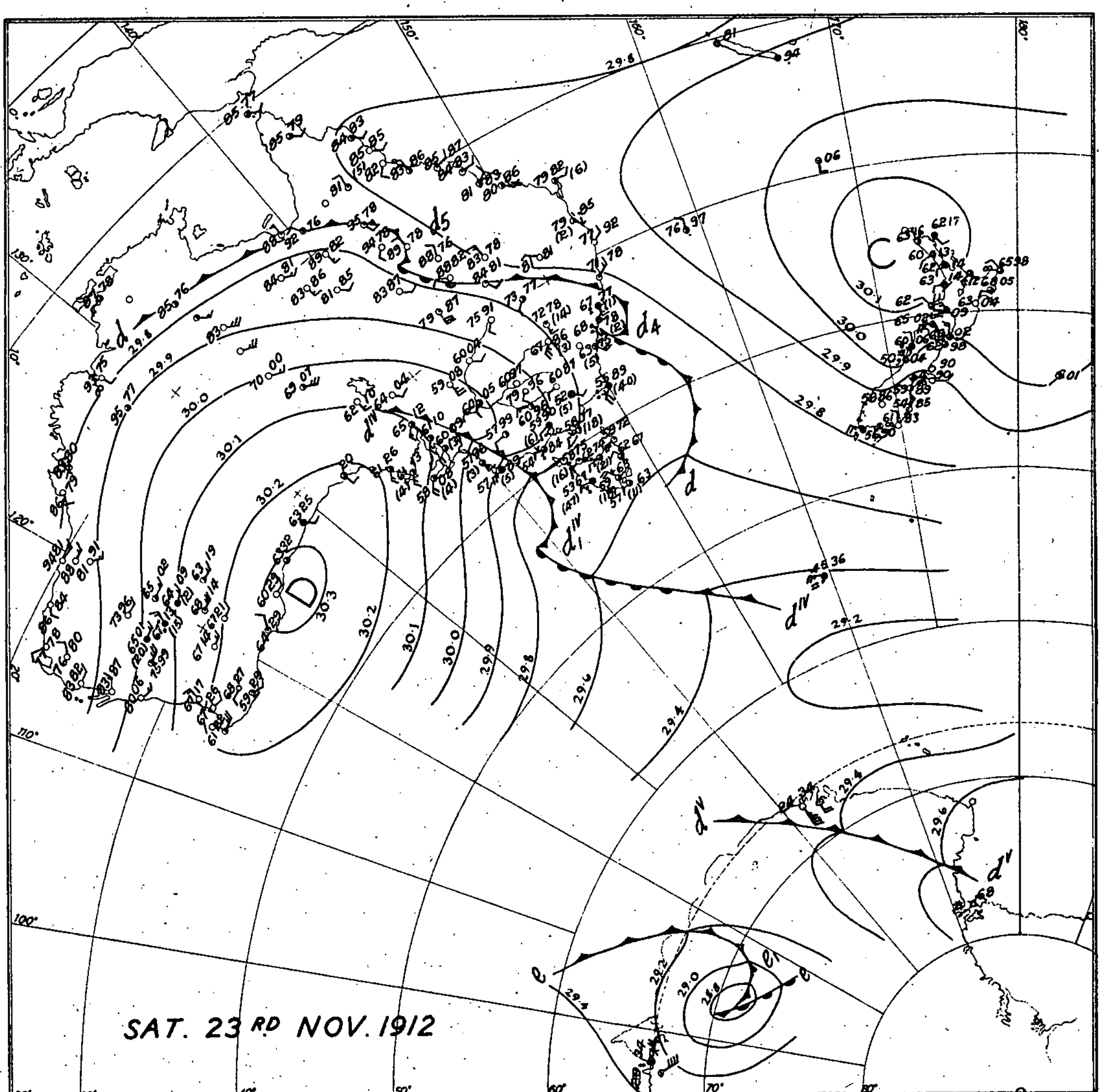
Note characteristics and movements of front c^{VII} and anticyclone C.



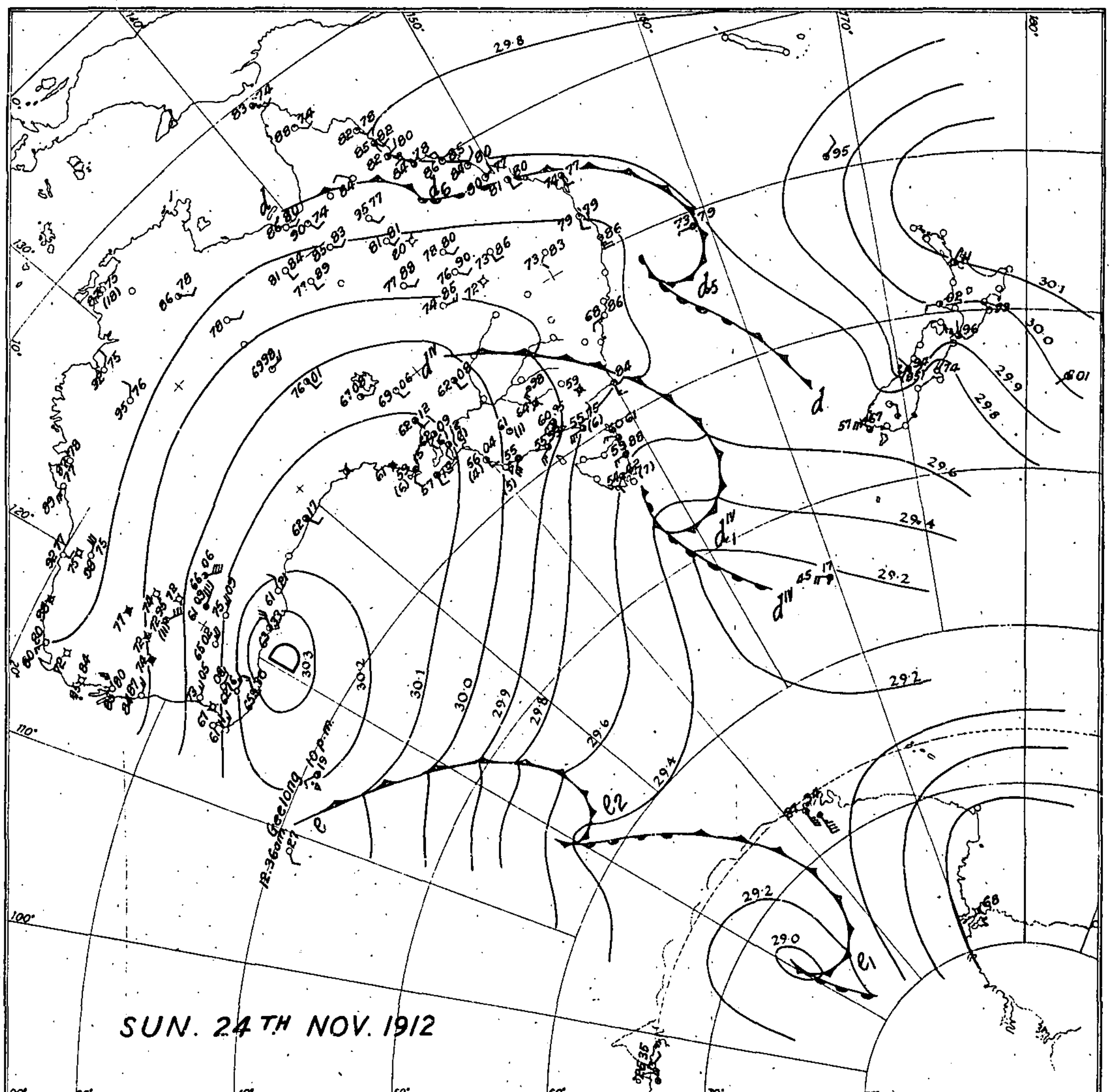
Fronts are still very weak in high latitudes but a vigorous depression is approaching Queen Mary Land.



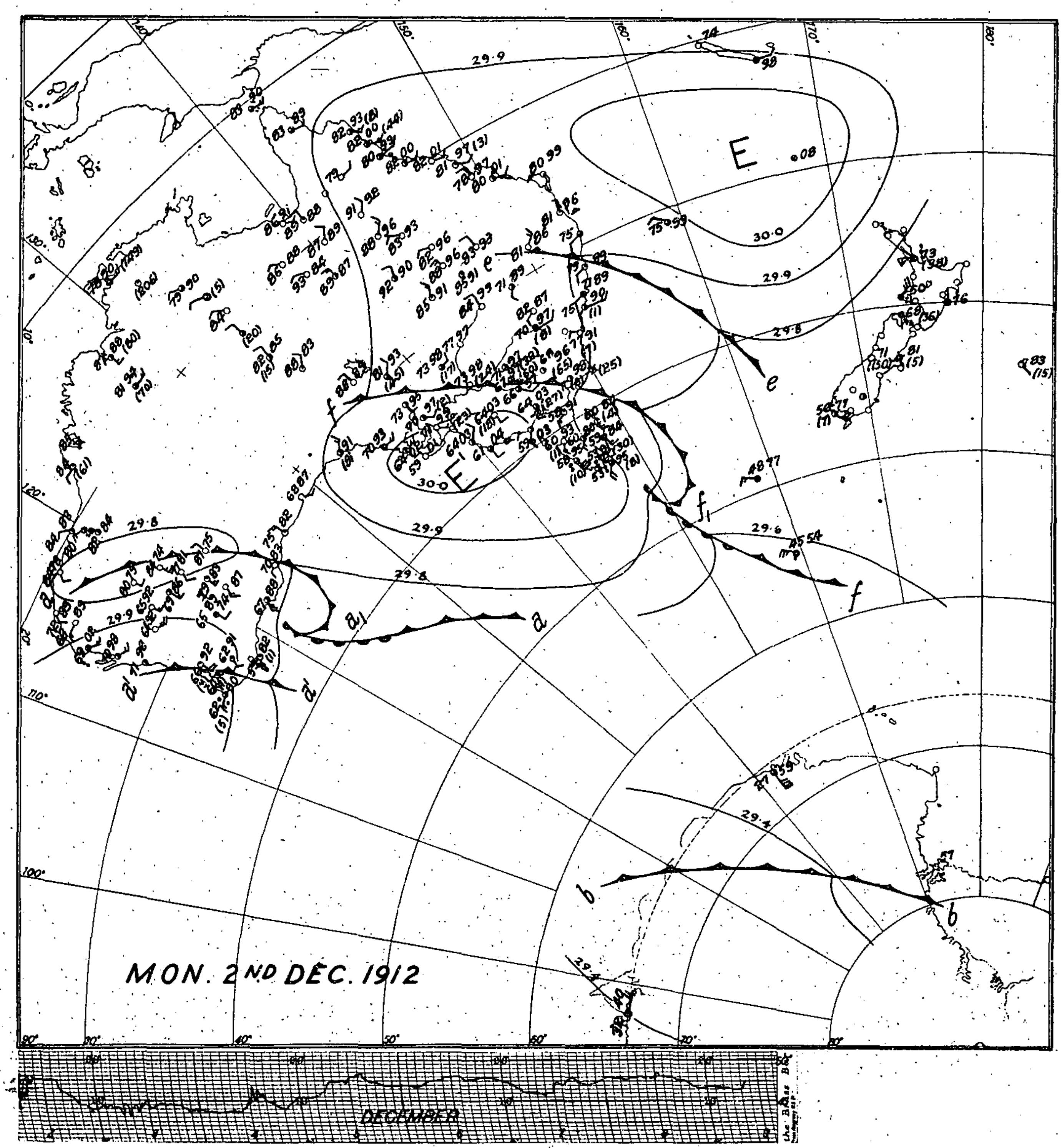
A blizzard at Queen Mary Land. Pressure changes suggest the passage of a cold front while an occlusion passes later to the south. Anticyclone C is now centred in normal latitudes.



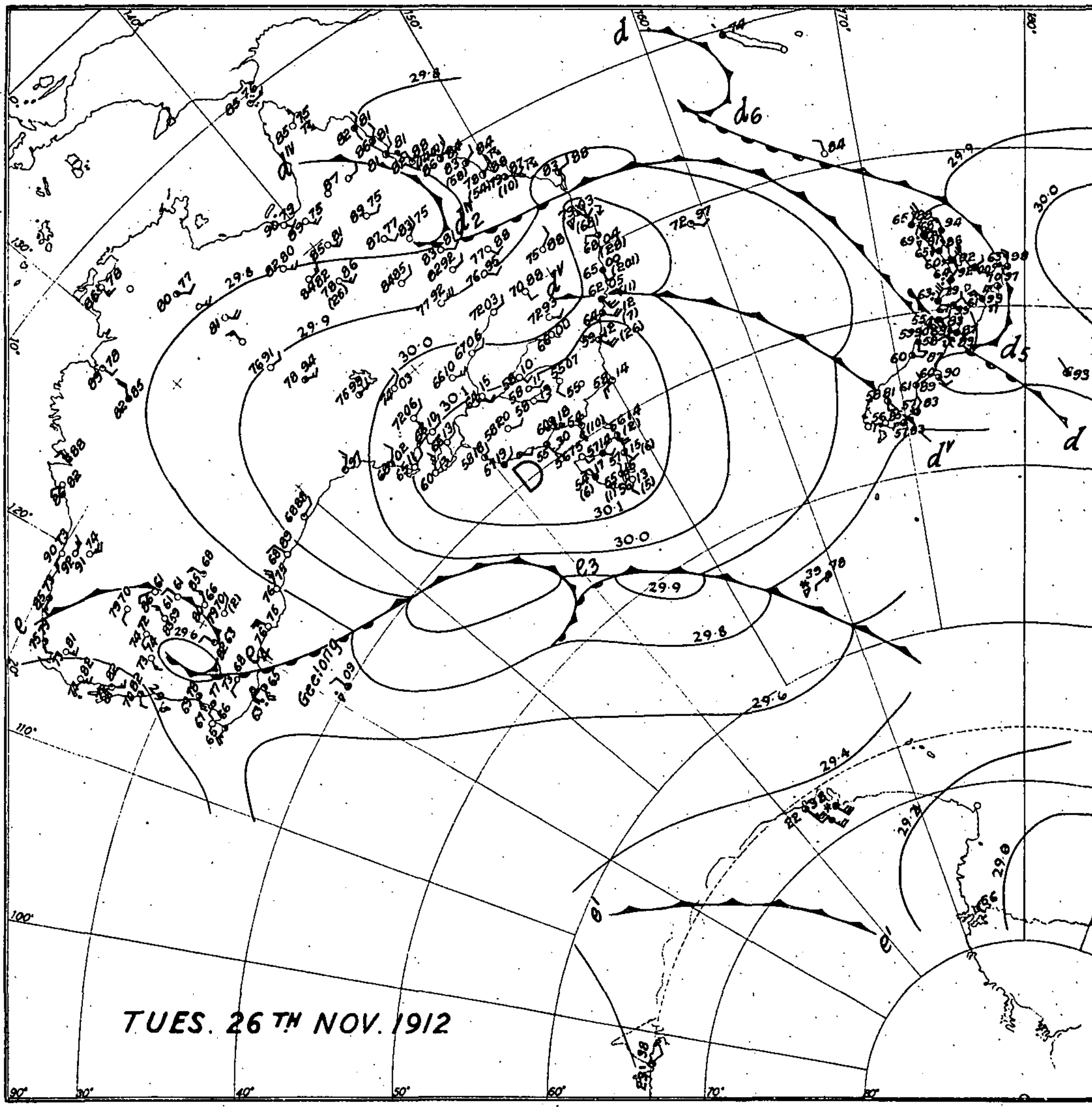
There is a well-marked front in north-eastern Australia.



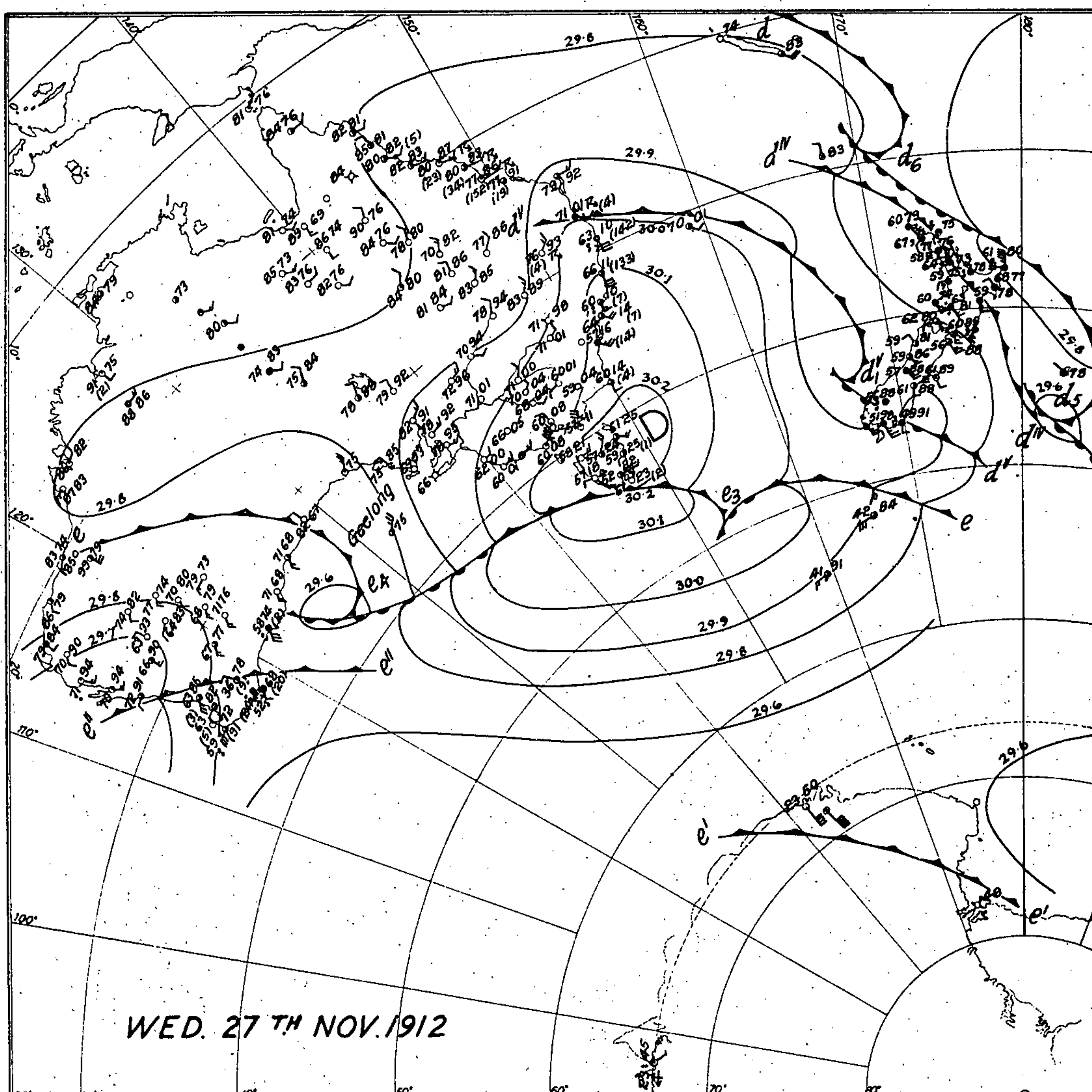
There are marked temperature changes at Macquarie Island with the passage of d_1^{II}. Note the very strong winds north of D in Western Australia but with fine weather. The s.s. "Geelong" passes through a front south of Western Australia.



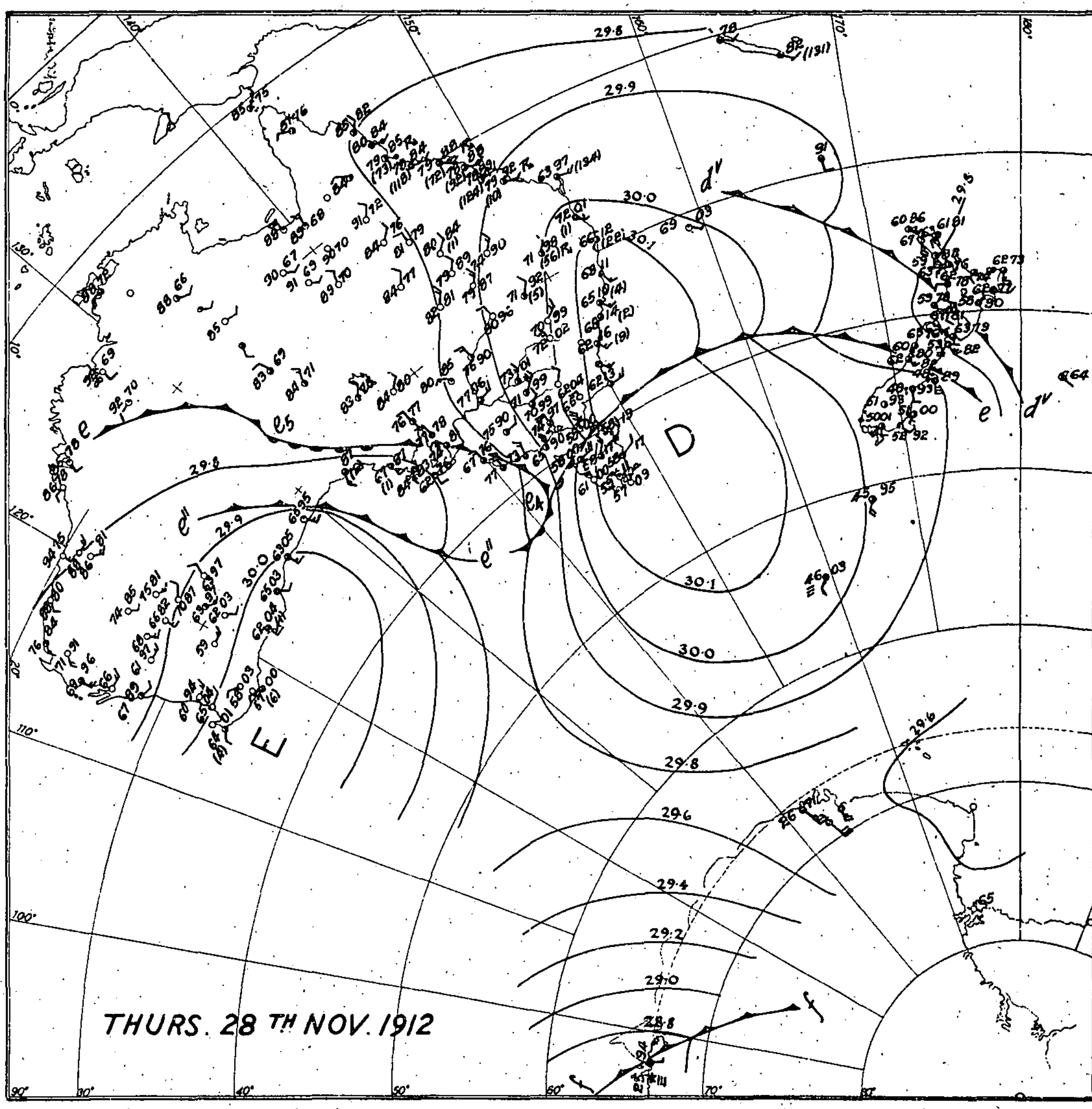
A sharp fall of temperature followed by unstable conditions with snow and hail showers occurred at Macquarie Island as front *f* passed.



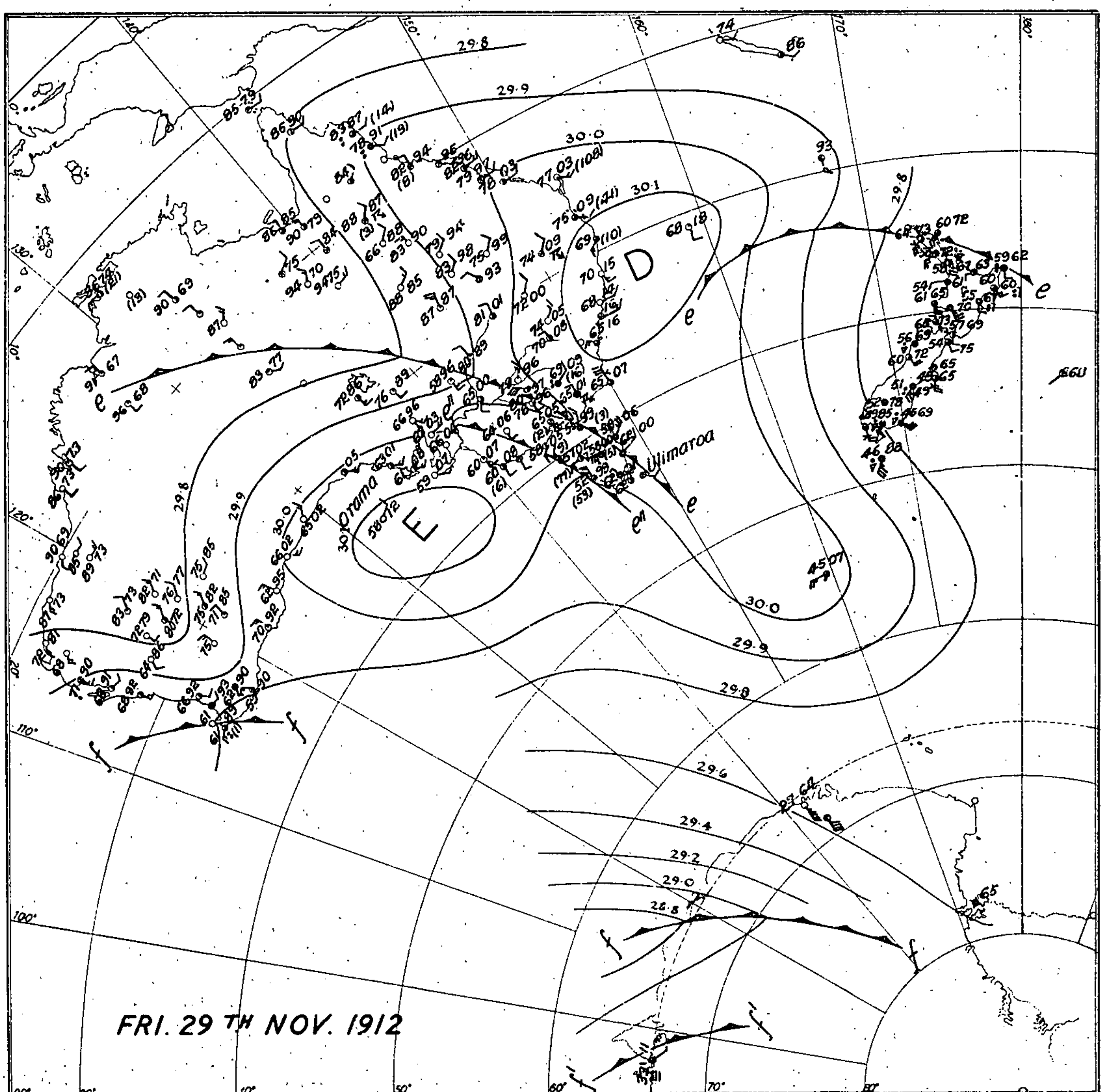
Unstable conditions and hail squalls again at Macquarie Island (see temperature record). There is a rather active depression over Western Australia.



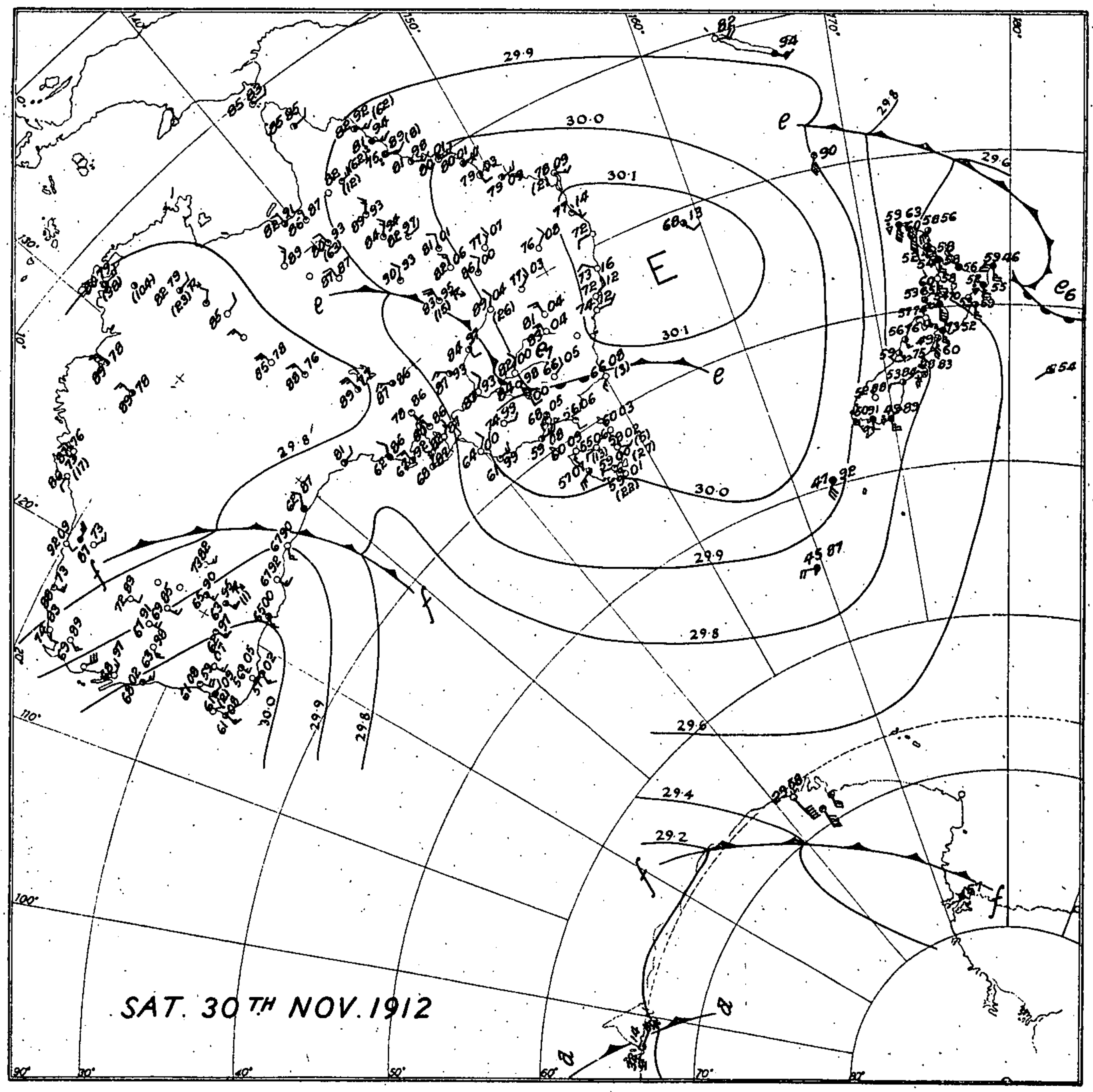
Pressure is high over Antarctica. Front e has passed both Macquarie Island and the "Aurora" to the north-east.



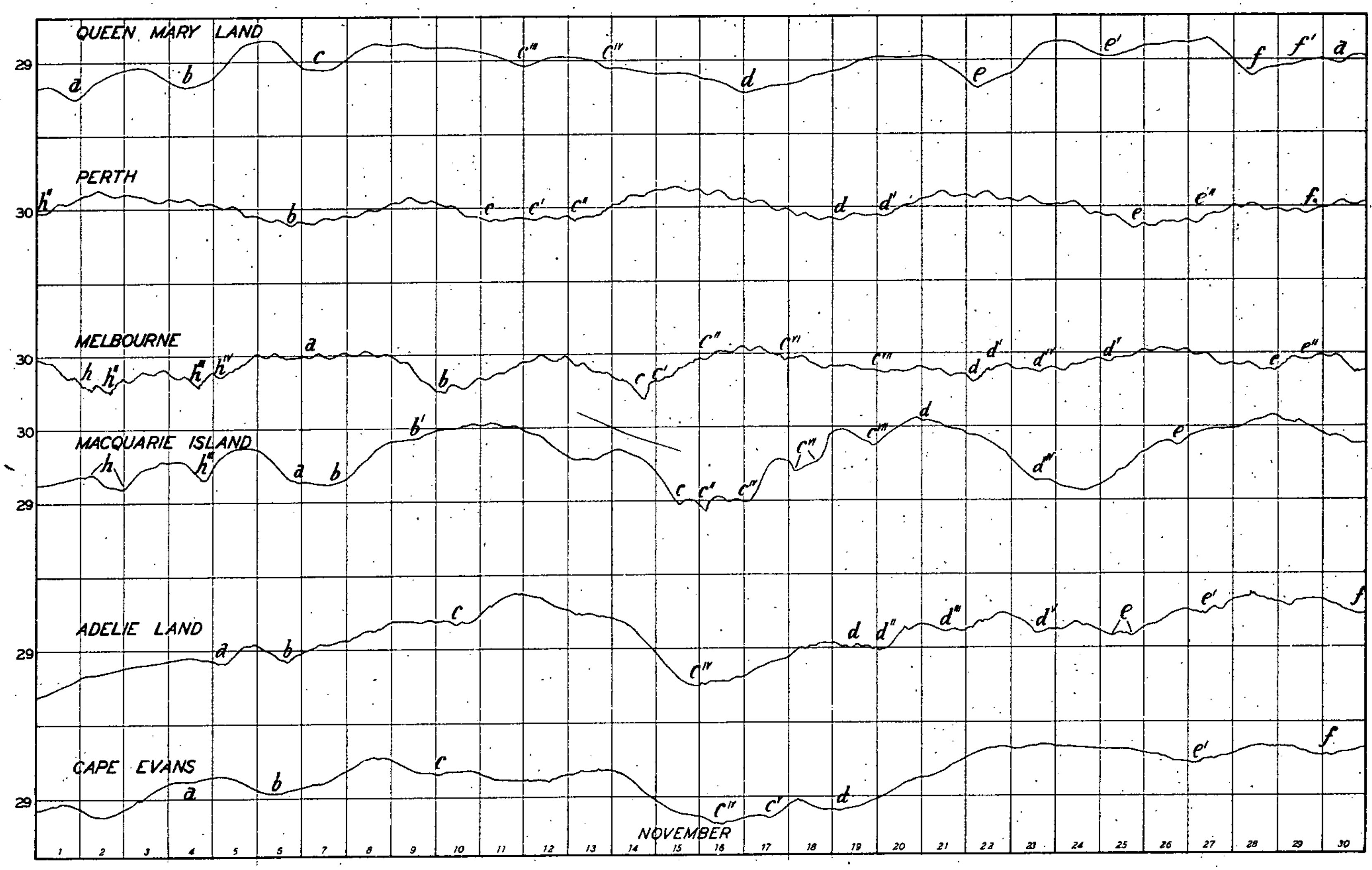
Front e is crossing anticyclone D. A sharp front is passing Queen Mary Land.



Anticyclones D and E appear to be merging.



Little activity. There are some high temperatures over eastern Australia.



