DEPARTMENT OF INDUSTRY AND COMMERCE
METEOROLOGICAL SERVICE

TECHNICAL NOTE No. 15

POTATO BLIGHT AND THE WEATHER IN IRELAND IN 1953

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CONTENTS

CHAPTER I

INTRODUCTION

1. The development of the rules on which the Radio Warning Service of Potato Blight Weather in Ireland is based is traced in Technical Note No. 12: 'Potato Blight and the Weather: A Fresh Approach'. Technical Note No. 13 ("The Potato Blight Weather Warning Service in Ireland is 1952") describes how the service is organised and endeavours to assess its first year of operation.

2. The present note deals with the experience gained during the 1953 potato growing season in Ireland.

Chapter 2 gives a brief Summary of the criteria in use and lists the participating observing stations. A much fuller description will be found in the earlier Technical Notes mentioned above.

Chapter 3 describes the progress of potato blight in Ireland in 1953. Chapter 4 records the corresponding occurrences of blight-weather, as defined by the Irish rules, and lists the Radio Warnings issued during the season.

3. Chapters 2 to 4, with the corresponding charts and appendices, deal with facts, in so far as these can be ascertained. The remaining two chapters run some risk of being accused, in Mr. E.C. Large's pungent phrase ("The Advance of the Fungi"), of "straying from the straight and narrow path of science into the brothels and gin-palaces of unbridled hypothecation." Chapter 5 consists in the main of comments on the measure of success reached during the season: here it is difficult to ensure complete objectivity, for the two sets of data (disease and weather) are far from being always clear-cut and it would be idle to seek an exact one-to-one correspondence between the two sequences. There can therefore be no question of <u>proving</u> the criteria employed: the most one can hope to do is to <u>illustrate</u> that the deductions made from the criteria are in good agreement with the subsequent course of the disease. The Radio Warnings issued during the course of the season are some guarantee against interpretations based on wisdom after the event.

Chapter 6 consists of a number of related items, some of possible importance, in which the discussion is to a greater or lesser degree speculative. The author assumes that the uncertainty is due to gaps in our knowledge of potato blight; it may very well prove, since a meteorologist can hope only to touch the fringe of botanical literature, to be due entirely to lacunae in the author's reading. If so, he will be sincerely grateful to any mycologist who is kind enough to comment or to direct his attention to published work.

4. For earlier assistance and the stimulus of informed comment, the author wishes to thank Dr. J. Grainger (Auchincruive), Dr. J.M. Hirst (Rothamsted) and, in particular, Mr. E.C. Large (Harpenden) whose remarkable book 'The Advance of the Fungi' provided initial inspiration and whose specialist advice has been freely given on several subsequent occasions. These distinguished mycologists have saved the author from many pitfalls. They are not, of course, in any way responsible for the opinions of the author nor for his errors or indiscretions.

CHAPTER 2

DEFINITIONS

The radio warnings of weather favourable to potato blight (Phytophthora-infestans), prepared by the Irish Meteorological Service and broadcast by Radio Eireann, are based on criteria for the recognition of such weather, which may be referred to as the "Irish rules"

The "IRISH RULES" for the recognition of weather favourable to the spread of potato blight make use of standard hourly meteorological reports, and require, as a minimum:-

(a) A 'humid period' covering at least twelve consecutive hourly reports in which the dry-bulb temperature is equal to or greater than 50.0°F and the relative humidity is equal to, or greater than, 90%.

(b) Free moisture on the foiliage for a subsequent period of at least four hours. If there is not adequate precipitation, the alternative requirement is a further four hours, beyond the initial twelve, with relative humidity at least 90%.

A period which fulfils these requirements is referred to as a "BLIGHT WEATHER SPELL". A spell is regarded as terminated whenever even a single hour occurs at which the temperature or humidity falls below the required values, and any subsequent sequence of humid weather is regarded as part of a new spell.

For assessing the relative importance of blight-weather spells of different lengths, account is taken of the "EFFECTIVE PERIOD" in hours, which is defined as the total number of consecutive hourly observations in the spell, less eleven in the cases accompanied by adequate precipitation, or less fifteen in "dry" cases. Consecutive blight-weather spells which are separated by five hourly reports or less are coalesced in calculating the "effective period", i.e. only one deduction, of 11 or 15 hours as appropriate, is made from the total duration of the consecutive periods.

Other criteria, suggested by Mr. A. Beaumont, have been used with success in England and elsewhere to forecast the first incidence of potato blight and may conveniently be referred to as the "English Rules". The English rules were not used in the operation of the Blight Weather Warning Service in Ireland in 1953, but, in the post-season check, a list was made of the "Beaumont Periods" which occurred and this has been included in Appendix III.

Using standard hourly meteorological reports, a "BEAUMONT PERIOD", i.e. a critical spell under the English rules, is considered to have occurred if, in a sequence of fortyeight consecutive hourly observations, the temperature does not fall below 50°F nor the relative humidity below 75%.

The observing stations which took part in the scheme in 1953 were Valentia Observatory, Midleton, Claremorris, Clones and Dublin Airport. Observations from Mullingar and Shannon Airport were also used in the post-season check. The positions and heights of all seven stations are given in Appendix II.

CHAPTER 3

POTATO BLIGHT IN IRELAND IN 1953

1. As in the previous year, regular reports on the onset and spread of Potato Blight in Ireland in 1953 were very kindly supplied by potato inspectors of the Department of Agriculture, operating in different parts of the country. In the case of County Kerry and of West Galway, for which no information was available in 1952, reports were obtained from a number of Parish Agricultural Advisory Agents. A list of the observers who so willingly co-operated is given in Appendix I.

2. There was an isolated early report of blight on June 1st from Dungarvan, Co. Waterford, where a few spots of the disease were noticed in a well-sheltered field of Epicure potatoes at digging time.

En passent, it may be mentioned that this field has a remarkable record of early appearances of blight. The very earliest reports, often many weeks in advance of other areas, came from here in the years 1952 (May 20th), 1950 (May 16th), 1949 (May 18th), 1948 (May 23rd) and 1945 (April 25th).

3. The disease was next observed on June 21st in the Fanad area in Co. Donegal on a crop of Ruby Queen; by June 23rd it was spreading slowly to a neighbouring crop of Kerr's Pink.

Before the end of June there were reports from four other areas, all in the North-West (Counties Donegal, Mayo and Sligo).

The details of these early cases include some points of interest. In Turloughmore, Co. Sligo the attack (June 30th) occurred in a crop of Up-to-Date potatoes, in which there had been a noticeable number of failures, a common feature if there is disease amongst the planted tubers. A neighbouring plot of Kerr's Pink showed no trace of blight. In Newtowncunningham, Co. Donegal the initial attack (June 30th) on a crop of King Edward was confined to about four square yards in the centre of an open field. By July 11th, this attack had spread to about 400 square yards still working outwards from the centre of the field.

The first week in July saw reports from Counties Dublin, Galway and Kerry, as well as fresh cases in Donegal and Sligo. During the second week new counties to report the disease included Wexford Monaghan, Louth and Cork.

4. The only report from a non-maritime county prior to mid-July was one from Co. Monaghan on July 10th. Blight did not appear in the Midlands until July 15th i.e. about three weeks later than last year. The observer in the Birr area comments that it must be many years since blight made so late an initial appearance in that part of the Midlands.

5. Meanwhile, the disease had become widespread in most areas - particularly in the West and Northwest, and in coastal regions generally - in the period July 14th-18th with further extension in the period July 21st-25th. In the Midlands, blight made steady if unspectacular progress during the month; nevertheless, in Co. Monaghan, the comparative freedom from blight at the end of July was considered remarkable for the time of the year.

The general position on August 1st was of widespread blight in all except a few Midland and North-eastern areas. The attack was mild in most districts, although isolated severe cases were reported, principally from coastal regions.

6. The disease intensified sharply in August and made spectacular

progress in most areas from August 8th onwards, so that by the end of the month many crops were virtually defoliated. Even in the Midlands, where the attack had been mostly late and mild, this mid-August attack led to a marked deterioration. Although the attack eased off later in the month, the disease was, by the end of August, more marked than in previous years in most districts.

7. It was difficult to observe the progress of the disease towards the end of the season due to the combined effects of ripening, blight and, in some areas, potash deficiency. Some varieties such as Kerr's Pink which preserved green foliage into September continued to show the spread of the disease in that month. Disease in the tubers was reported from several areas.

8. SUMMARY

The disease came particularly late this year to the Midlands and indeed was rather late everywhere. It made quiet progress in mild form in the second half of July, but by mid-August has become rampant, so that growth in many areas was finished by early September. In general, a sharp late attack of above average intensity.

CHAPTER 4

WEATHER AND WARNINGS

1. The forty-five occasions on which Blight-Weather, under the Irish rules, occurred in 1953 are listed in Appendix III and illustrated in charts 1 to 45 in Appendix IV. This formidable total covers every occasion in which favourable conditions occurred, no matter for how short a period or over how small an area; it therfore includes some cases of quite negligible importance and others of purely local significance.

In considering the general picture of blight in Ireland in 1953 it will suffice to concentrate on the periods May 20-27 (Charts 3 to 6), June 21st-22nd (Chart 14), July 5th-6th (Chart 18), July 11th-13th (Chart 21), July 19th-20th (Chart 23) and August 4th-9th (Chart 28). The synoptic weather situations which gave rise to these major cases are shown in Charts 47 to 54 inclusive.

2. No spells occurred in late April; last year South Munster had such an occurrence. The earlier occurrences in May were similar to those of 1952 though less intense. Midleton had a remarkable total of blight-eather hours but nevertheless had only two "generations" during the month.

There was a long hiatus in the earlier part of June, broken only by spells of minor importance. The spell of June 21st-22nd, however, covered virtually the entire country and was particularly prolonged in the North-west. The first radio warning was inspired by this spell and was broadcast on June 22nd:-

> "POTATO BLIGHT WARNING
> Weather favourable for the spread of potato blight occurred over most of Ireland during the past week-end and is likely to recur in the West during the next few days. Blight may be noticeable about mid-week in many areas. Weather will be suitable for spraying during most of the week."

Suitable spraying weather occurred, but the recurrence of "Blight-Weather" in the West in the form expected did not take place, although, after spotty patches inland and in the East, a further spell did occur in the West at the end of the month (Chart 17).

