DEPARTMENT OF TRANSPORT AND POWER
METEOROLOGICAL SERVICE

TECHNICAL NOTE No. 28

OPERATIONAL WEATHER CONDITIONS AT SHANNON AIRPORT

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DUBLIN
DECEMBER 1961

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SUMMARY:

The half-hourly observations at Shannon Airport, during the 12 years from 1st March, 1948 to 29th February, 1960, inclusive, have been examined. Those observations with conditions of ceiling and/or visibility below 500 ft. and/or 1 mile, respectively, have been classified, as also those below 200 ft. and/or ½ mile. Annual, monthly and diurnal variations are shown. Spells of different durations are examined, and some conclusions are reached as to the wind and gradient directions associated with these conditions. Particular synoptic situations of interest are illustrated.

INTRODUCTION:

In this survey consideration is given to landing conditions below 500 ft. ceiling and/or 1 mile visibility, but emphasis has been laid on cases where ceiling and/or visibility were below 200 ft. and/or ½ mile, as these limits approximate closely to the general minima conditions required by airlines operating through Shannon. These latter conditions will, in this paper, be referred to as "sub-minima".

CEILING AND VISIBILITY:

Ceiling is defined as the lowest level at and below which the cloud amount as observed from the ground covers more than half the sky. In this paper the term "visibility" refers throughout to the prevailing visibility, i.e., the greatest visibility common to at least half the horizon. During the 5 years from 1949 to 1953, inclusive, the minimum visibility in any direction was reported as synoptic visibility, while during the remainder of the period synoptic visibility referred to the prevailing visibility. The relevant reports for 1949-1953 were all examined and the prevailing visibility determined. This re-computed visibility was used in this analysis to give consistent material for the 12-year period.

The use of prevailing visibility resulted in a smaller number of occurrences in each category of conditions than would have emerged from the use of minimum visibility. Because of the constraint of ceiling limits, only 135 observations were affected in the 5-year period. The comparable figures for the 5 years are shown in Table I.

TABLE I

Frequency of stated conditions at Shannon Airport using different definitions of visibility, during the 5-year period, 1949-1953.

Visibility Definition	No. of obs. with ceiling and/or visibility	
	less than 500 ft. and/or 1 mile	less than 200 ft. and/or ½ mile
"Prevailing"	2365	1184
"Minimum"	2479	1244

TOPOGRAPHICAL FEATURES OF SHANNON AIRPORT:

Shannon Airport is situated on the northern bank of the Shannon Estuary. At that point the river is almost two miles wide. To the West and northwest of the Airport the mouth of the River Fergus, joining the Shannon Estuary is from four to six miles wide. During the period considered, the official elevation of the highest landing point was 15 feet above Mean Sea Level. The land within 5 miles of the area is relatively flat reaching heights in excess of 200 feet in only a few isolated places. Further to the east and east-northeast the ground rises sharply to over 1000 feet; while in the sector between north-west and south-west on both sides of the Shannon Estuary, the ground rises to a height of over 200 feet at a distance of 8-12 miles from the Airport. The nearest point of the Atlantic seaboard is approximately 25 miles to the west-northwest (cf. Fig. 1). Situated close to the west coast of Ireland and near the main tracks of the North Atlantic depressions, the Airport has an oceanic climate with a high frequency of fresh to strong winds. As smoke sources in the environments are negligible, visibility is generally excellent, and often in excess of 20 miles.

SUMMARY OF LANDING CONDITIONS:

In the 12-year period under review, there were 5451 half-hourly observations below 500 ft. ceiling and/or 1 mile visibility, i.e. an average of less than 38 observations per month. Of these, there were 2617 observations under 200 ft. and/or ½ mile, i.e. an average of less than 19 observations per month.

Fig. 2 shows the monthly variation in conditions over the 12 years, and Fig. 3 shows the annual distribution for each month.

SUB-MINIMA CONDITIONS:

The two months January and November together contribute 34.8% of the total of sub-minima conditions, while the 6 months April to September, inclusive, contribute only 25.1%.

Fig. 4 contains histograms showing the distribution of sub-minima conditions for the 24-hour period 1200-1200, G.M.T., over the 12 years. The times of sunrise and sunset are indicated for the middle of each month.

The sub-minima conditions were also classified by months and expressed as percentage frequencies for each hour. Fig. 5 illustrates the results. In connection with the high frequency in March near 0600 G.M.T., it is to be noted that March, 1953, contributed almost half the 12-year total for March. Times of sunrise and sunset are shown for the middle of each month. During April to August the sub-minima conditions rarely persisted longer than 5 hours after sunrise.

SPELLS:

As the persistence of sub-minima conditions is of prime importance to aircraft operations, the frequency of occurrence of spells has been examined. Records show many periods where sub-minima conditions prevail and which are occasionally interrupted by one or two reports of better conditions. Consequently, in this treatment a "spell" is defined as a set of sub-minima conditions which is continuous or without a break of over two half-hourly observations.

Table 11 shows the frequency of "spells" in excess of specified durations. Long spells of sub-minima conditions at Shannon are uncommon, and only 4 cases in excess of 18 hours occurred during the 12 years.

TABLE 11

Frequency of "spells" of sub-minima conditions (below 200 ft. and/or ½ mile).

	No. of cases of duration in excess of:					
	24 Hours.	18 Hours.	12 Hours.	9 Hours.	6 Hours.	3 Hours.
January				2	8	19
February			3	4	7	9
March			1	2	9	21
April						4
May				1	3	4
June					4	8
July						5
August					2	7
September					4	11
October		1	1	2	5	13
November	1	3	4	4	12	26
December			4	4	5	11

The longest spell in the period occurred in November, 1958. It commenced at 1630 G.M.T. on the 23rd. and lasted until 0400 G.M.T. on the 25th altogether 35½ hours. On this occasion sub-minima conditions were due to radiation fog which developed over the field in a very slack pressure gradient. Although there had not been any appreciable rainfall for nearly a week prior to this, the grass surfaces were saturated with dew.

VARIATION WITH WIND DIRECTION:

The surface and geostrophic winds were tabulated for each sub-minimum observation. Surface winds below 5 knots and geostrophic winds below 10 knots were regarded as calm. Table III shows the percentage frequency of occurrence with wind direction.

TABLE III

Percentage frequency of occurrence of conditions below 200 ft. and/or ½ mile visibility with wind direction.

Direction in degrees true	Surface wind	Geostrophic wind
Calm	36.1	56.1
360 to 030	5.9	3.5
030 to 060	3.1	4.2
060 to 090	4.2	5.1
090 to 120	13.4	4.5
120 to 150	15.7	4.8
150 to 180	3.2	5.5
180 to 210	0.8	5.3
210 to 240	1.9	2.4
240 to 270	5.0	3.5
270 to 300	1.4	3.7
300 to 330	1.7	0.1
330 to 360	7.1	1.2

Apart from calms, sub-minima conditions were chiefly associated with surface winds from 090° to 150°, 330° to 030°, and 240° to 270°. Sub-minima conditions were rarely associated with geostrophic winds in the sector 300/360°.

WEATHER SITUATIONS ASSOCIATED WITH SUB-MINIMA CONDITIONS:

The situations associated with sub-minima conditions at Shannon may be classified as follows:

(a) fog, other than sea fog; (b) moist warm sector;
(c) frontal passages; (d) sea fog;
(e) snow (f) miscellaneous.