QUEEN MARY LAND
PERTH
MELBOURNE
MACQUARIE ISLAND
ADELIE LAND
CAPE EVANS
NOVEMBER
29
30
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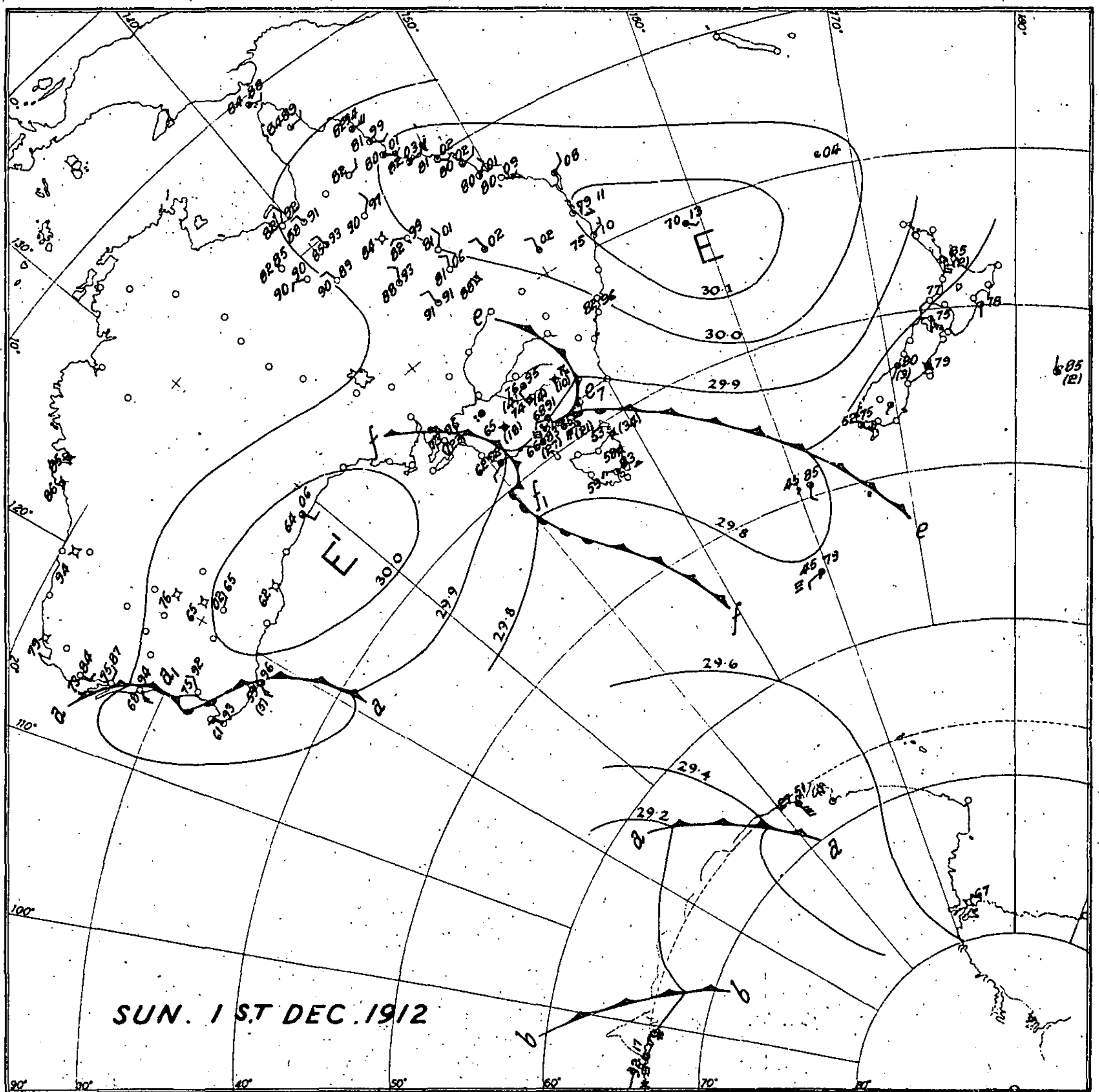
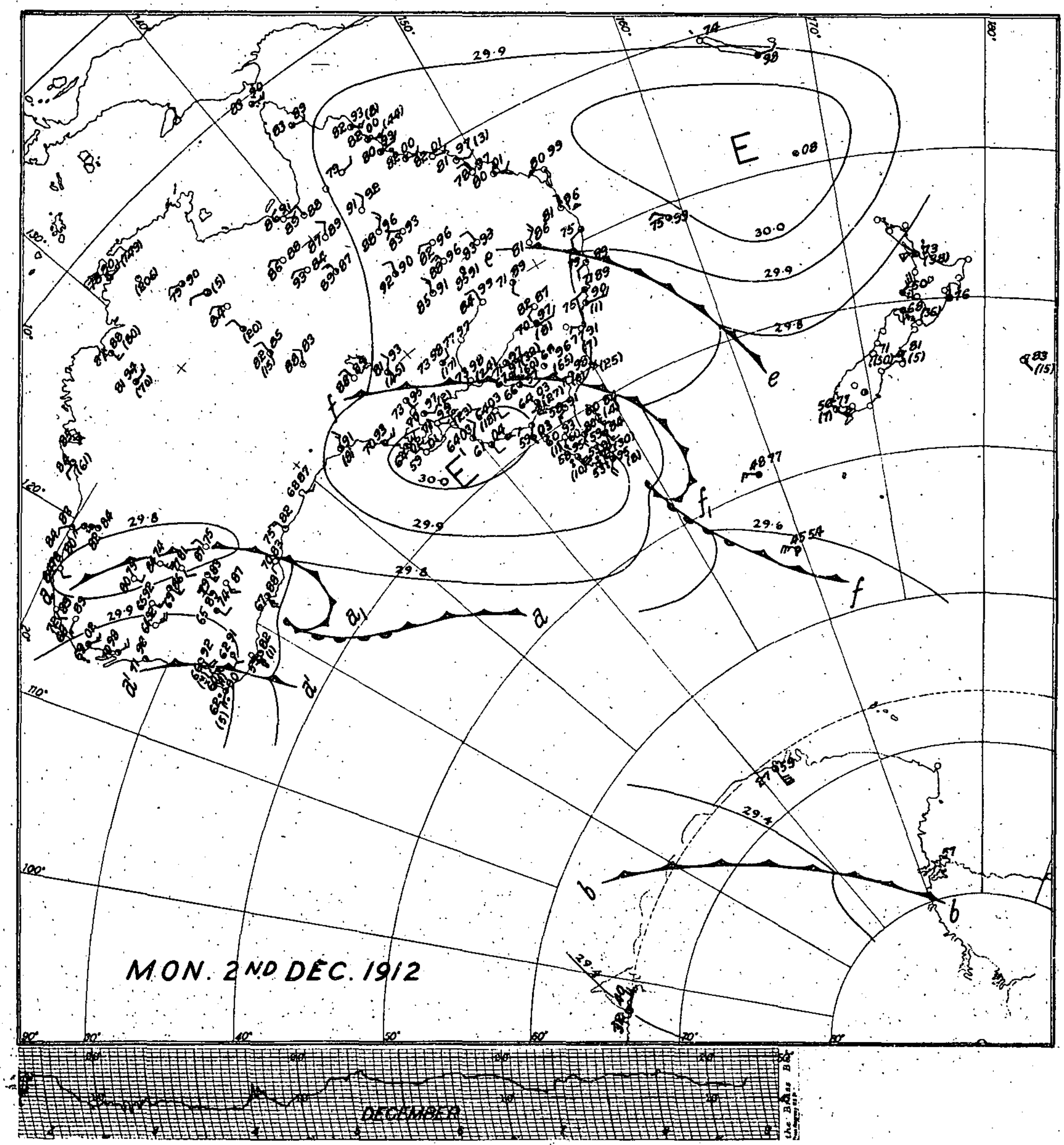
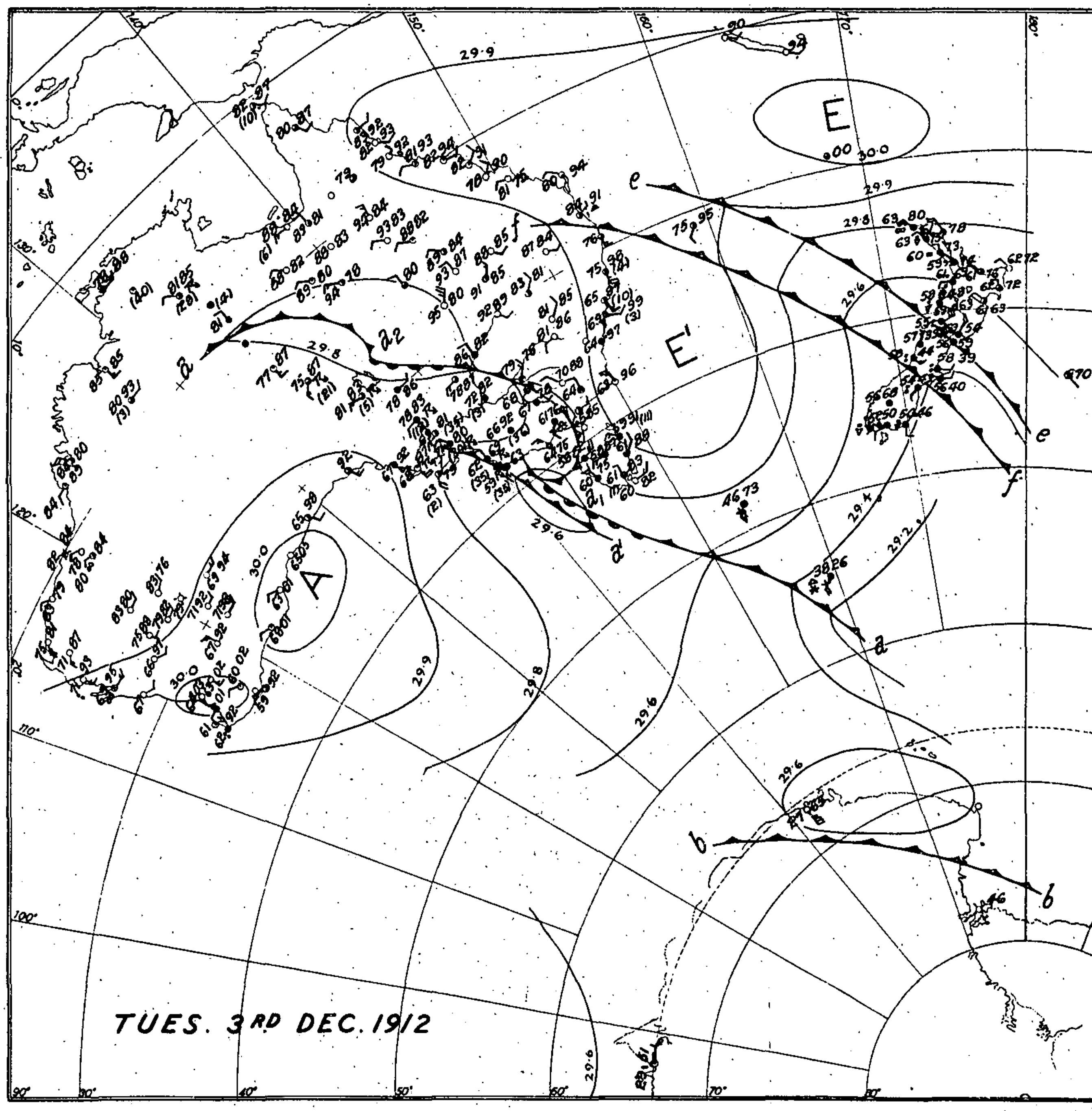
29
29



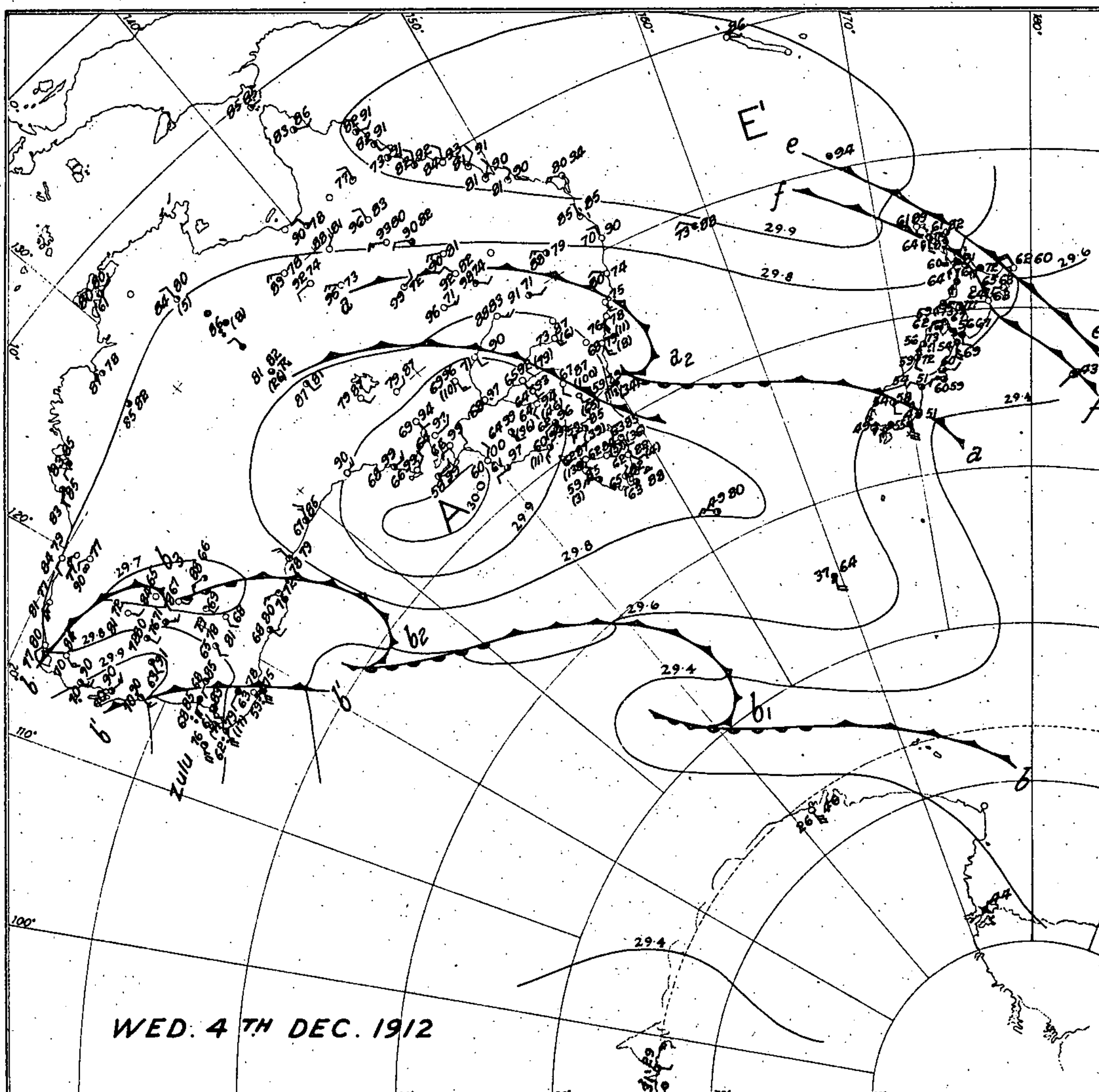
Pressure is still high in Antarctica and activity slight.



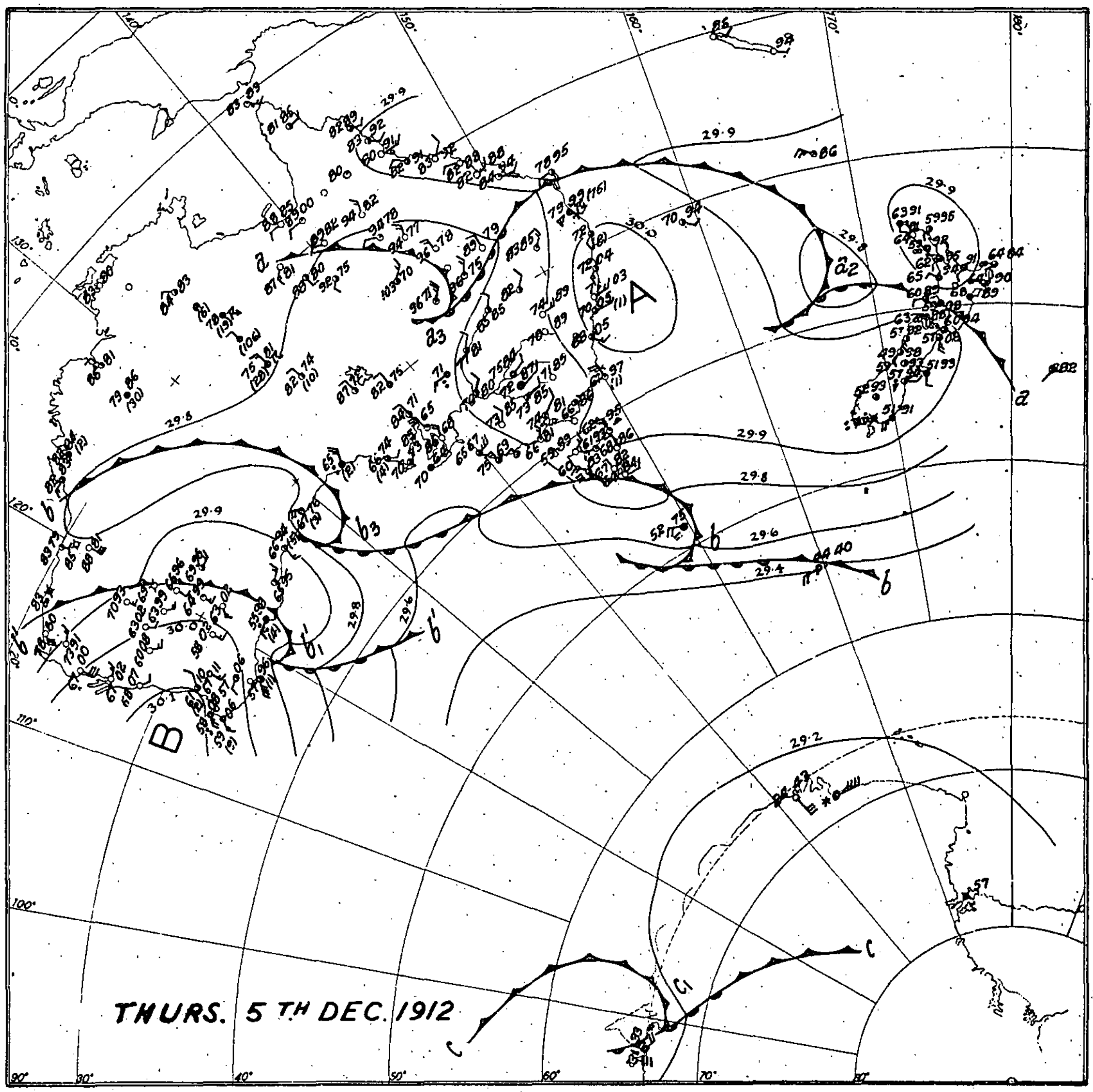
A sharp fall of temperature followed by unstable conditions with snow and hail showers occurred at Macquarie Island as front *f* passed.



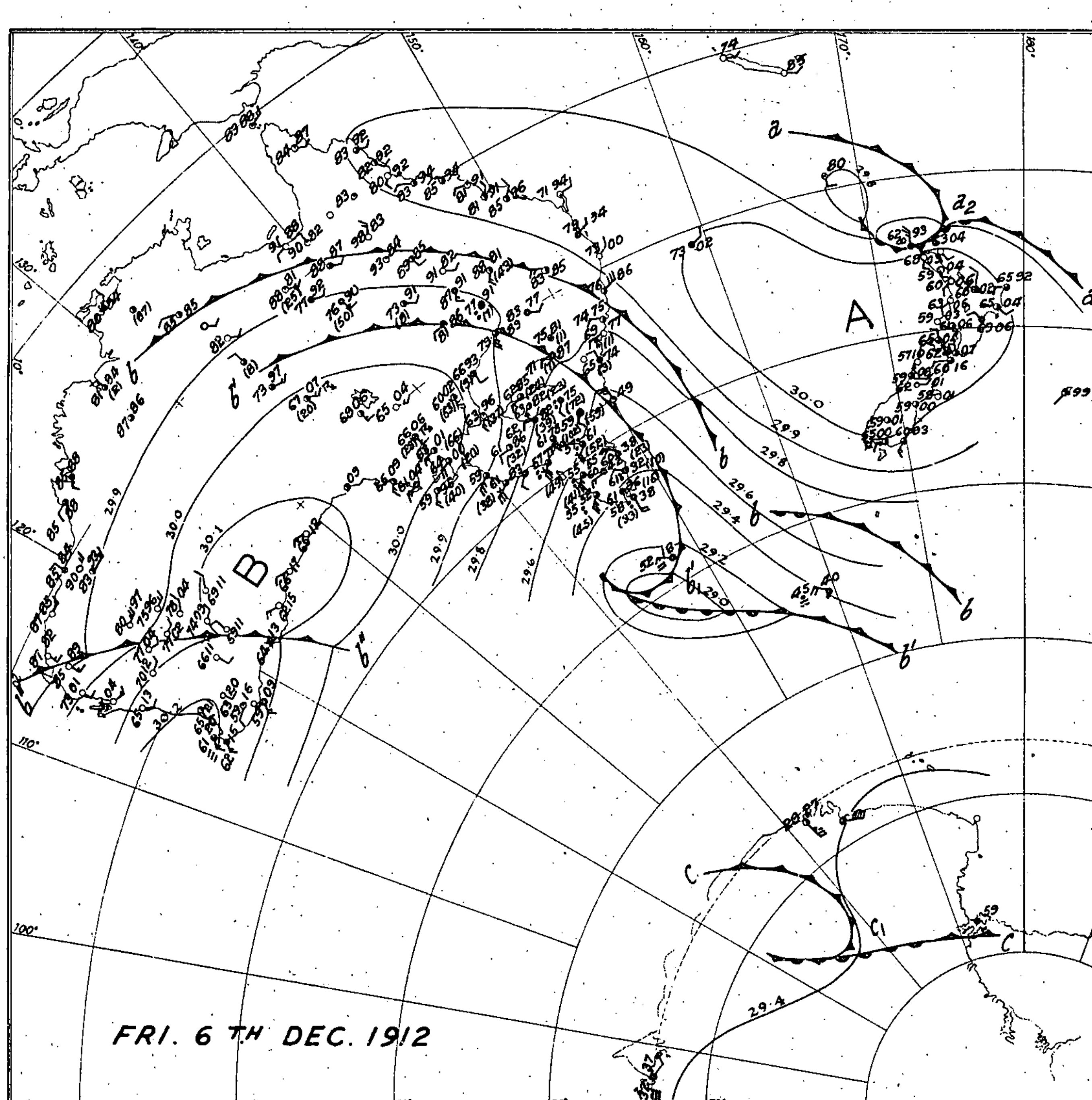
The movement of front *a* over Australia has been rapid. Its passage is shown in the Macquarie Island records but is not clear in those of the "Aurora" to the northward. There is widespread rain over New Zealand.



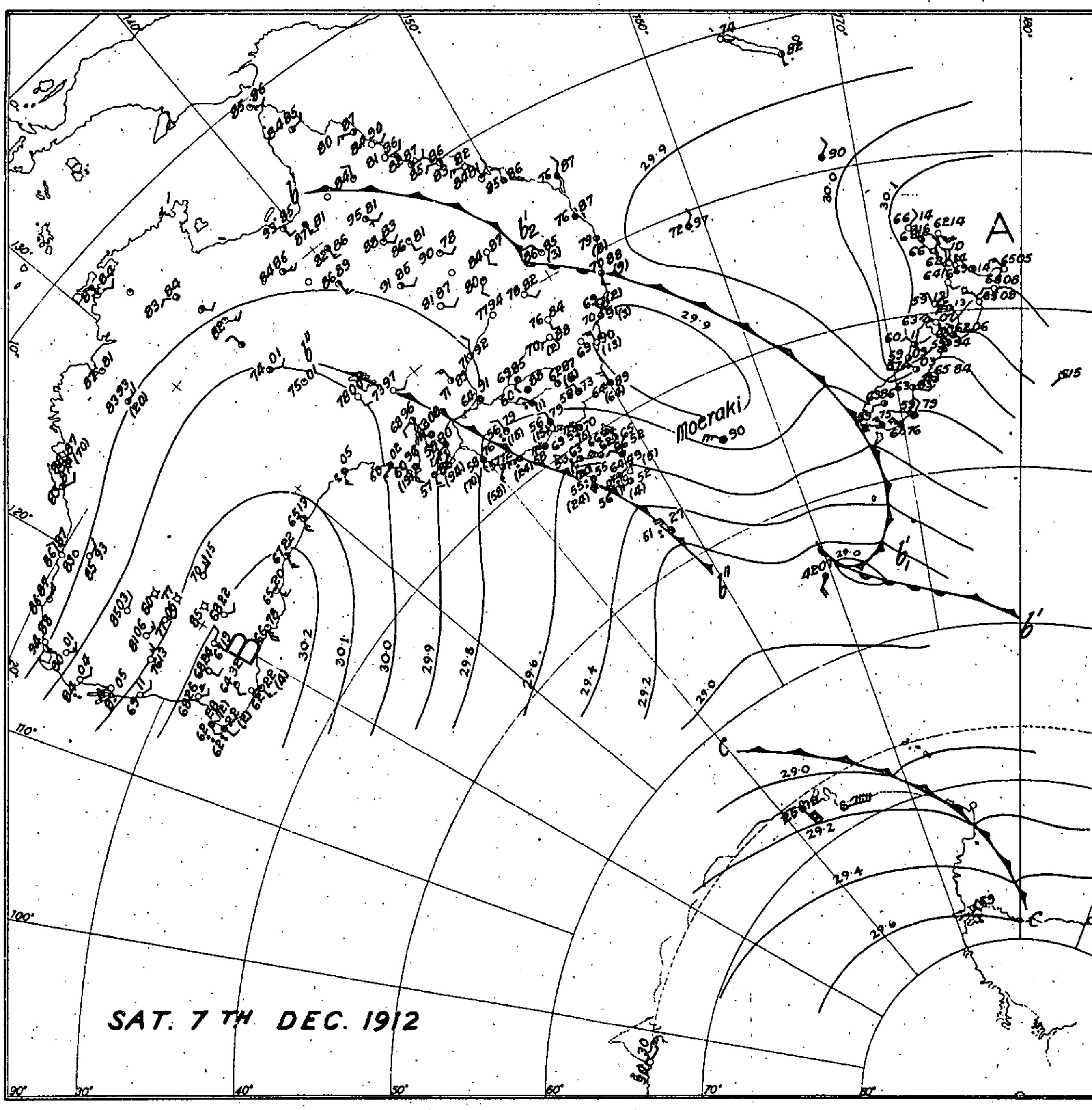
Little of note. Temperatures are high over the eastern interior of Australia.



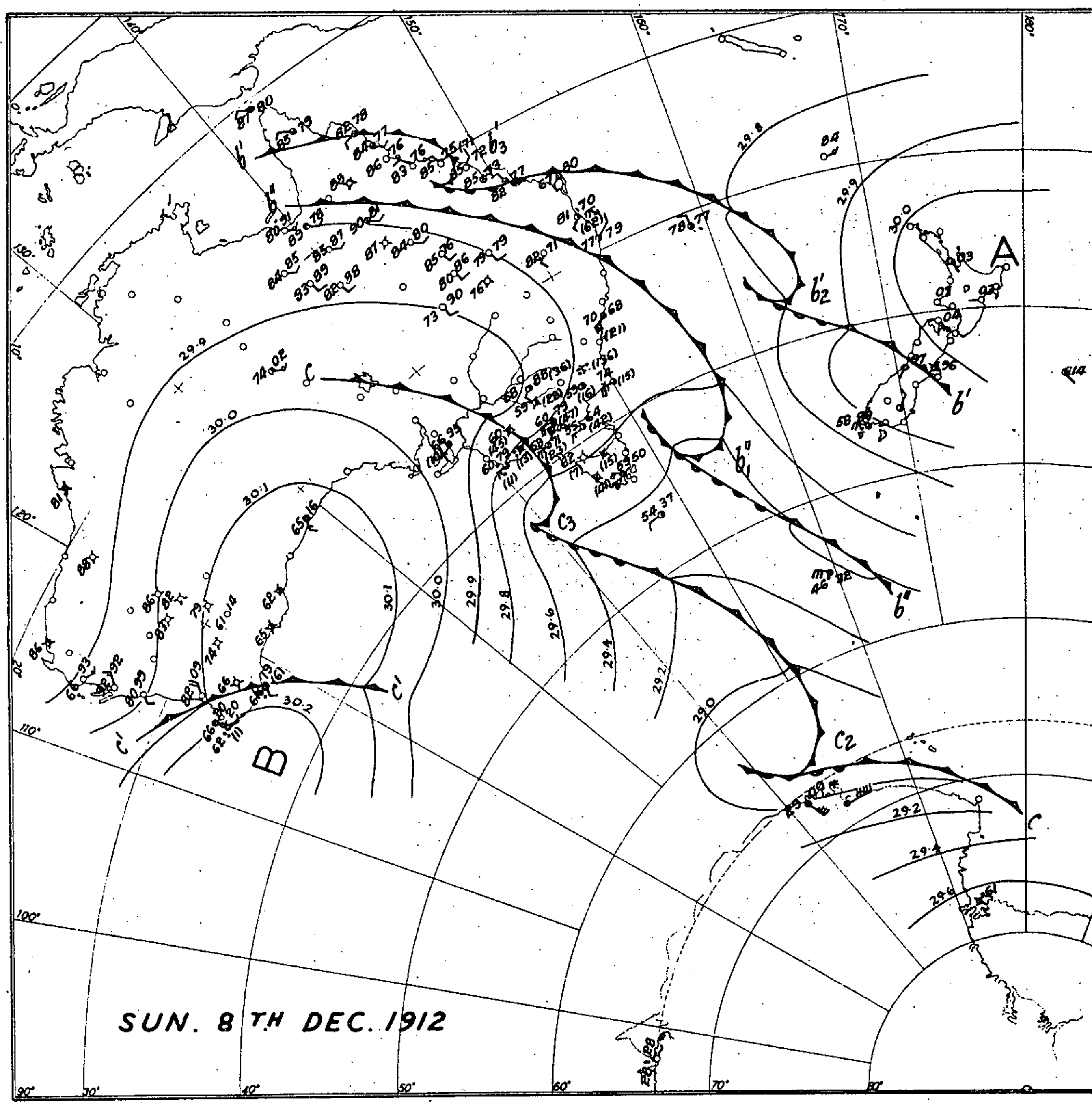
It is very hot in the interior of Queensland while over Western Australia there is a strong outbreak of cold air.



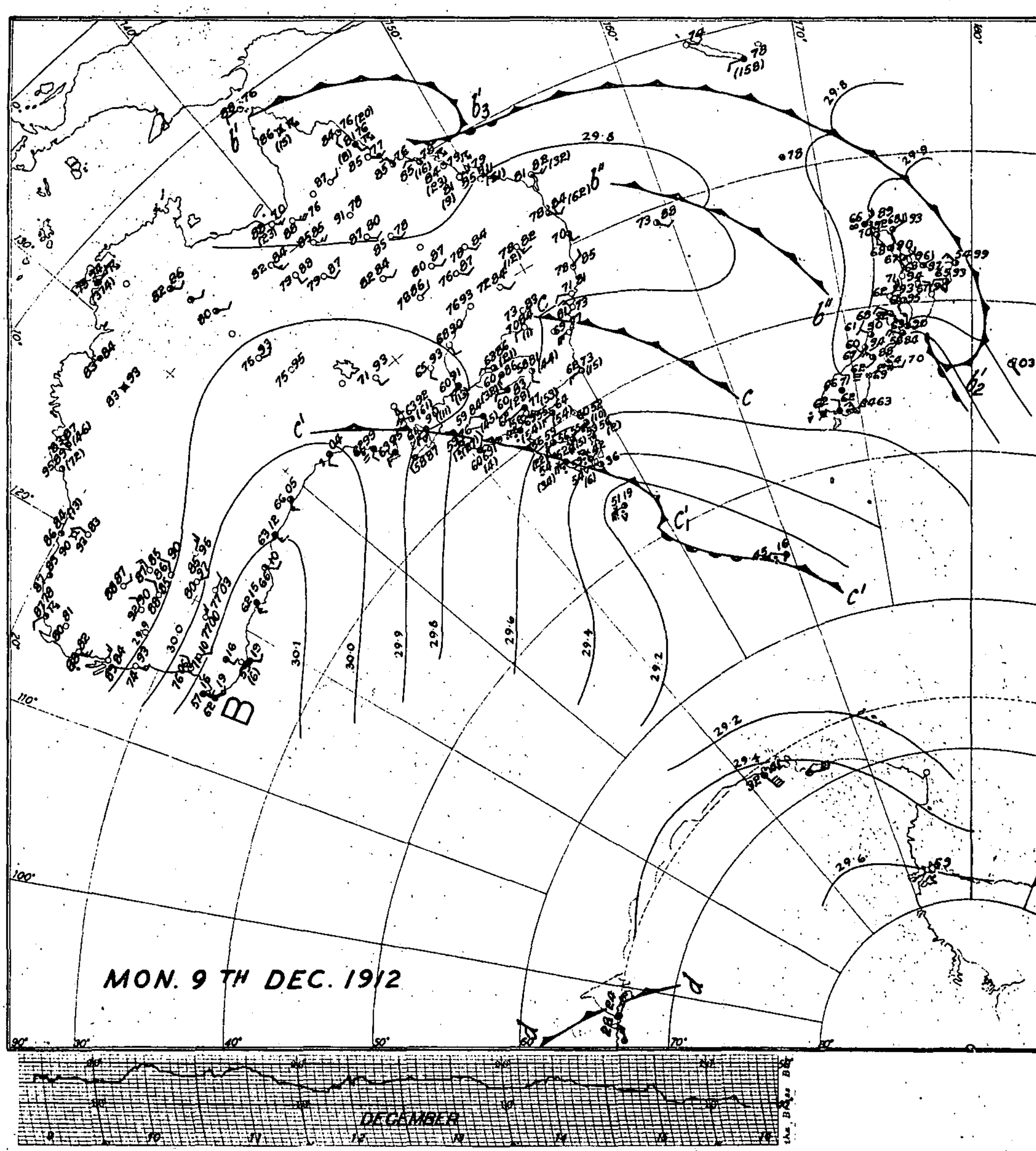
Fronts have moved very rapidly over Australia but are well marked. b^{I} is just passing the "Aurora" which is south of Tasmania and passes Macquarie Island later in the day, b^{I}_{1} being a rather deep depression.