3. A further substantial spell on July 5th-6th (Chart 18) gave rise to the second warning, broadcast on July 6th:-

> "The warm wet weather of yesterday is likely to lead to a noticeable spread of potato blight in most parts of Ireland this week. Further spells of weather favourable to blight are expected to occur tonight and in the following days. Weather will be such as to permit spraying during most of this week."

There were minor recurrences on June 7th and 9th, and a major one on July 11th-13th.

4. The next important case was on July 19th-20th (Chart 23). The following warning was broadcast on July 19th:-

> "Present weather will give strongly favourable conditions for the spread of blight in unsprayed potato crops throughout the country. Weather will be suitable for spraying in most districts to morrow afternoon and at times during the week."

5. An important case of blight-weather occurred on August 4th-9th (Chart 28). The following radio warning was issued on August 6th:-

"Weather during the past few days has been favourable for the propagation of potato blight, particularly in the South-west of the country where short periods of similar weather are likely to recur in the next few days."

The expected continuation occurred but its extent and duration were underestimated.

6. The late season blight-weather illustrated in Charts 35, 36, 37 etc. came at a time when there was little foliage left to damage but could have caused serious tuber damage if coincident with digging out, in cases where there was still some green foliage and stems. The following bulletin was issued on August 29th:

"During last night and to-day conditions were favourable to potato blight. It is expected that during the coming week there will be further spells of weather conducive to the growth of the disease"

The expectation of further blight-weather was fully justified.

7. No later bulletins were issued.

CHAPTER 5

COMMENT

1. This was a year of more clear-cut development of blight in Ireland than was 1952. The Irish rules came quite well out of the test and the initial and subsequent warnings were, apparently, well timed.

2. There were fewer scattered early attacks this year. This may be due in part to the fact that the weather data did not, in fact, really favour such spells, and in part to the comparative drought early in the season (see Chapter 6, paragraph 3). June was a very dry month, the rainfall for the country as a whole being only 46% of average; the corresponding figure for May was 84%. The dryness was most marked in the Midlands; this may be related to the late apperance of blight there, although a major factor must have been the comparative absence of favourable weather spells there (c.f. Shannon Airport).

3. Once again the earlier part of June was almost devoid of blight-weather and once again this occurred in a year without an early serious blight attack. This concurrence can readily be explained in terms of blight generations (See Chapter 6, paragraph 2). The fact that an entire month occurred between the second and third generations deferred the time at which blight became widespread by a most valuable three weeks.

4. The cause of almost every major blight-weather spell in Ireland in 1953 was the presence of maritime tropical (mT) air over the country for lengthy periods. This is illustrated in Charts 47-54. It might conceivably prove possible to dispense with artificial criteria entirely and forecast blight solely on the basis of the frequency and duration of mT invasions.

The significance of mT is particularly clear in the case of the period August 4th-9th (Chart 28), which is further discussed in Chapter 6, paragraph 3. It was as a result of this period that blight became really destructive in Ireland in 1953.

5. Although the "blight-weather" cases showed a marked increase from 29 to 45 compared with last year, the total number of Beaumont Periods at the seven observing stations was almost unchanged (46 as against 47). Thirty-eight of the Beaumont Periods contained spells of blight-weather as defined under the Irish Rules. Several others occurred in dry weather.

There was a relative paucity of Beaumont Periods in the earlier months e.g. in May-June-July there were only 18, as against 30 last year. The period June 21st-22nd, widely significant under the Irish procedures, was unmarked under the English rules, and that of July 5th-6th had a Beaumont Period only at Valentia. On the other hand, the important spell from August 4th to 9th was very well marked, particularly in the Southern stations. Thus, although this year the period of initial outbreaks was indicated uncertainly by the English rules, the period of most violent development was well indicated.

CHAPTER 6

SPECULATION

1. EFFECTIVE PERIOD

The "Irish rules" are not merely intended to identify periods of weather favourable to potato blight, but aspire, by the concept of the "effective period" as defined in Chapter 2, to grade the relative importance of different blight-weather spells.

The implication that the spread of the disease increases with the length of the favourable weather period has been criticised in comments kindly forwarded by a distinguished mycologist. The conclusions of Crosier (2) on which the "Irish rules" are based were drawn from small-scale laboratory experiments. Even if one assumes that they apply equally well in field conditions (e.g. if one accepts that the longer the period of suitable weather the greater the number of spores released under natural conditons) there is, it is stated, evidence to show that little correlation exists, in field conditions, between the number of spores produced and the amount of infection resulting.

Experience with operating the Irish rules in practice suggests, nevertheless, that the lengthier spells (i.e. those of effective duration of at least the order of ten hours) are also the more efficient in spreading or intensifying the disease. One reason for this may be that the rules require not merely conditions favourable for the production of spores, but also subsequent conditions favourable for the germination of the spores and for the infection of the host, i.e. they provide for inoculation as well as dissemination.

The criticism is however a timely warning against giving too precise a significance to the observed durations. In particular, accumulated totals of effective durations, as quoted e.g. in Charts 46 and 55, may be deceptive if considered other than as broad indications of trend. Thus, it seems most likely that a single effective period of 20 hours has less effect than two separate periods of 10 hours each which constitute separate generations, i.e. are separated by at least five days.

2. PERIOD OF LATENT SPREAD

A problem to which much attention has been given in the past is the fact that blight rarely appears in the field until the plants have reached a certain stage of development, seldom indeed before flowering time. Attempts to explain this fact in terms of absence of inoculum or variations in susceptibility of the host at different stages of its development have not had any marked success.

A plausible solution may be found in the properties of geometrical series, which constantly surprise the non-mathematician by combining a slow start with rapid acceleration later (c.f. the old story of the chessboard and the grains of corn). A suggestion along these lines was first put forward in rather naive form by Rostrup [1]; it has recently been developed and refined by Müller and Haigh [8], from whom the following is a quotation: "Under the climatic conditions of the major potato-growing areas of Europe, the parasite has to start at the beginning of each new season from comparatively small foci of infection, and it takes a relatively long time for the disease to reach epidemic proportions. Numerous observations by one of us (K.O.M) indicate that at least five generations of the parasite are necessary to infect a larger plot from a few primary foci of infection". Müller and Haigh's paper includes an interesting diagram showing the comparative degree of infestation to be expected in varieties of different susceptibility after one, two, three, ... six generations of the fungus, under certain simplifying assumptions.

Our hypothesis, then, is that there is normally a PERIOD OF LATENT SPREAD of blight between the time of emergence of the primary foci and the time at which the blight becomes visible in the field, and that this period covers several "generations" of the parasite (the minimum length of a generation in our climatic conditions is taken as five days). The date on which blight is observed no doubt depends in some measure on the skill and care of the observer; however, there is evidence [e.g.7] that on occasions the early stages of spread of the disease have escaped even the most painstaking observer.

There are obvious difficulties in reducing this hypothesis to a working rule, amongst them the fact that the different generations are normally far from being of equal relative weight. Any prudent formula should clearly be expressed in fairly broad terms. The following rule, in which each suitably-spaced blight-weather spell is assumed to give rise to a generation of the fungus, has been based on fairly limited experience and needs further confirmation:-

"Apart from isolated cases of little importance, the first visible appearance of blight in the field is rarely noted before the third generation of the fungus has taken effect. On the other hand, it is rarely delayed beyond the time when the fifth generation of the fungus has taken effect."

Assuming the validity of the Irish rules, the bulk of the country, apart from the North-east and parts of the Midlands, experienced two generations of potato blight in May 1953, mostly occurring in the period May 20th-27th. Ignoring minor cases, the third generation occurred on June 21st-22nd, the fourth on July 5th-6th and the fifth on July 11th-13th. By the time the fifth generation had begun to take effect (say, July 16th-18th), blight had made its appearance in almost every part of Ireland.

In forecasting potato-blight in Britain, the difficulty of the delayed appearance of the disease has been countered by introducing the concept of a "Zero date" which is determined empirically and which must be past before a suitable weather period is regarded as valid [4, 6] If the hypothesis of latent spread is true, however, what happens before the zero date cannot be ignored; whether the generation occurring after the zero date is immediately effective will depend on the build up from the initial foci of infection which occurred before the zero date.

3. MODIFYING INFLUENCE OF DROUGHT

In reviewing the 1952 data, it was suggested that drought was a factor which might tend towards moderating the effect of weather spells favourable to the disease; conversely, it was felt that in a wet season suitable moist spells might have added effect.

The literature on this question is conflicting. Experiments by Napper [10] indicate that high water-content of the host tissues favoured infection by potato blight. Crosier [2], however, found that plants grown in a hot, dry climate were as susceptible to blight under favourable conditions as those grown in a warm, wet environment. His results may have been complicated by the fact that wilted leaves which are exposed to a saturated atmosphere gradually absorb moisture from it [5]. Thus, after a period in the saturation chamber, there would have been little difference between the water-content of the two sets of leaves. The results obtained by Crosier may not, therefore, be inconsistent with the theory that, when exposed to humid periods of limited length, wilted plants will, so to speak, use up part of the period in increasing their water-content, and that the effective period for disease propagation will be correspondingly reduced in comparison with plants of high initial water content.

Apart from this controversial aspect, there is another reason why high water-content of the soil and wet ground might well increase the effect of humid periods, and that is its effect on the microclimate around the plants. As an illustration, consider the period August 4th-9th of this year [case No.28].

Here maritime tropical air covered the country for the better part of a week; but there were periods, particularly when frontal activity was weak, when the sun broke through the clouds for short periods and temporarily reduced the relative humidity in the free air. It is clear, however, that these interruptions would have little or no influence within the crop. At this period, the haulms would be just about at their maximum (see chart 56) and the ground was sodden after an abnormally wet July (Average rainfall over Ireland 150% of normal; there had been some difficulty in spraying in parts of Donegal at the end of July due to the heavy condition of the fields). Saturation within the crop would, therefore, be almost continuous throughout the entire period and the effect of the spell much more vigorous than might have been deduced from the screen values of temperature and humidity alone.

The practical deduction is that blight-weather spells should be given added weight when they occur after rainy periods (particularly in the months of July and August) and should be given lesser importance in periods of drought.

4. OBJECTIVITY

A criticism advanced against the Irish procedure for forecasting potato blight is that, although almost entirely objective in the initial stages (i.e. the collection and correlation of data), it involves a large measure of subjective judgment when it comes to deciding whether warnings should be issued, and, if so, in what terms. Although quite a number of cases of blight-weather in any season are clearly unimportant to the general picture, so that the problem presented to the forecaster is not as chaotic as might appear at first sight, it is perfectly true that the method does not lay down a mechanical procedure for the final stages and that the forecaster is called upon to use judgment and knowledge; and to take into account such general factors as are discussed in paragraphs 2 and 3 above.