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(a) Fog: By far the greater part of the sub-minima conditions were associated with fog. Radiation on the field at Shannon rarely produces more than shallow ground fog - though on some occasions it does develop into a full-scale fog, and this occurs most often in the north-east sector of the airfield. Most fog at Shannon is of the drifting type, having originally formed in the valley of the River Shannon, or in the marshy regions in the south-east.

After much radiational cooling, on the field, or in a frost situation, a slight wind-shift to give advection of warmer moist air from the river, can produce fog.

Synoptic situations associated with fog formation fall into three categories. The most favourable situation appears to be associated with an anti-cyclone to the north maintaining a weak easterly gradient (cf. Fig. 6).

A slack ridge to the rear of a cold front or a cold occlusion may provide suitable conditions for fog (cf. Fig. 7).

Another relatively common fog situation is the slack area associated with a dying depression. (cf. Fig. 8).

The pre-existence of a saturated grass surface is a major factor in the formation of fog at Shannon. In the last two situations this is provided by recent falls of rain, while heavy dews unevaporated by a weak sun are a feature of late Autumn mists and fogs in slack anti-cyclone situations.

(b) Moist Warm Sector:

A westerly or north-westerly airflow in an open warm sector frequently gives continuous low stratus with outbreaks of drizzle. Ceilings of 300 to 400 feet are common in such cases, and in exceptional cases ceilings of 100 feet, and visibilities less than $\frac{1}{2}$ mile have been reported. Such conditions are almost invariably associated with surface winds between 240° and 290°, but especially between 250° and 270°. Conditions will remain poor while the surface winds are within the above limits and the warm air persists, but a change of wind direction outside these limits will normally bring marked improvement in landing weather. Warm sector low stratus at Shannon seems to be largely independent of wind

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strength and was observed with surface winds over 20 knots, and geostrophic winds of 40 to 50 knots. Diurnal or seasonal variations of this phenomenon are not marked.

In June 1948 a warm front passed east of Shannon just before 0000 G.M.T. on the 24th. Conditions deteriorated on the afternoon of the 24th when the wind direction became westerly. Low stratus persisted for almost 24 hours. Sub-minima conditions occurred between 2330 and 0730 G.M.T. Ceilings improved when the gradient backed to southwesterly (cf. Fig. 9).

(c) Frontal Passages:

These occur very frequently at Shannon but rarely give poor conditions. However, with a cold front approaching from the north-west such conditions may occur a few hours before the front reaches Shannon (cf. Fig. 10); or the passage of a diffuse warm front with a slack gradient may on rare occasions bring on sub-minima conditions, (cf. Fig. 11).

(d) Sea Fog:

Sea fog rarely penetrates as far inland as Shannon. In the 12-year period, it was observed on only 8 occasions - three times in June, twice in May and July, and once in each in September. Sea fog frequently forms in western coastal districts during Summer anti-cyclonic situations. Development of a thermal low pressure area inland, can cause the fog to be advected from the Atlantic seaboard. In 6 of the above-mentioned cases the sea fog drifted over the Airport between 1900 and 2200 G.M.T.

Sea fog is usually intermittent in character and short-lived, but where conditions are favourable for radiation, the fog may persist until the following morning, (cf. Fig. 12).

(e) Snow:

Snow is quite rare at Shannon, but when it does occur it is usually accompanied by a marked deterioration in ceiling and visibility, which frequently fall below 400 feet and ½ mile.

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(f) Miscellaneous:

Low stratus and poor visibility sometimes occur at Shannon with non-frontal drizzle. Some isolated cases of poor landing conditions occurred with outbreaks of non-frontal rain. These were not sufficiently numerous to be associated definitely with particular synoptic situations.

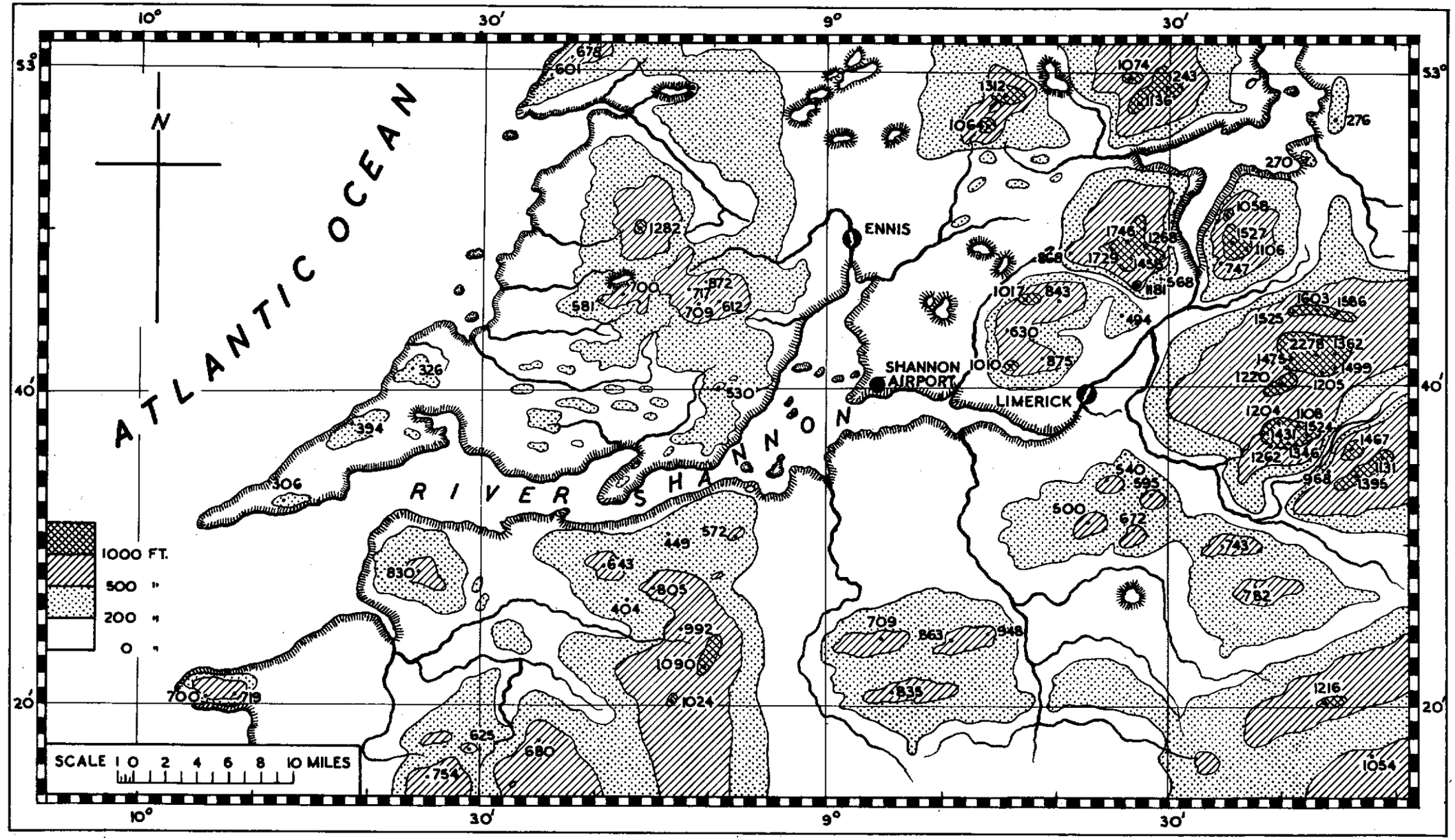

Fig. 1 Topography of Environments of Shannon Airport.