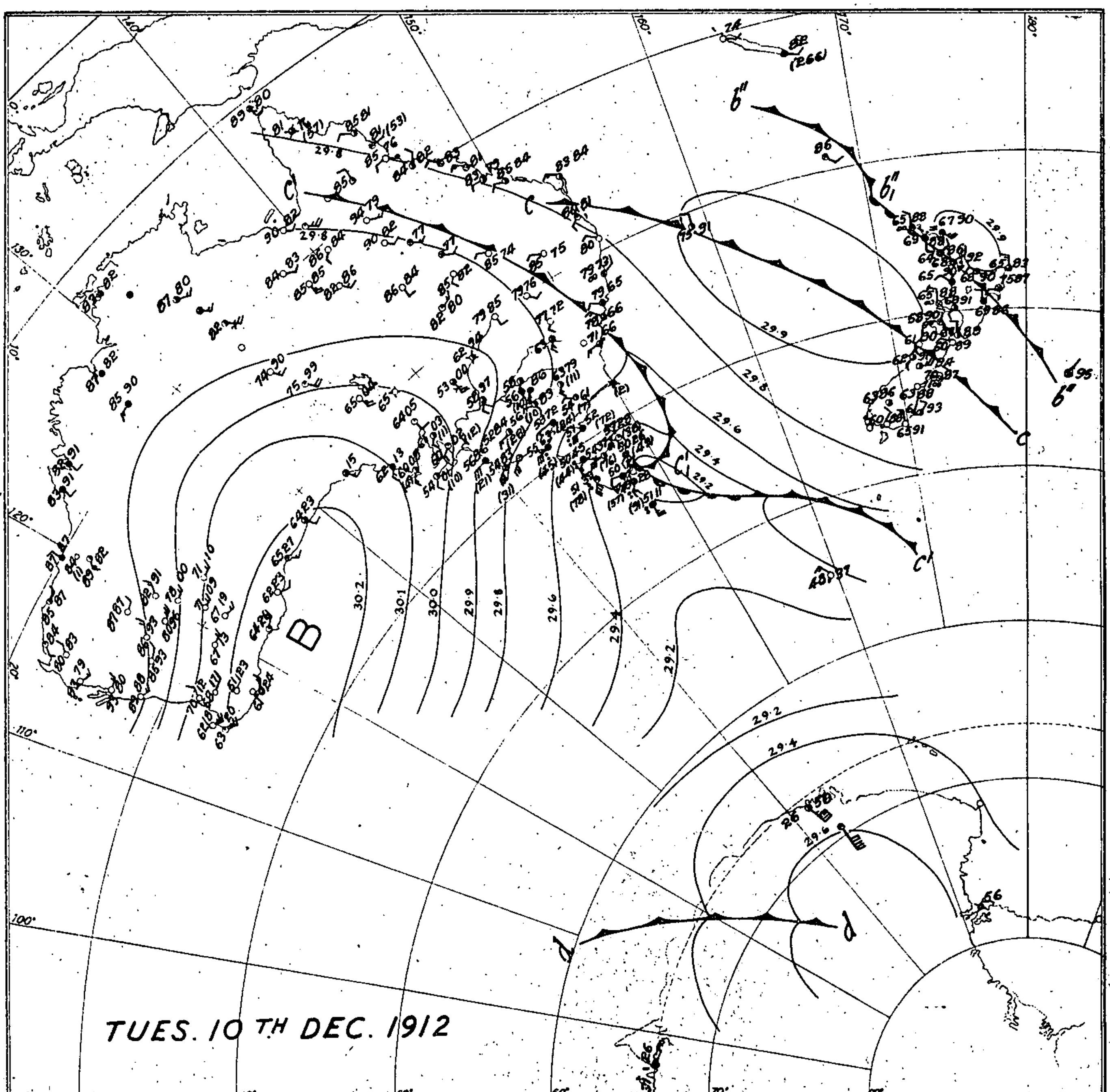
Another secondary front is passing the "Aurora" which is south of Tasmania. The wind has increased at Adélie Land with the passage of c.



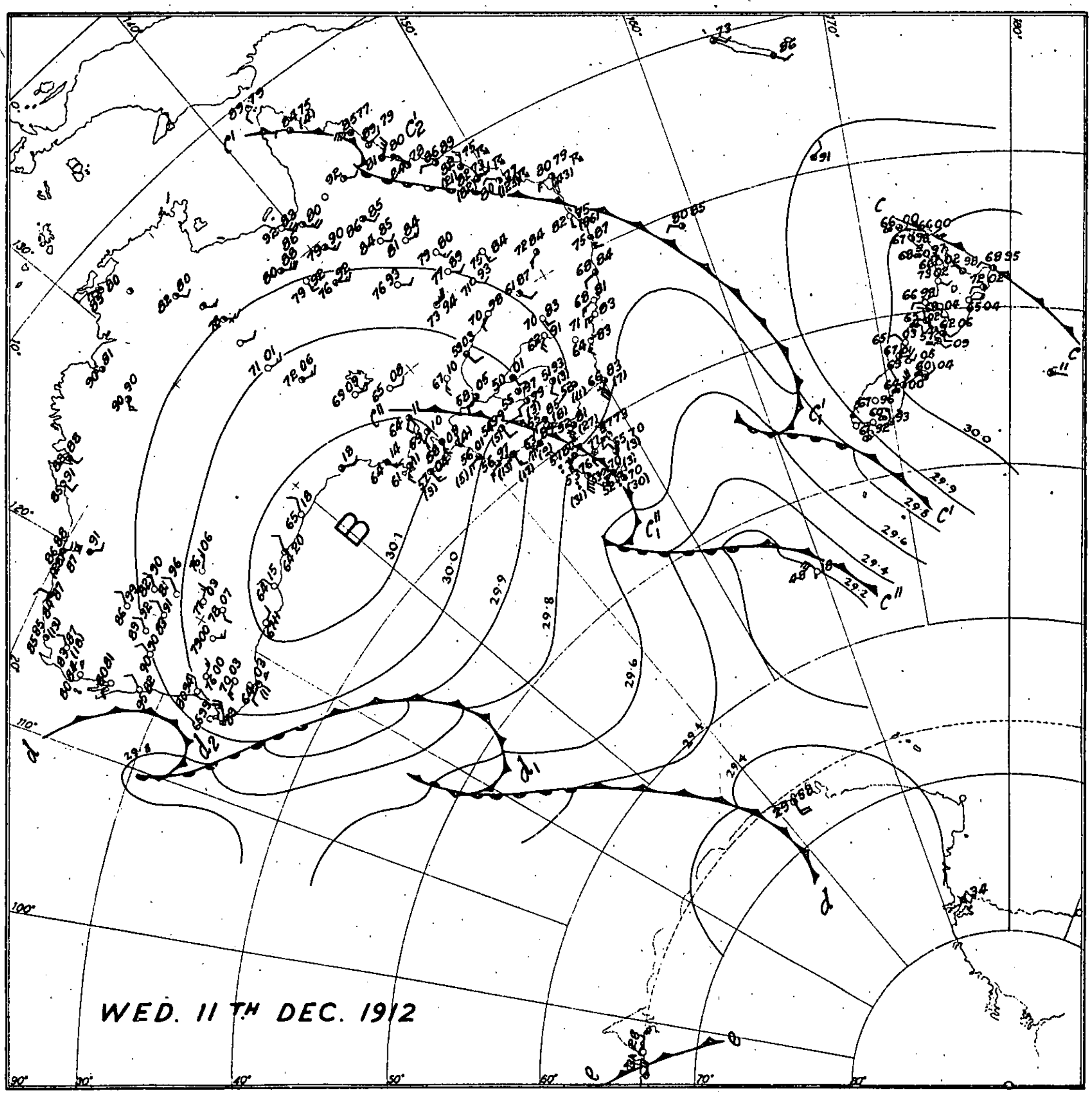
The passage of front c is shown at both Macquarie Island and the "Aurora."



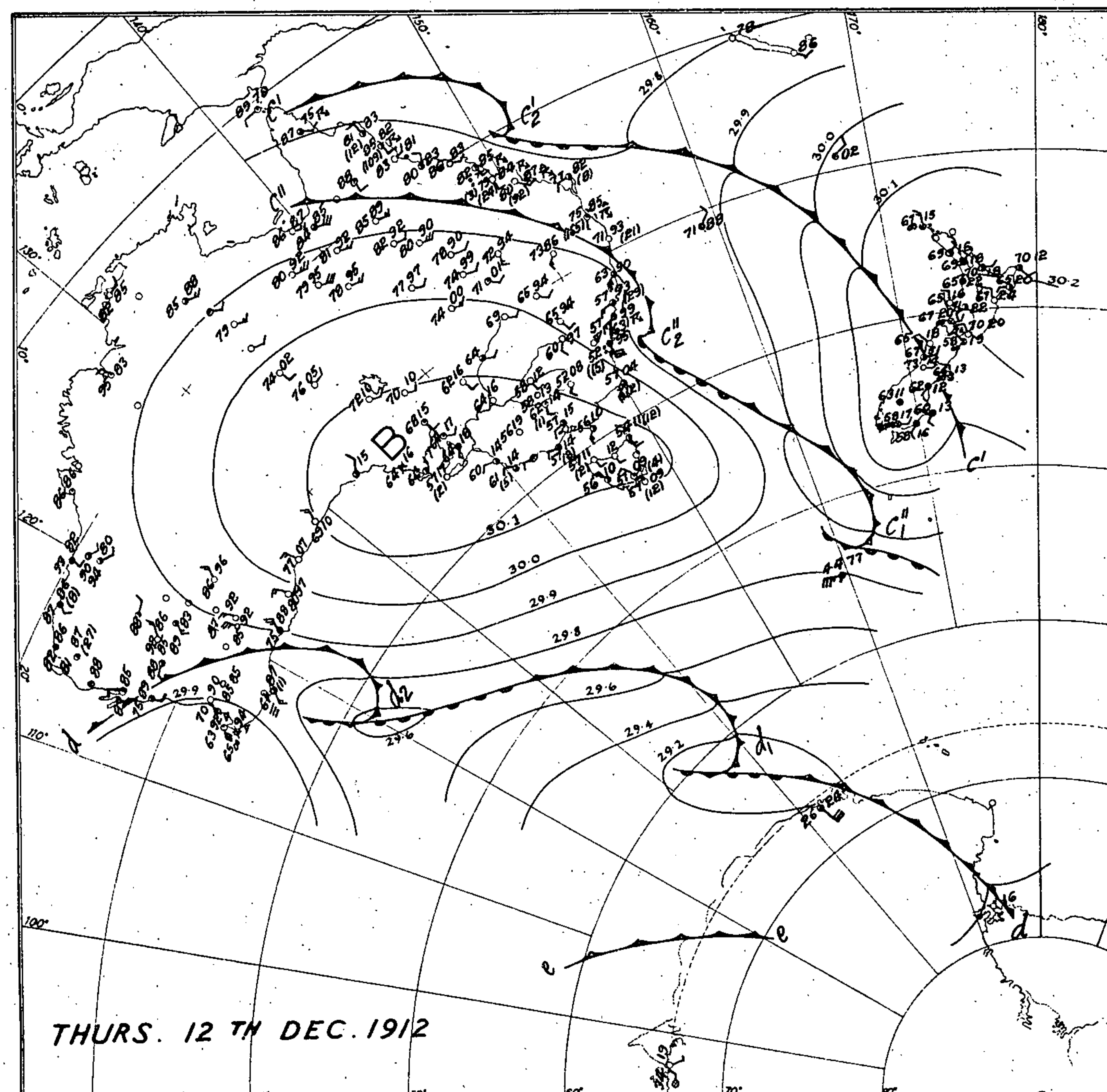
Secondary front c^1 is well marked at Melbourne and at the "Aurora," which is south of Tasmania, and also passes Macquarie Island. Fronts generally during this period are, however, poorly marked and the analysis is difficult.



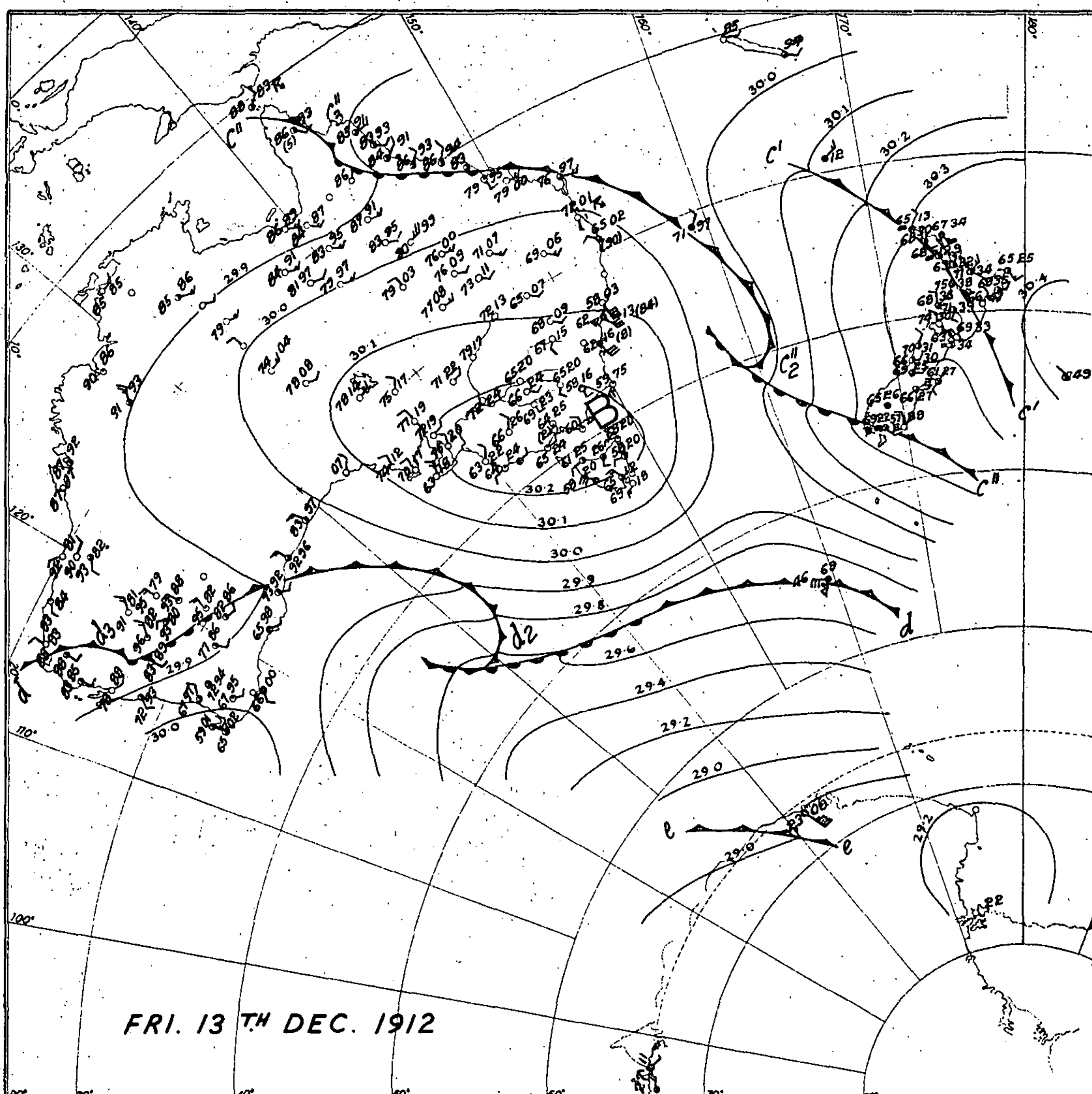
High pressure continues in Antarctica. Fronts remain poorly developed in the New Zealand area.



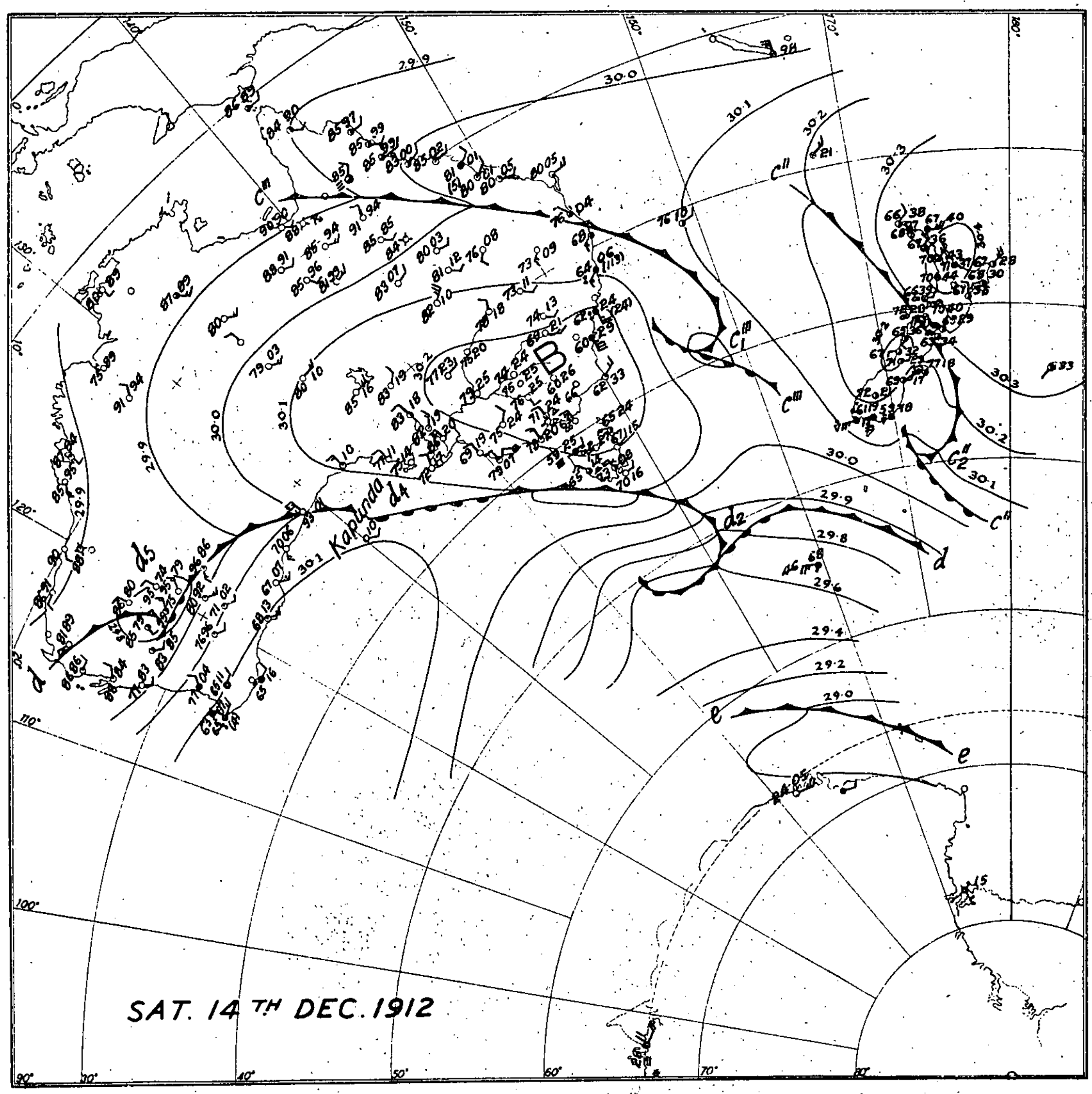
Little of note.



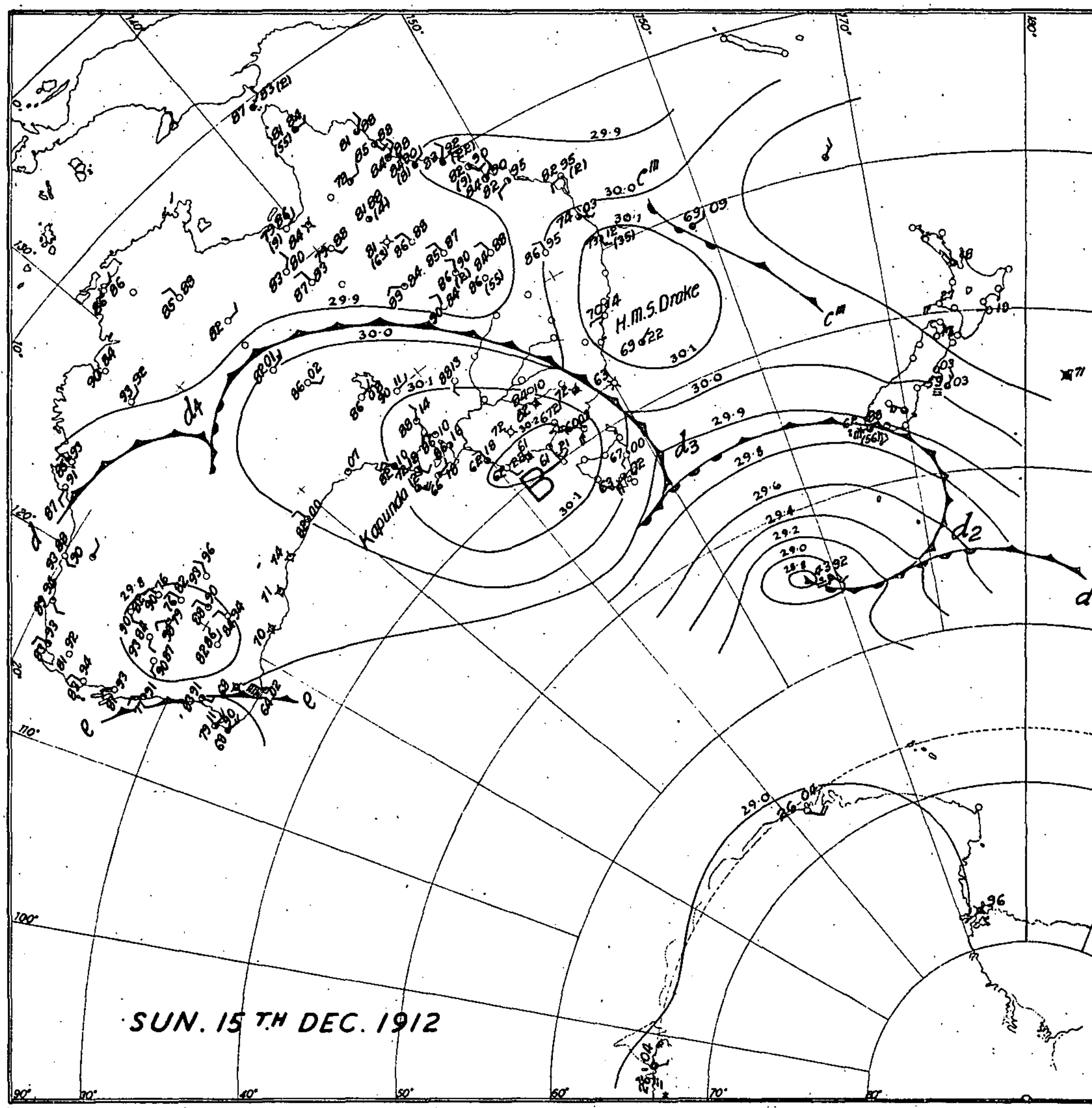
Pressure has fallen somewhat in Antarctica and a front has passed Adélie Land and Cape Evans.



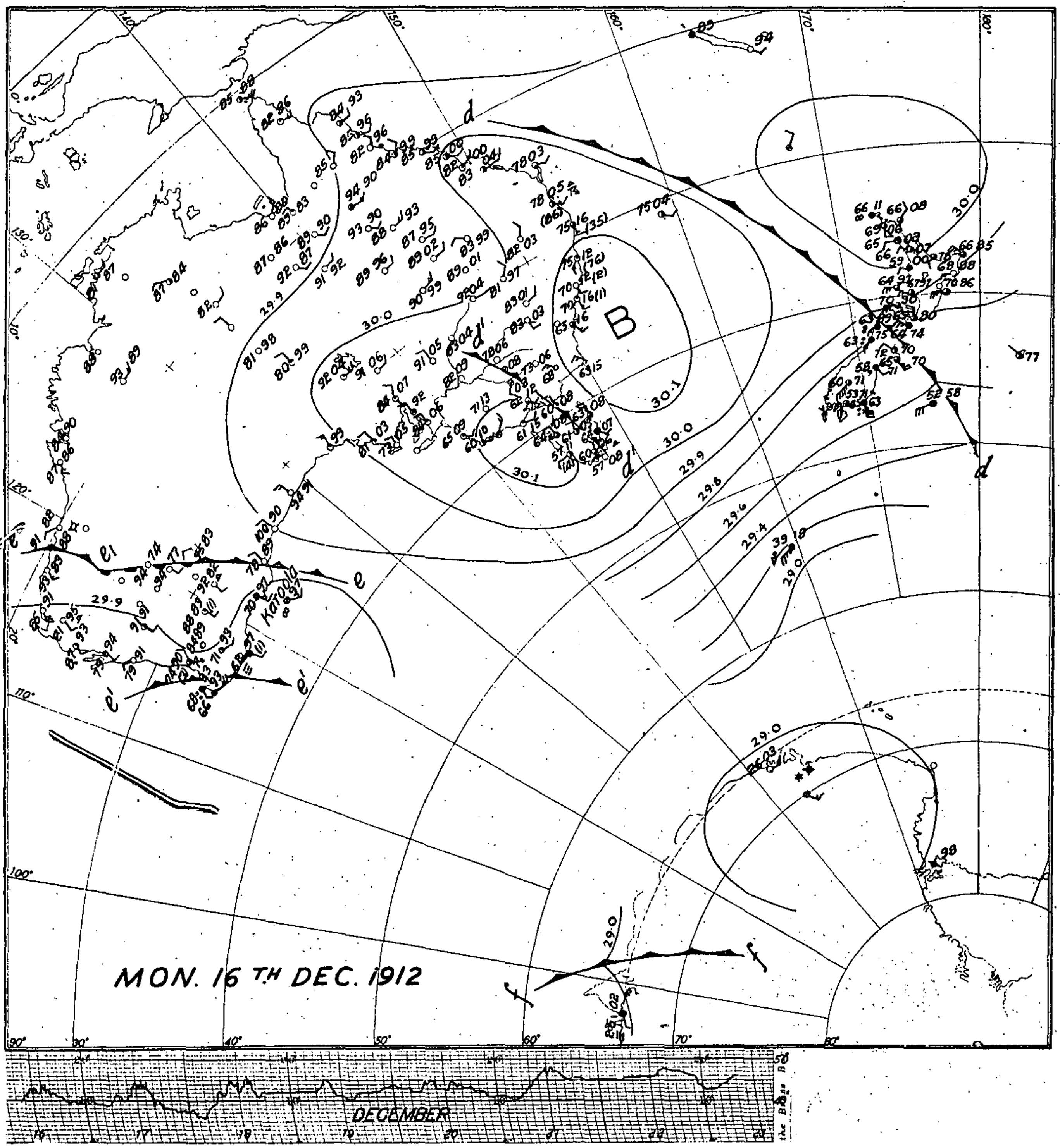
Note persistence of north-westerly winds at Macquarie Island. The analysis is difficult.



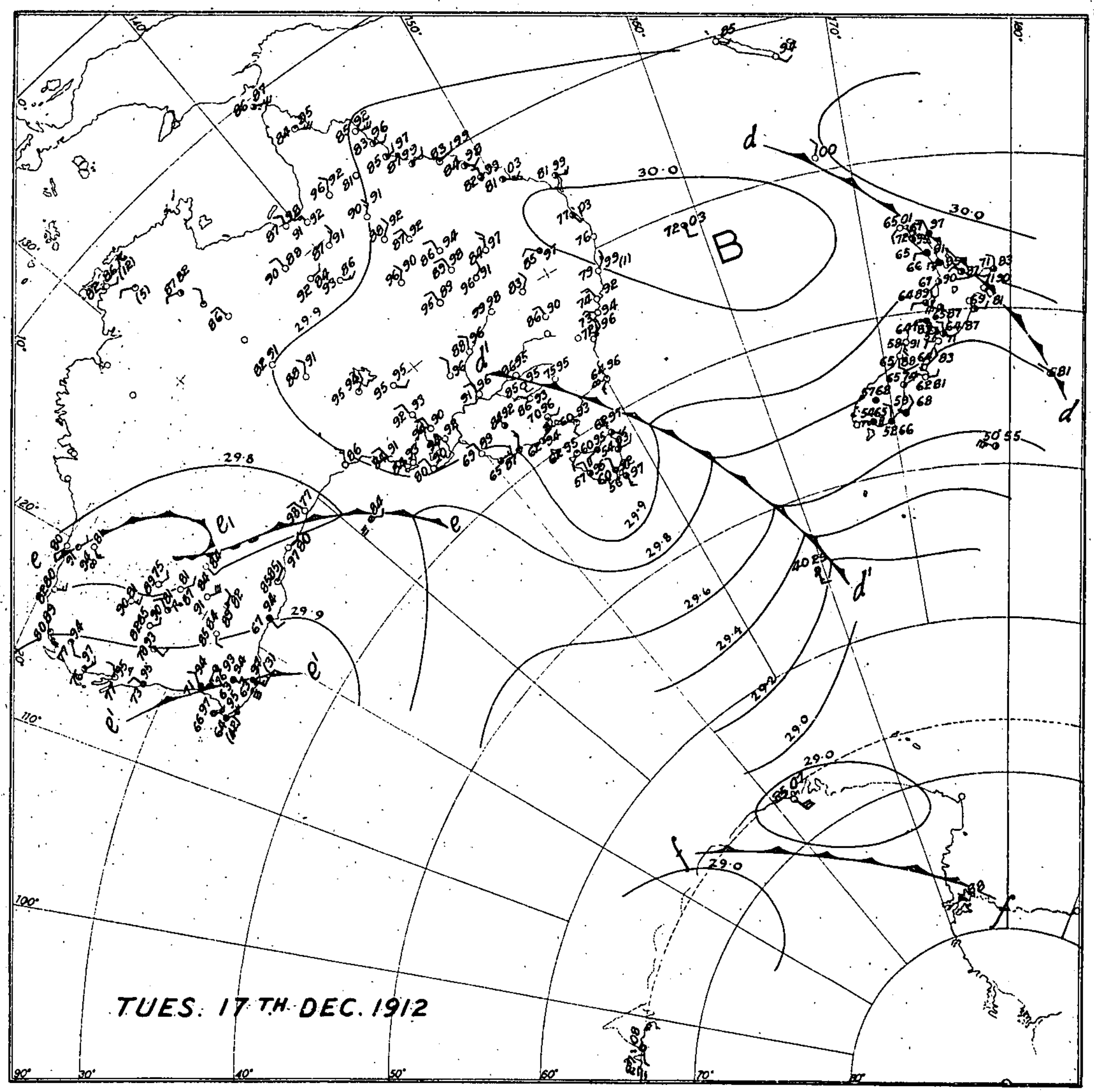
The analysis is still difficult and activity slight. Pressure is becoming low in Antarctica.



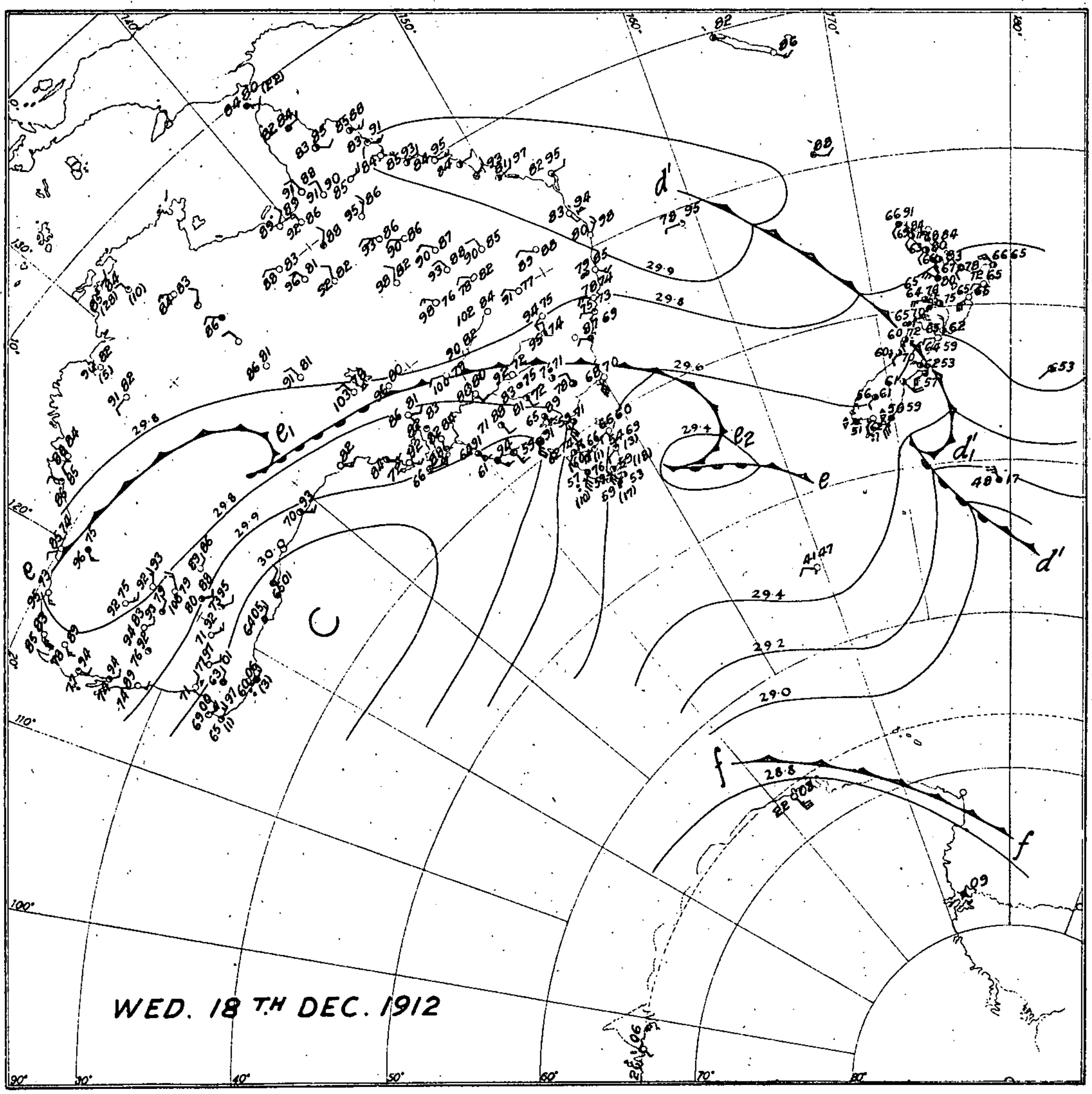
A cyclone centre passes Macquarie Island; the temperature changes seem to indicate that the occlusion is passing just south of it. It is very hot and the atmosphere is unstable in Western Australia.