Probably this procedure appears more natural and promising to a meteorologist than to others, since it is similar to that operated in weather forecasting. It is difficult to see how the timing and extent of warnings could be made less subjective for the factors involved on both the weather and disease side are very complex; indeed the best results are likely to be obtained after joint discussion between the meteorologist and plant pathologist, where this can be arranged.

5. INCUBATION PERIOD

A question of considerable practical impportance in checking blight progress against weather is the following:-

How long after a particular favourable weather spell has caused infection with potato blight will (a) the first results and (b) the final results of infection appear on the plants?

The incubation period is normally given as about 5 days in our climate. It seems likely, however, that the incubation period is not of a fixed length, even to the first approximation, but that it stretches over a fairly wide range of which the lower limit (or perhaps the "peak-point") is about 5 days.

Murphy and Mc Kay (10) carried out experiments to determine the incubation period of tubers. The blight appeared on the fifth day after infection; the rate of development rose rapidly to a maximum about the seventh day and then after the eighth day fell rapidly at first and then very slowly, with some indication of a second maximum about the twelfth day.

As the writer is unaware of exactly similar work on potato foliage, he adapted Murphy and Mc Kay's results for tubers and assumed that the the effects of a particular spell of blight weather might be expected to appear on the haulms 5-12 days later. So far as can be judged from the fairly crude data available, this assumption works reasonably well.

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APPENDIX I

OBSERVERS OF POTATO BLIGHT

Grateful acknowledgment is made to the following Potato Inspectors of the Department of Agriculture, who furnished detailed reports of the onset and spread of potato blight in their districts throughout the growing season

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T. Gleeson, Ardee, Co. Louth
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J.J. Bowen, Mountrath, Co. Laoighis
P. Minnock, Clare and Woodford
H.A. Dunlop, Birr, Co. Offaly
J.J. Campion, Banagher, Co. Offaly
D.F. O'Grady, Tullamore, Co. Offaly
B. McLean, Athlone, Co. Westmeath
M.P. Timmons, Menlough, Co. Galway
J.J. Stack, Monivea, Co. Galway
J. Tully, Athenry, Co. Galway
T.L. O'Conchubhair, E. Galway and Roscommon
P.F. Heavey, Turloughmore, Tuam
J. Rooney, Crossmolina, Co. Mayo
J. McGee, Enniscrone, Co. Mayo.
F. Murphy, Cloghboley, Co. Sligo
T.P. Brennan, Castlefin, Co. Donegal
E. Kelly, Ballybofey, Co. Donegal
P. Cullen, Stranorlar, " "
N. Wilkinson, Lifford " "
J. McGinley, Raphoe, " "
J. McBride, St. Johnstone "
A. Egan, Letterkenny " "
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F. Henderson, Newtowncunningham " "
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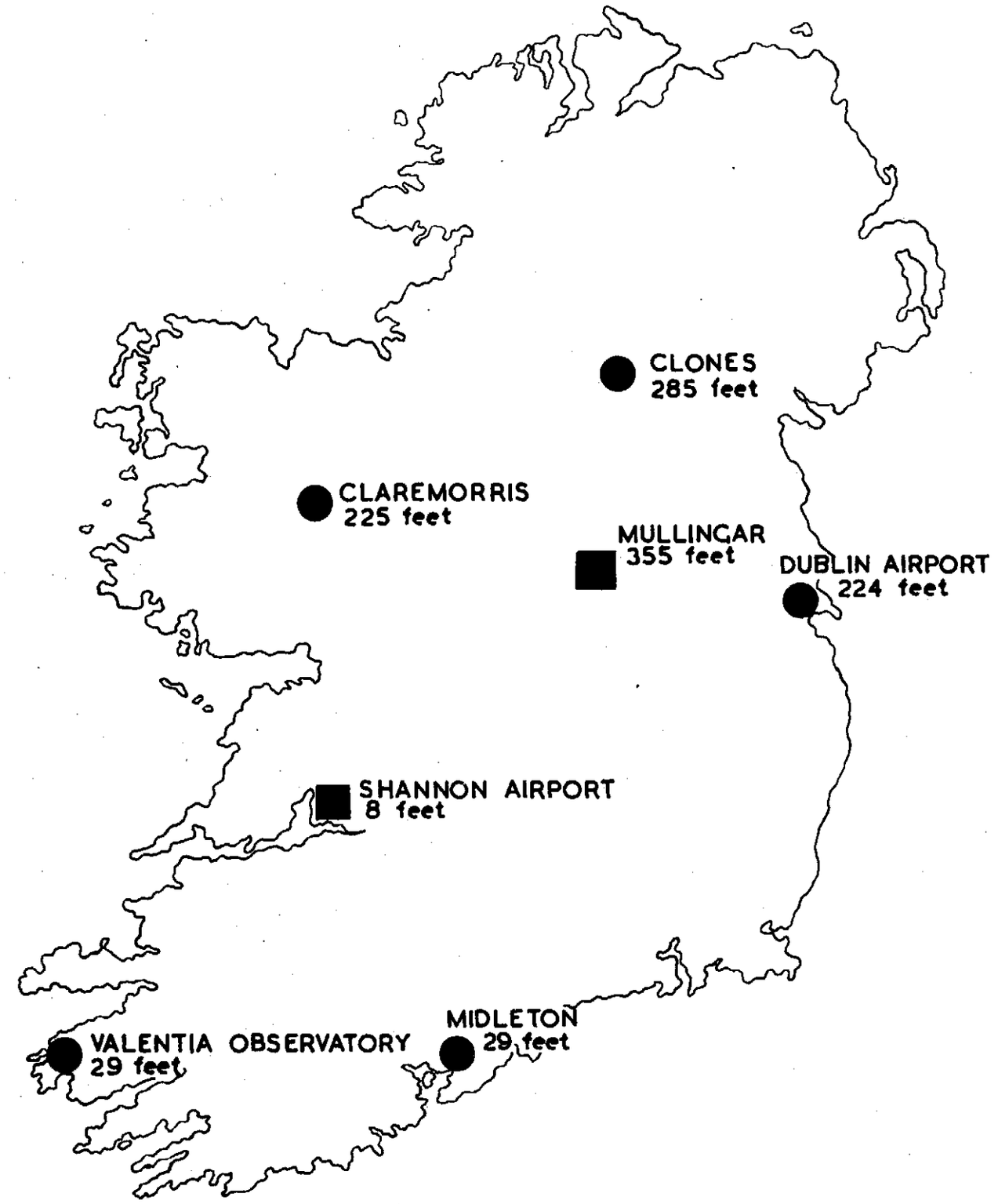
P. Landers, Cahirciveen
M. O Spiolain, Tralee
M. Walshe, Ballylongford
J.V. Cronin, Castleisland
W. Brophy, Rathmore
D. MacCarthaigh, Killorglin
J.F. Murphy, Listowel
J. O'Connor, Brosna

Co. Galway

C. Mac an Bhaird, Headford
P. O Flathartha, Clifden
A. Daly, Letterfrack
M. O Dobhainn, Spiddal

APPENDIX II
LOCATION AND HEIGHTS OF WEATHER OBSERVING STATIONS



● STATIONS PARTICIPATING IN ALERTING PROGRAMME

■ ADDITIONAL STATIONS USED IN POST-SEASON CHECK

APPENDIX III

BLIGHT WEATHER IN IRELAND IN 1953

Notes:-

1. In Columns 2 and 3, CLN = Clones, CLR = Claremorris, DBN = Dublin Airport, MID = Midleton, MUL = Mullingar, SHN = Shannon Airport, VAL = Valentia Observatory.
2. In Columns 2 and 3, use is made of the date-time group, DDGG, where DD is the date and GG the hour (Greenwich Mean Time).
3. Lenght of 'effective periods' of blight weather, in hours, is shown in brackets in Column 2.
4. The date on which a blight-weather period is considered to begin is that of the end of the first twelve hour humid period i.e. the date of first formation of the sporangia of the fungus.
5. Duration of Beaumont Periods, in hours, is shown in brackets in Column 3.

(1) DATE	(2) BLIGHT-WEATHER SPELLS	(3) BEAUMONT PERIODS	(4) CAUSE AND NOTES	(5) CASE AND CHART NUMBER
May 8th	NIL	CLR 0708-0910 (51)	Foggy. No precipitation	0
May 13th	MID 1214-1308(8)	MID 1200-1703 (124)	Warm occlusion from South	1
May 14th	MID 1320-1408(2)	See MID above	Occlusion from SW. Unimportant case, confined to South coast.	2
May 20th-21st	CLN 2018-2108(4) CLR 2016-2107(5) DBN 2014-2107(7) MID 2004-2110(20) MUL 2016-2111(9)	MID 2004-2509(126) VAL 2008-2505(118)	Warm occlusion from the South	3
May 22nd-23rd	CLR 2219-2314(9) DBN 2214-2302(2) MID 2118-2311(31) MUL 2213-2308(9) VAL 2211-2311(14)	CLR 2215-2414(48) See MID, VAL above	Wave to South on 22nd; later warm front moved North over Ireland, so that broad warm sector covered Ireland. See weather map.	4

(1) DATE	(2) BLIGHT WEATHER SPELLS	(3) BEAUMONT PERIODS	(4) CAUSE AND NOTES	(5) CASE AND CHART NUMBER
May 24th-25th	CLN 2421-2510(3) CLR 2319-2409; 2421-2509(17) MID 2314-2508(43) SHN 2421-2508(1) VAL 2314-2406(17)	See CLR, MID, VAL above	Continuation from previous case. Thundery cold frontal trough moved through on 24th-25th. Blight weather spells at CLR, MID and VAL represent resumption after short intervals of previous spells	5
May 27th	CLR 2613-2711(12) DBN 2620-2711(5) MUL 2617-2712(9) SHN 2616-2711(9) VAL 2612-2715(17)	VAL 2606-2811(54)	Active warm front from West on 26th; cold front trailing East-West across Midlands early on 27th but later moved away to the South-East. See weather map	6
May 29	VAL 2820-2910(4)	VAL 2813-0109(93)	Weak frontal system from West	7
May 30th-31st	CLR 2922-3011; 3021-3112(8) VAL 3000-3114(28)	CLR 2917-3118(50) See VAL above	Two weak warm sectors from WNW	8
June 10	CLN 0919-1007(2) MID 0910-1005(9) MUL 0918-1007(3)	NIL	Narrow warm sector from West. Effects spasmodic and mostly weak.	9
June 13	VAL 1217-1309(6)	NIL	Weak occlusion from West	10
June 15	CLR 1420-1507(1) DBN 1416-1509(7) MUL 1421-1514(7)	CLN 1405-1605(49) DBN 1319-1621(75)	Occluded low from NW. Point of occlusion passed through Midlands	11
June 16	NIL	NIL	Deduced from synoptic charts. Moist air stream from N or NE caused 12-24 effective hours in Northern coastal strip.	12
June 19	MID 1818-1906(2)	NIL	Apex of narrow warm sector passed Eastwards across Munster	13