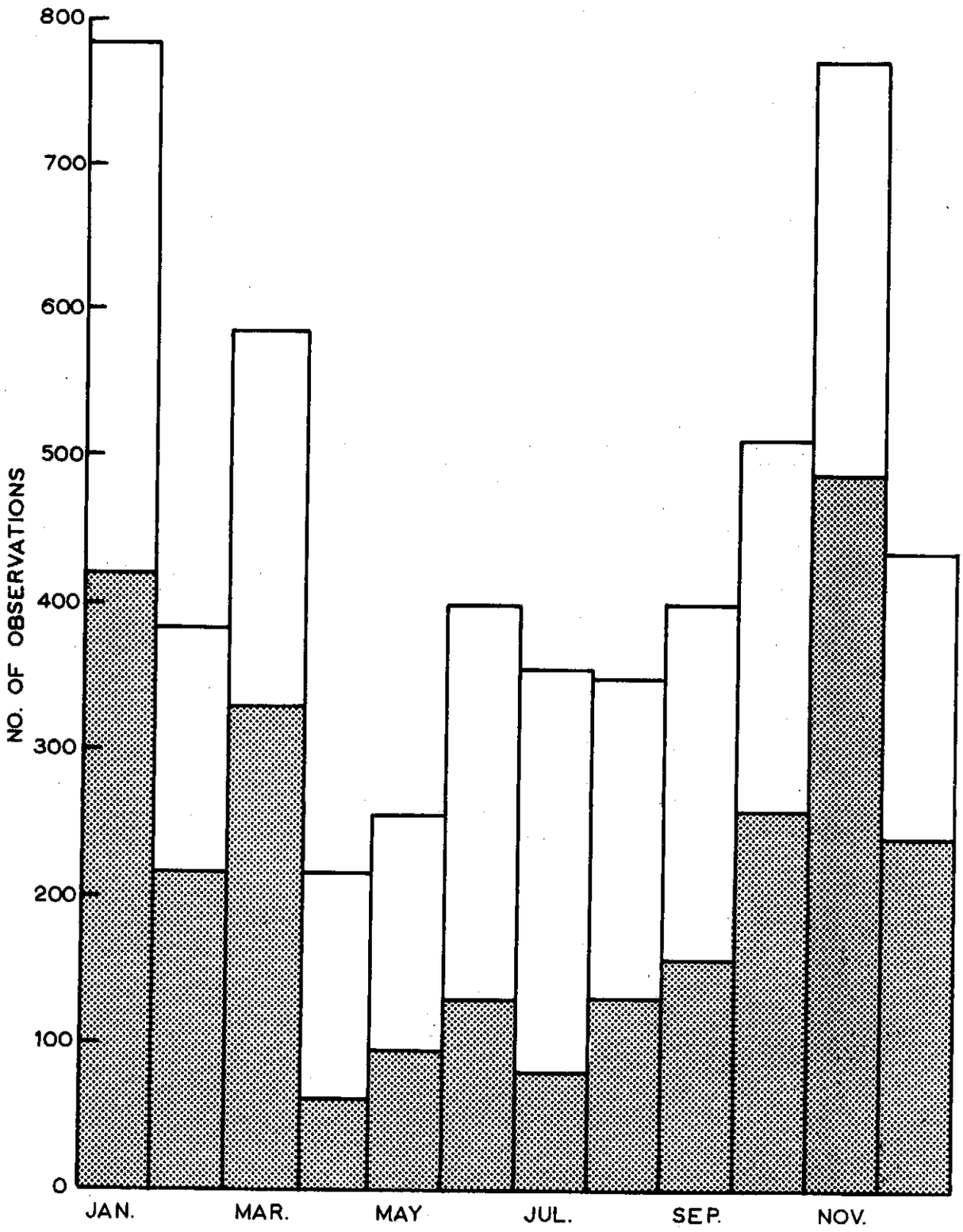

Fig. 2 Monthly summary of conditions during the period March 1948 - February 1960.

Ceiling and/or visibility below 500 ft and/or 1 mile.

Ceiling and/or visibility below 200 ft and/or 1/2 mile.