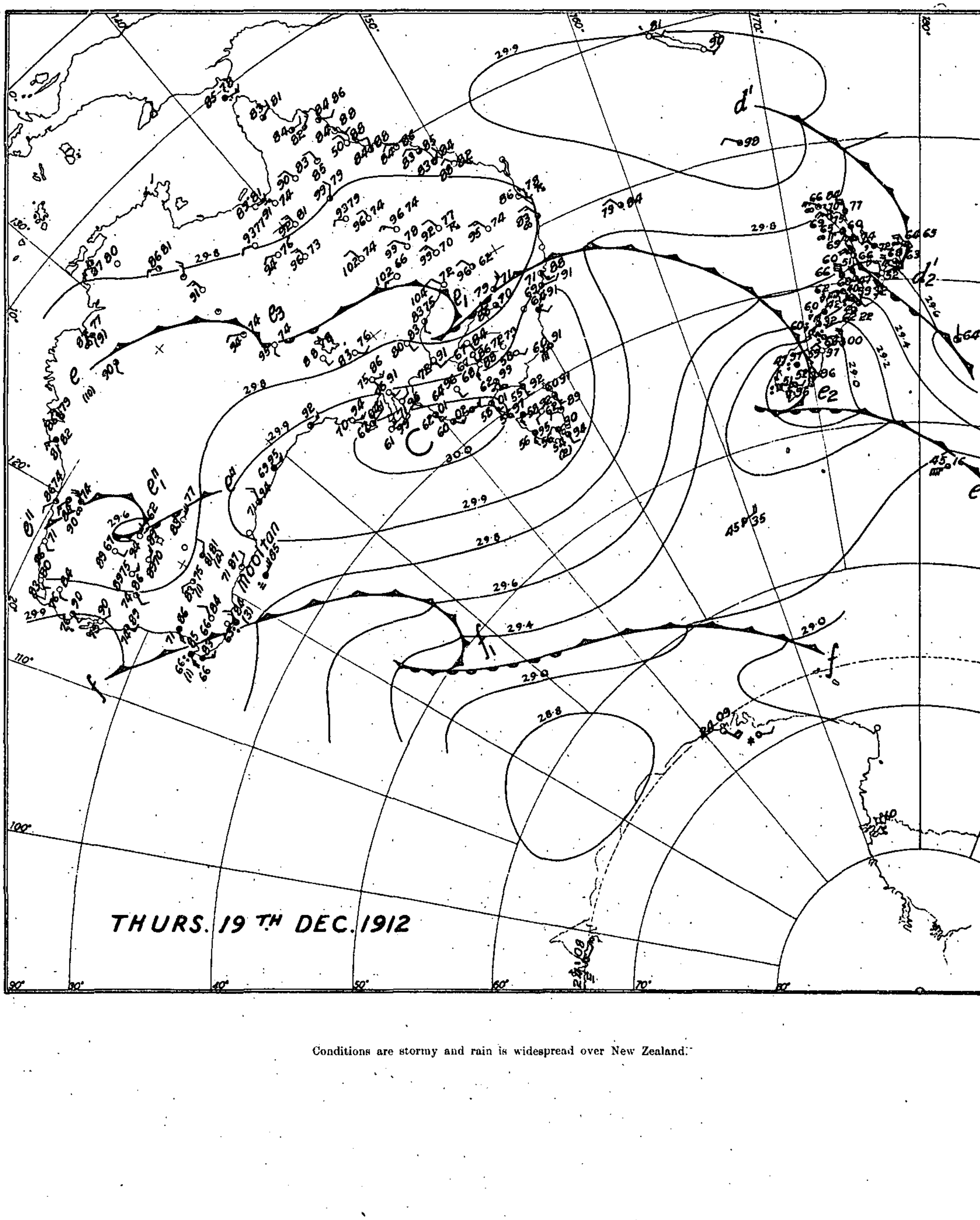
A front has passed the "Terra Nova" which is east of the South Island of New Zealand. Irregular fluctuations of temperature continue at Macquarie Island for several days. There is also considerable diurnal variation.



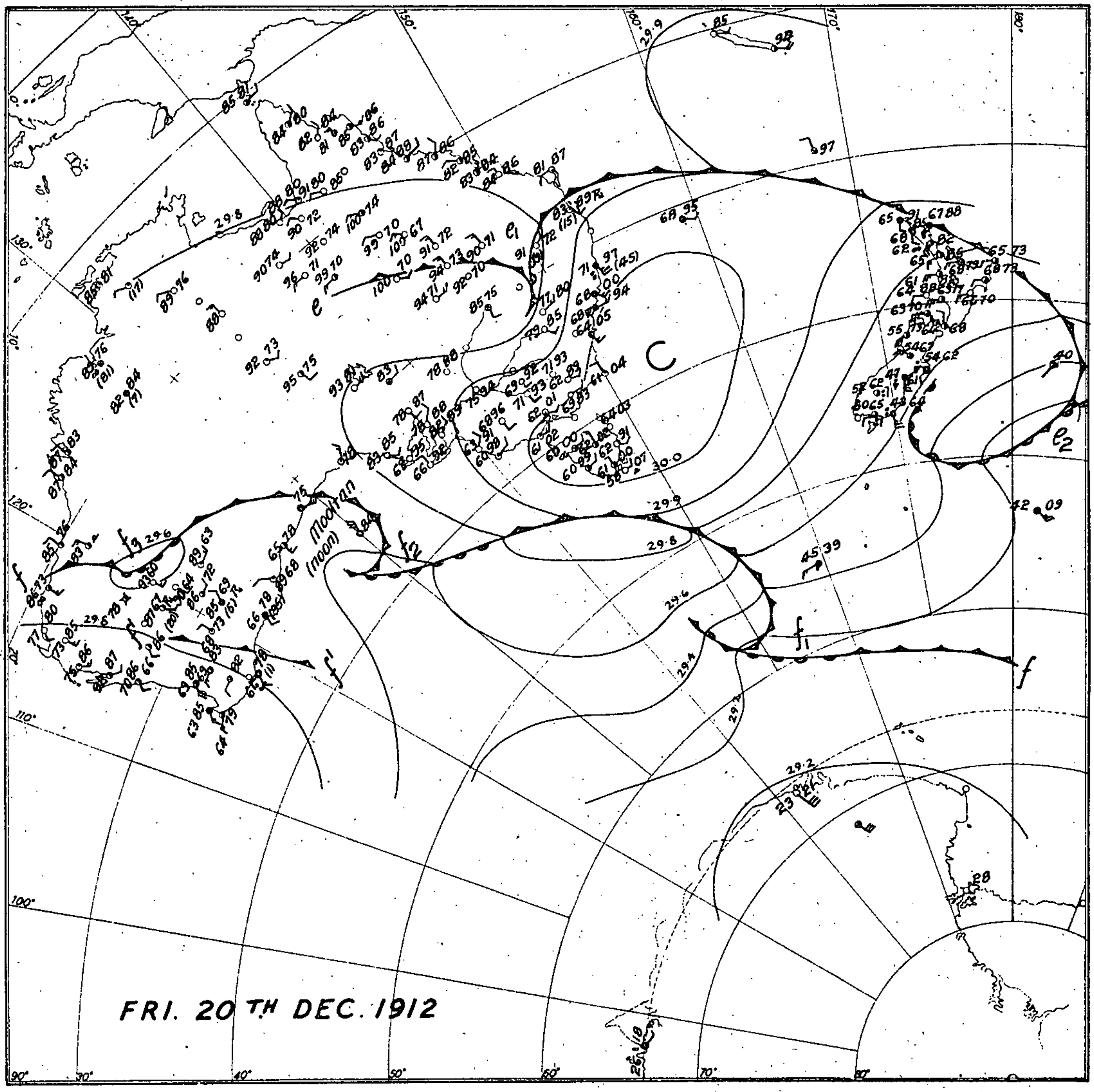
Little of note.



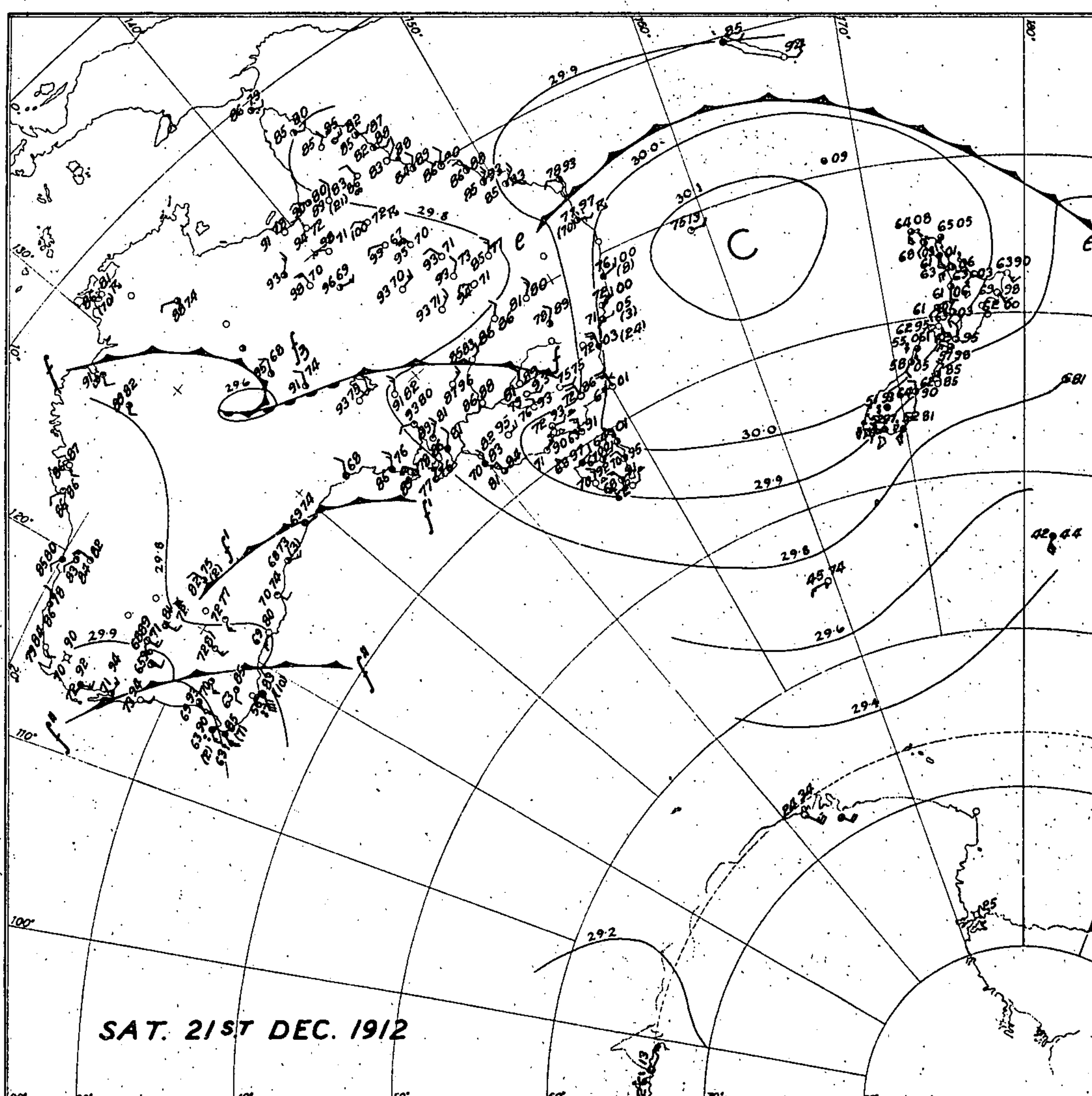
The passage of front d^1 is shown at the "Terra Nova." Front e does not seem to reach Macquarie Island but later passes the "Terra Nova."



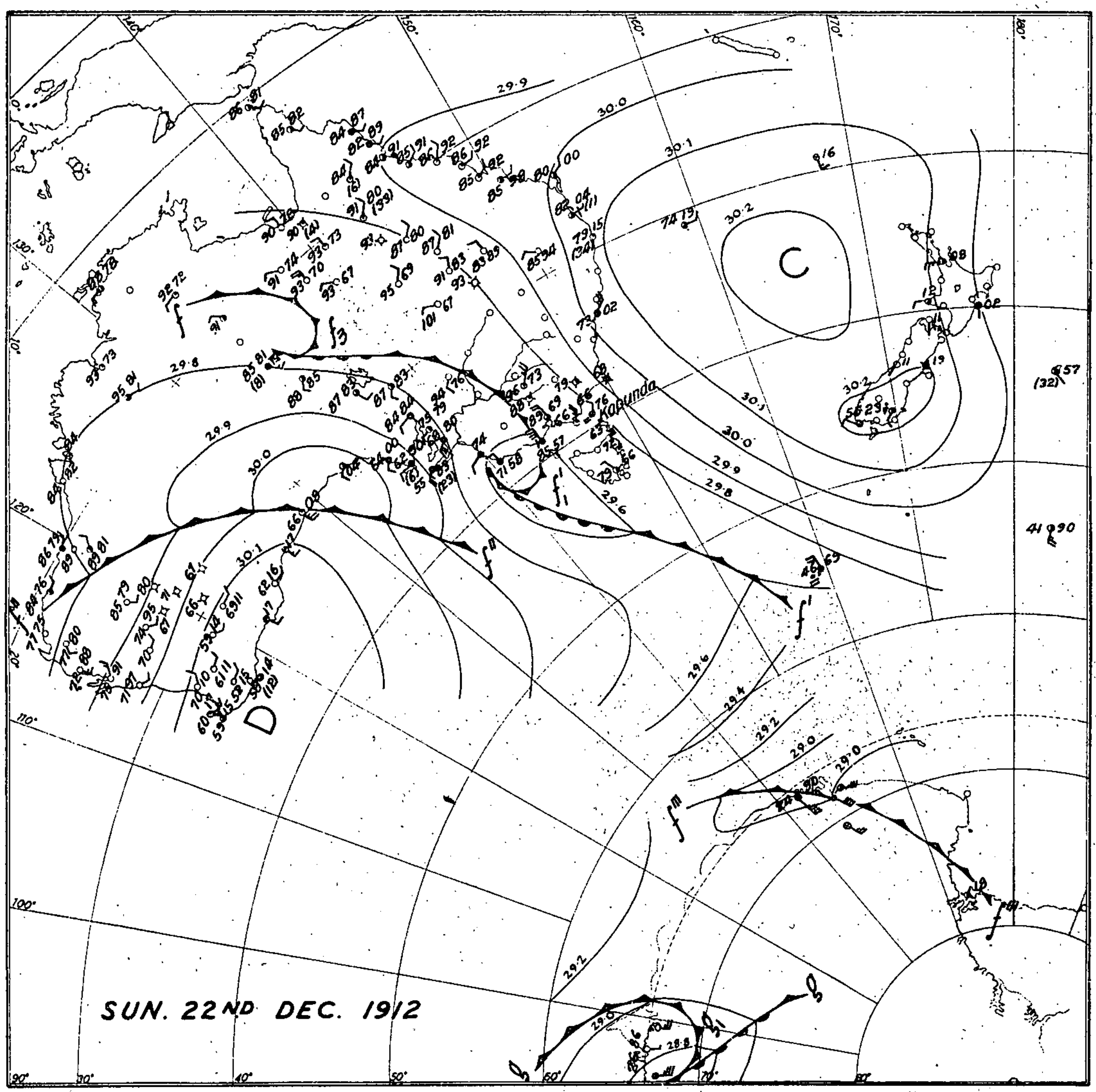
Conditions are stormy and rain is widespread over New Zealand.



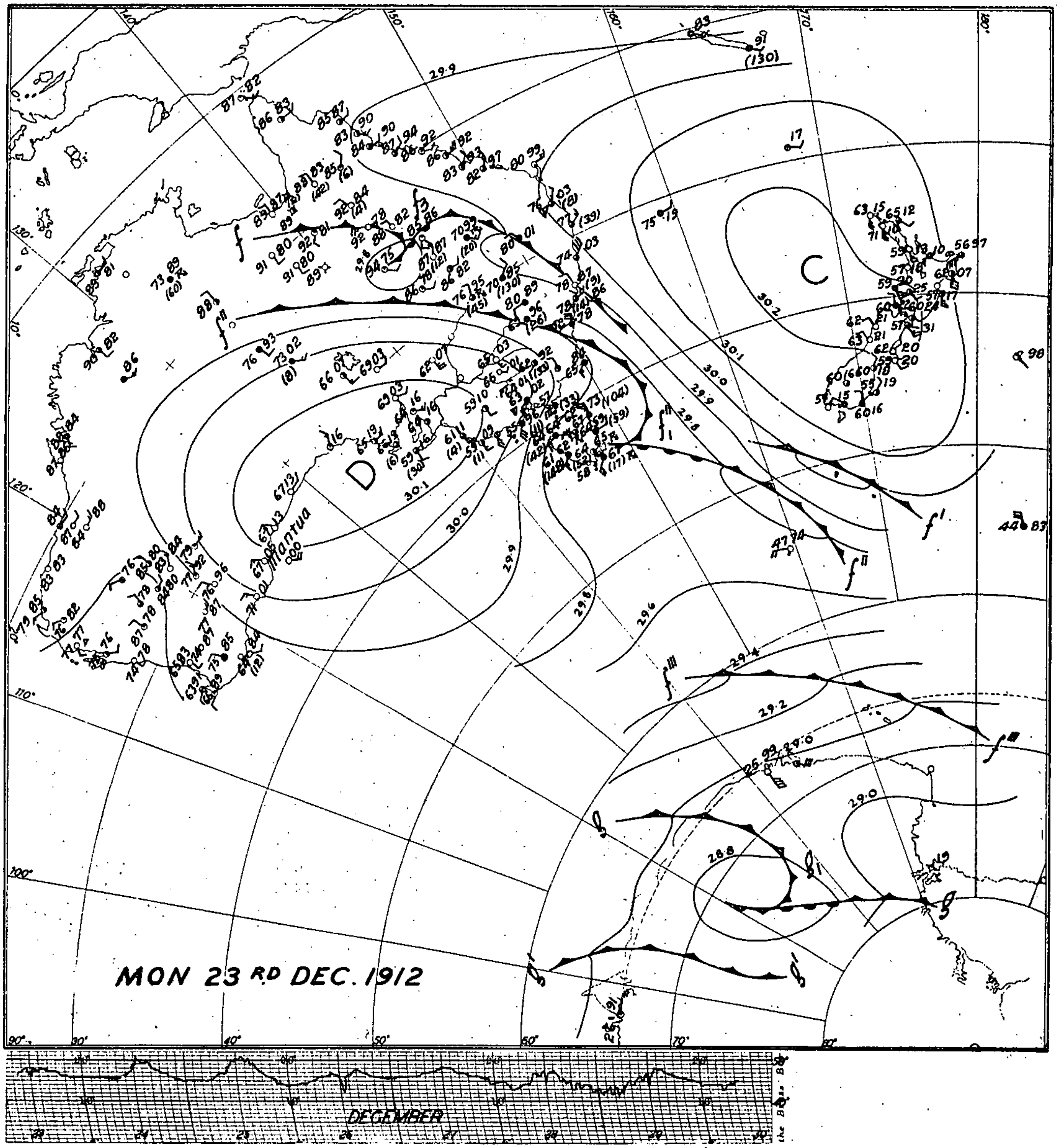
Note the south-easterly wind at the "Terra Nova," south-east of New Zealand, and consequent location of occlusion to the north of it. The report from s.s. "Mooltan" in the Great Australian Bight is somewhat doubtful.



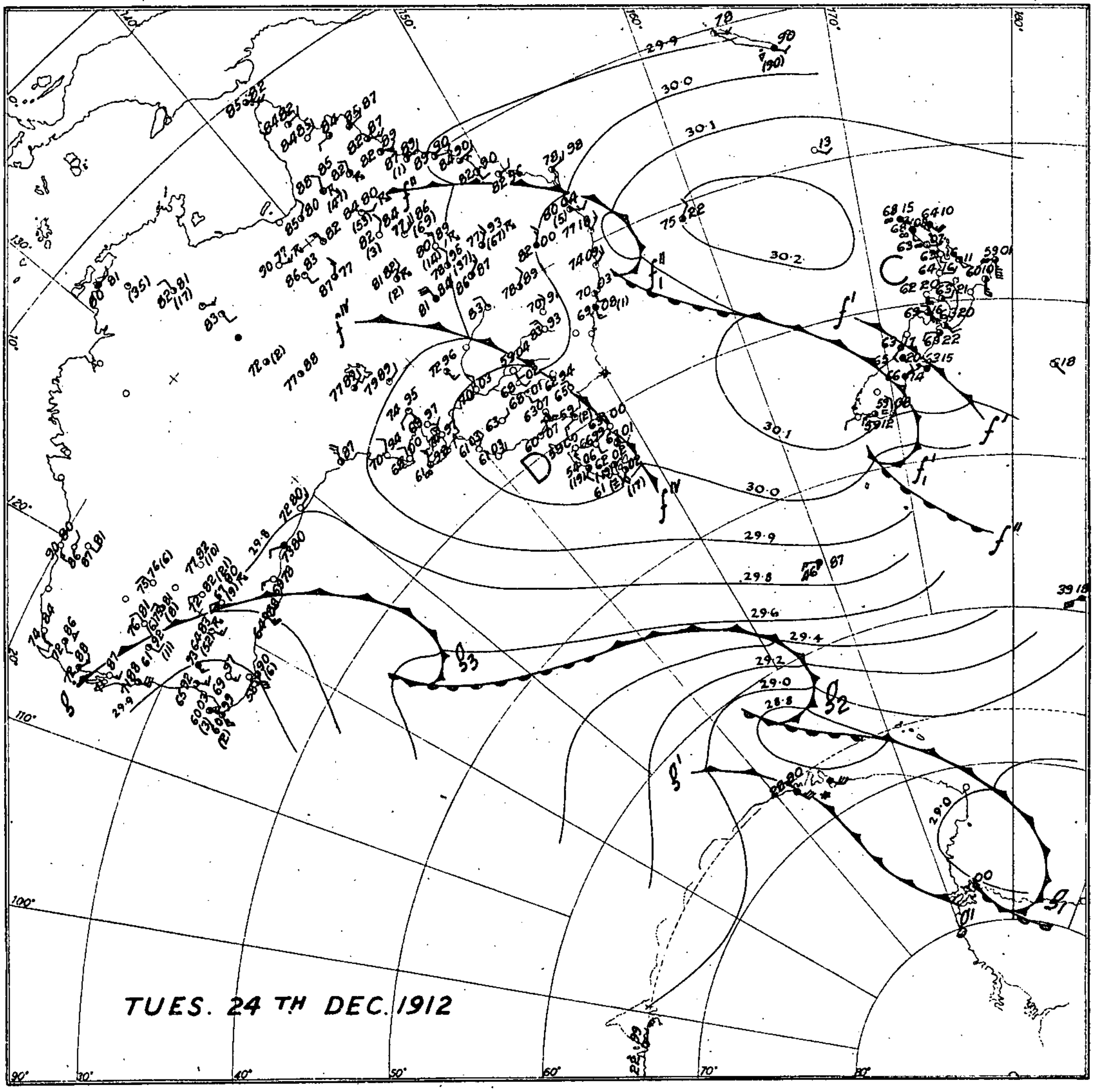
It was not possible to trace the passage of front f at the "Terra Nova." It is very hot in the interior of Australia.



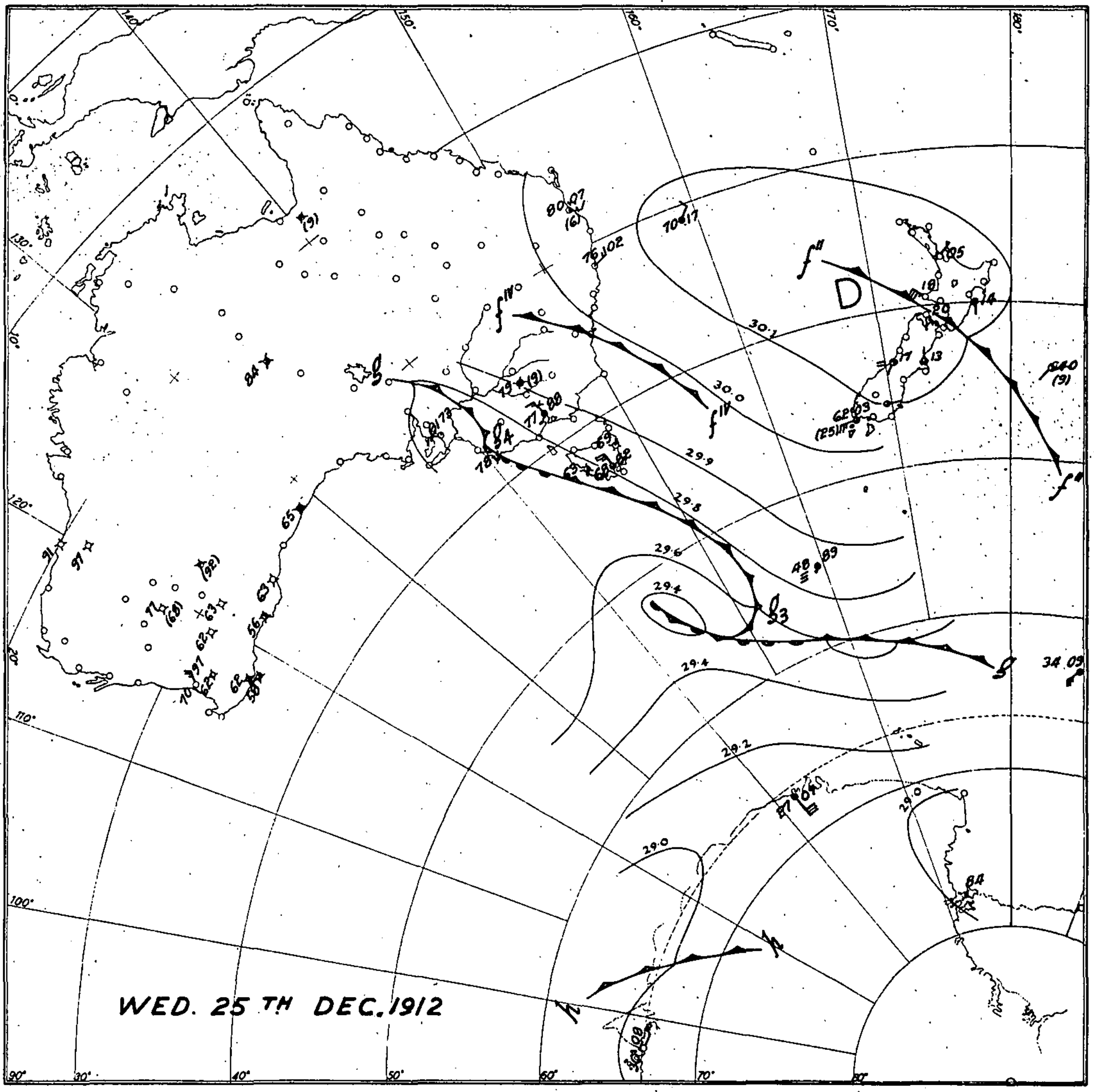
Front f^{I} is well marked in Australia but produces little change of temperature at Macquarie Island where the wind remains north of west. A depression is crossing Queen Mary Land. The wind and pressure changes indicate that a cold front first passes and that then an occlusion passes just to the south.



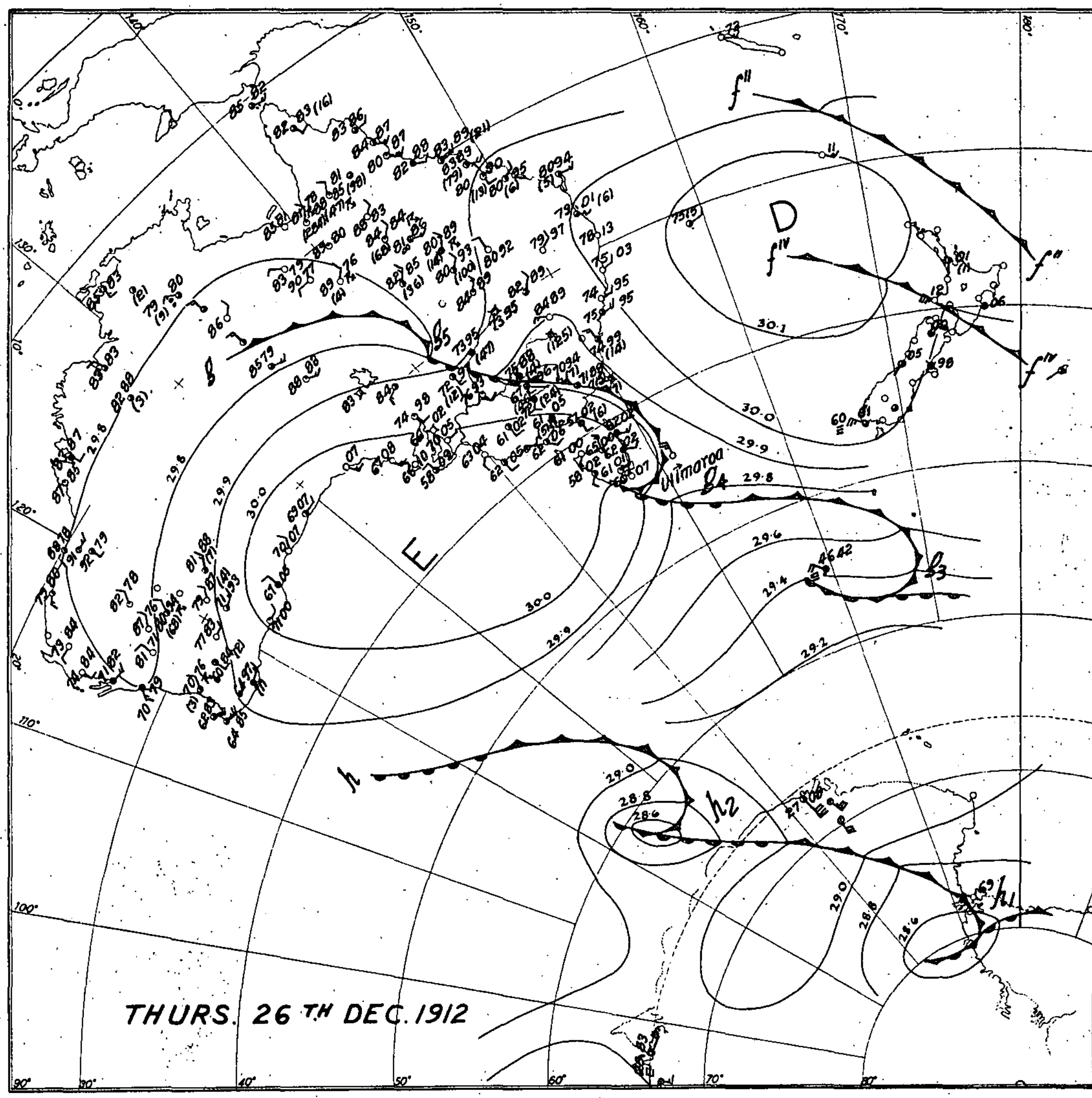
The passage of front f^{II} is shown definitely at both Macquarie Island and at the "Terra Nova" which is to the eastward.



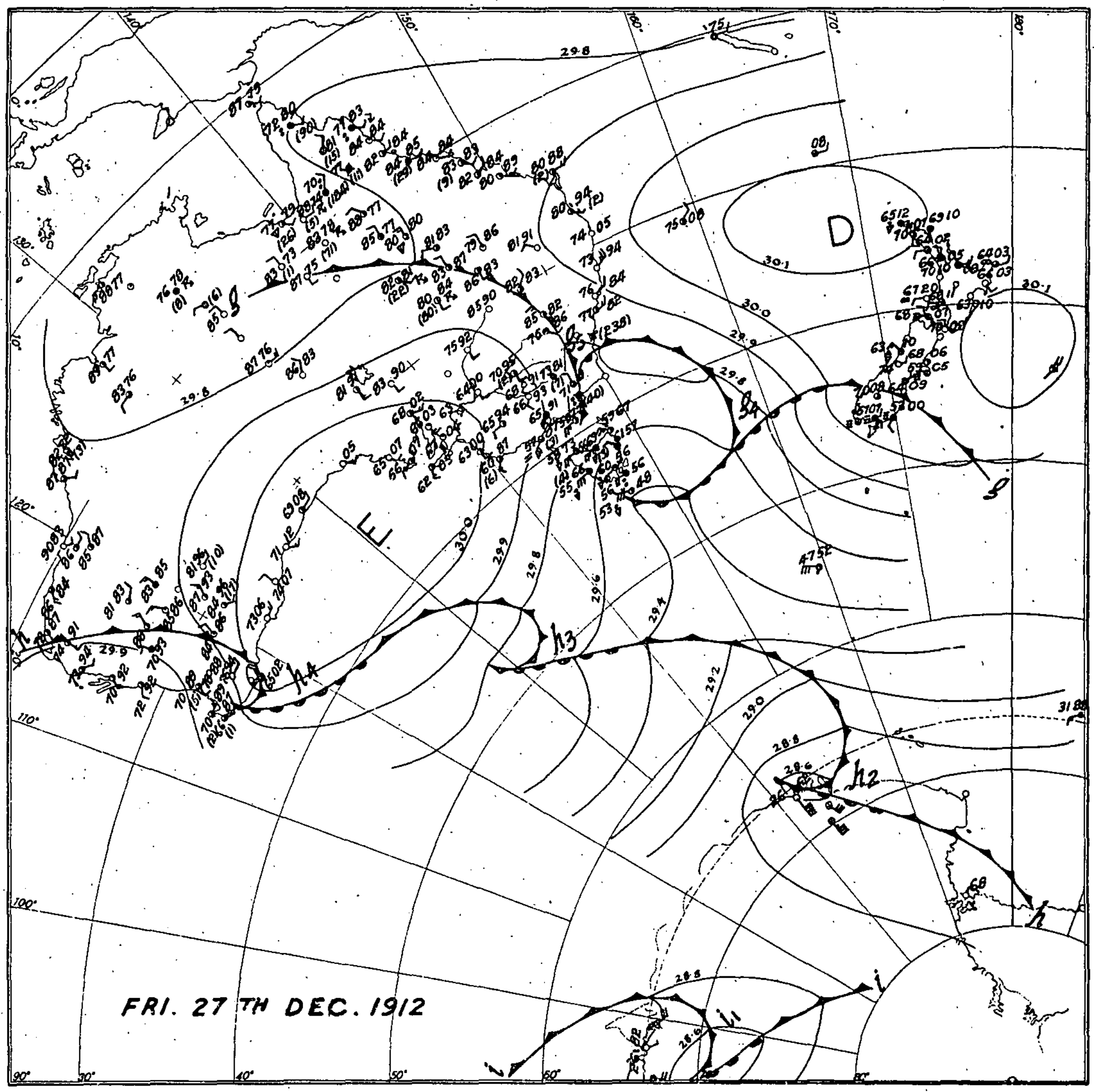
There is more activity now in Antarctica.



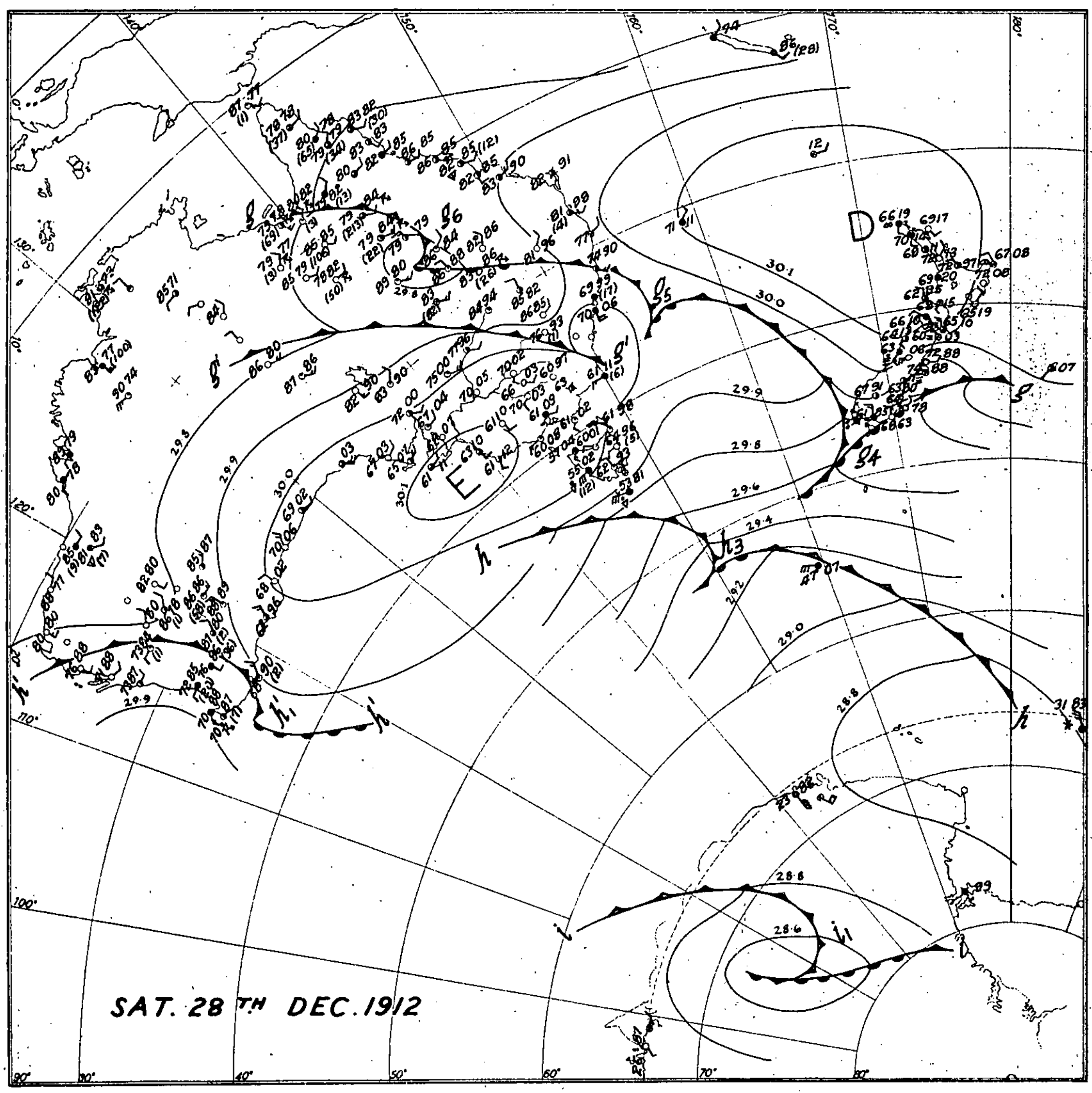
Few reports available from Australia.