(1) DATE	(2) BLIGHT WEATHER SPELLS	(3) BEAUMONT PERIODS	(4) CAUSE AND NOTES	(5) CASE AND CHART NUMBER
June 21st-22nd	CLN 2113-2208(9) CLR 2022-2210(26) DBN 2109-2206(11) MID 2022-2113(5) SHN 2101-2112; 2119-2208(4)	NIL	Depression moved into Ireland and stagnated. Warm front moved North on 21st and broad warm sector covered country. Cold front passed Kerry coast early, hence zero at Valentia. See weather map.	14
June 25	MUL 2418-2510(2) VAL 2422-2511(3)	NIL	Unimportant case of isolated short periods in col situation with fog and dew in many places	15
June 26th 28th	DBN 2521 2609 2700-2711; 2721-2809(5)	DBN 2517-2911(91)	Humid N or NE'ly current would have given favourable conditions each night in many areas but for lack of free moisture. Dublin area had thunderstorms.	16
June 30th- July 2nd	VAL 0119-0210(1)	NIL	Sea fog along the Western seaboard giving fairly lengthy effective periods in extreme coastal fringe of the Northwest.	17
July 5th 6th	CLN 0510-0608(12) CLR 0420-0602(20) MID 0421-0509 0511-0605(21) MUL 0513-0606(7) SHN 0514-0603(3) VAL 0417-0604(25)	VAL 0219-0612(90)	Open warm sector conditions with cold front trailing along West coast during 5th. See weather map.	18
July 7th	CLR 0618-0706(2) MUL 0620-0707(1)	NIL	Narrow warm sector. Unimportant case, slight effect being confined mainly to NW coastal area.	19
July 9th	MUL 0820-0907(1)	NIL	Isolated spot in a very showery North Westerly current.	20

(1) DATE	(2) BLIGHT-WEATHER SPELLS	(3) BEAUMONT PERIODS	(4) CAUSE AND NOTES	(5) CASE AND CHART NUMBER
July 11th-13th	CLN 1109-1209; 1217-1305(16) CLR 1023-1210; 1212-1309(47) DBN 1110-1121(1) MID 1118-1211(7) MUL 1108-1211; 1218-1305(18) SHN 1118-1207(3) VAL 1100-1208(22)	CLR 1020-1311(64) MUL 1106-1310(53) SHN 1022-1309(60) VAL 1213-1609(93) Note: VAL period would start at 1018 but for one deficient value.	Warm sector over country, followed by trough conditions associated with low stagnating to North of Ireland. See weather map.	21
July 16th	CLN 1521-1609(2) CLR 1521-1609(2) MID 1519-1607(2) VAL 1520-1607(1)	NIL	Thundery trough moved NE-wards across country.	22
July 19th-20th	CLN 1918-2010(6) CLR 1914-2011(11) MID 1912-2015(17) MUL 1916-2010(8) SHN 1913-2000(1) VAL 1911-2011(14)	NIL	Broad warm sector. Tropical air penetrating from SW covered entire country by a.m. 20th. Cold fronts cleared Eastwards in the afternoon. See weather map.	23
July 24th-25th	CLN 2323-2411(2) CLR 2321-2410; 2416-2508(20) DBN 2418-2505(1) MID 2404-2503(13) MUL 2401-2413(2) VAL 2323-2411(2)	VAL 2317-2518(50)	Narrow warm sector crossed from the West on the 24th. The cold front with minor waves stagnated in the South-east and did not clear the country until 25th.	24
July 27th	CLN 2621-2708(1) CLR 2621-2708(1) MUL 2621-2711(4)	See VAL below	Moist showery westerly current	25

(1) DATE	(2) BLIGHT- WEATHER SPELLS	(3) BEAUMONT PERIODS	(4) CAUSE AND NOTES	(5) CASE AND CHART NUMBER
July 31st	CLR 3017-3107(4) DBN 3021-3109(2) MID 3014-3110(10) MUL 3017-3108(5) SHN 3016-3108(6) VAL 3013-3107(8)	VAL 2520-3111(136)	Active wave depression moved across Munster. Broad rain belt to North of wave	26
Aug. 3rd.	VAL 0217-0308(1)	VAL 0211-0914(220)	Anticyclonic fog. Temps. too low inland	27
Aug. 4th-9th	CLN 0400-0411; 0523-0610; 0721-0811; 0822-0909(7) CLR 0320-0410; 0520-0609; 0621-0711; 0721-0812(16) DBN 0621-0710; 0719-0812(10) MID 0320-0407; 0618-0811; 0819-0907(34) MUL 0422-0512; 0520-0610(8) SHN 0422-0611; 0721-0808(28) VAL 0318-0608; 0720-0808; 0820-0912(60)	CLN 0516-0718(51) CLR 0419-0813(91) MID 0519-1023(125) VAL See above	On 3rd p.m. an occluded low came in from West; tip of warm sector crossing Midlands. Slowmoving cold front stagnated with waves over Ireland on 4th-5th; moved NE as warm front on 6th. Cold air reached West coast on 7th but did not clear East coast until 9th. Much sea fog throughout period. See weather maps.	28
Aug. 14th-15th	CLN 1410-1505(9) DBN 1418-1507(3)	NIL	Cold front with minor waves which tended to stagnate in East Ireland. Spell at CLN extended by fog.	29
Aug. 17th	CLN 1705-1716(1) CLR 1619-1710(5) MUL 1710-1721(1)	NIL	Warm sector with weak frontal system.	30
Aug. 20th	CLN 1913-2009(10) DBN 1920-2008(2) MUL 1920-2008(2)	VAL 1819-2110(64)	Warm front moved up from SW on 19th; cold front followed on morning of 20th	31
Aug. 22nd	CLR 2117-2208(5)	CLR 1918-2210(65)	Unstable thundery conditions.	32

(1) DATE	(2) BLIGHT-WEATHER SPELLS	(3) BEAUMONT PERIODS	(4) CAUSE AND NOTES	(5) CASE AND CHART NUMBER
Aug. 24th-25th	CLR 2320-2413; 2418-2507(21) MID 2421-2508(1) MUL 2401-2412; 2420-2508(3)	CLR 2304-2511(56) VAL 2217-2600(81)	Moist NW'ly current with thunder in places. Similar to case 32.	33
Aug. 28th	CLR 2719-2808(3) VAL 2721-2811(4)	VAL 2715-3009(67)	Cold front moving slowly from NW	34
Aug. 29th-30th	CLN 2903-2917(4) CLR 2818-2913(9) DBN 2819-2915(10) MID 2818-2908(4) MUL 2819-3007(26) SHN 2816-2915(13) VAL 2816-2917(26)	SHN 2719-3008(62) VAL See above	Active depression moved up West coast, mT air in warm sector	35
Aug. 31st-Sept. 2nd.	CLN 3103-0107(18) CLR 3102-0111(23) MID 3118-0201(21) MUL 3101-0106(19) SHN 3114-0101(1) VAL 3023-0119(34)	CLN 3020-0209(62) CLR 3019-0201(55) MID 3019-0209(63) VAL 3013-0208(63)	Broad warm sector of mT air covered entire country by 31st p.m. Cold front moved through on the afternoon of Sept. 1st.	36
Sept. 4th-6th	CLN 0417-0510(7) CLR 0320-0415; 0417-0507; 0520-0608(28) DBN 0414-0512(12) MID 0322-0509; 0515-0608(43) MUL 0322-0509; 0521-0608(26) SHN 0414-0509; 0520-0607(10) VAL 0414-0507; 0512-0604(24)	CLR 0317-0609(65) VAL 0317-0605(61)	Frontal system from SW on 4th was followed by broad current of mT air which covered entire country on 5th. As pressure built up the warm air became drier and spells ended.	37
Sept. 7th-9th	CLR 0819-0907(2) MUL 0819-0908(3) SHN 0821-0909(2) VAL 0719-0810(1)	CLR 0809-1009(49) VAL 0718-1010(65)	See previous case. Isolated periods in radiation fog on 7th-8th, and in association with cold fronts on 8th-9th.	38

(1) DATE	(2) BLIGHT-WEATHER SPELLS	(3) BEAUMONT PERIODS	(4) CAUSE AND NOTES	(5) CASE AND CHART NUMBER
Sept. 11th-13th	CLN 1118-1308(28) CLR 1106-1208(16) DBN 1220-1311(5) MUL 1122-1210; 1218-1309(7) SHN 1119-1214(9) VAL 1117-1209(6)	CLN 1106-1412(55) DBN 1109-1712(148) MUL 1109-1312(52) SHN 1018-1310(65)	Warm front from NW on 12th. Cold front moved down country on 12th; retrogressed as warm front on 13th.	39
Sept. 14th-15th	MID 1410-1501(5) SHN 1416-1506(4)	CLN 1414-1613(48) MUL 1318-1612(67)	See previous case. Cold frontal trough passed over Ireland from SW.	40
Sept. 16th	CLN 1519-1610(5)	See CLN above	Retrograde movement of front in previous case	41
Sept. 17th-18th	MID 1615-1711(10) MUL 1620-1708(2) SHN 1716-1808(6)	VAL 1615-2201(131)	Shallow thundery low moving Northwards	42
Sept. 19th-20th	CLN 1915-2007(6) CLR 1821-2007(24) MID 1901-2000(13) MUL 1906-2006(14) VAL 1901-1914(3)	CLR 1803-2010(56) SHN 1817-2211(91) See VAL above	Active occluded depression from the West	43
Sept. 22nd-24th	CLR 2223-2310; 2320-2411(6) MID 2317-2408(5) MUL 2120-2208(2) SHN 2323-2410(1)	NIL	Intermittent precipitation in rear of an intense low which passed across Ireland on 21st. Much radiation fog on 24th	44
Sept.25th-27th	CLN 2517-2611; 2617-2709(25) CLR 2518-2704(24) MID 2523-2709(24) MUL 2519-2611; 2619-2706(7) SHN 2420-2509; 2519-2609; 2619-2708(10) VAL 2516-2706(28)	VAL 2222-2713(112)	Double frontal system from NW on 25th; stagnated over Ireland on 26th. Cold fronts passed through on 27th.	45

Note: A further spell, commencing on September 30th and running on to October 2nd-3rd has not been listed above

APPENDIX IV

CHARTS

Charts 1 to 45

Extent and Observed Effective Duration of Individual Blight Weather Spells in Ireland, May to September, 1953.