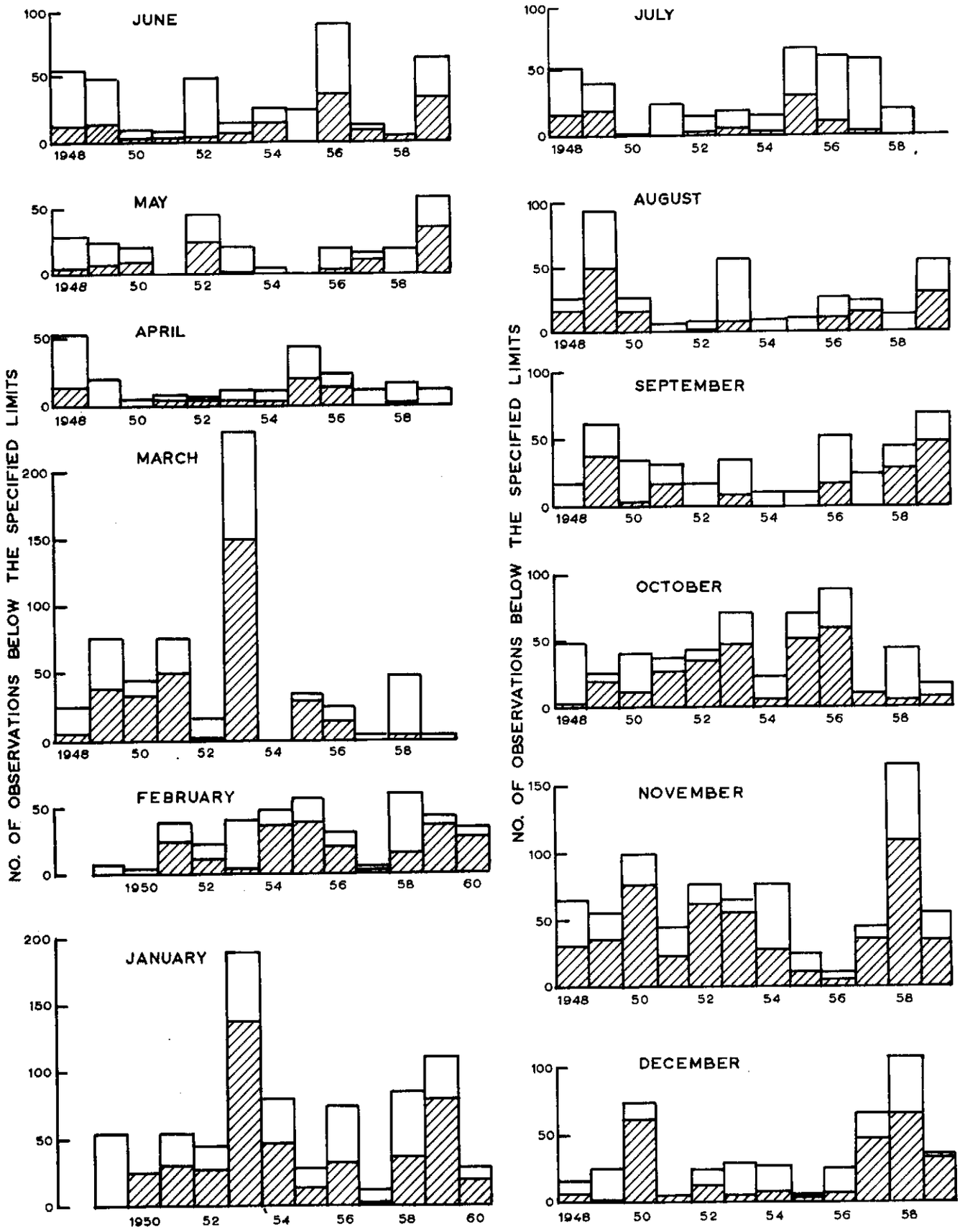

Fig. 3 Histograms showing annual variations for each months observations.

Conditions of ceiling and/or visibility below 500ft and/or 1 mile.

Conditions of ceiling and/or visibility below 200ft and/or $\frac{1}{2}$ mile.

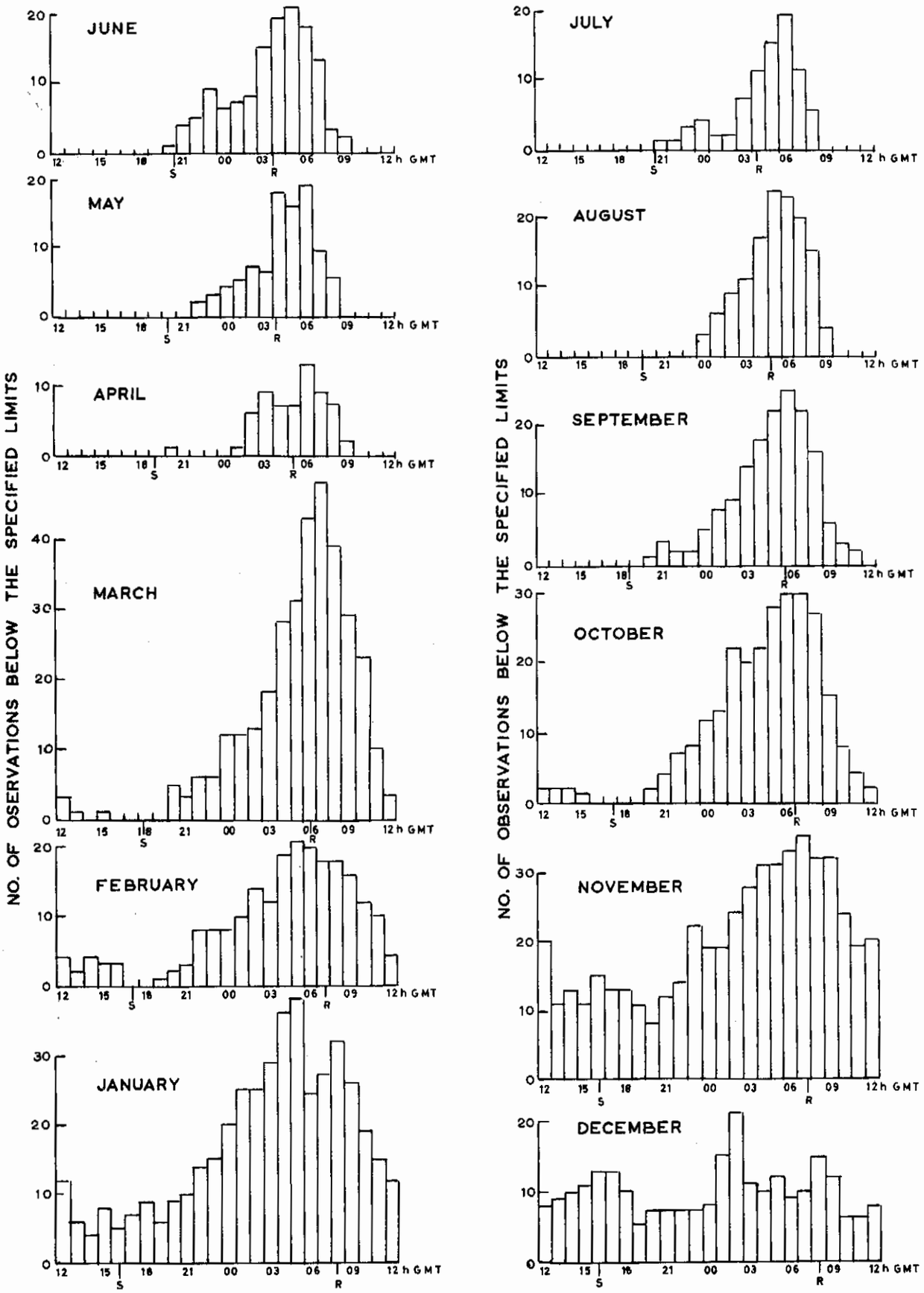

Fig. 4 Histograms showing the diurnal variations in the occurrence of conditions with ceiling and/or visibility less than 200 ft and/or 1/2 mile, for each month of the year, and over the period March 1948 - February 1960. (Times of sunrise R, and sunset S, at middle of each month, are indicated)