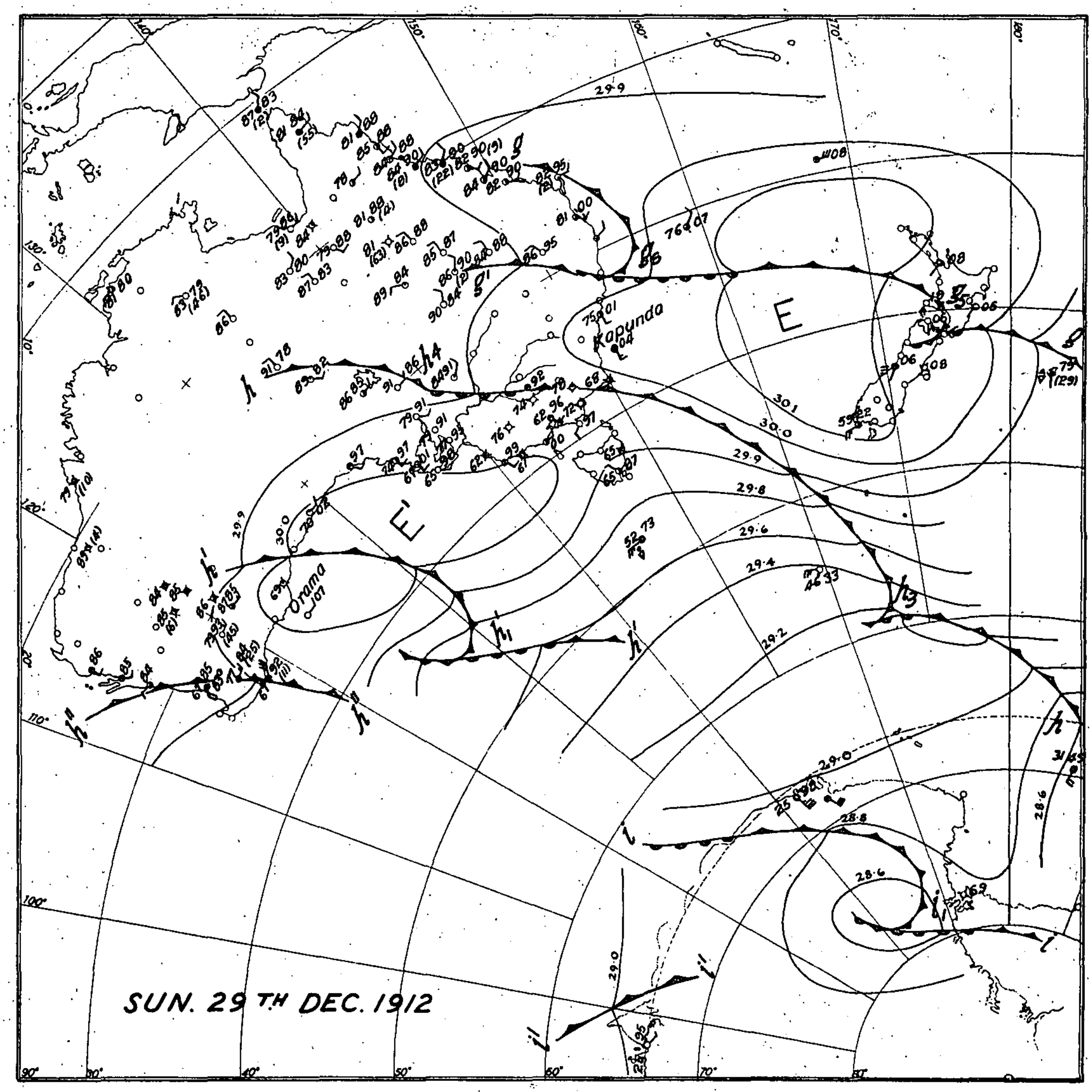
A depression is passing to the south of Cape Evans while another is approaching Adélie Land.



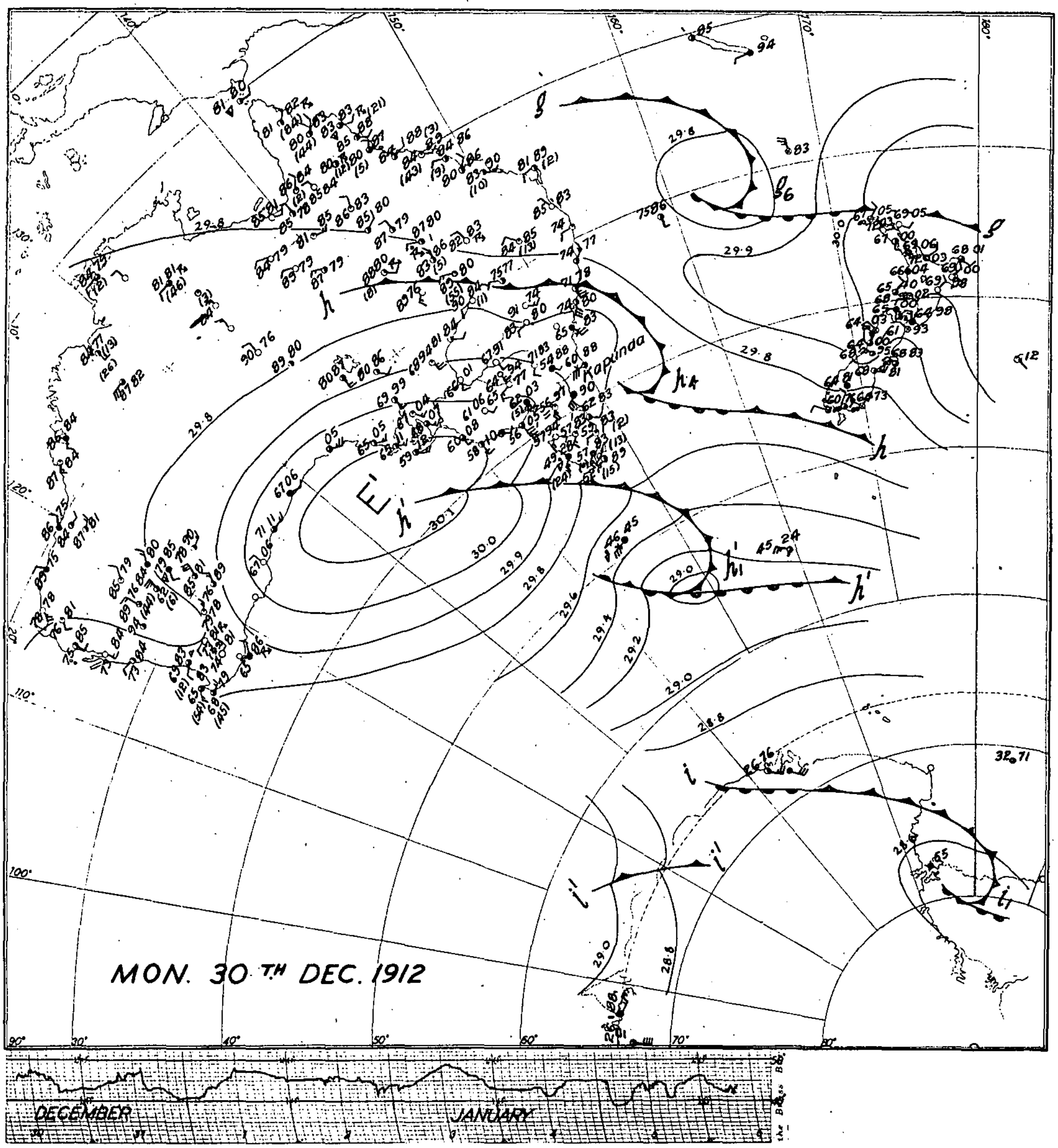
A wave has just passed Adélie Land while a fresh front is crossing Queen Mary Land.



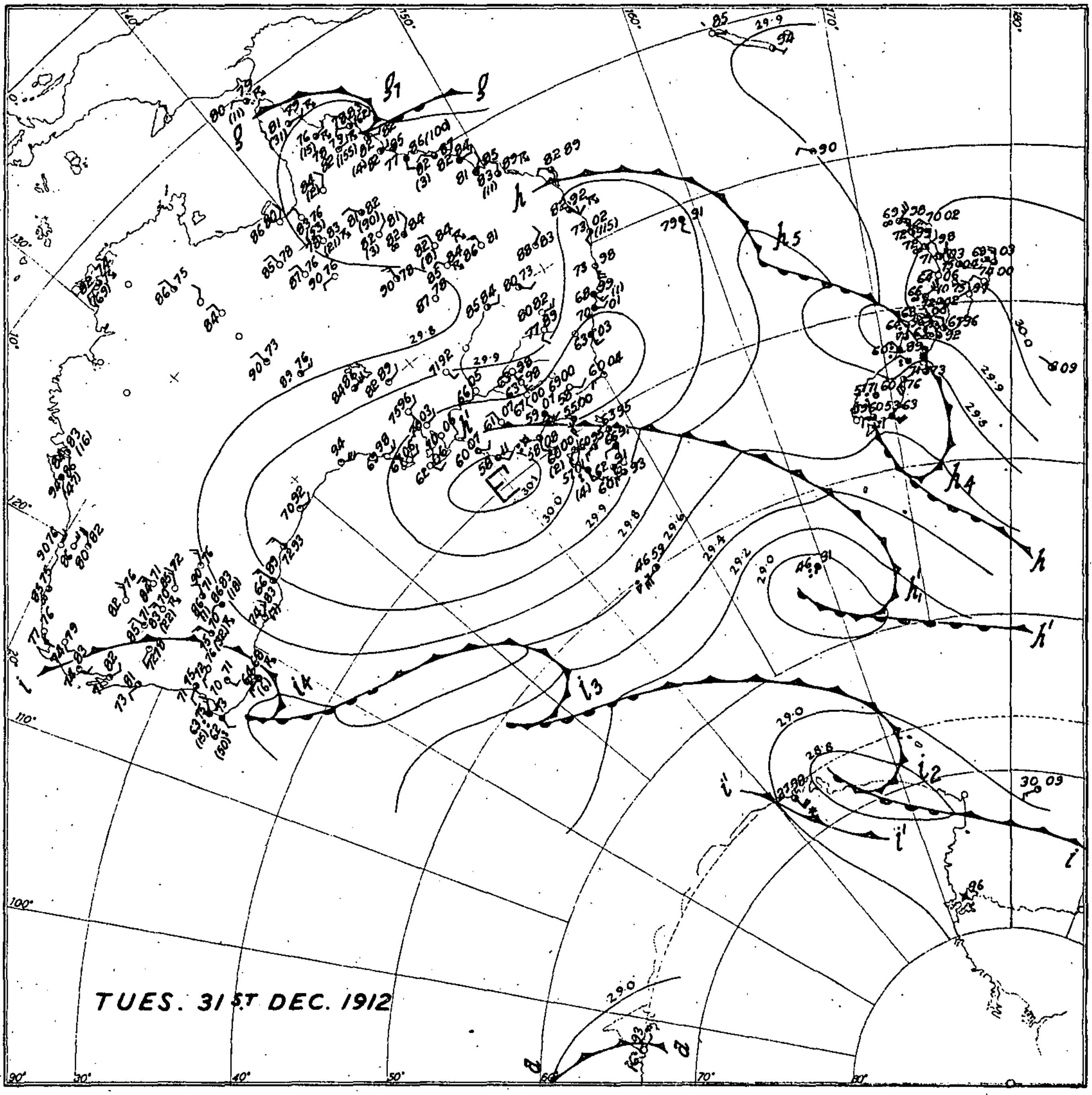
Note the weather sequence at the "Terra Nova" in the Ross Sea as front *h* passes. Unstable conditions at Macquarie Island following the passage of *h* are shown in the temperature trace.



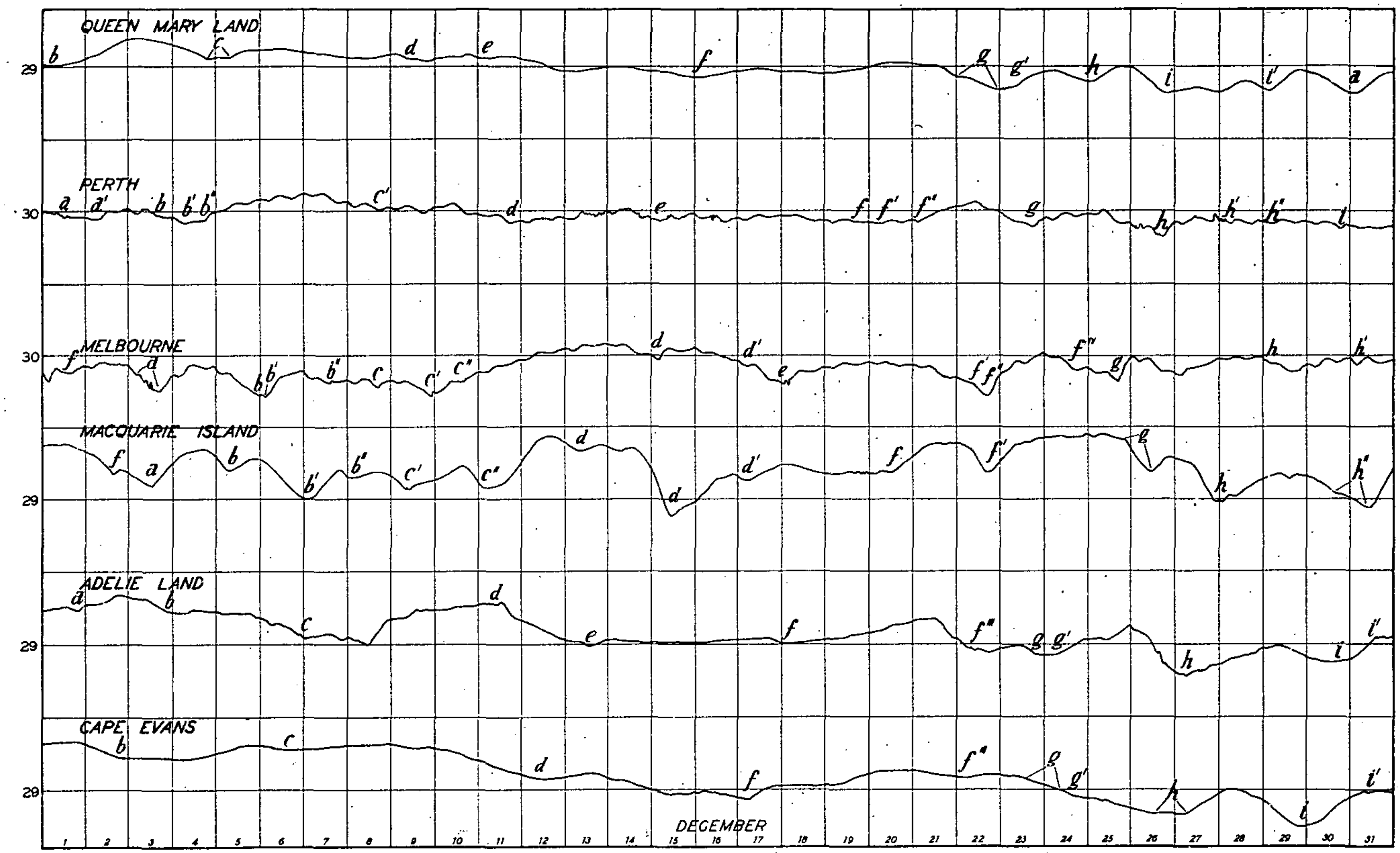
Front h' was probably originally part of h from which it was separated as the latter passed anticyclone E'. A depression appears to pass south of Cape Evans.



Note the series of changes at the "Aurora" south of Tasmania and at Macquarie Island. The occlusion of wave h'_1 evidently passes to the south of the latter where the temperature falls sharply in the afternoon of the next day. The "Aurora" also shows the effect of its passage.



Little of note.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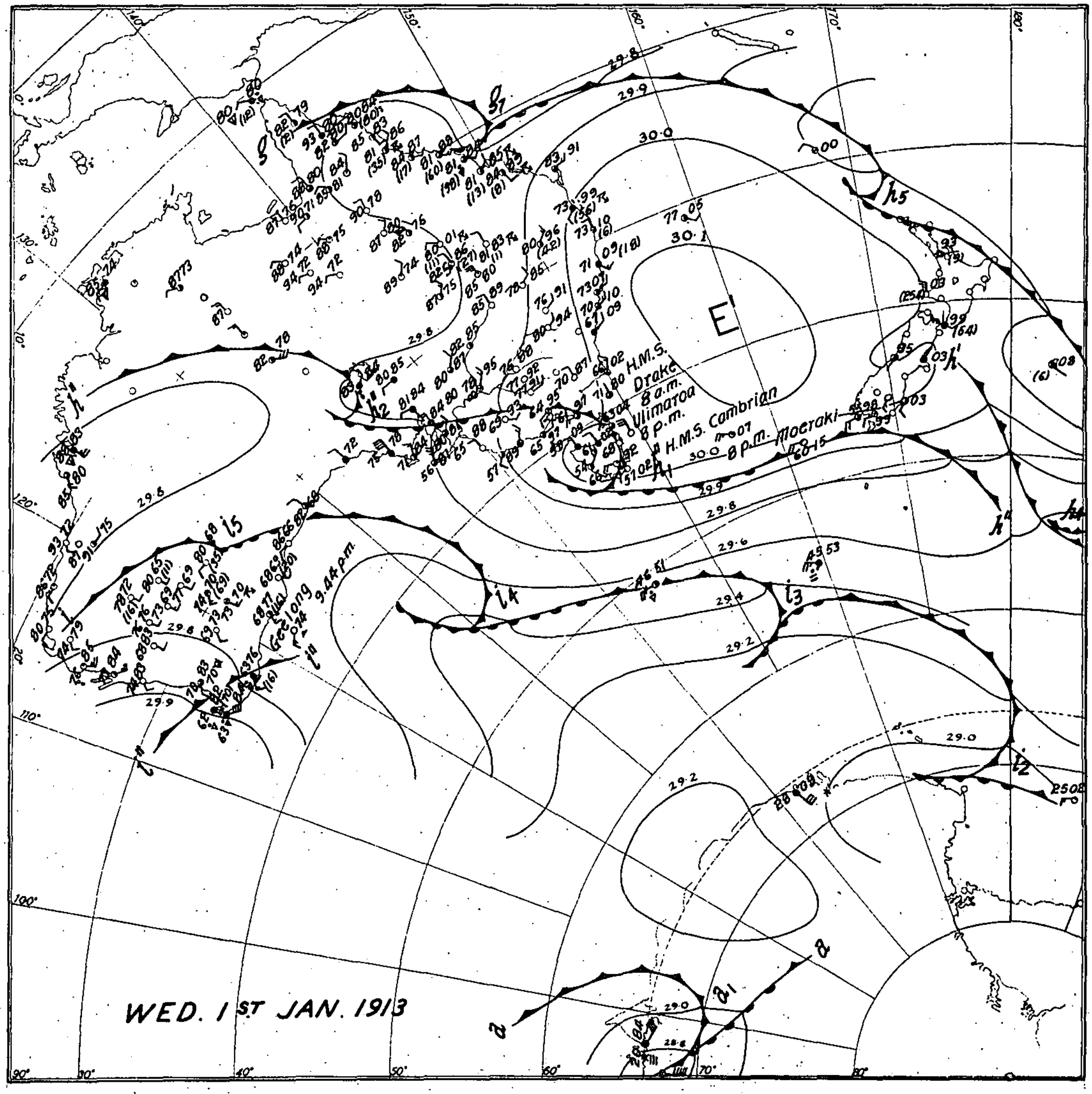
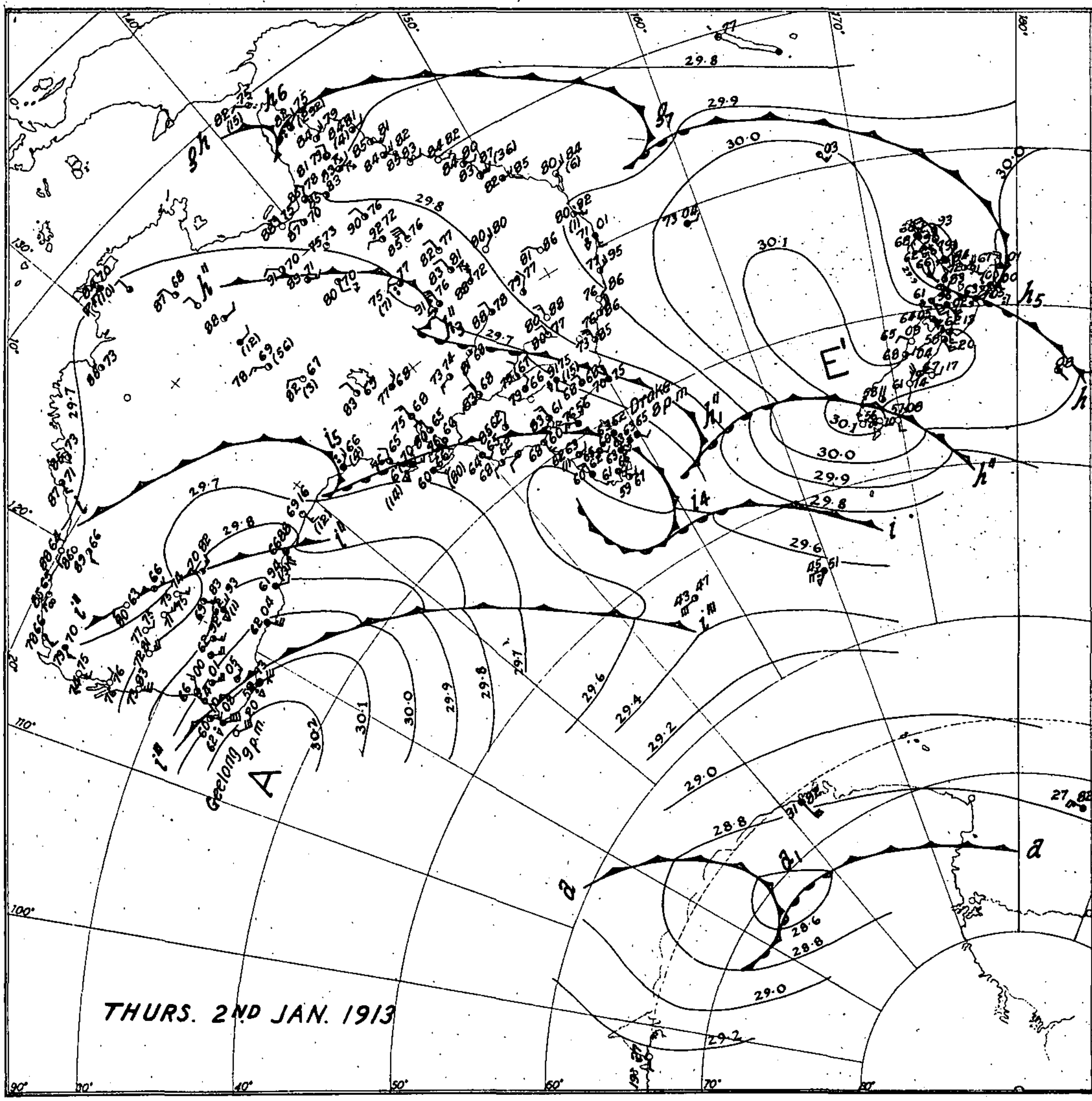
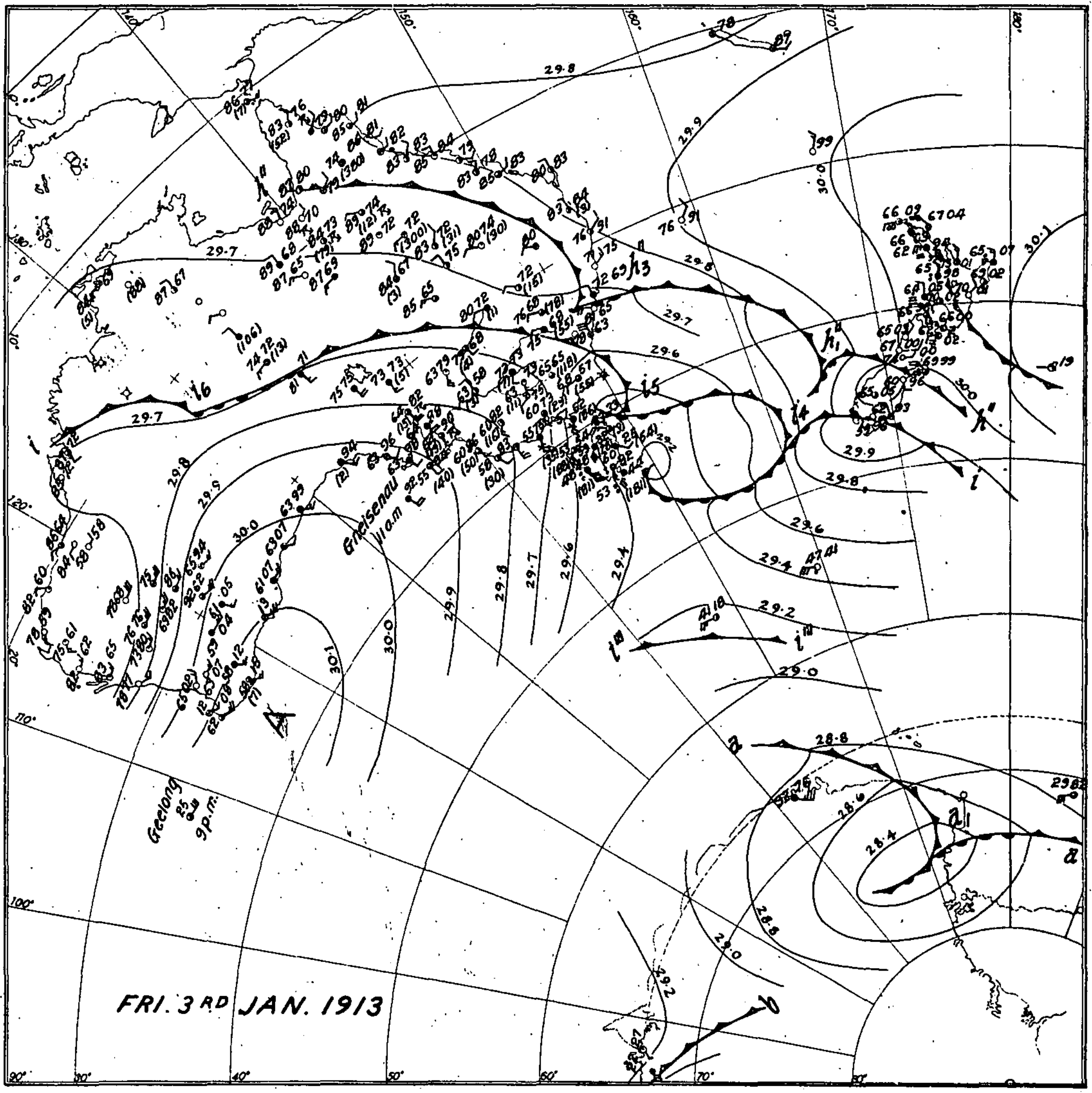
ADELIE LAND
CAPE EVANS
DECEMBER



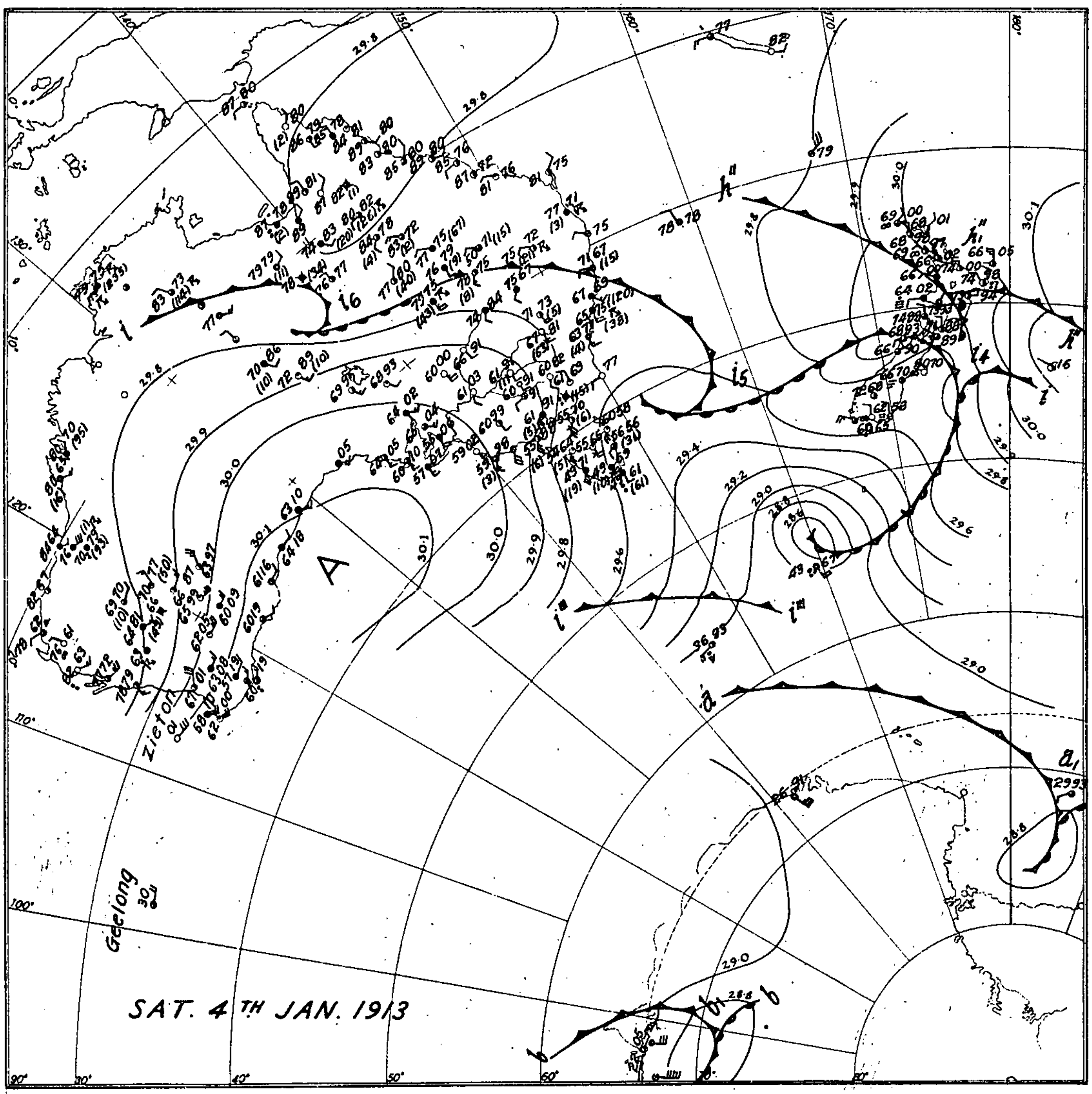
Analysis difficult. The passage of front *i* was shown in the records of the "Aurora," south of Tasmania, and later by those of Macquarie Island. At the "Terra Nova," in the Ross Sea, there were only slight traces. A depression is crossing Queen Mary Land and that an occlusion was passing to the south is suggested by subsequent developments to the east.



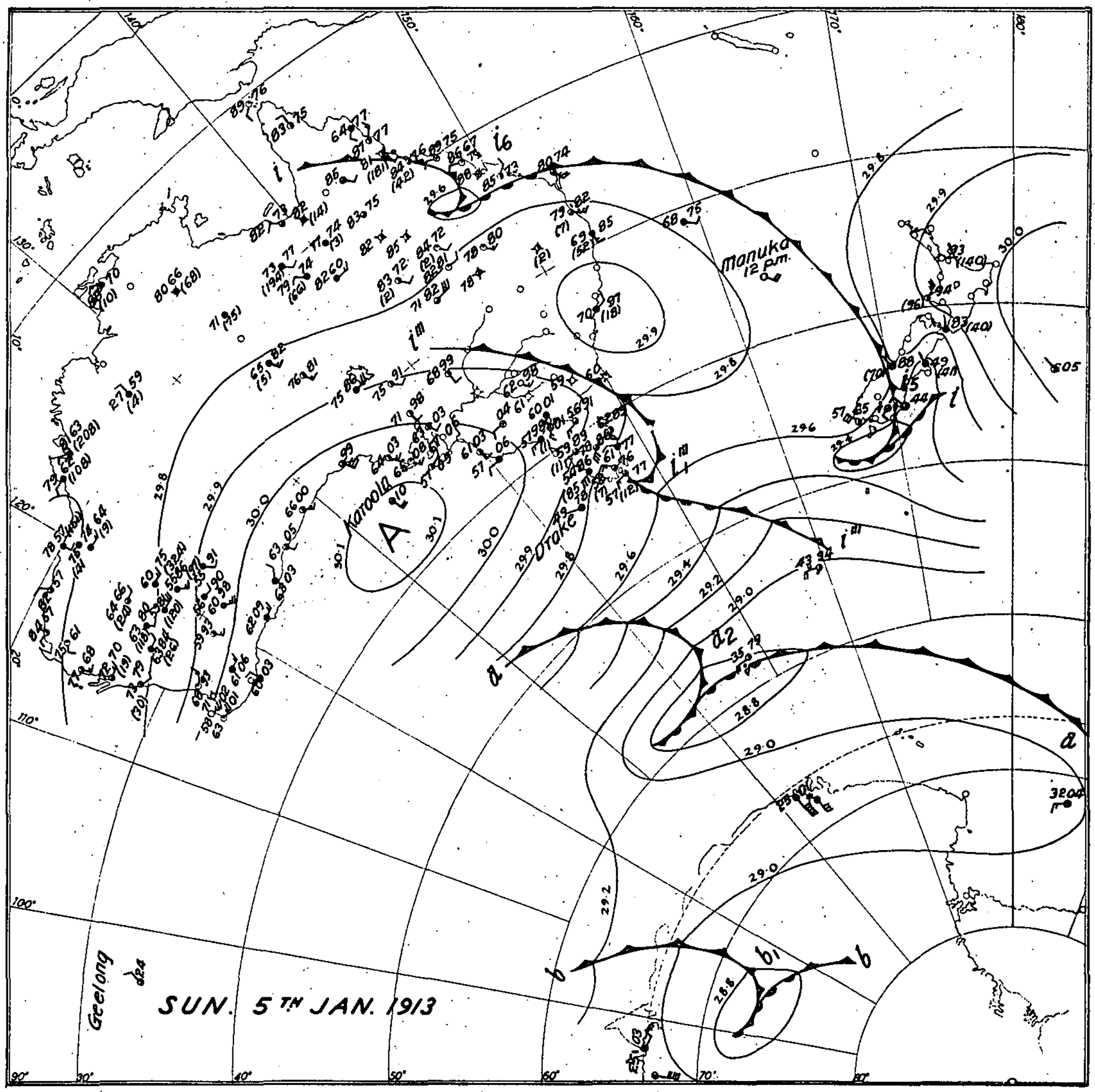
A shallow cyclone is centred over northern New Zealand. There are indications of a front passing the "Aurora" later in the day.