Notes (1) The observed effective duration is shown not only (in circles) for stations participating in the alerting programme, but also (in squares) for the stations used in post-season checking.

(2) Extra information regarding the weather spells is contained in Appendix III; the location and heights of the observing stations will be found in Appendix II.

(3) The scale of the maps of Ireland illustrating blight weather spells is 1 : 5,000,000.

Chart 46

Isopleths of Total Number of Hours of Effective Blight Weather, May-August, 1953.

Charts 47 to 54

The Surface Synoptic Weather Charts corresponding to some of the main Blight Weather Spells

Note: The scale of these charts is 1 : 12,500,000

Chart 55

Aggregate of Effective Blight-Weather Hours in Ten-day Periods, May-September, 1953.

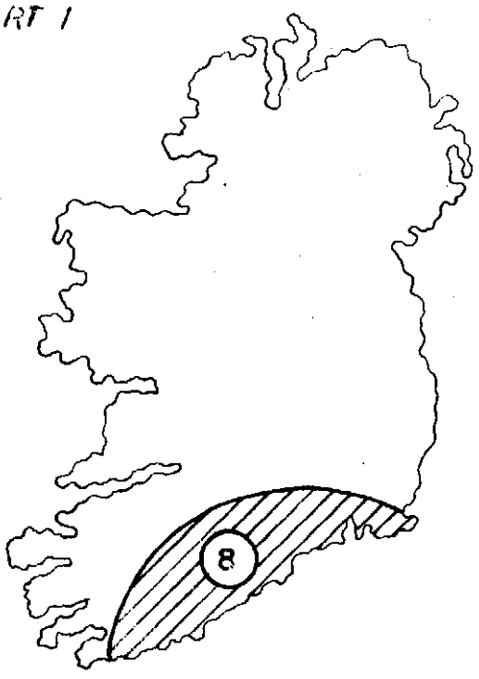
Chart 56

Idealised Diagram of Seasonal Growth of Maincrop Potatoes in Ireland

Notes (1) This diagram is based primarily on a paper by Paul A. Murphy: "A Study of the Seasonal Development of the Potato Plant in relation to Blight Attack and Spraying." (Sci. Proc. Royal Dub. Soc., 22 (N.S.) (1939)). The figures for tuber production have been rounded from those given by Murphy for blight-free and commercially sprayed up-to-date potatoes in the Dublin area. The figures compare remarkably well with weighted averages calculated from data given in Doncaster and Gregory: "Spread of Virus Diseases in the Potato Crop" (Agric. Res. Com. Rep. Ser., No.17, page 2, Table I). Doncaster and Gregory's figures refer to Majestic potatoes grown in England.

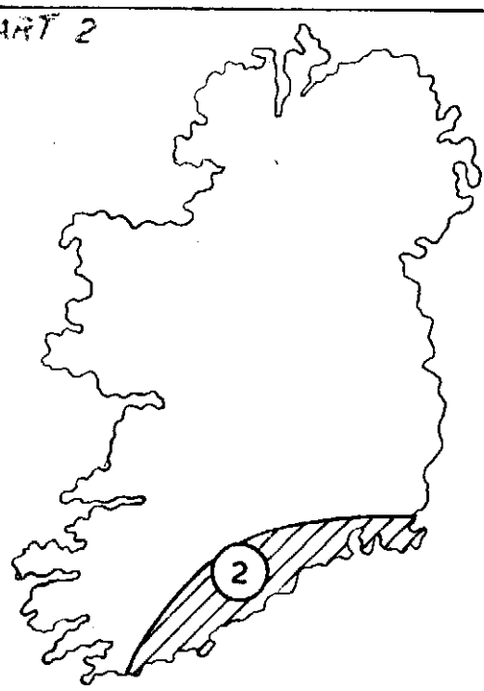
(2) The idealised picute shown is subject to considerable modification with seasonal conditions and is, in particular, influenced by the blight attack, particularly in respect of the period from August 1st onward.