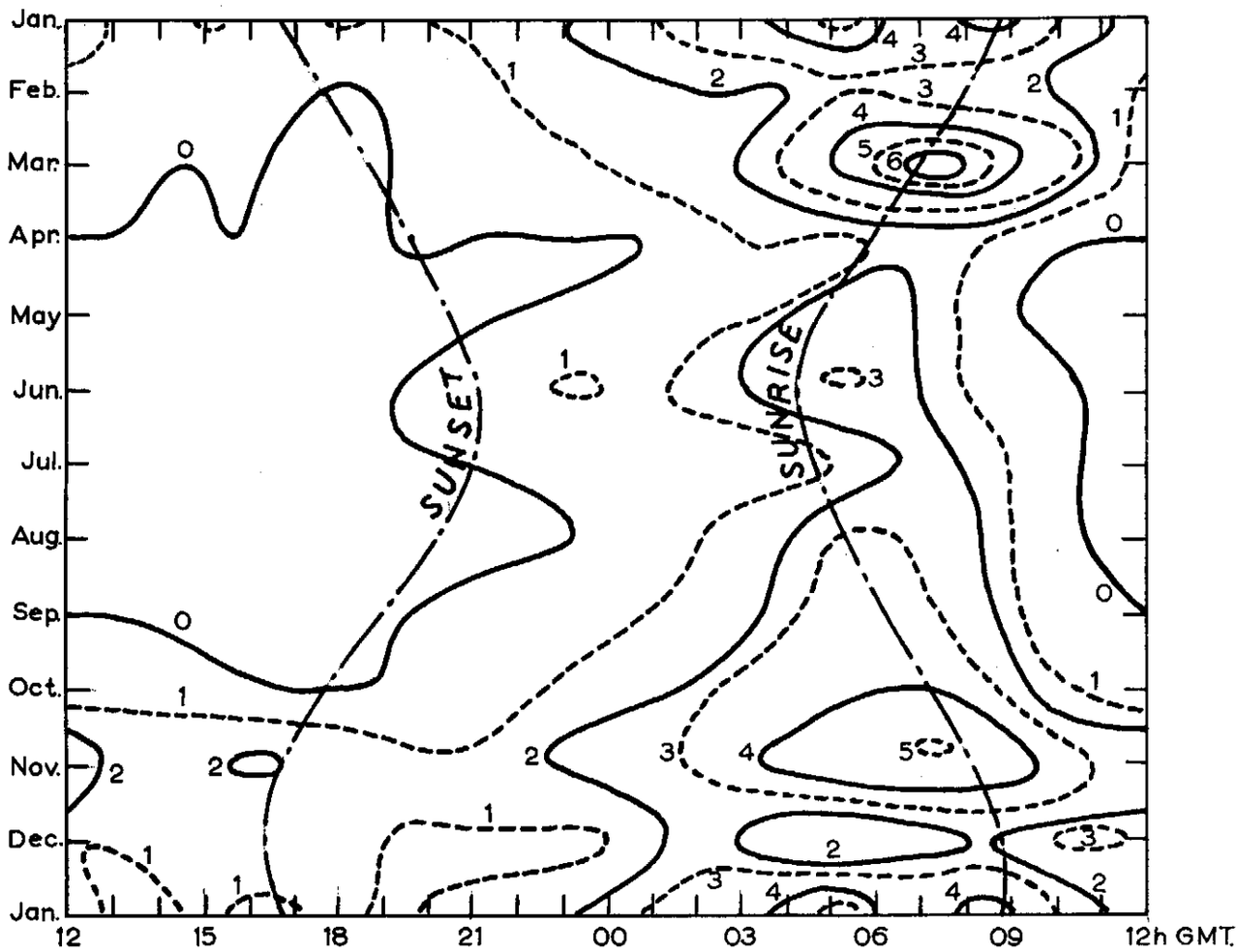

Fig. 5 Frequency of occurrence of conditions with ceiling and / or visibility less than 200 ft and or 1/2 mile, for each hour, classified by months, during the period March 1948 - February 1960 inc. Frequencies are expressed as percentages - even percentages being shown as continuous lines.

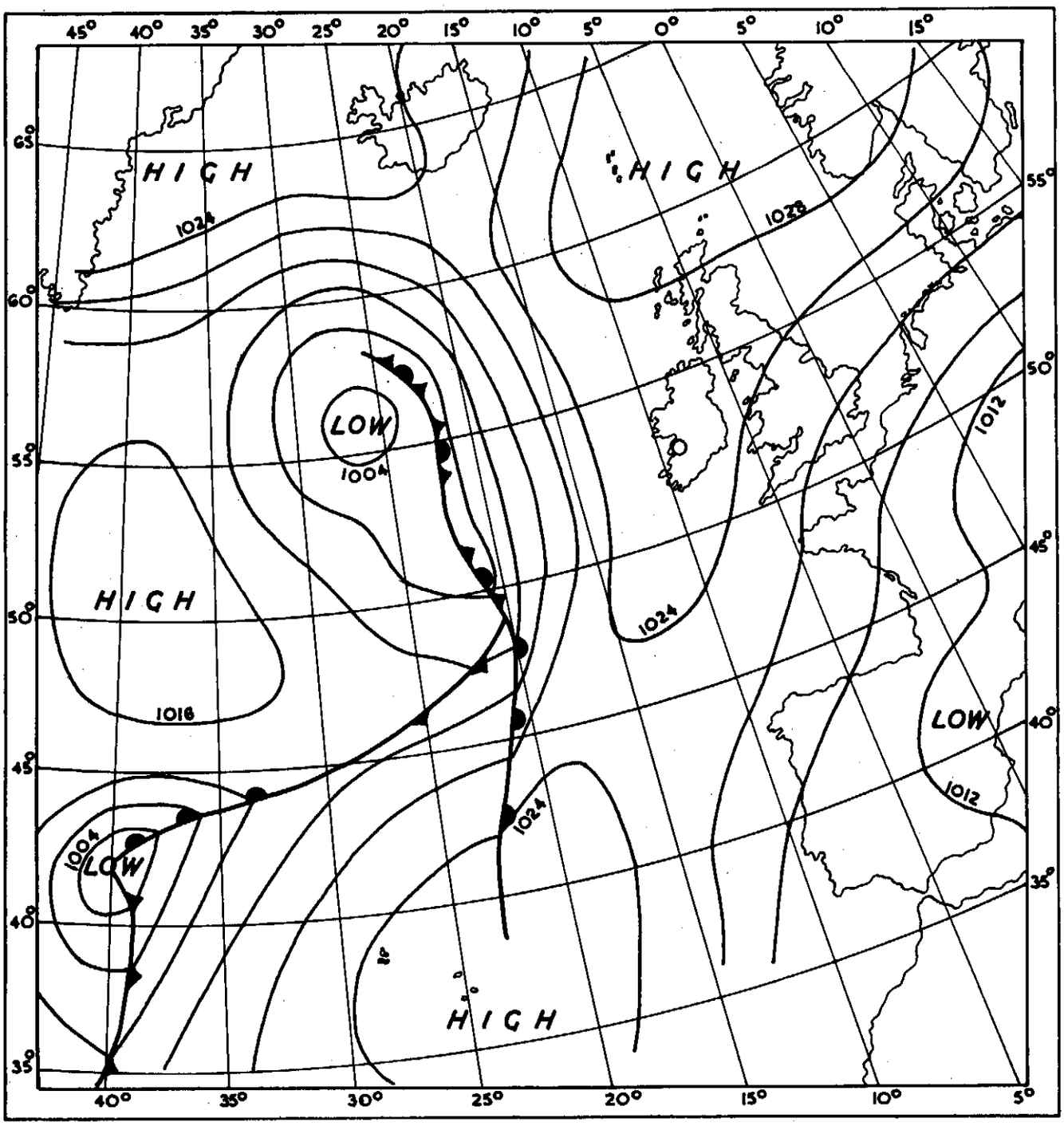

Fig. 6 Surface chart, 1800 G.M.T. 26th December, 1950.