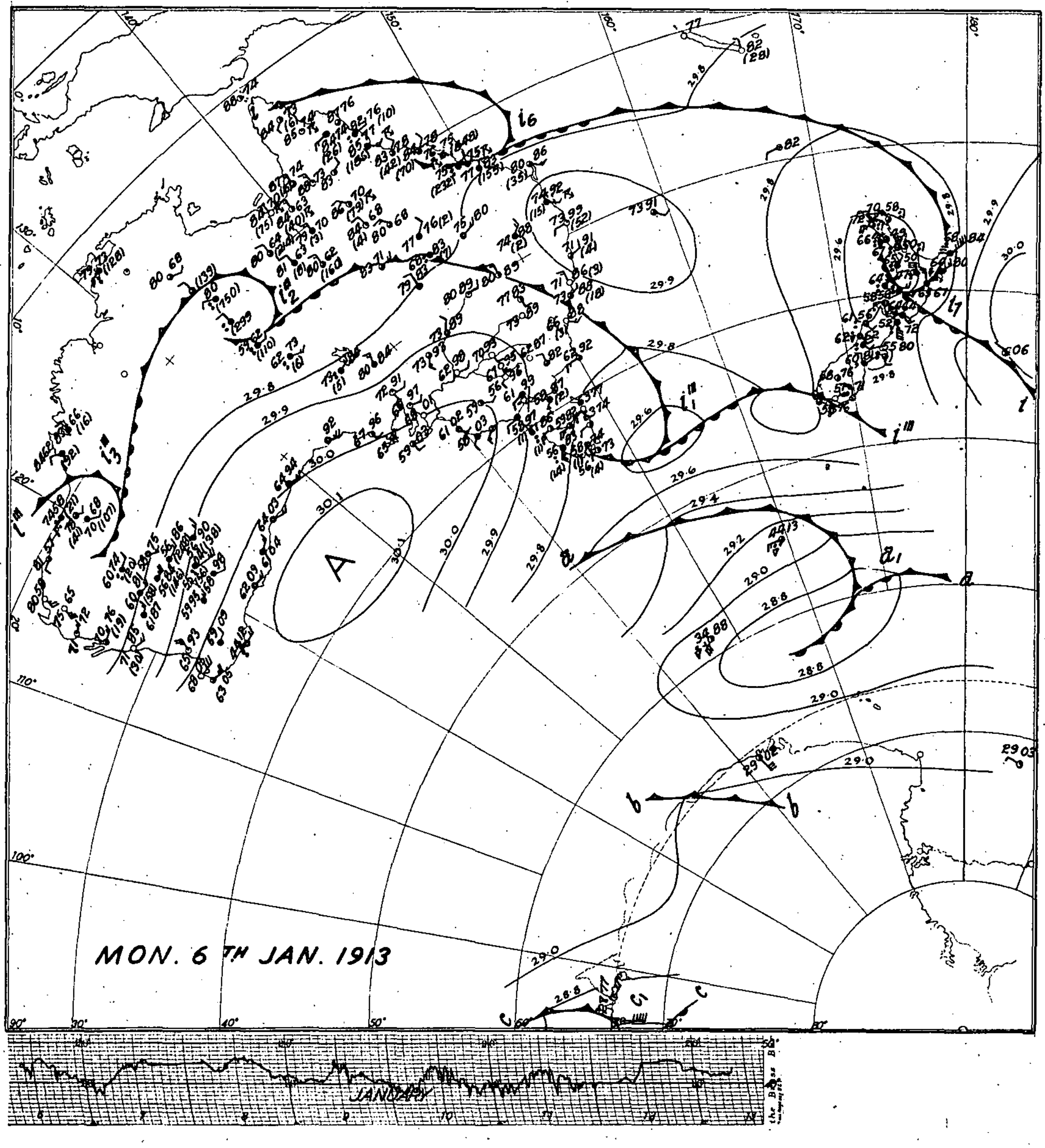
Another slight front appears to pass the "Aurora" later. A low pressure centre has formed south-east of Tasmania.



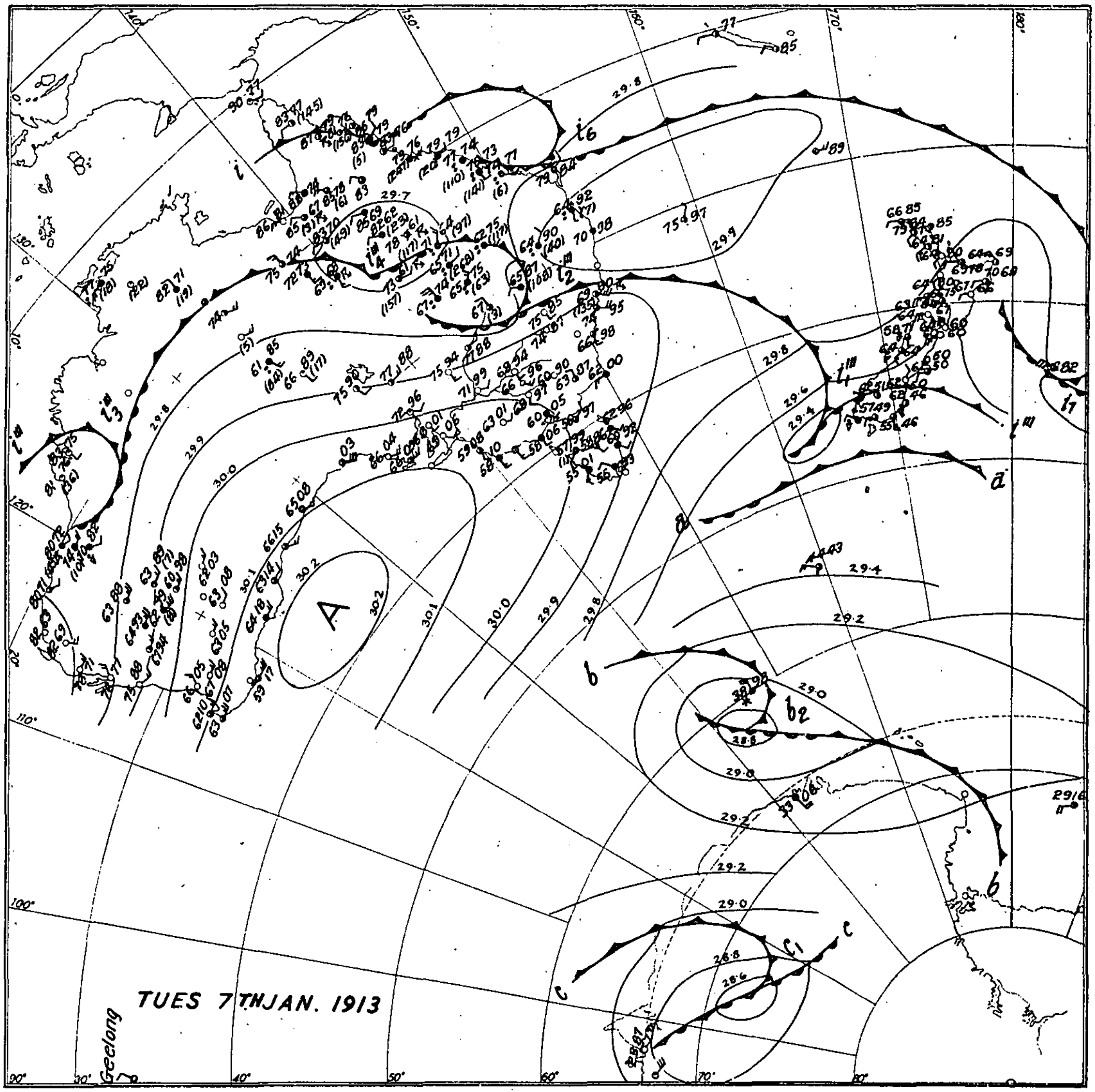
A deep cyclone has passed Macquarie Island. Temperature, however, remains rather high till front i^{III} passes during the night. The passage of front a is shown by the records of the "Terra Nova" in the Ross Sea.



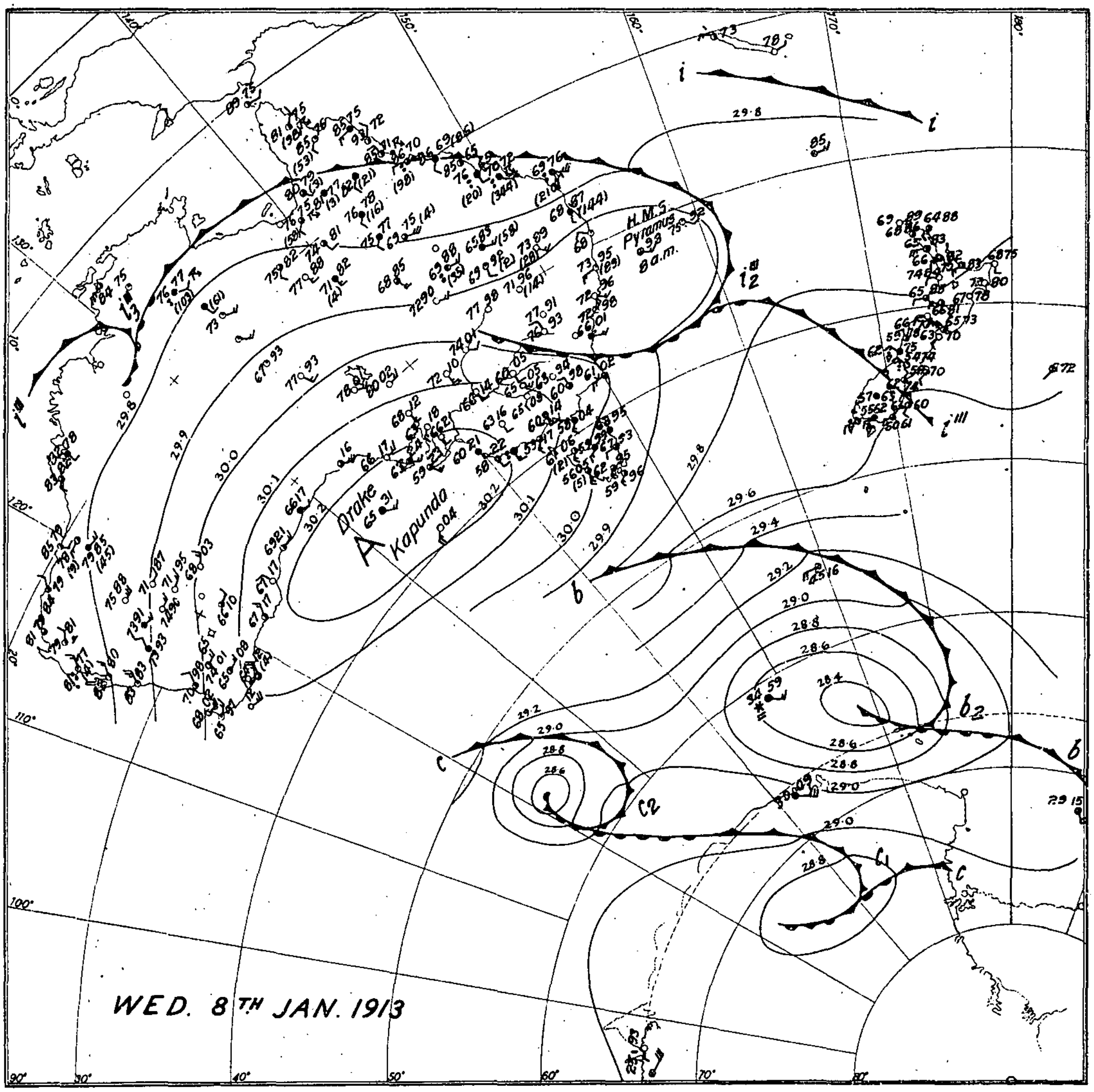
i''' produces a sharp drop of temperature at Macquarie Island. A front passes the "Aurora" west-south-west of Macquarie Island about noon.



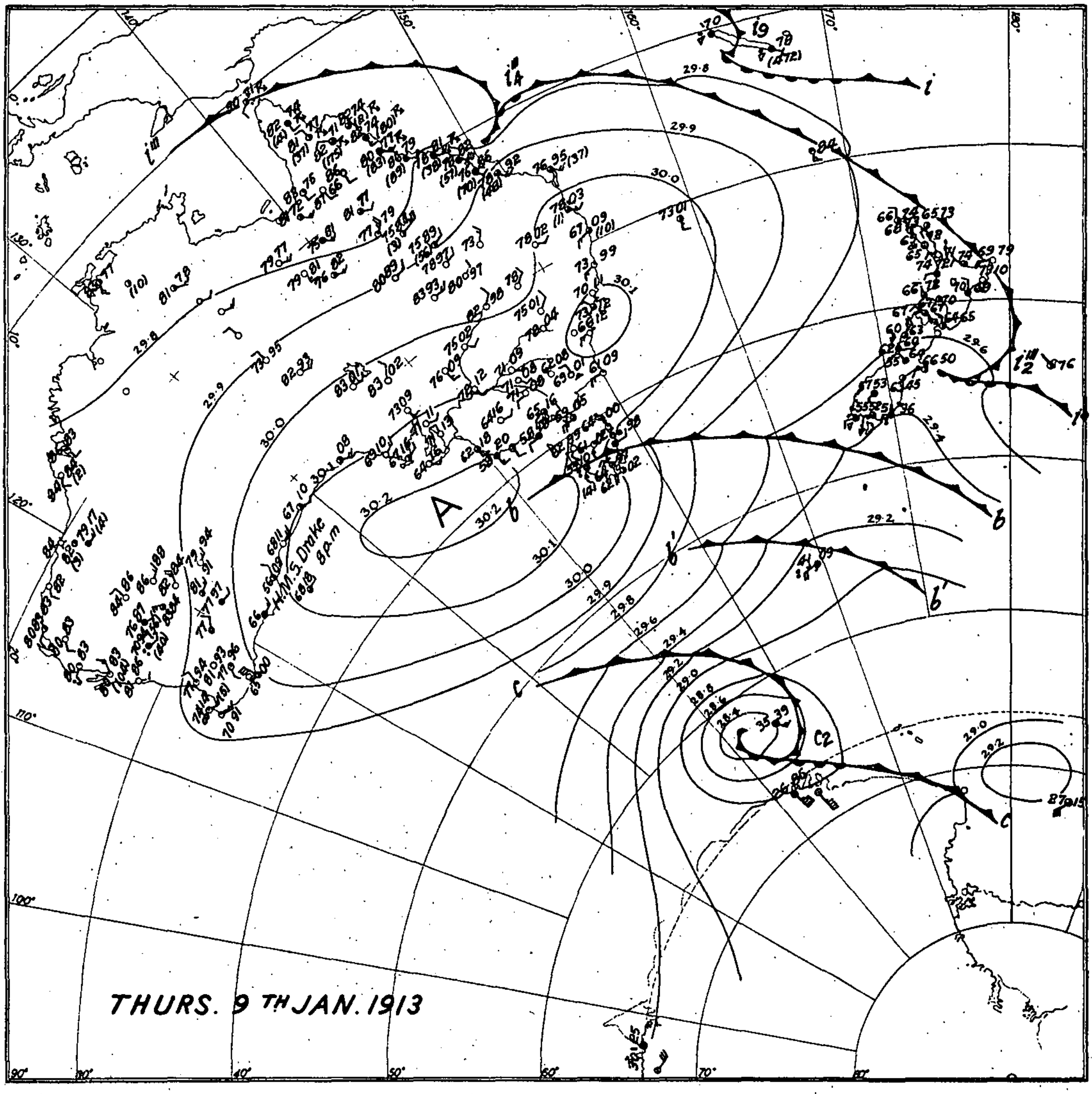
A vigorous wave has developed on front *i* over New Zealand where there is very widespread rain. Note the activity in central and Western Australia, also, where heavy rains have fallen. These developments are very interesting but little is known regarding the structure of the atmosphere in such cases.



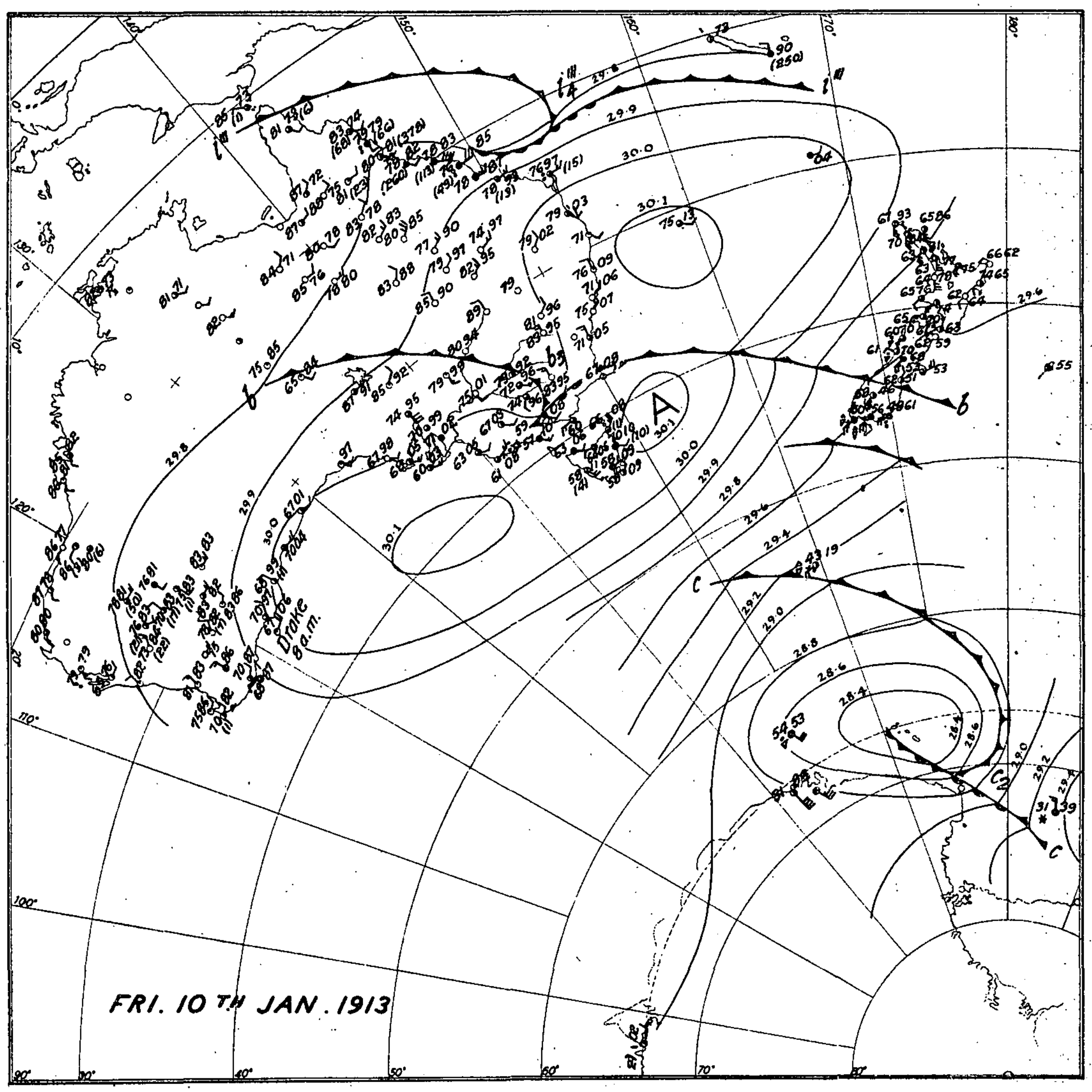
There are still signs of a strong air flow from the east across Australia. The front shown is rather clearly marked. A rather deep depression is passing the "Aurora" which is north of Adélie Land. The centre passes to the south of the vessel. The wind had changed just previously from W to NNE, later turning to E × S.



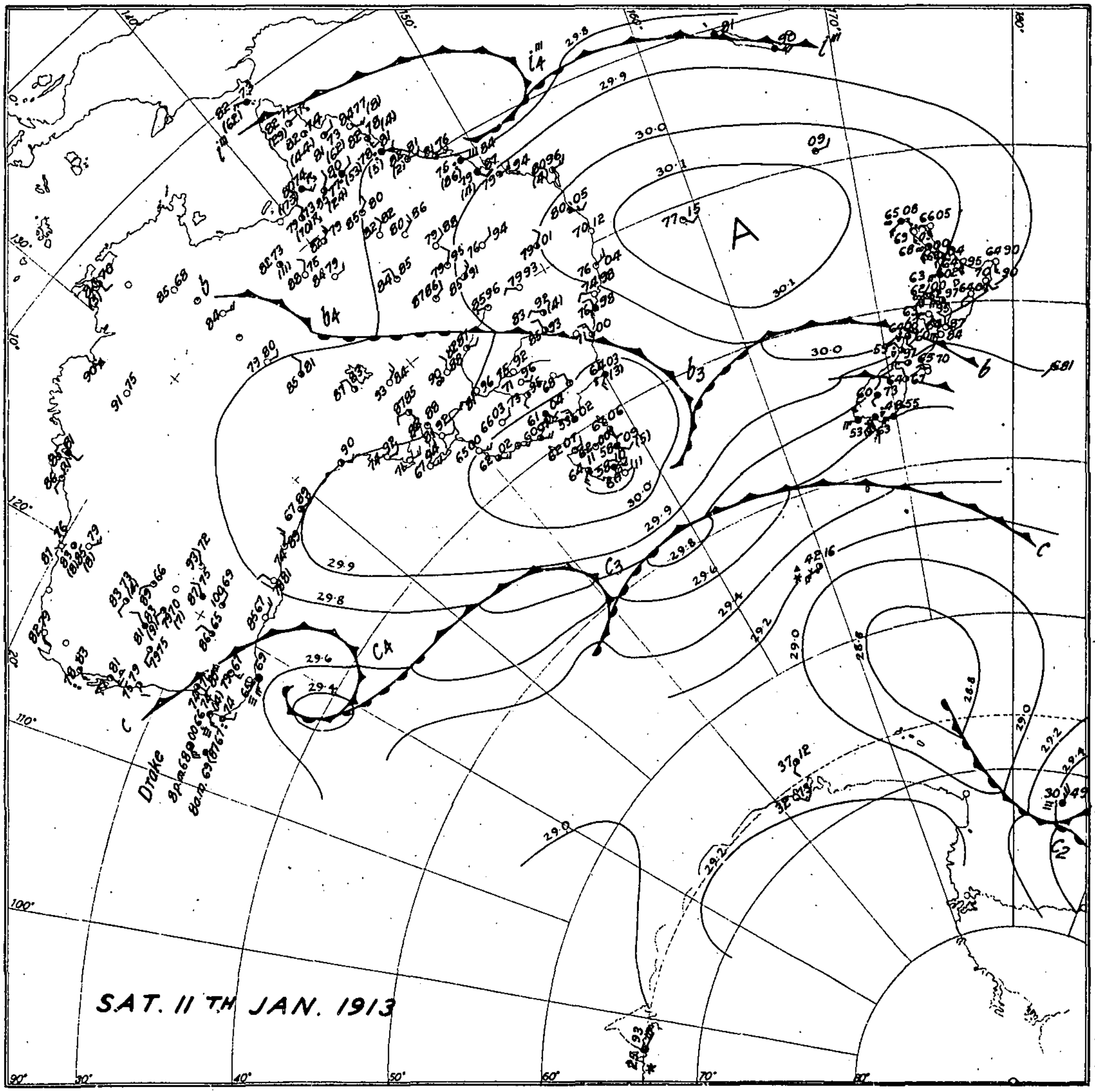
The passage of front *b* was shown at both the "Aurora" which is north of Adélie Land and the "Terra Nova" in the Ross Sea.



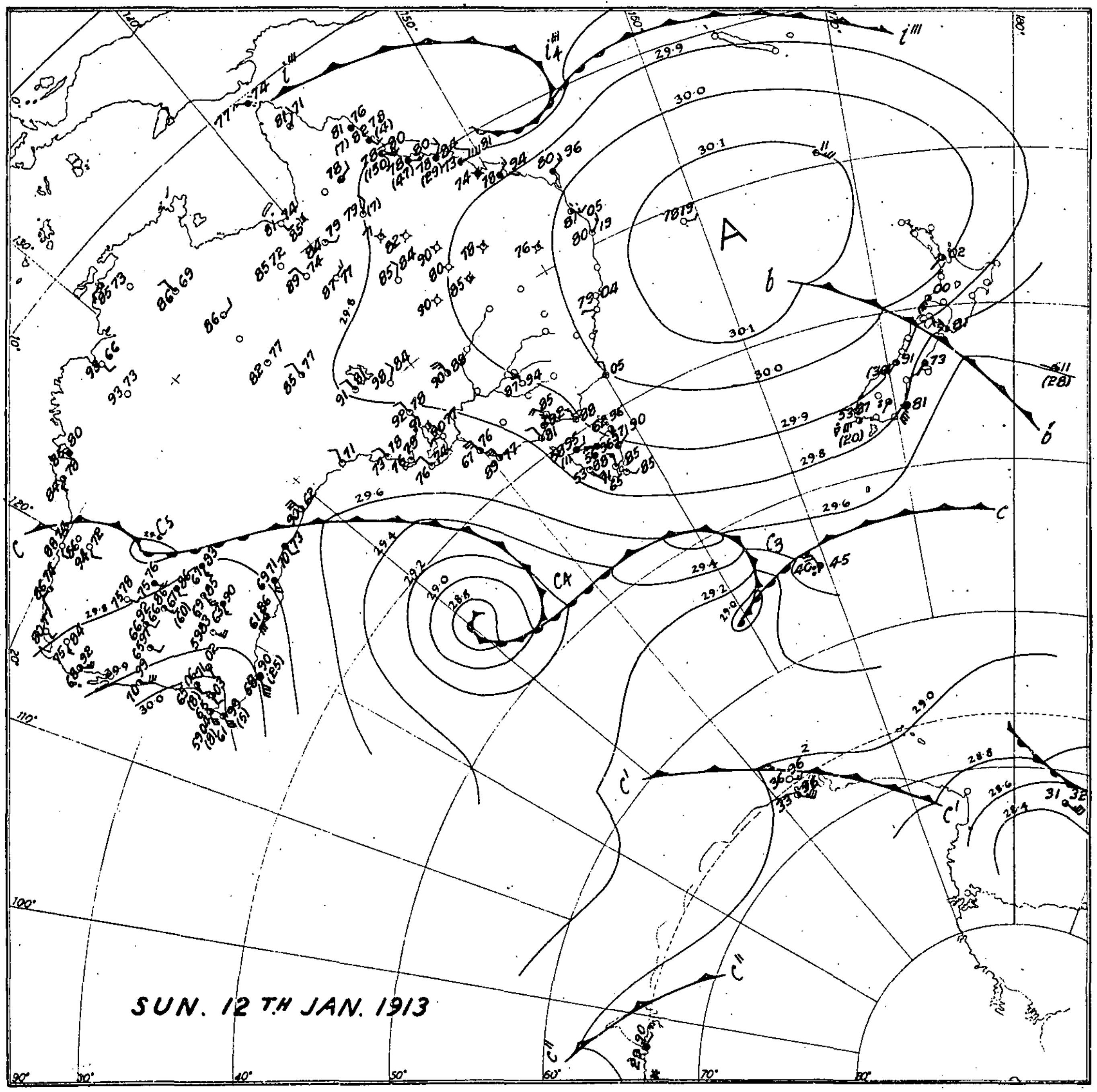
Another cyclone centre is passing the "Aurora." Very variable temperature with hail and snow squalls prevailed at Macquarie Island during the next three days.



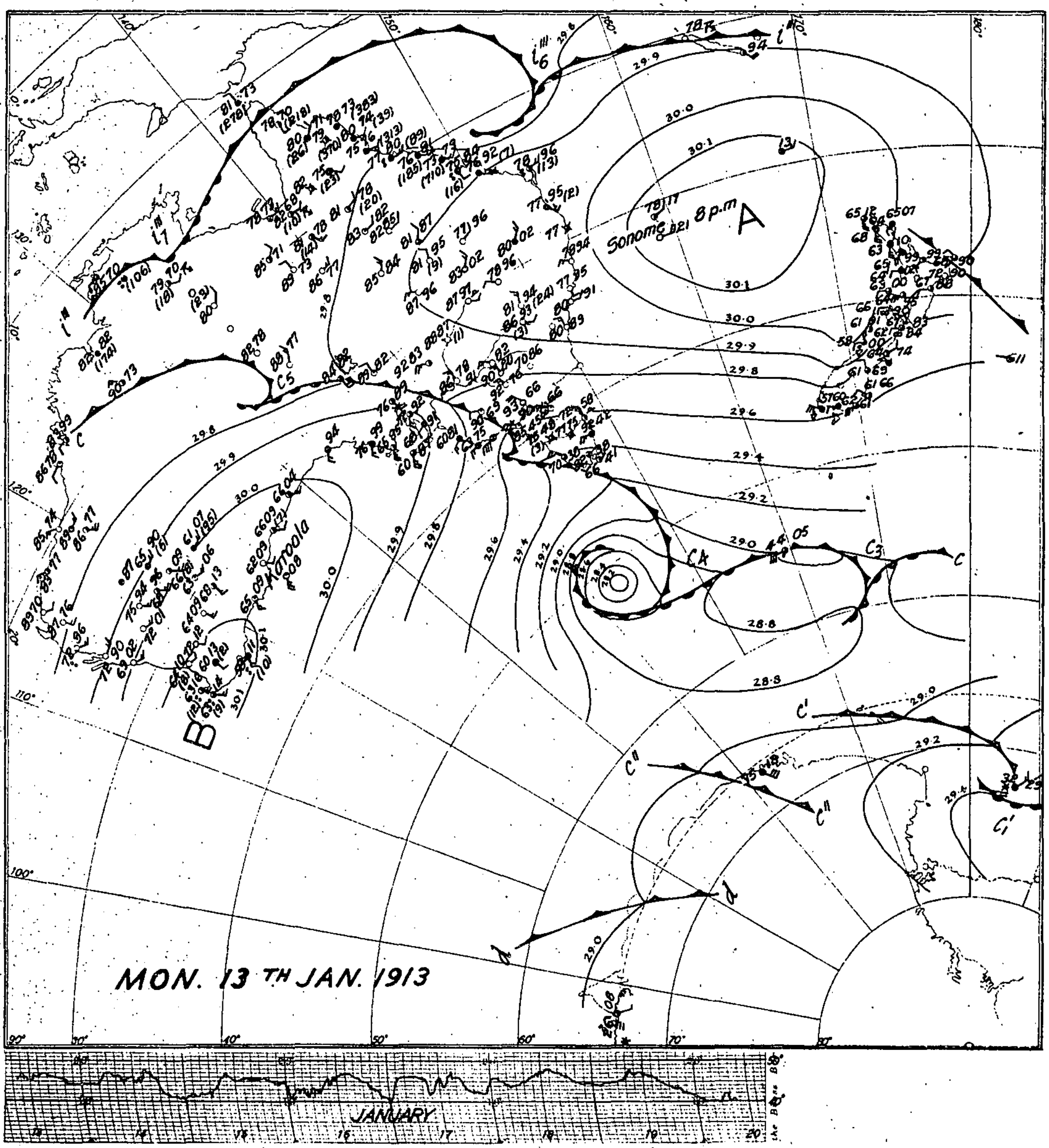
The "Terra Nova" in the Ross Sea experiences an interesting series of changes at this period. It now appears to be in the warm sector of c_2. In other parts the analysis is difficult.



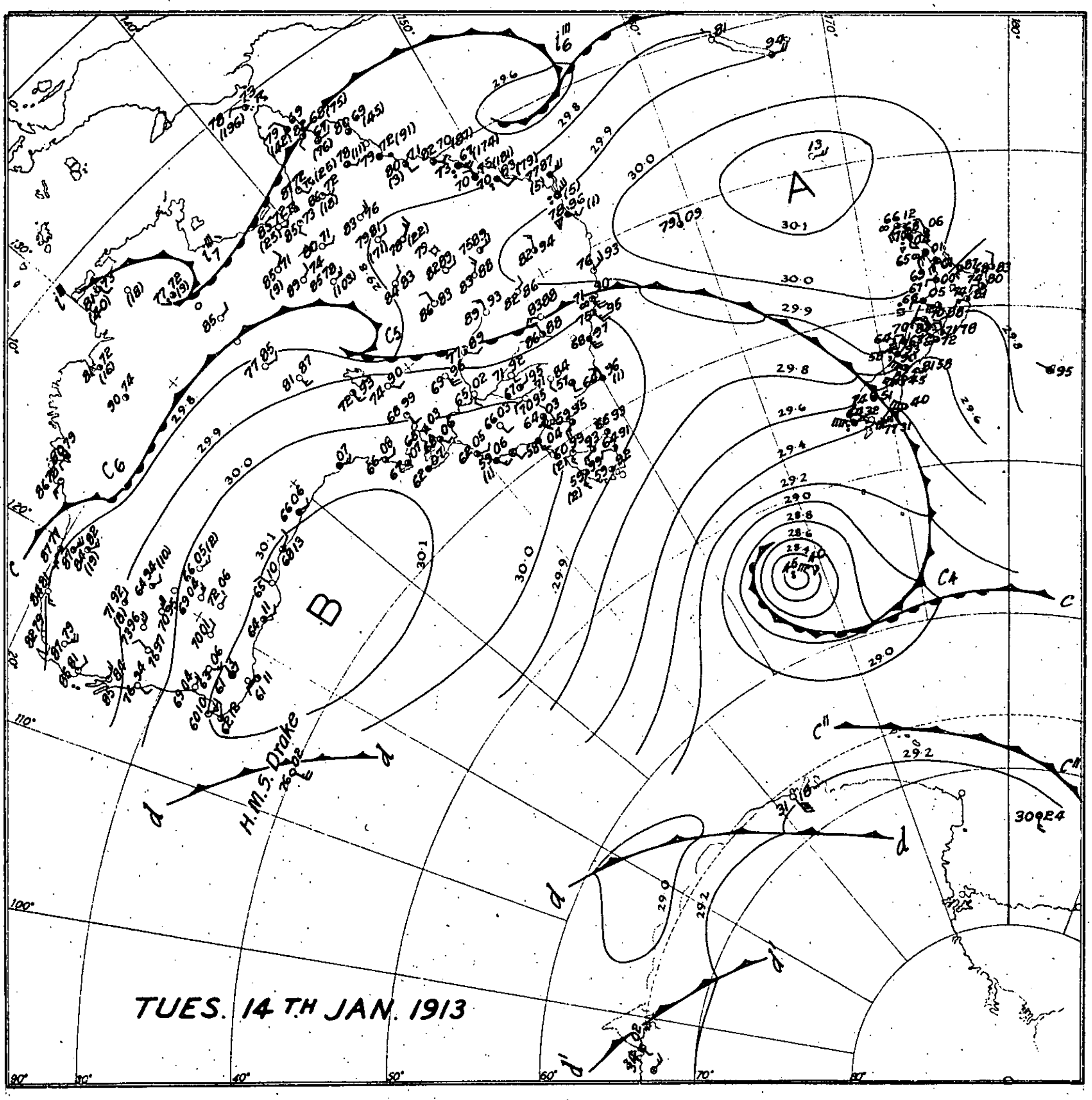
A rather deep depression is passing south of Western Australia. At the "Terra Nova" the wind has changed from NNW to NNE.