CHART 1



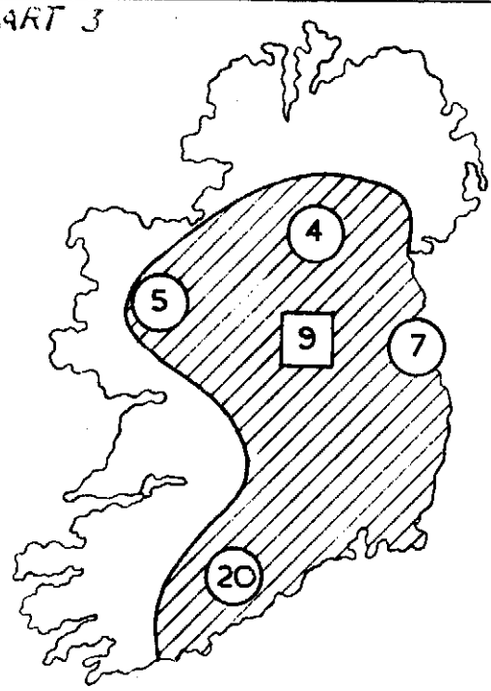
May 13th

CHART 2



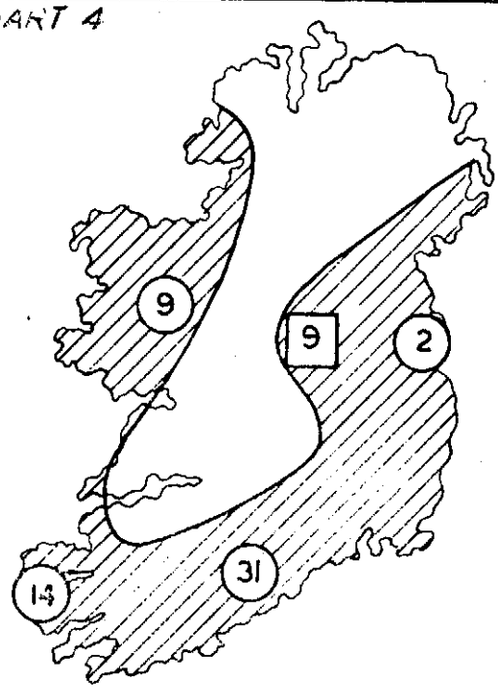
May 14th

CHART 3



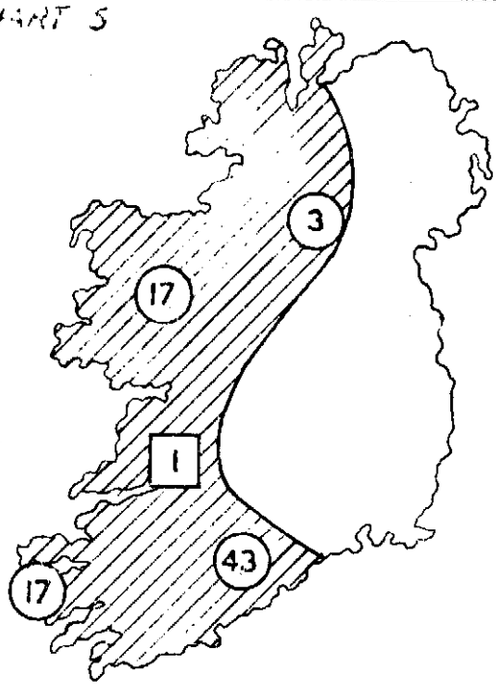
May 20th – 21st

CHART 4



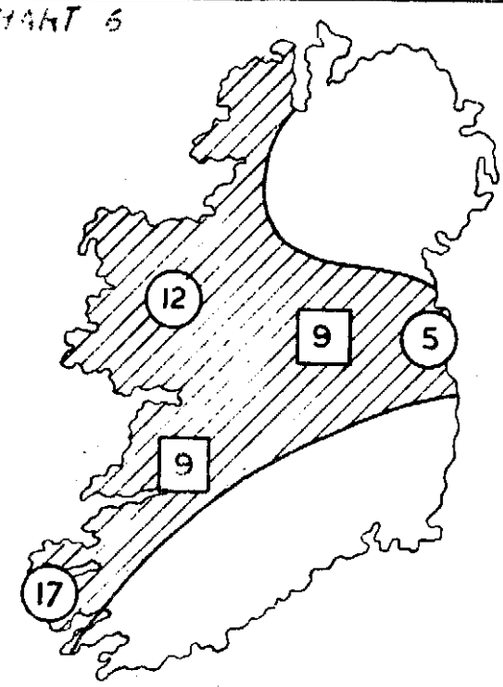
May 22nd – 23rd

CHART 5



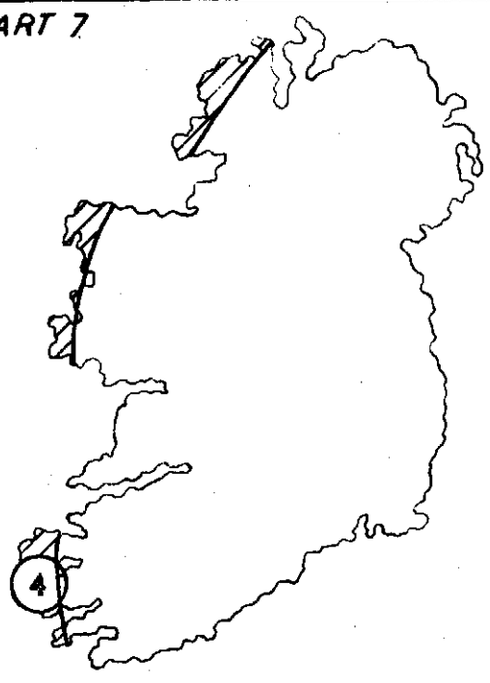
May 24th – 25th

CHART 6



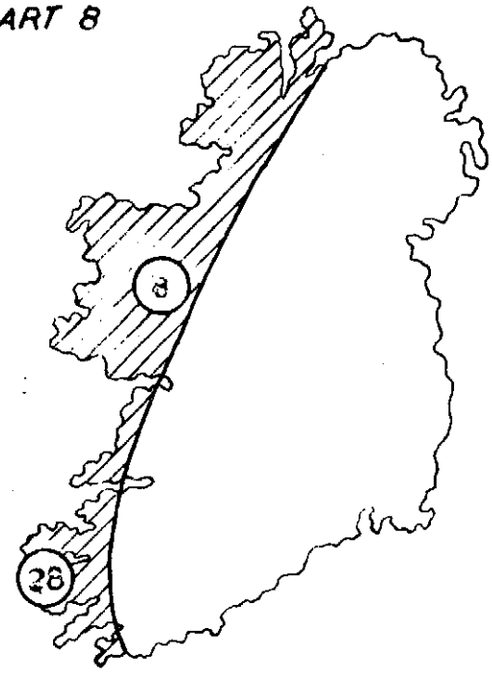
May 27th

CHART 7



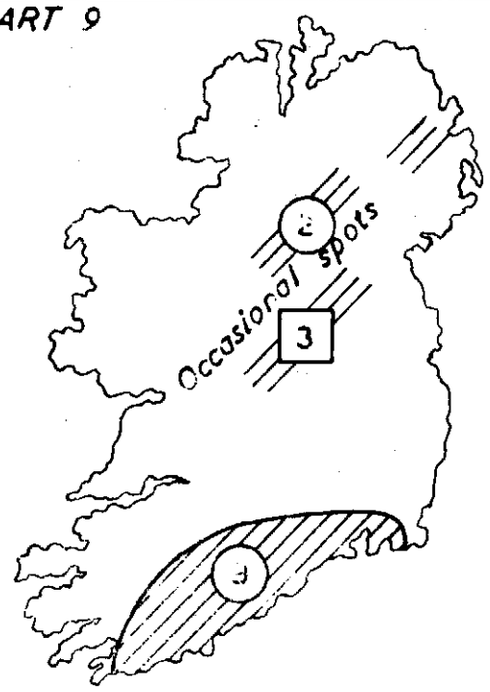
May 29th

CHART 8



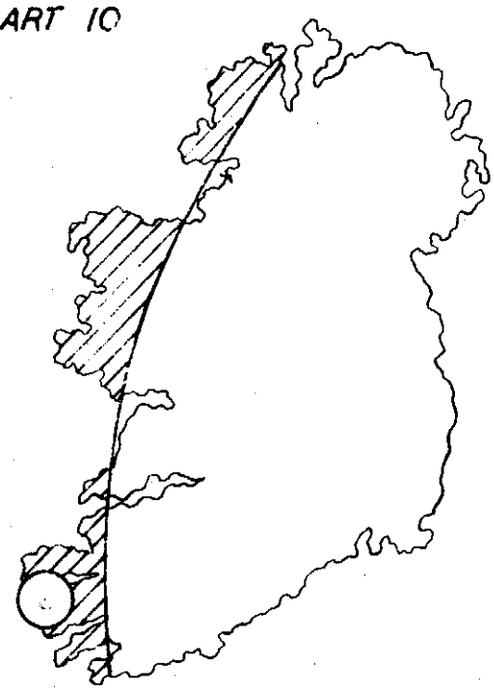
May 30th – 31st

CHART 9



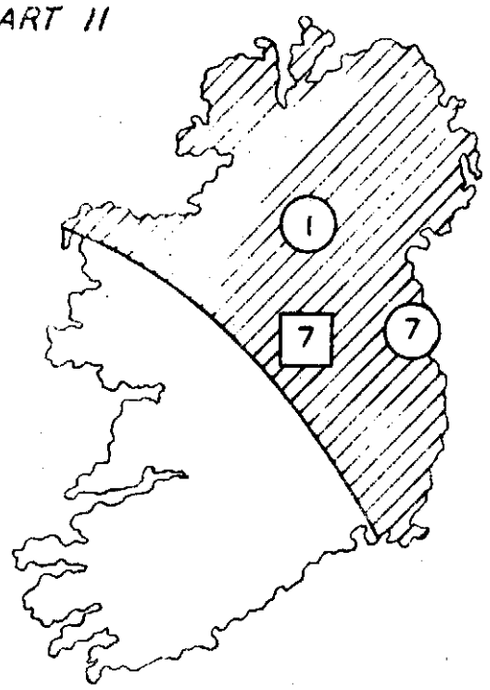
June 10th

CHART 10



June 13th

CHART 11

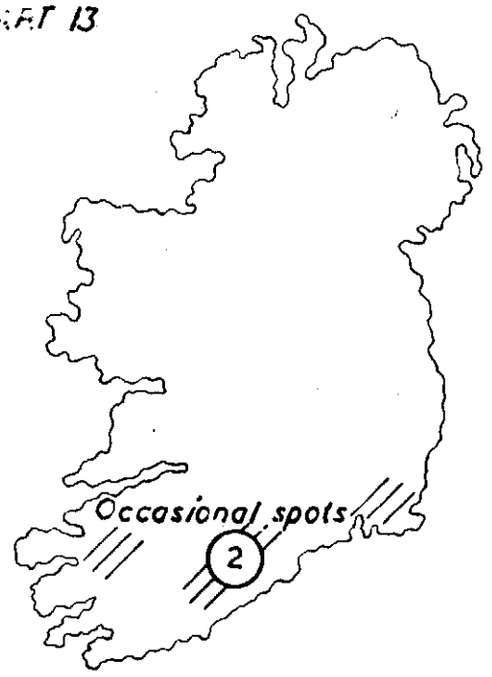


June 15th

CHART 12

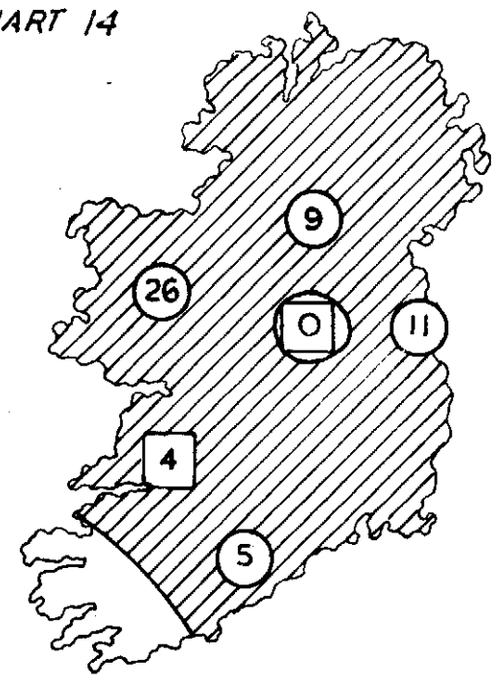