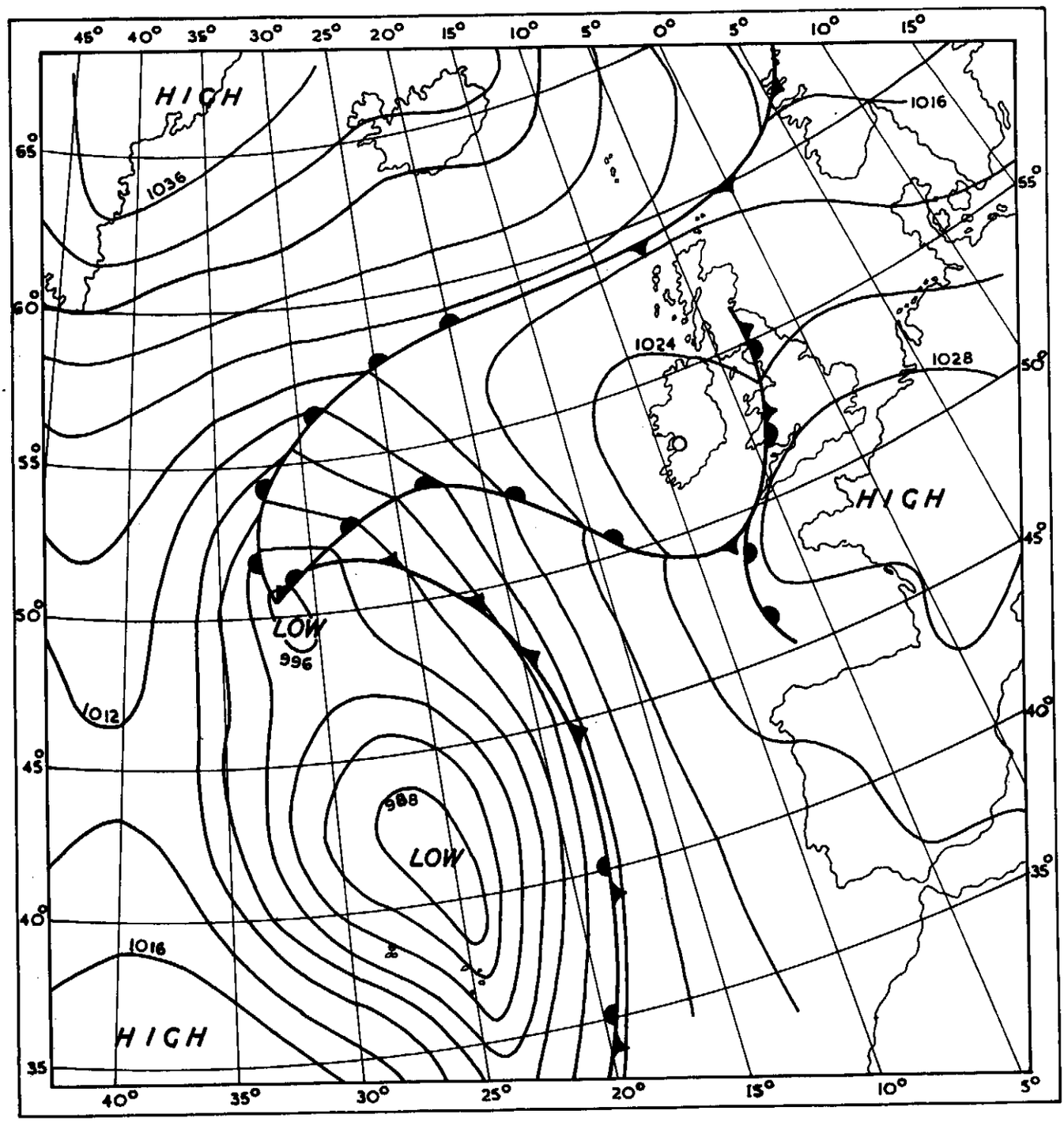

Fig. 7 Surface chart, 0000 G.M.T. 29th February, 1952.

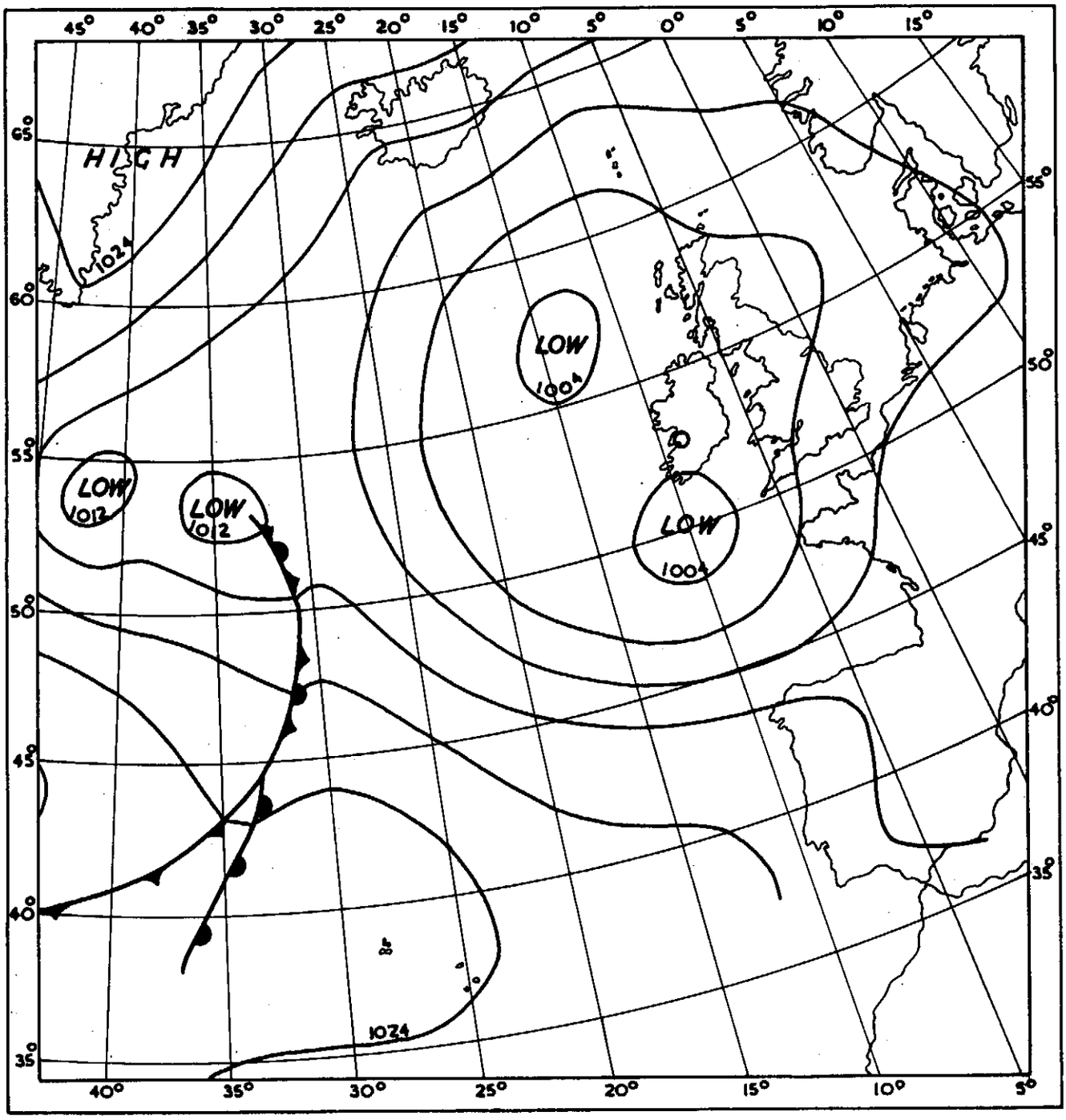

Fig. 8 Surface chart, 0000 G.M.T. 24th August, 1950.