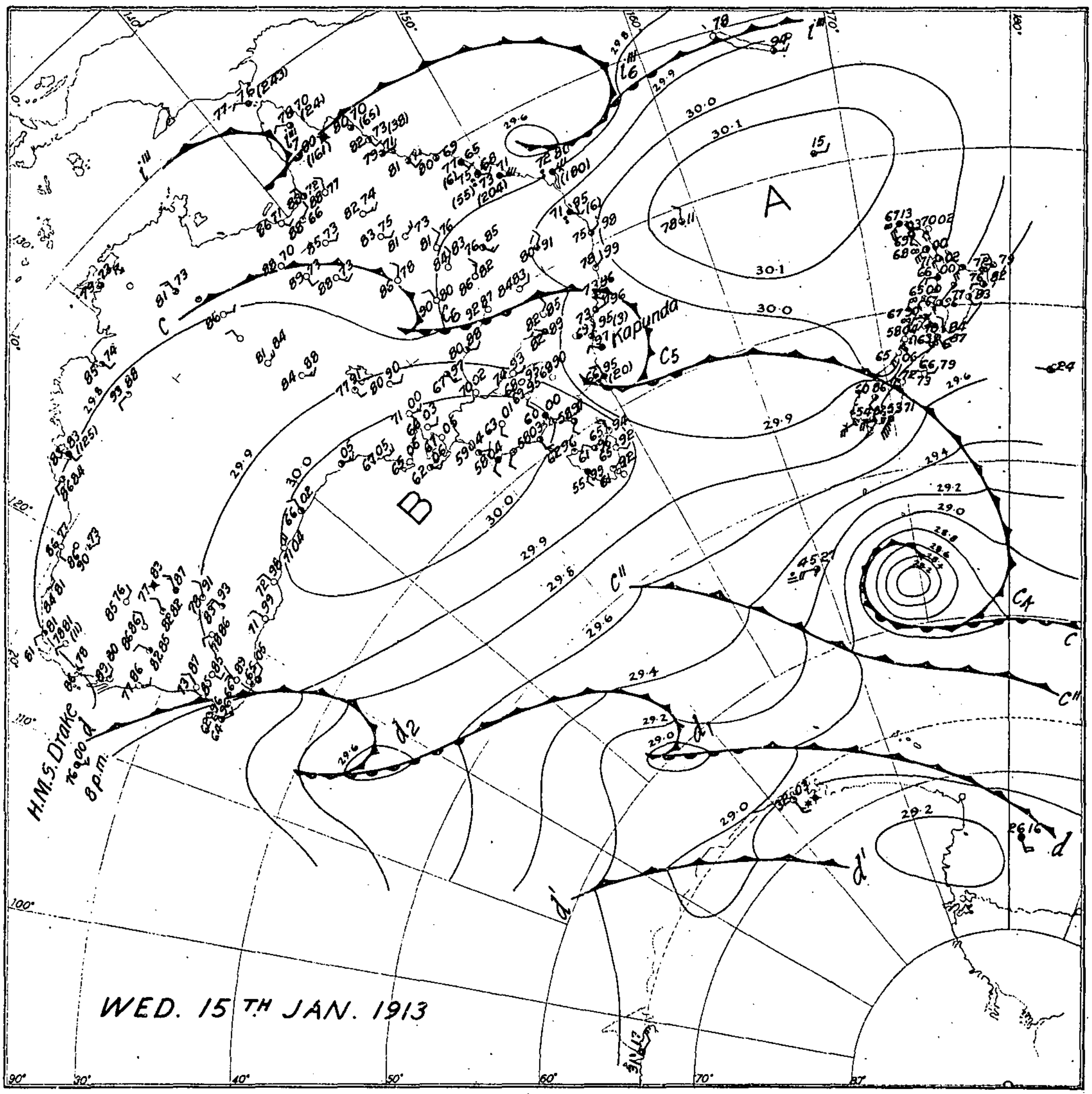
Front *c* is now past the "Terra Nova." Macquarie Island, according to the thermograph trace, appears later to pass through a warm sector.



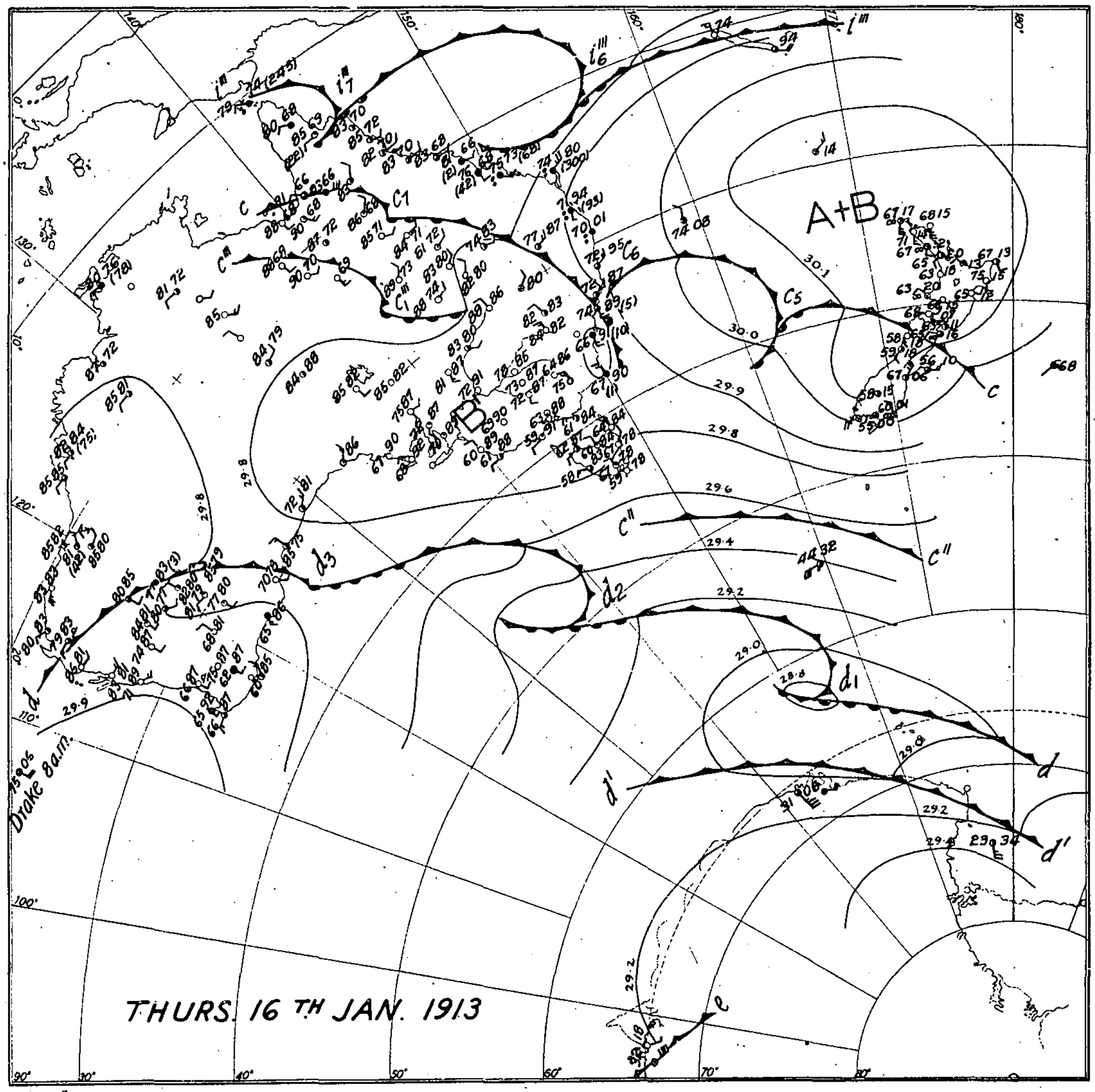
The sequence of changes at the "Terra Nova" suggest that a wave on front c passes it.



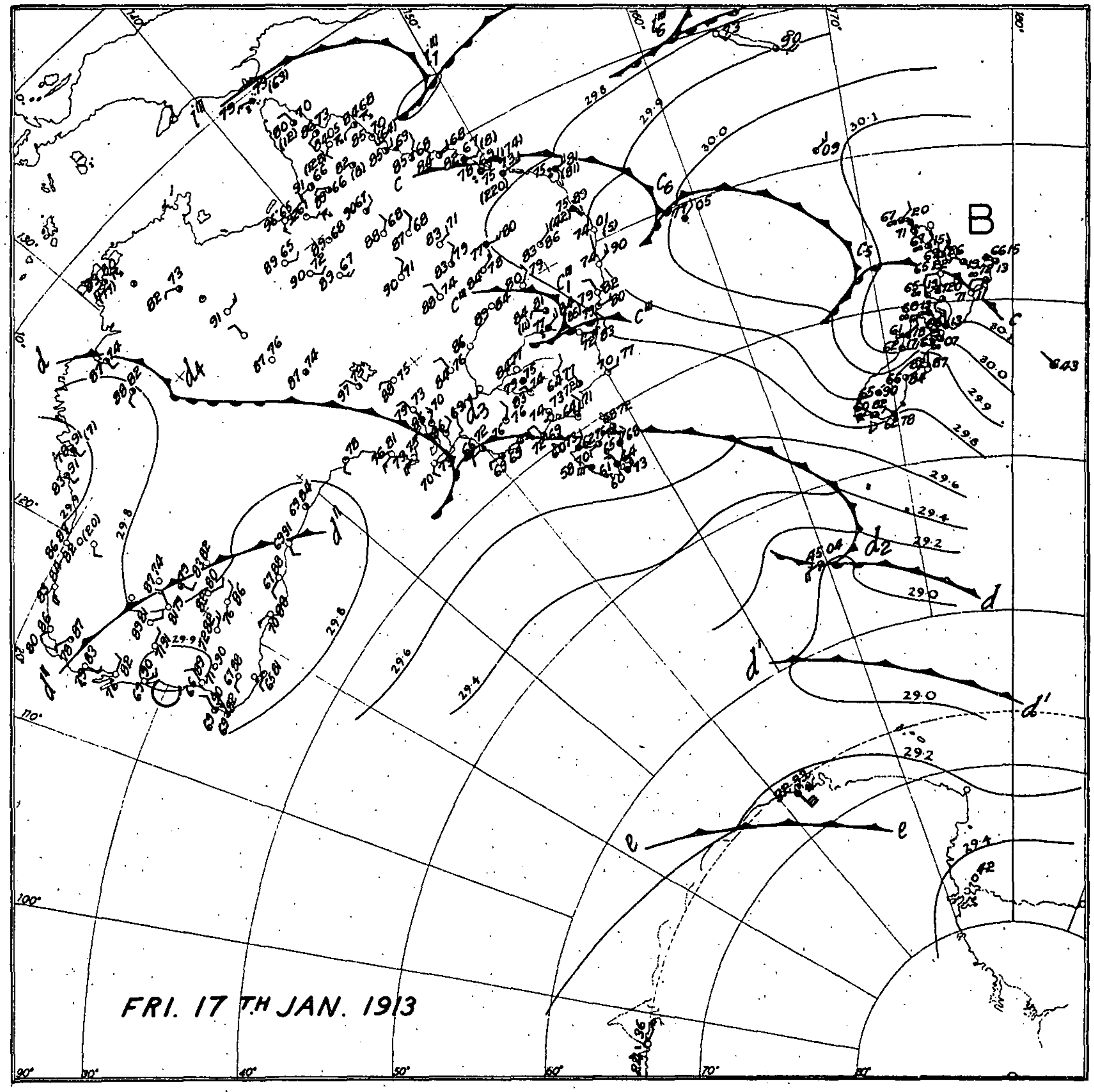
A deep cyclone passes near Macquarie Island, the centre being to the south. Temperatures were very variable at Macquarie Island during this week. The "Terra Nova" now has a southerly wind.



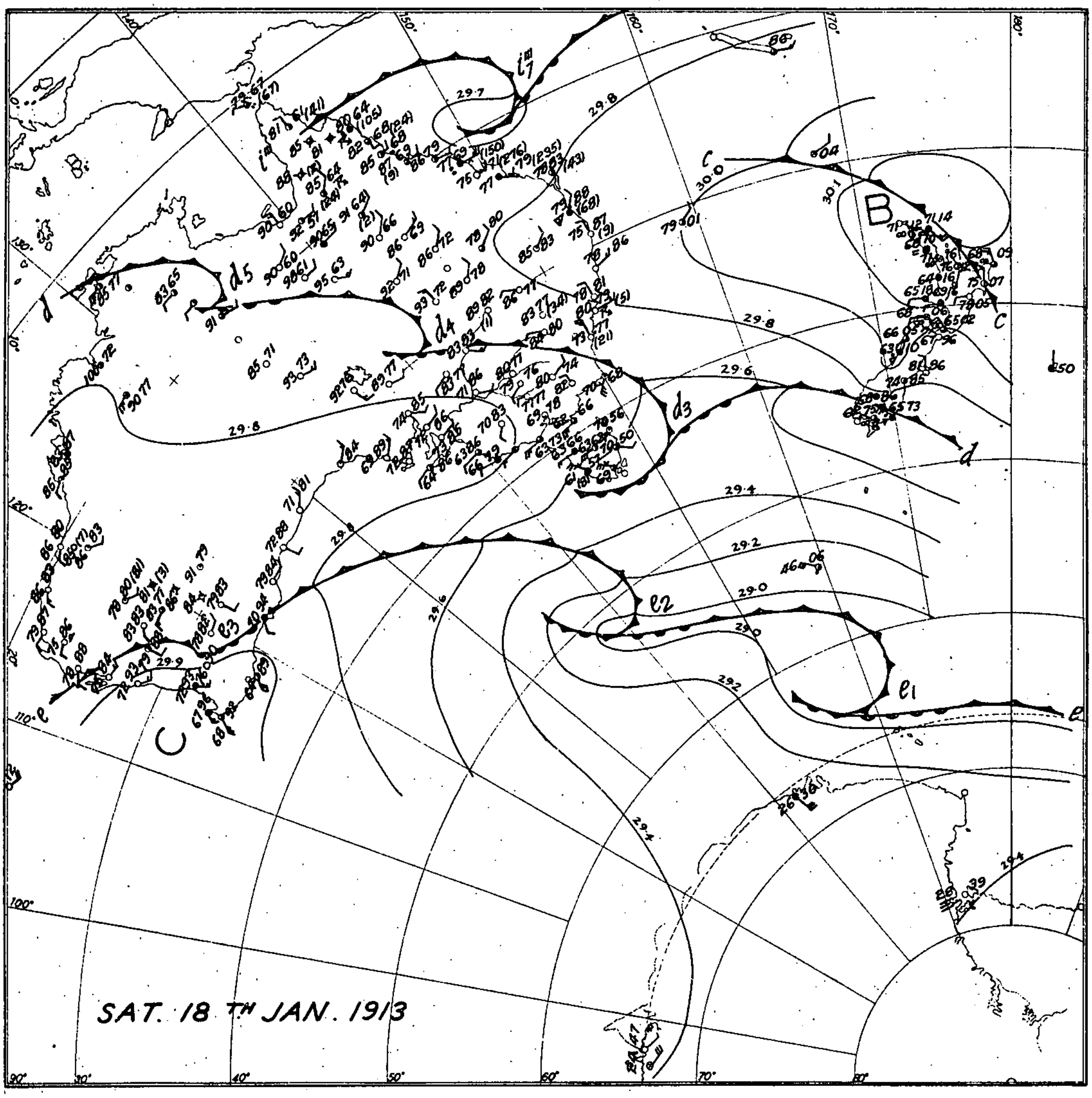
There has been considerable activity in the tropics off north-eastern Australia for several days. There are only slight indications of front *d* passing the "Terra Nova" in the Ross Sea.



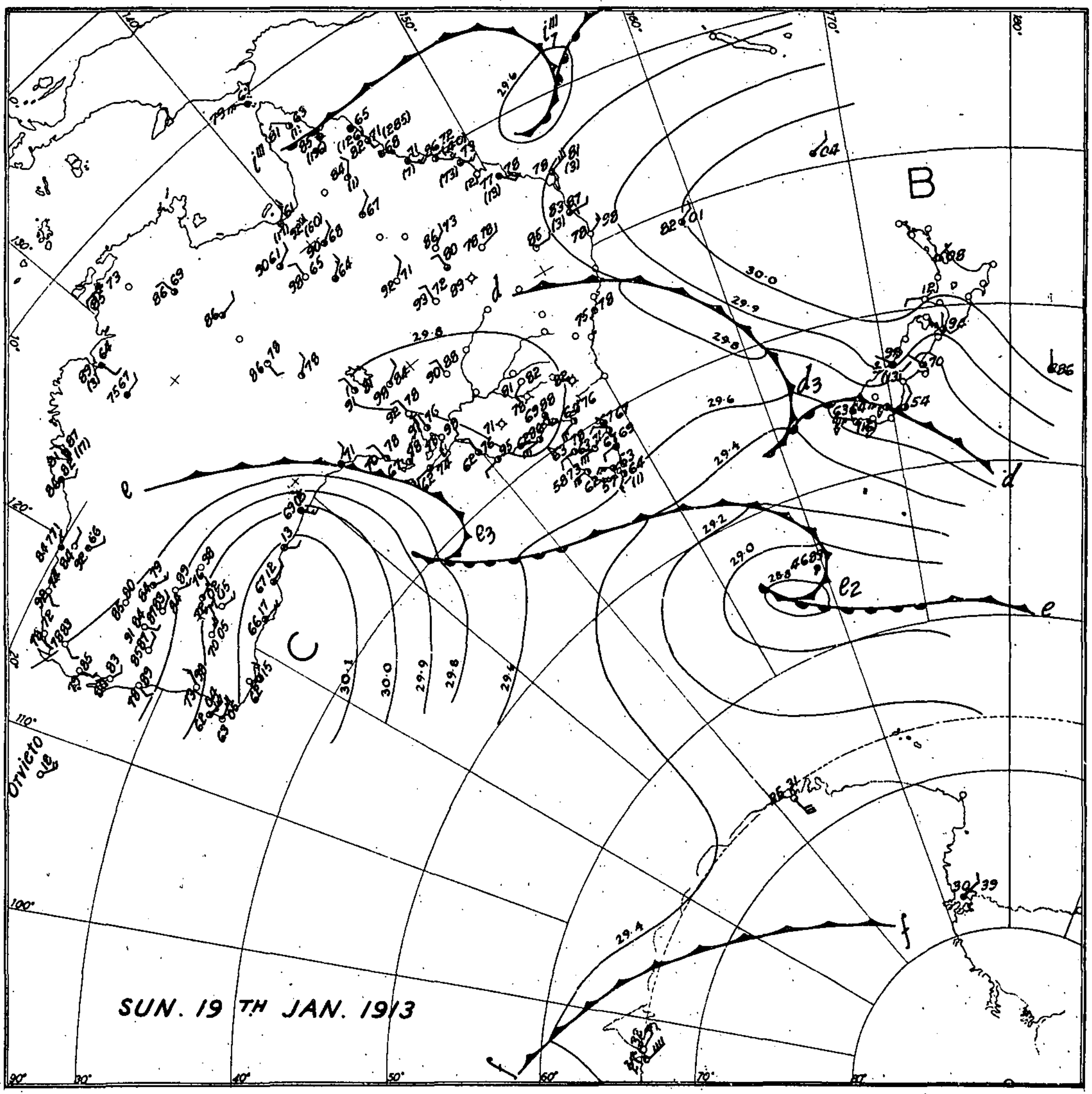
Anticyclones A and B appear to amalgamate. There is still considerable activity in the tropics.



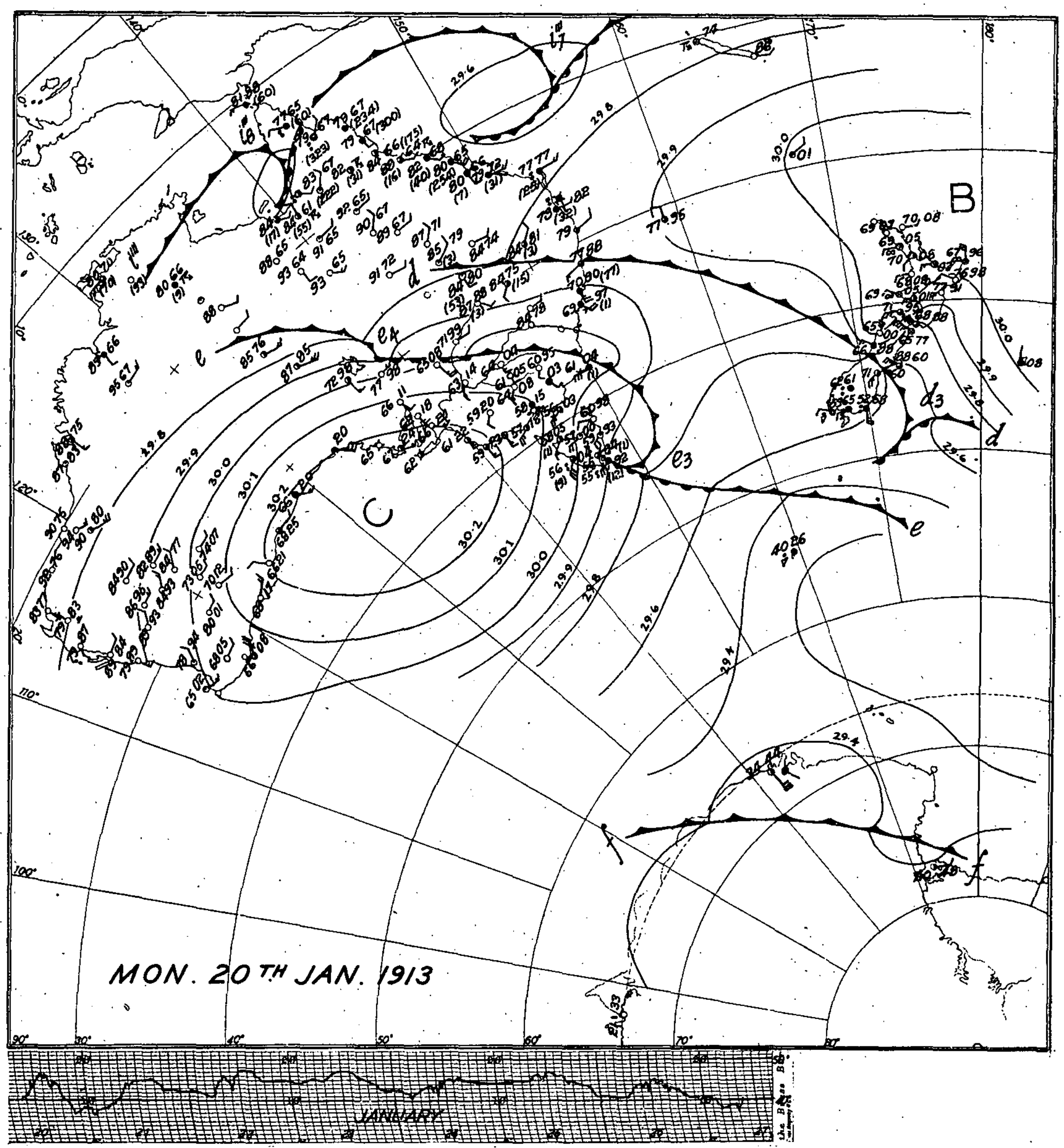
The passage of wave d_2 is well shown in the Macquarie Island records. Elsewhere there is little activity.



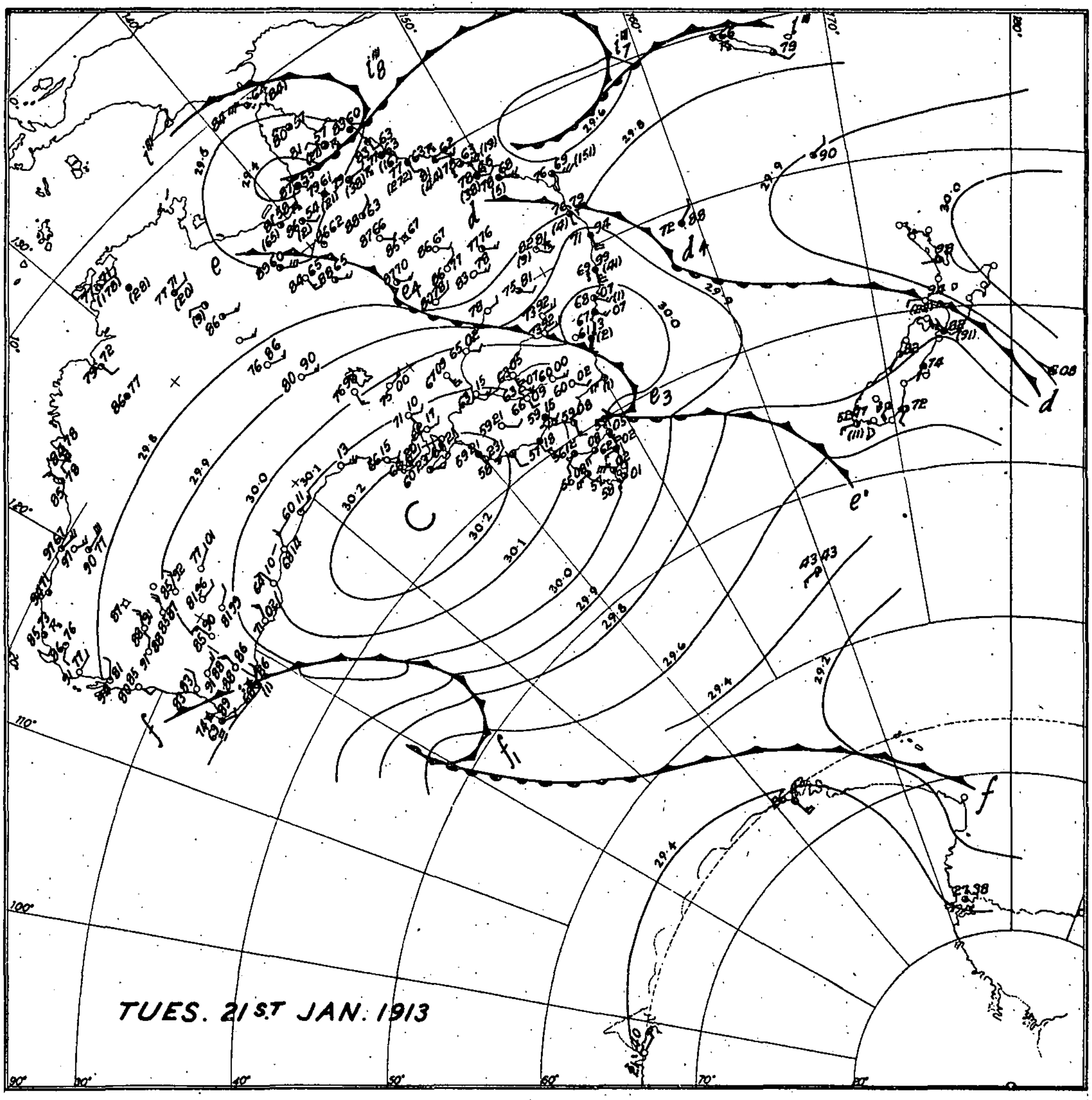
Little of note.



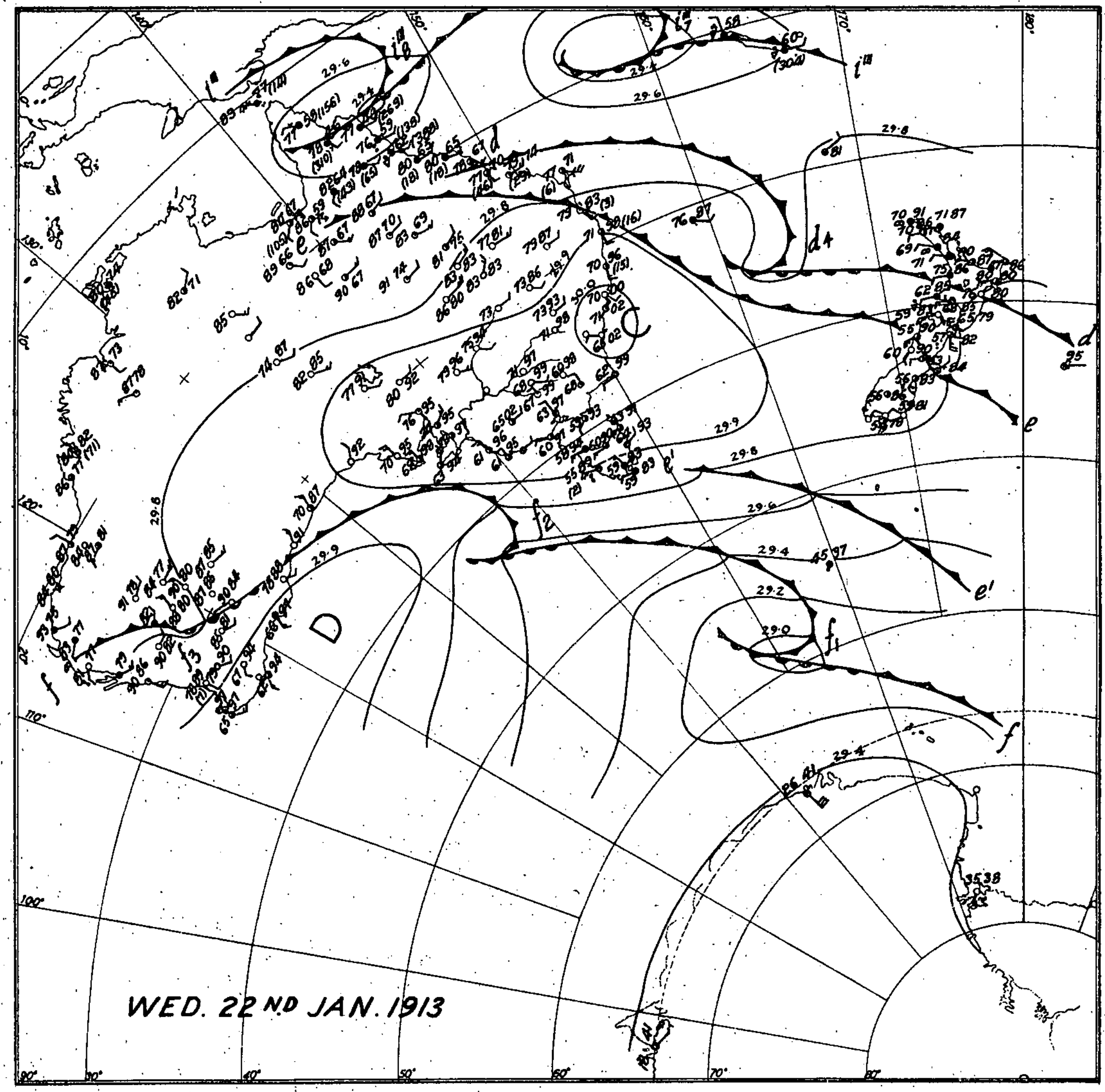
Note the strong westerly winds about Tasmania. A wave passes south of Macquarie Island.



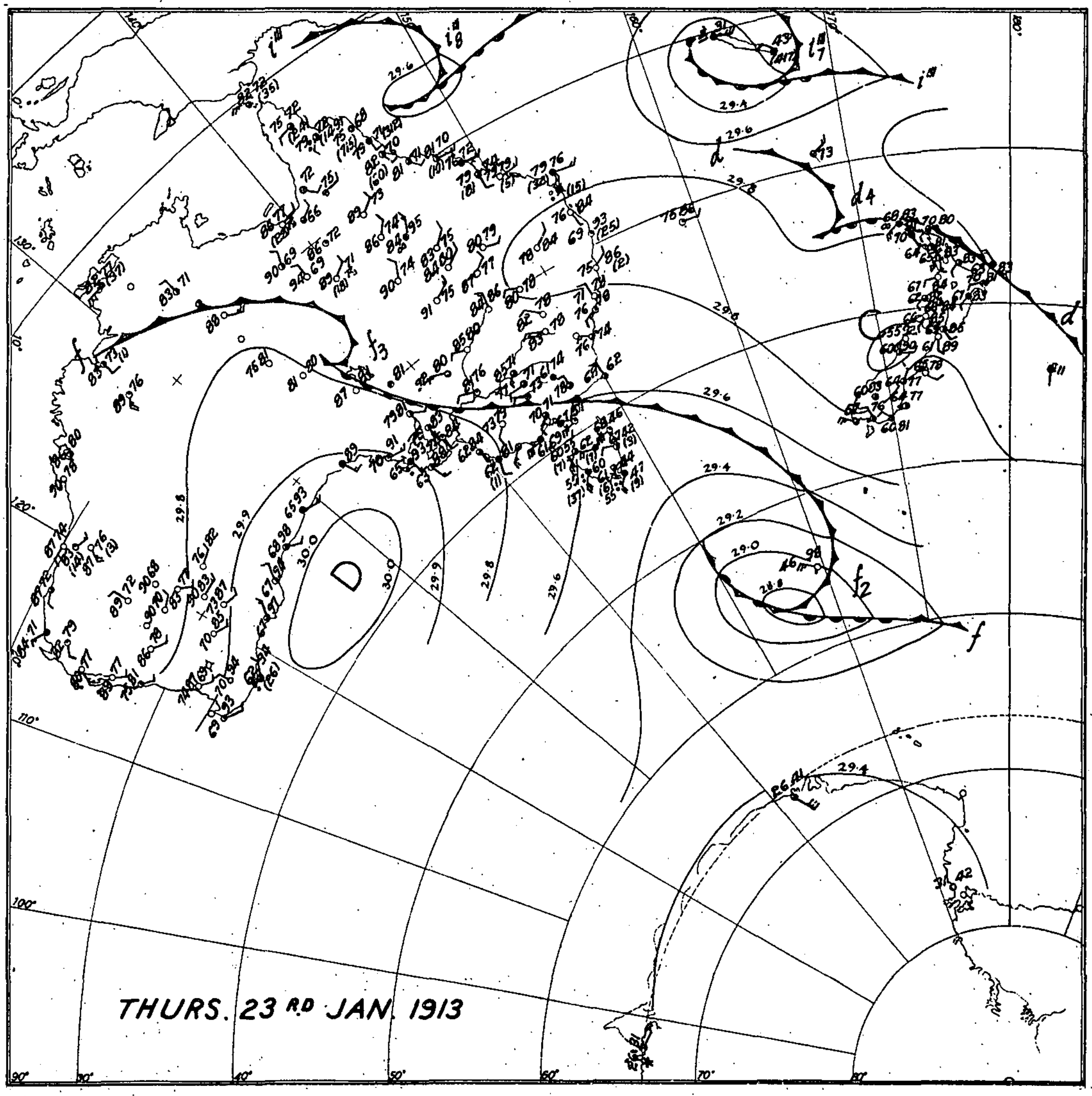
Front *f* passes the "Terra Nova" at Cape Evans. There is still some activity in the tropics.