June 16th

CHART 13



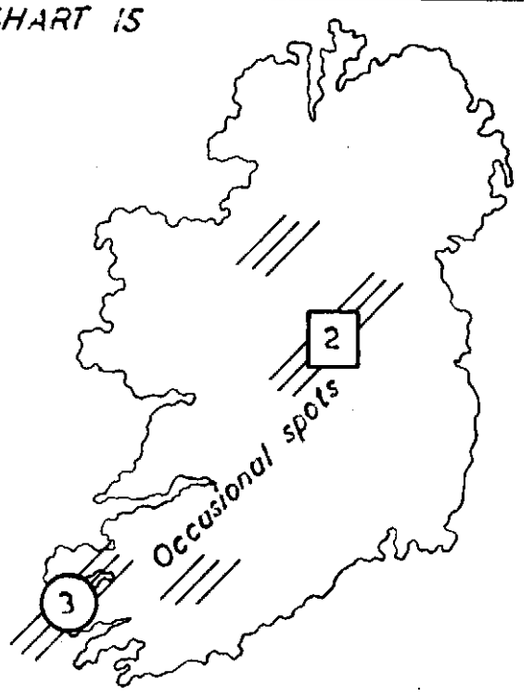
June 19th

CHART 14



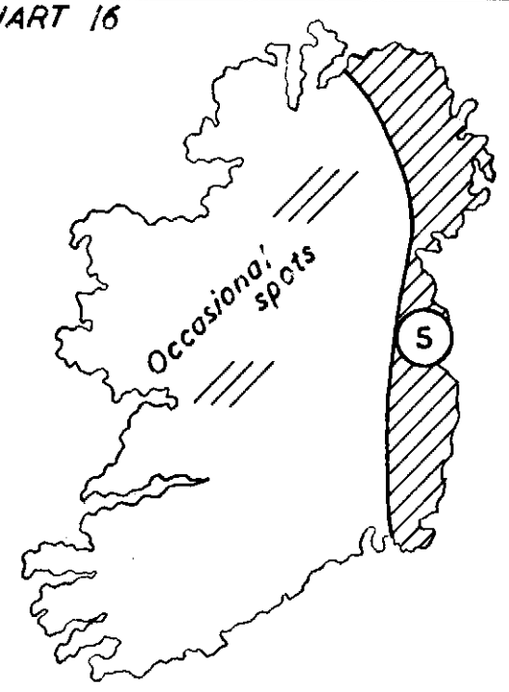
June 21st – 22nd

CHART 15



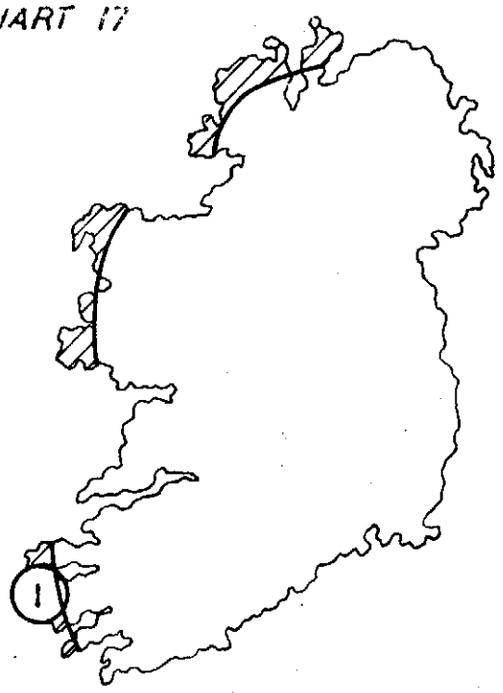
June 25th

CHART 16



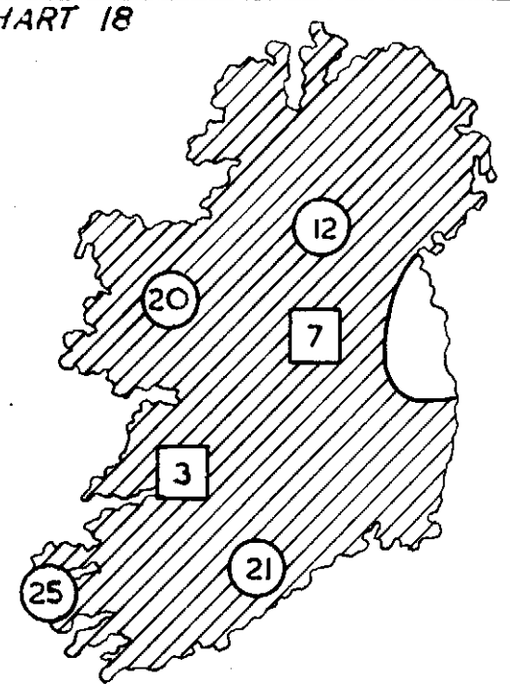
June 26th – 28th

CHART 17



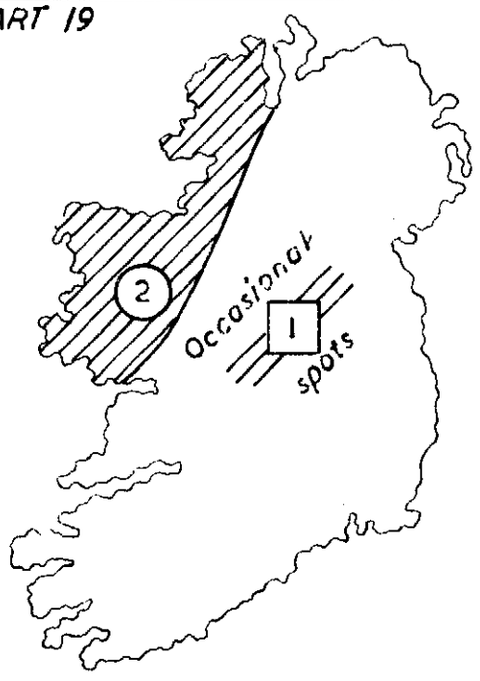
June 30th – July 2nd

CHART 18



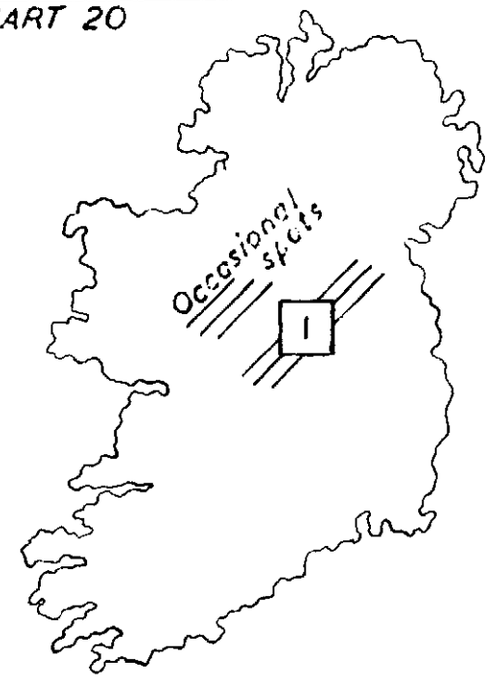
July 5th – 6th

CHART 19



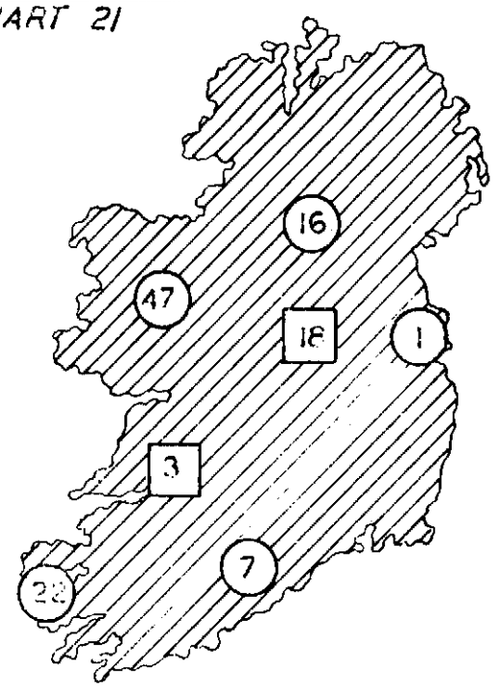
July 7th

CHART 20



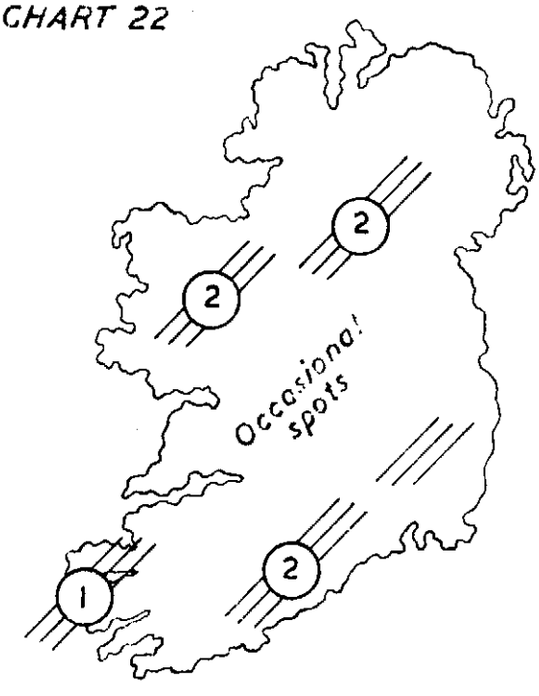
July 9th

CHART 21



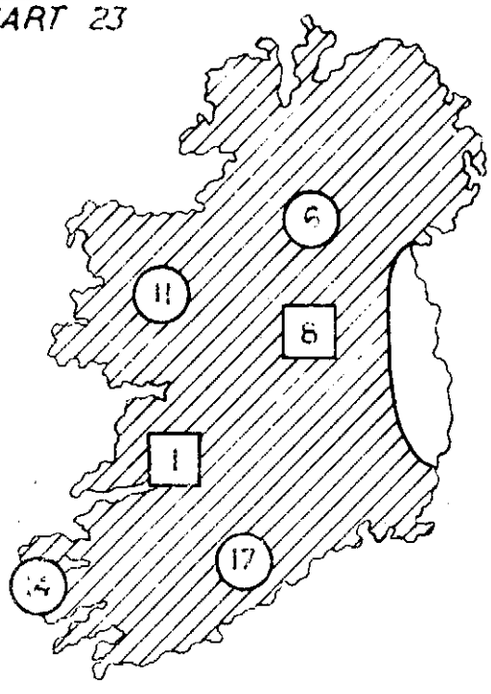
July 11th — 13th

CHART 22



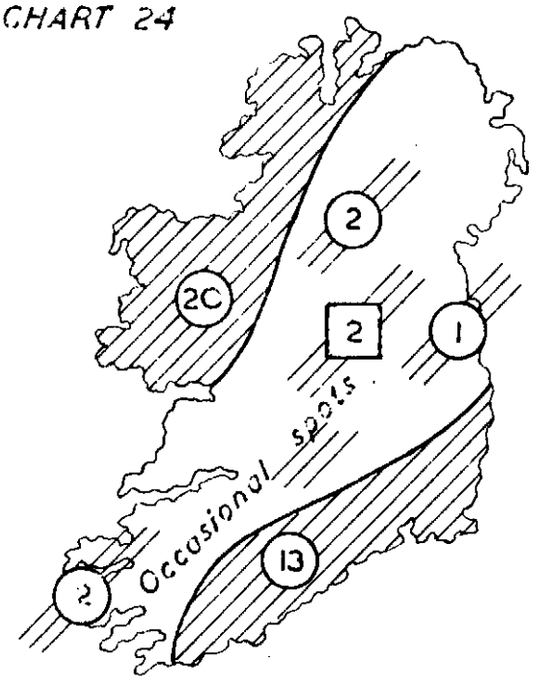
July 16th

CHART 23



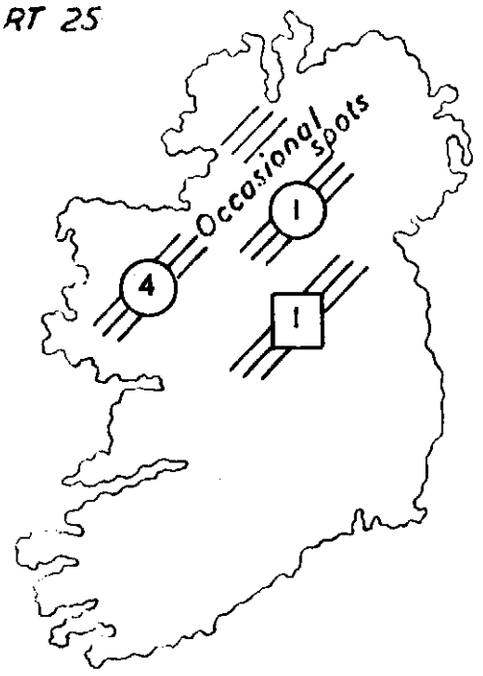