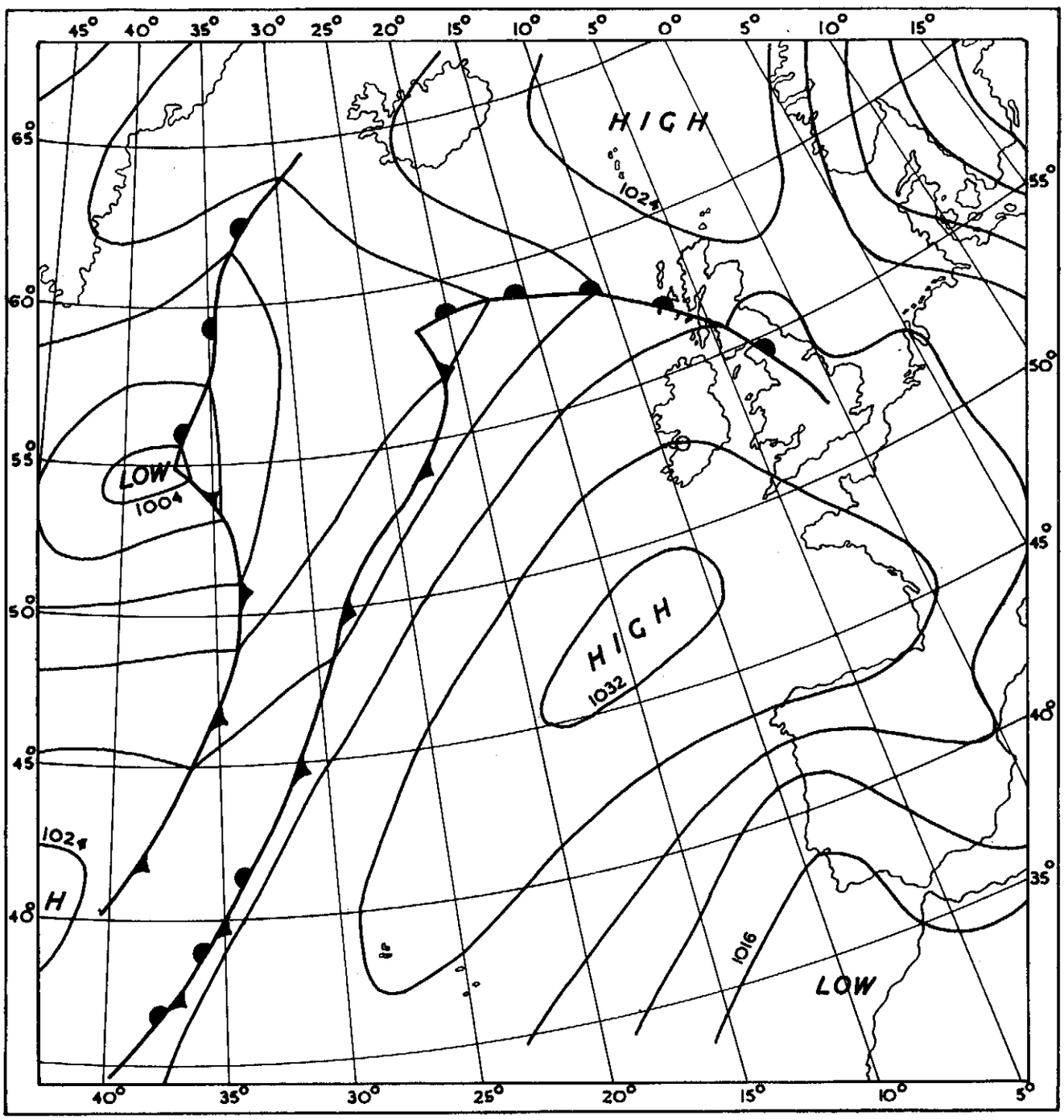

Fig. 9 Surface chart, 0000 G.M.T. 25th June, 1948.

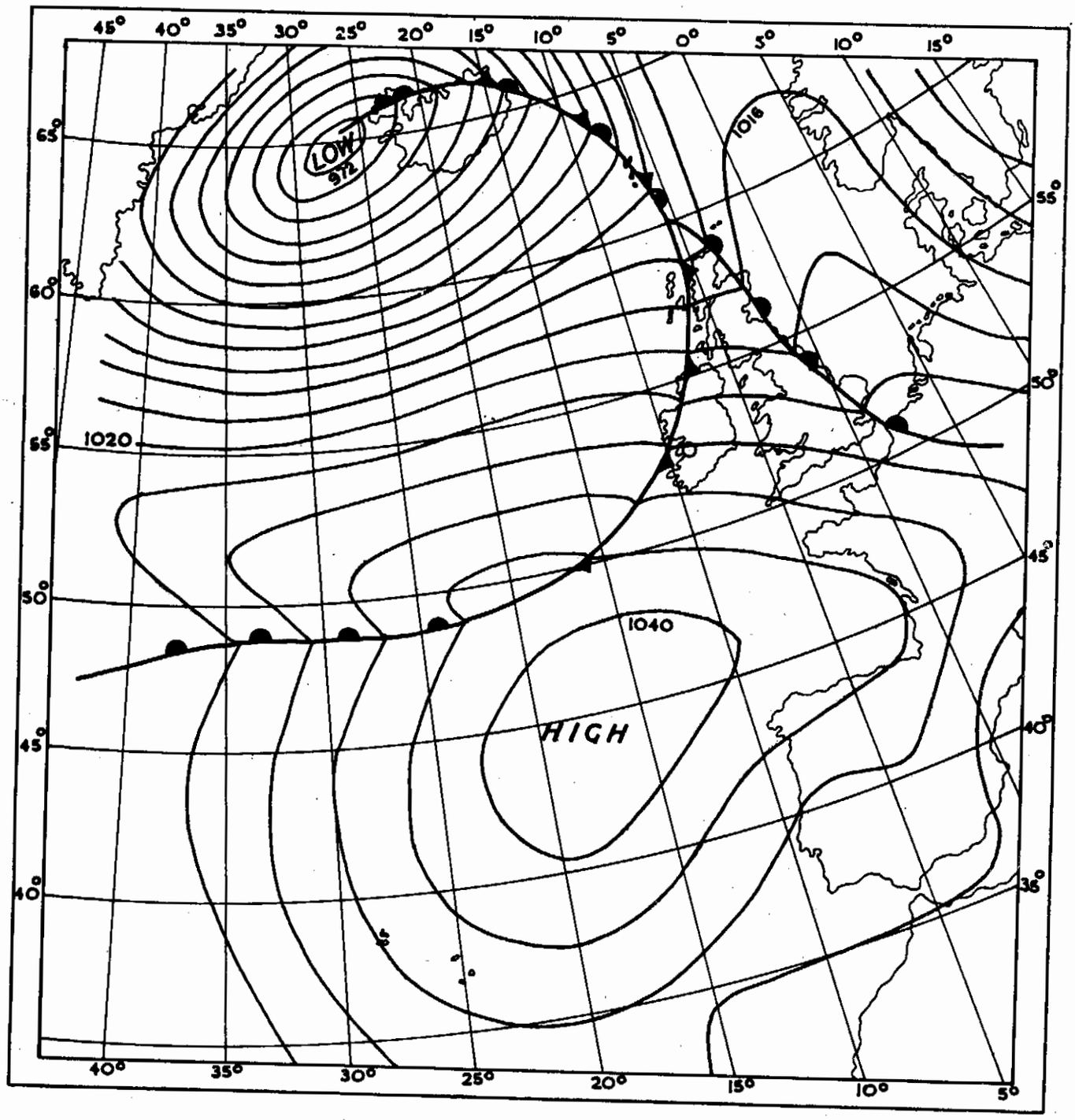

Fig. 10 Surface chart, 1800 G.M.T. 15th January, 1949.