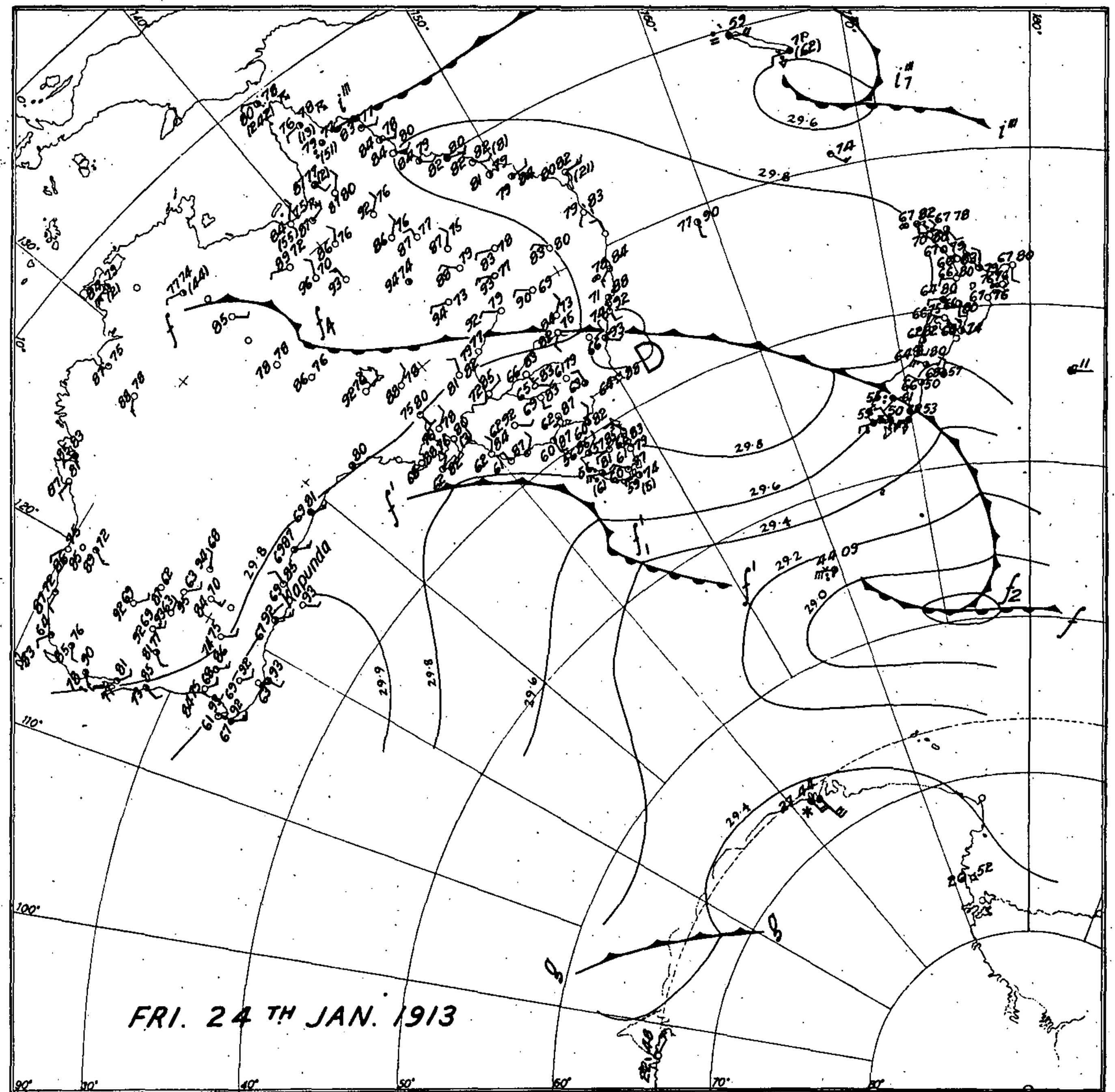
Little change.



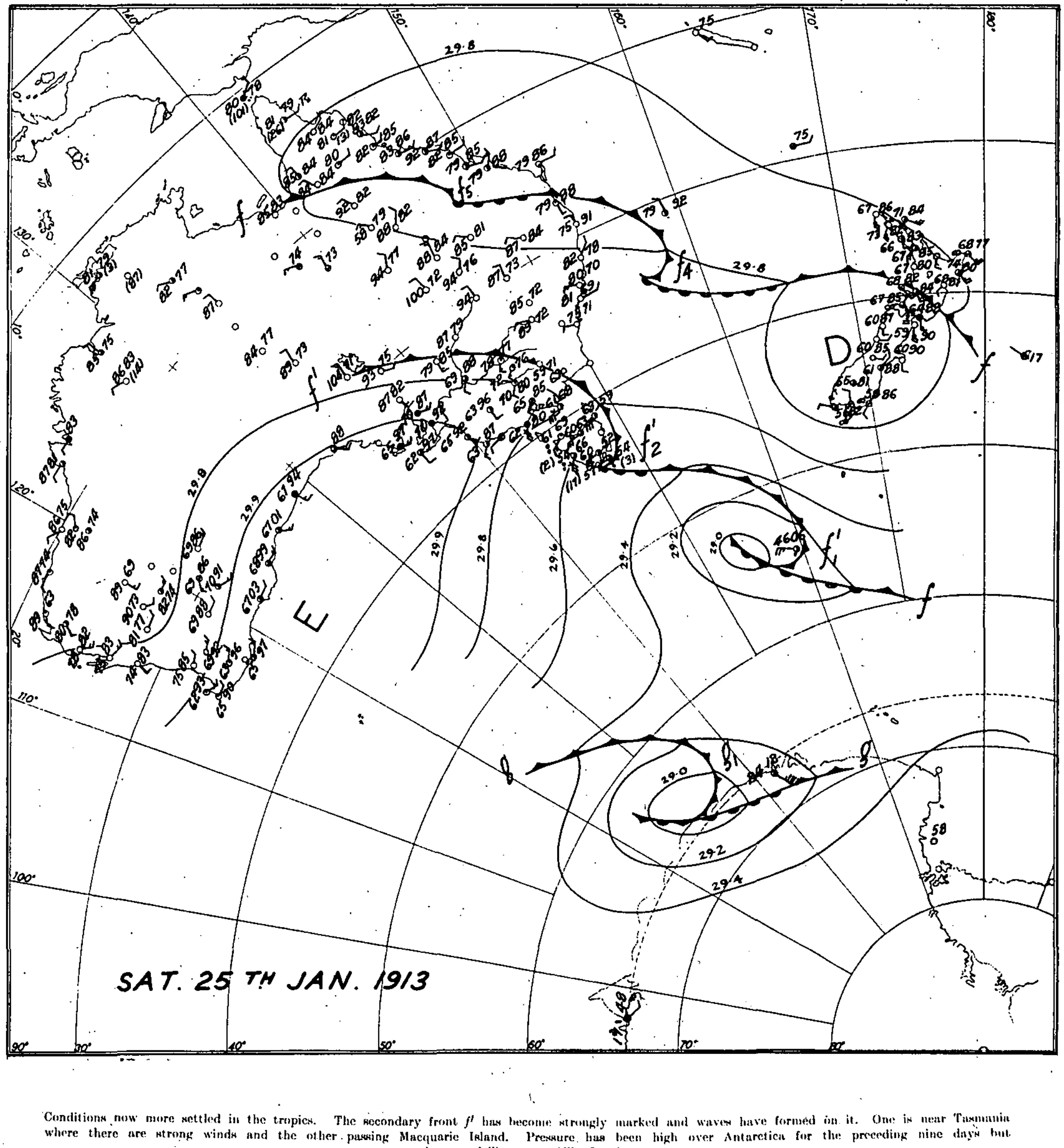
Pressure is falling in the tropics.



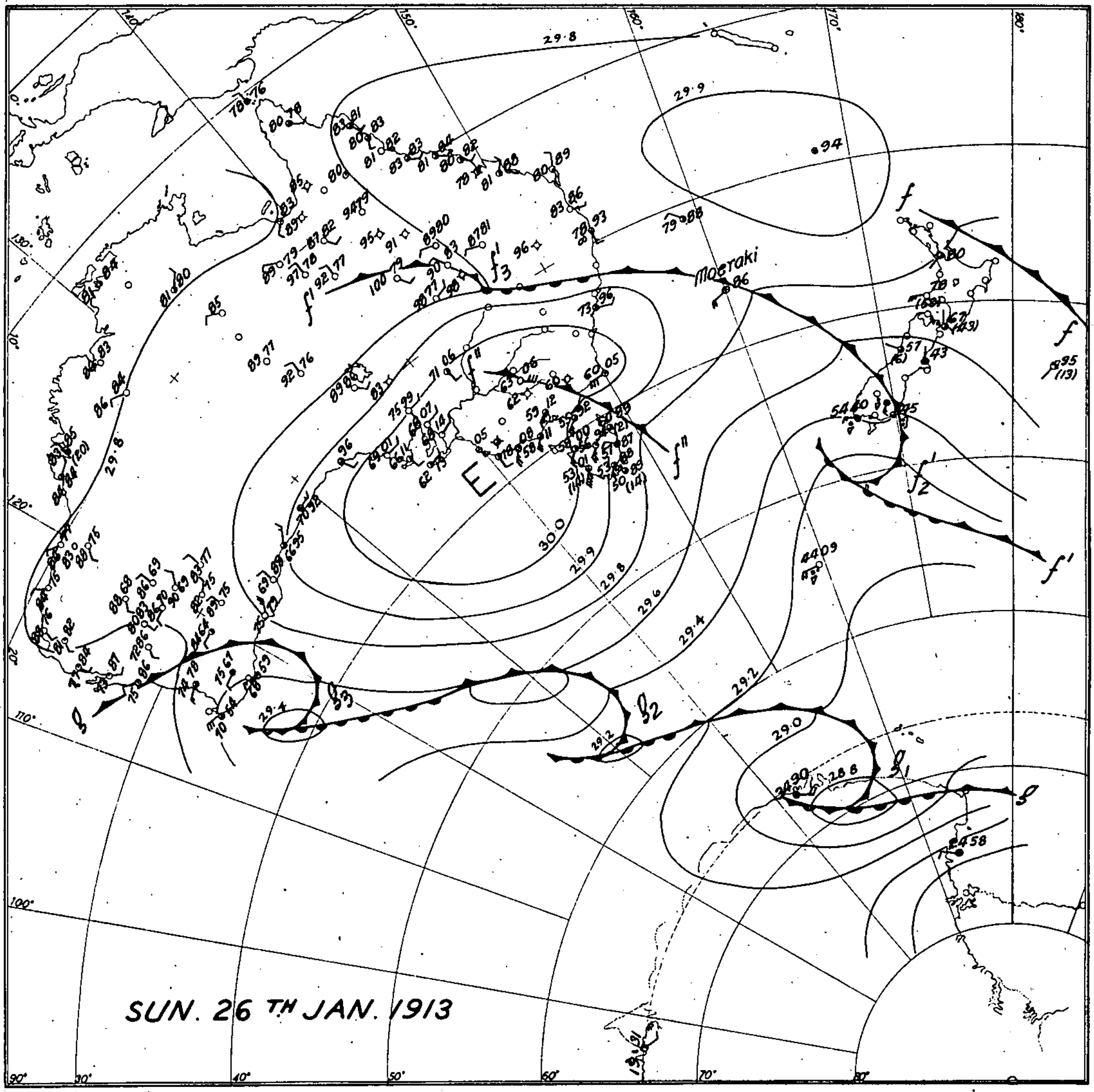
A shallow cyclone is now passing New Caledonia and another south of Macquarie Island.



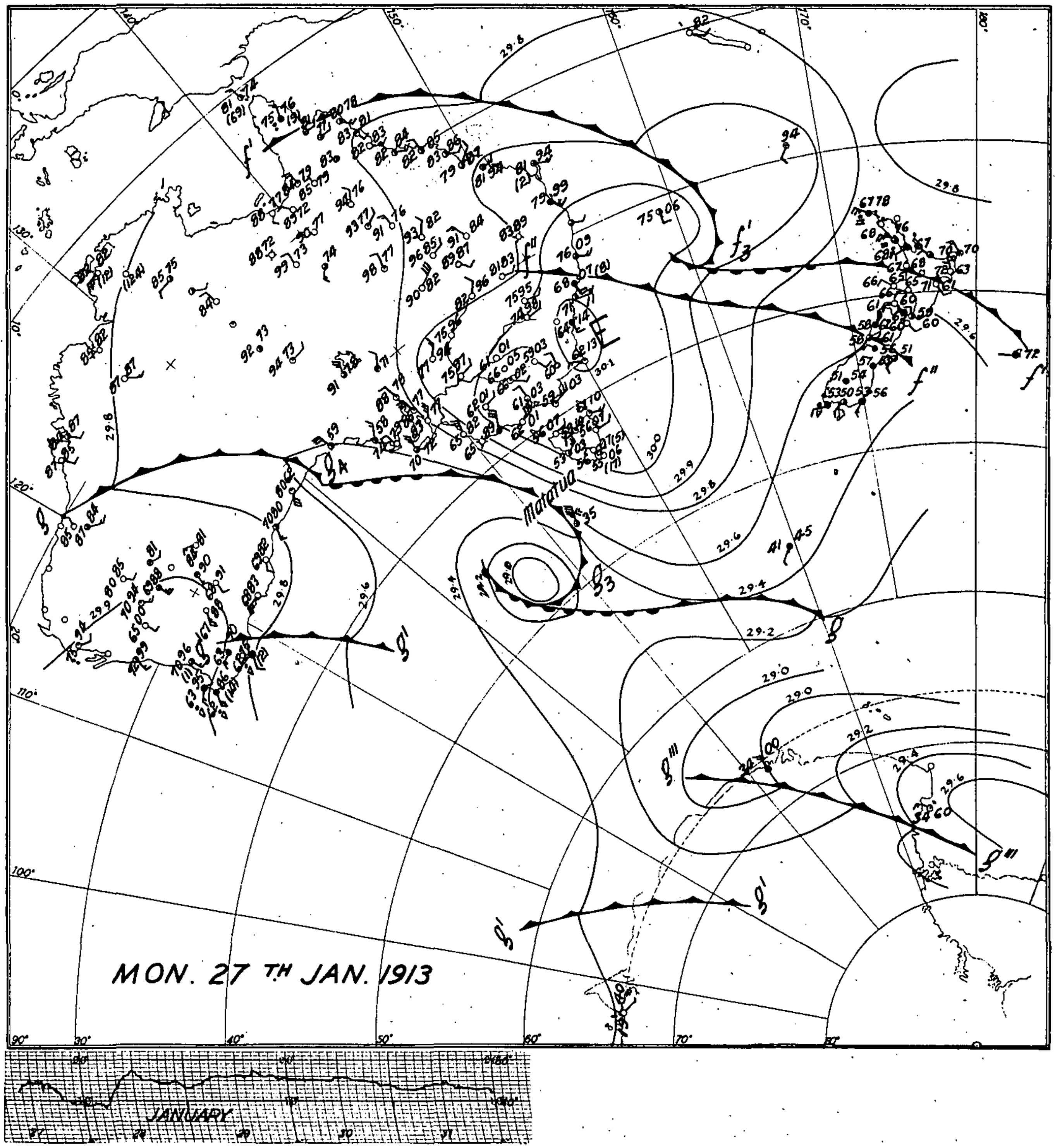
Little of note.



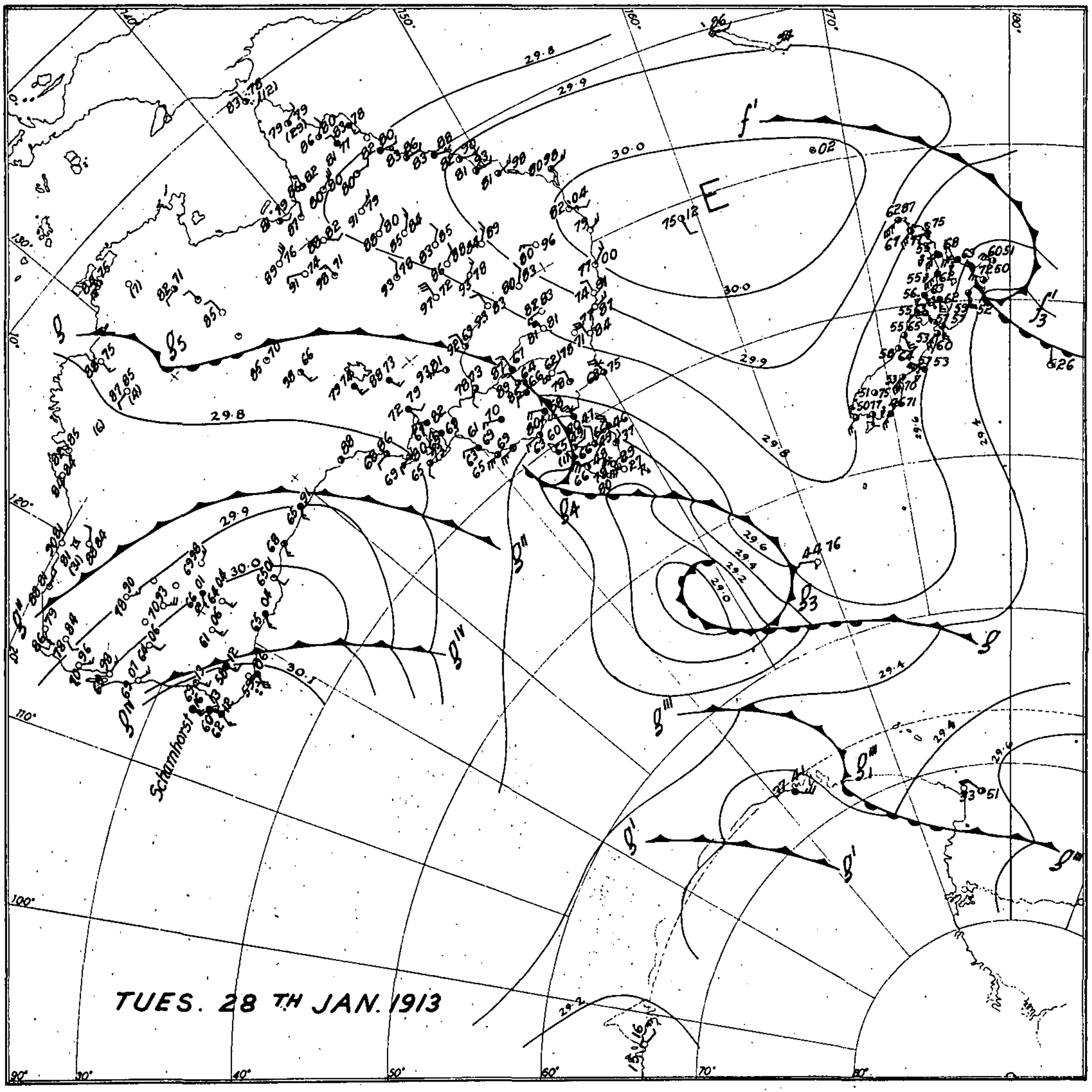
Conditions now more settled in the tropics. The secondary front f^1 has become strongly marked and waves have formed on it. One is near Tasmania where there are strong winds and the other passing Macquarie Island. Pressure has been high over Antarctica for the preceding nine days but is now falling at Adélie Land.



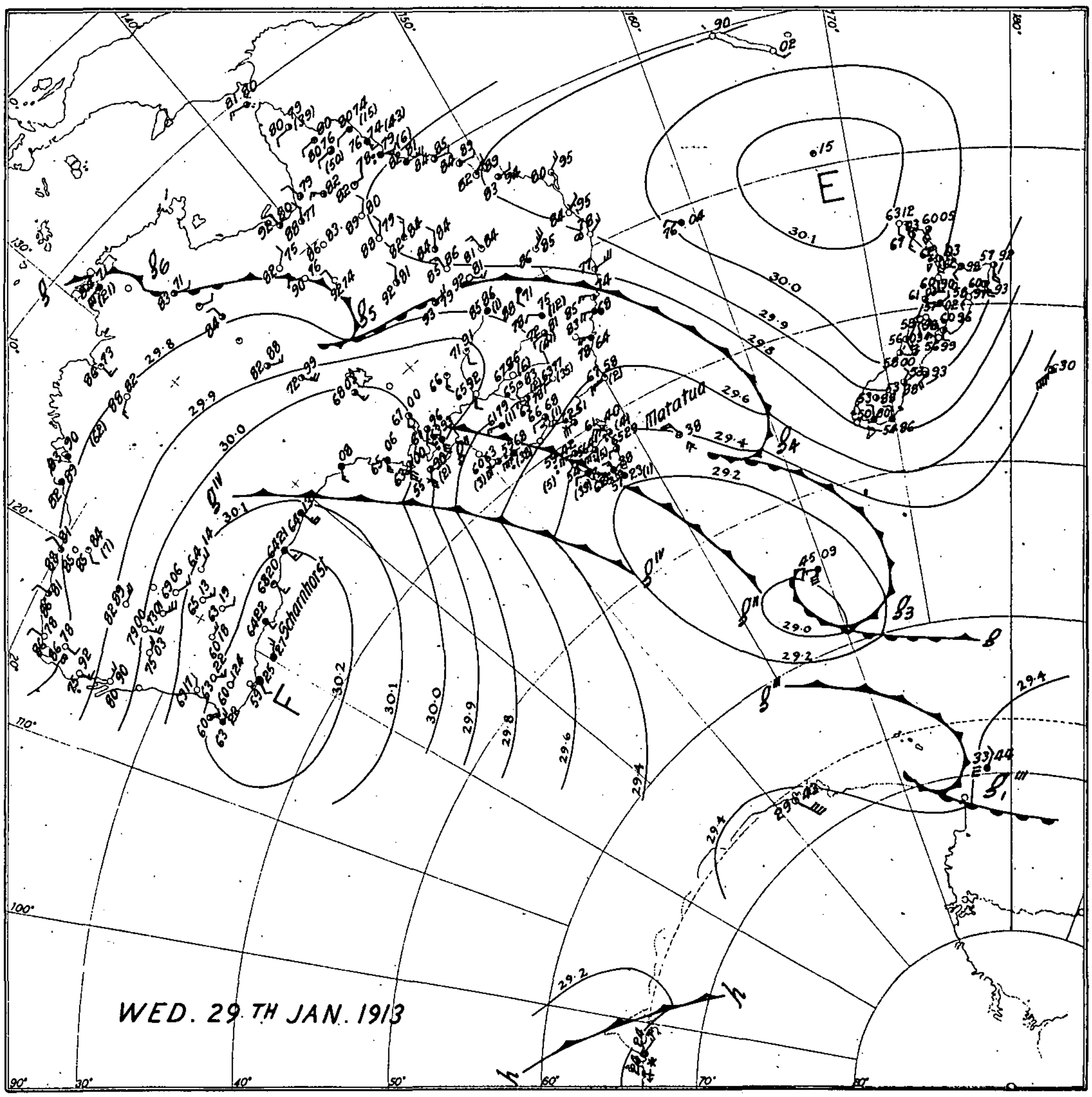
Wave g_1 appears to pass south of Adélie Land but the "Terra Nova" at Cape Evans is unaffected by it.



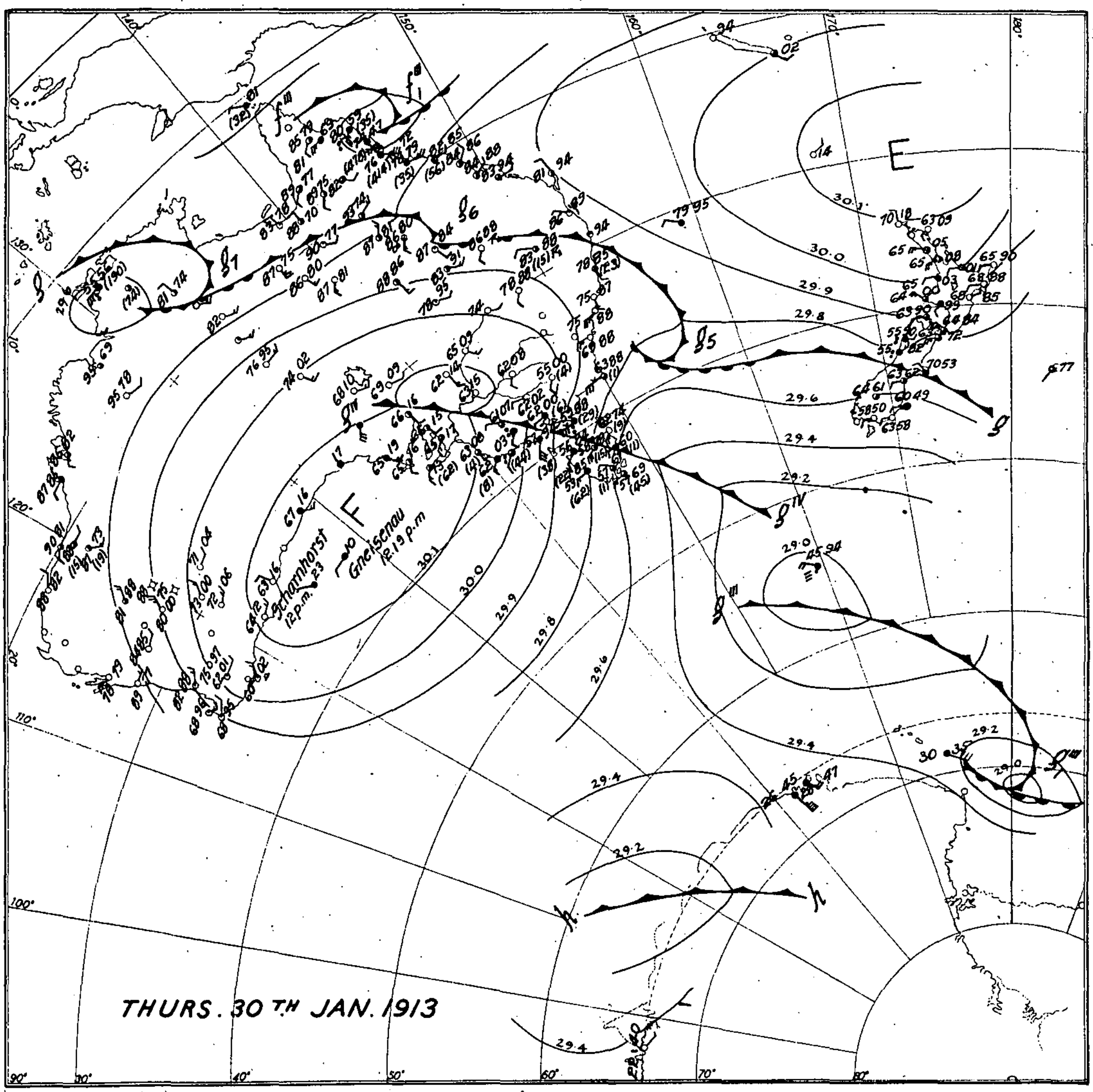
There is considerable activity over Australia and a report from s.s. "Matatua" indicates that a cyclone is passing to the south.



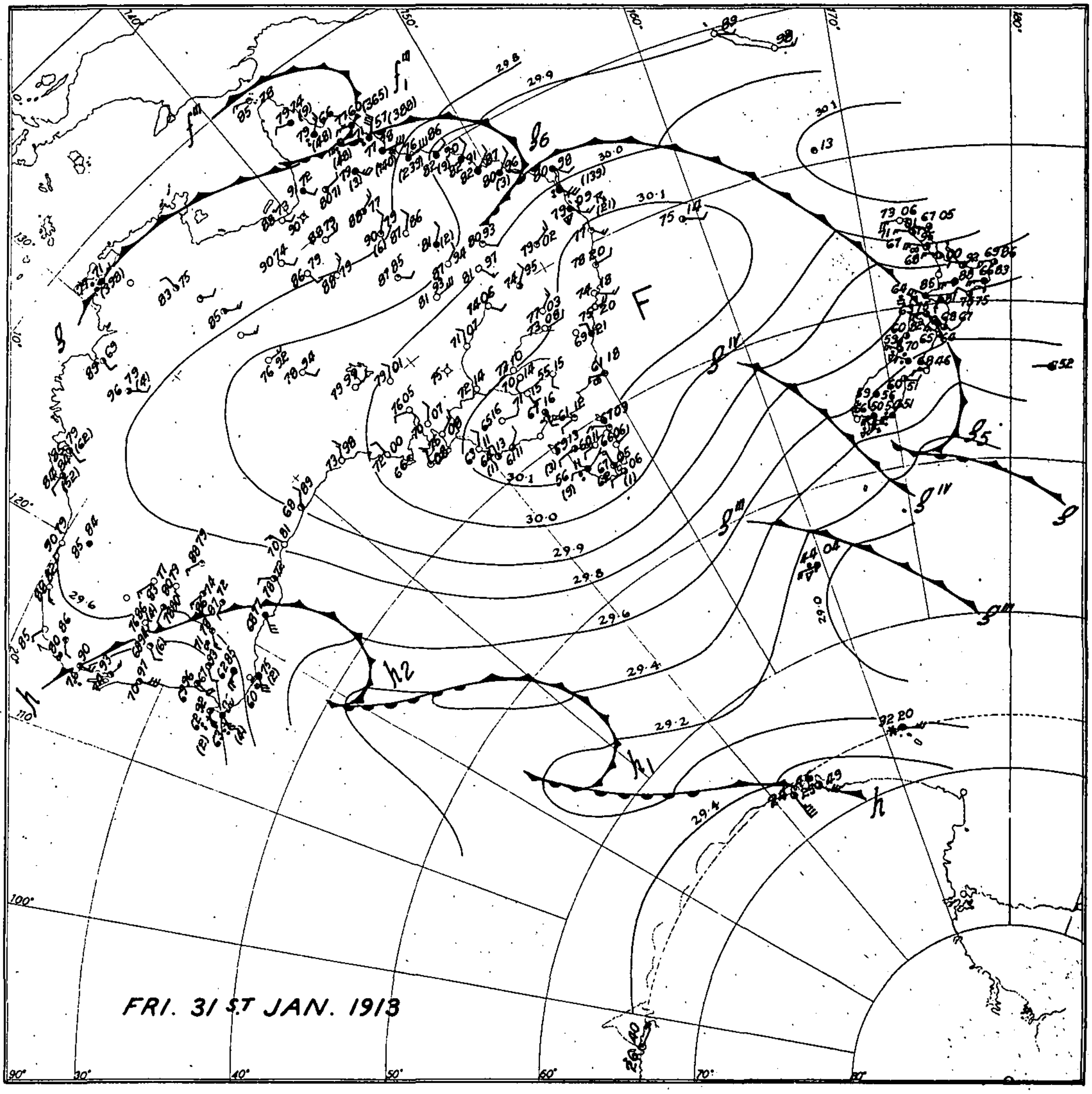
There is a strong southerly outbreak over New Zealand behind wave f_3. Rain is very widespread and snow was falling on the high levels of the South Island. There is a rapid rise of temperature at Macquarie Island as front g approaches and only a slight fall following it.



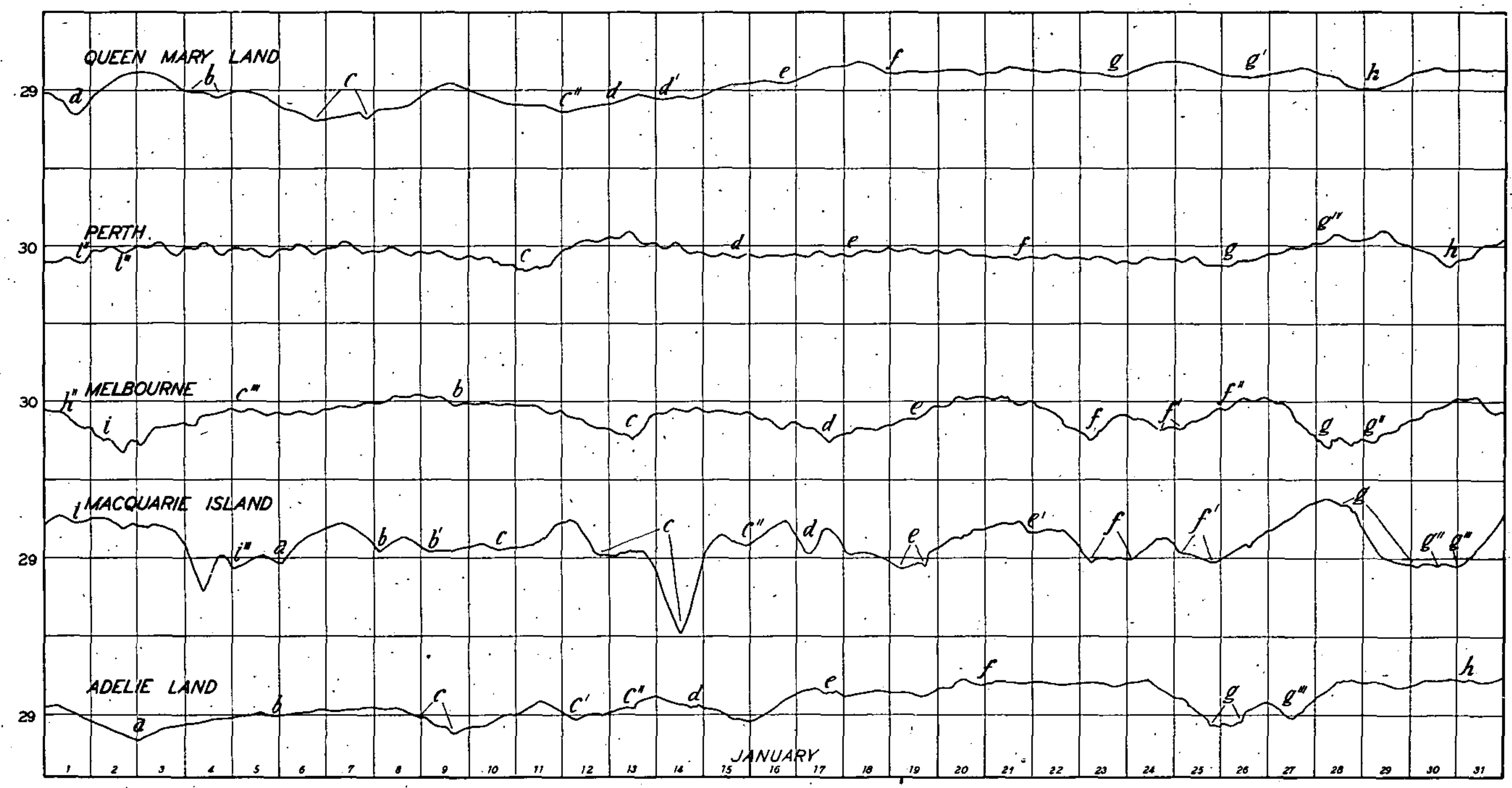
The cyclone g_3 probably loses energy as it passes southward of Macquarie Island.



Front g has moved slowly. The passage of front g^{III} is shown clearly at the "Terra Nova" which is just north-east of the Ross Sea.



There is some renewal of activity in several places.



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