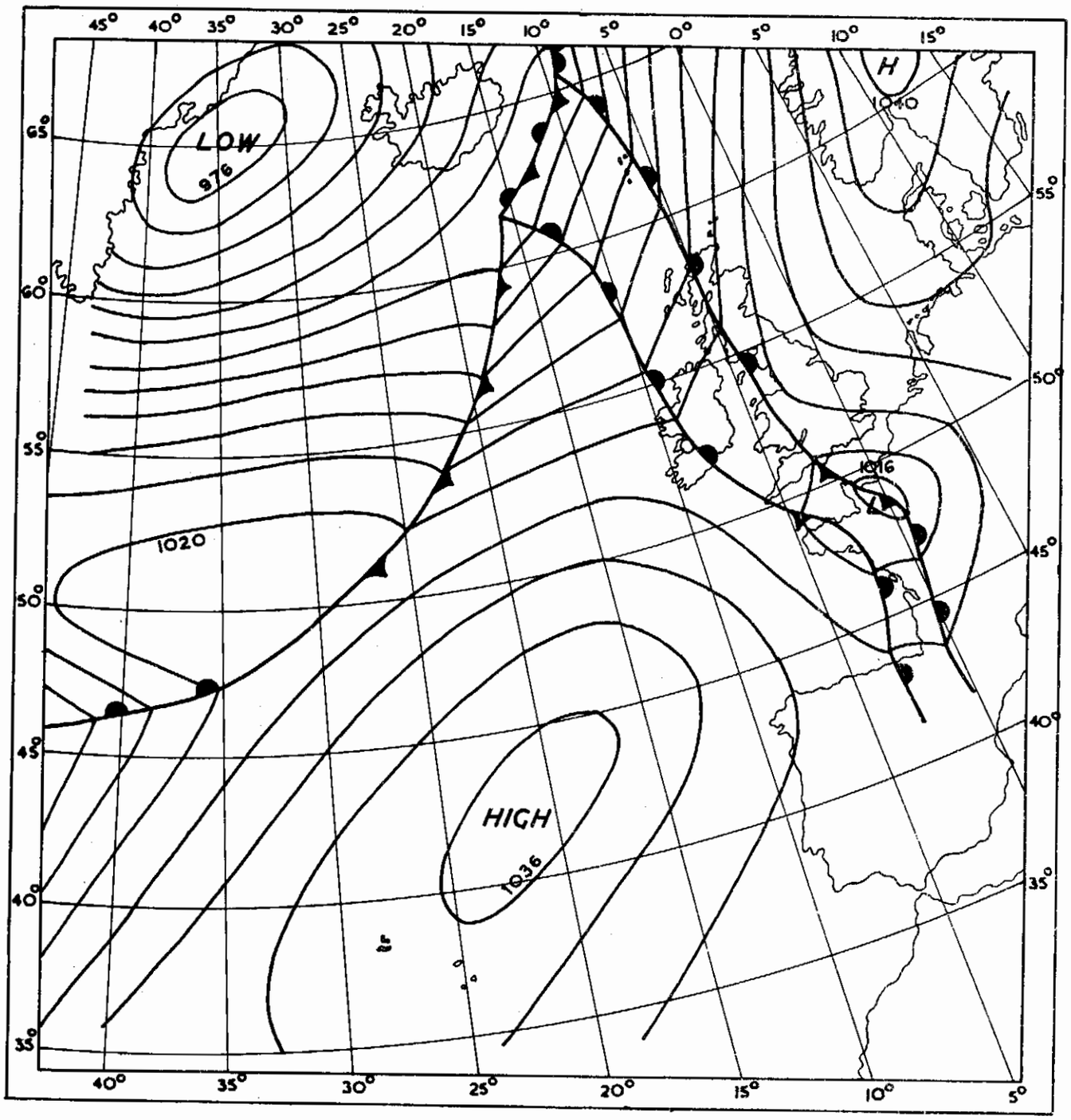

Fig. 11 Surface chart, 0000 G.M.T. 5th, 1949.

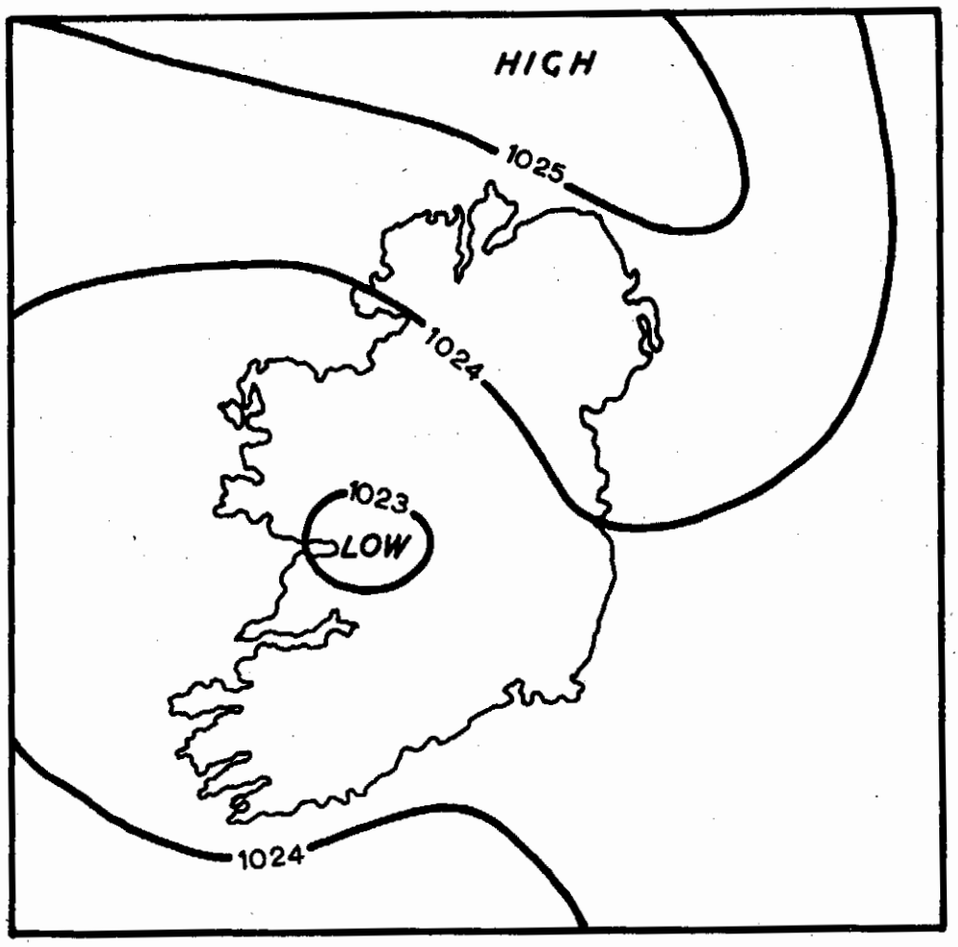

Fig. 12. Surface Chart, 2000 G.M.T., 15th May, 1959.