July 19th – 20th

CHART 24



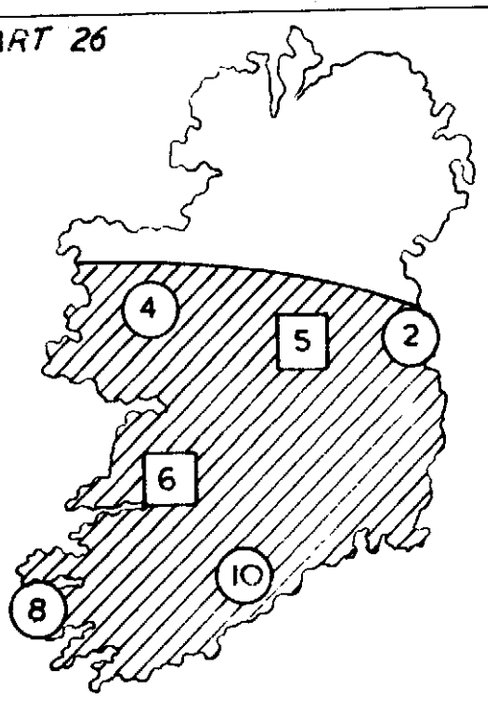
July 24th – 25th

CHART 25



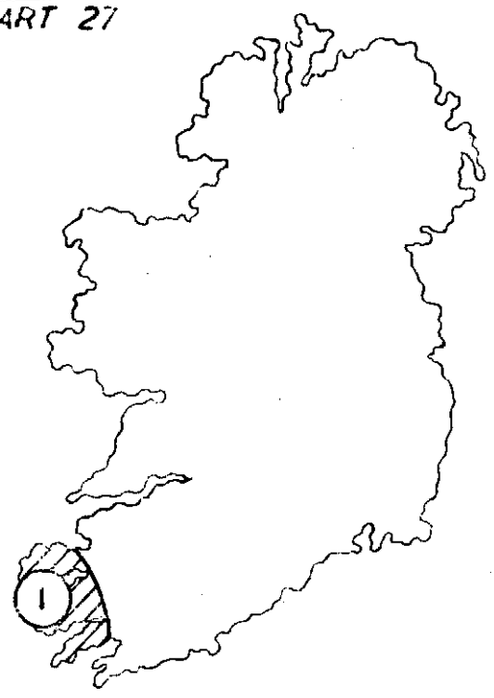
July 27th

CHART 26



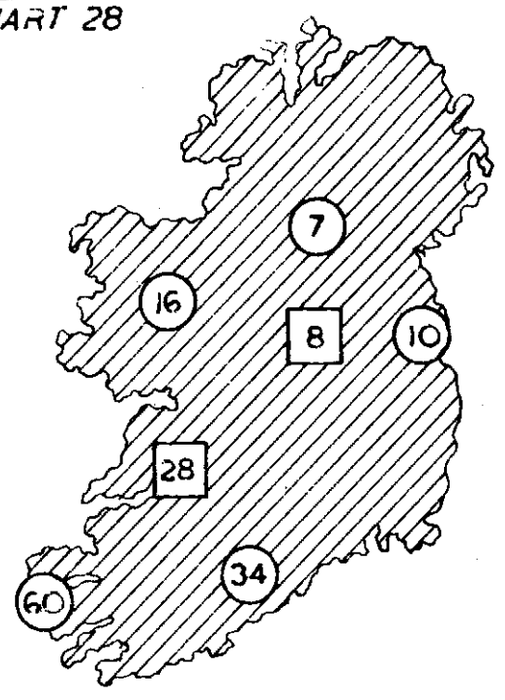
July 31st

CHART 27



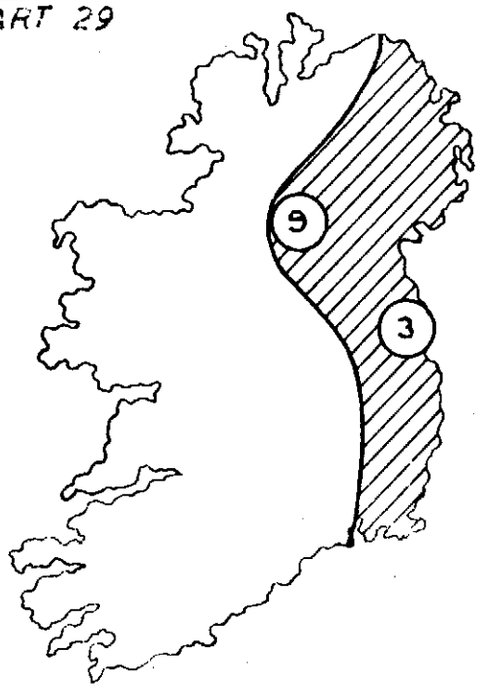
August 3rd

CHART 28



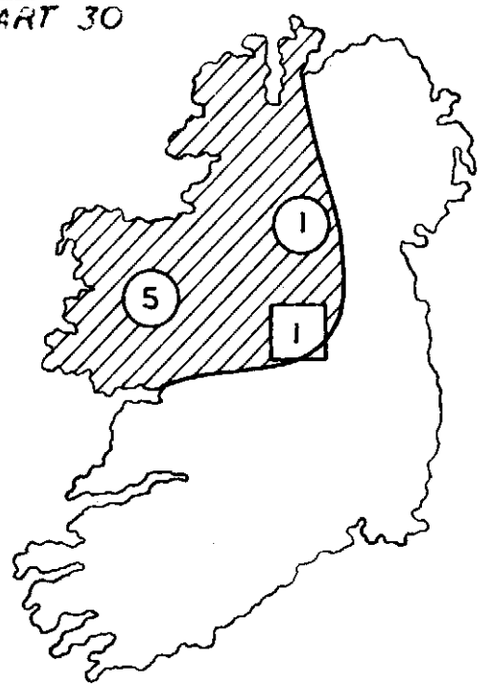
August 4th – 9th

CHART 29



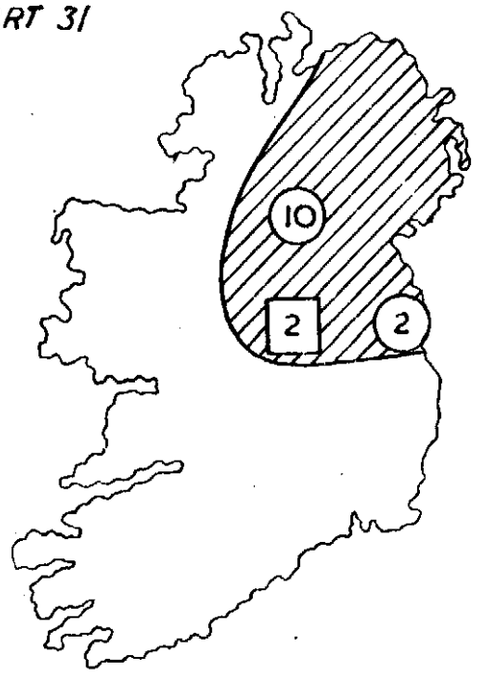
August 14th–15th

CHART 30



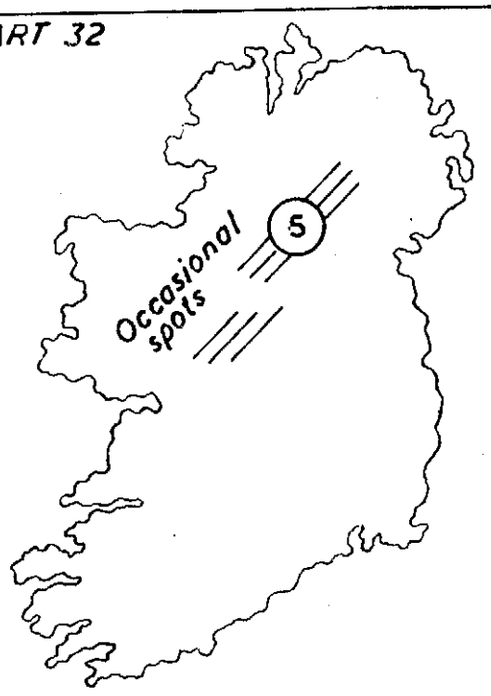
August 17th

CHART 31



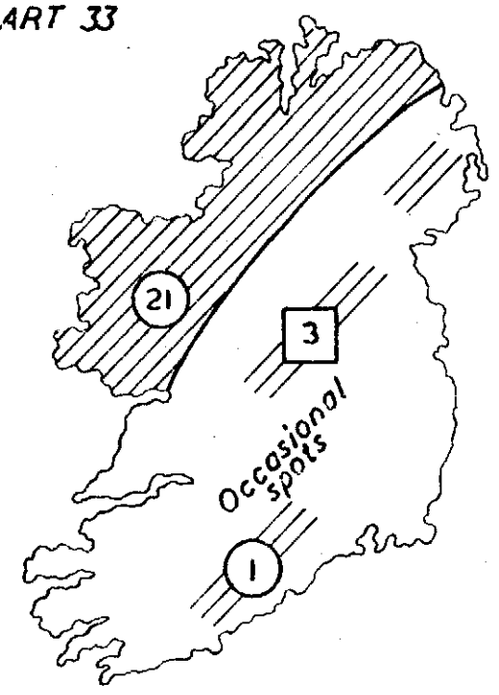
August 20th

CHART 32



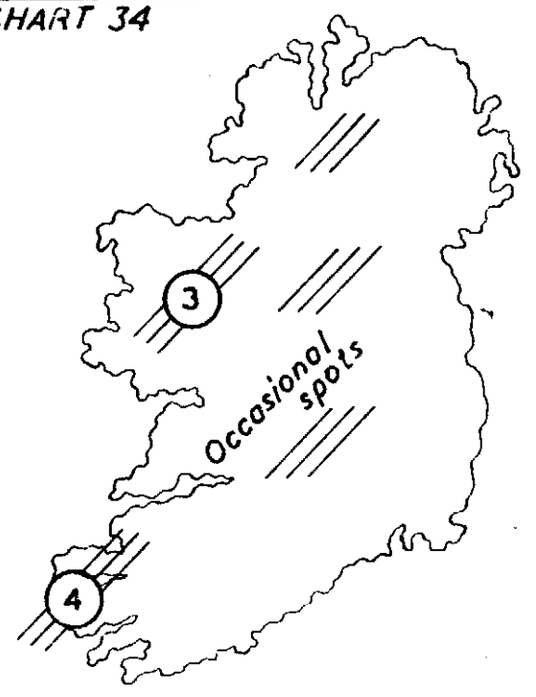
August 22nd

CHART 33



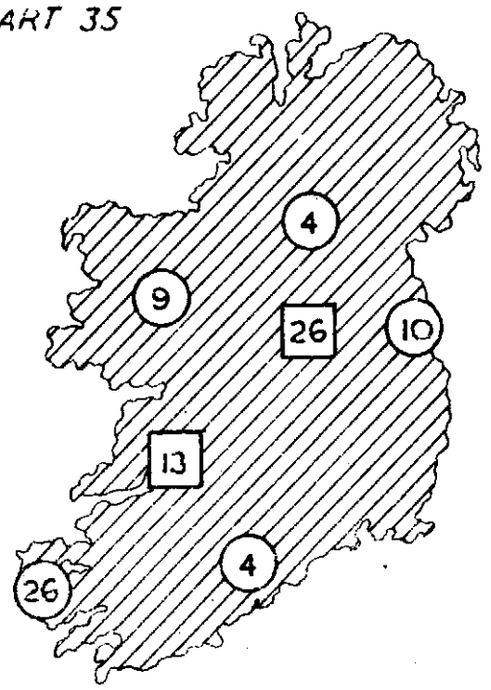
August 24th–25th

CHART 34



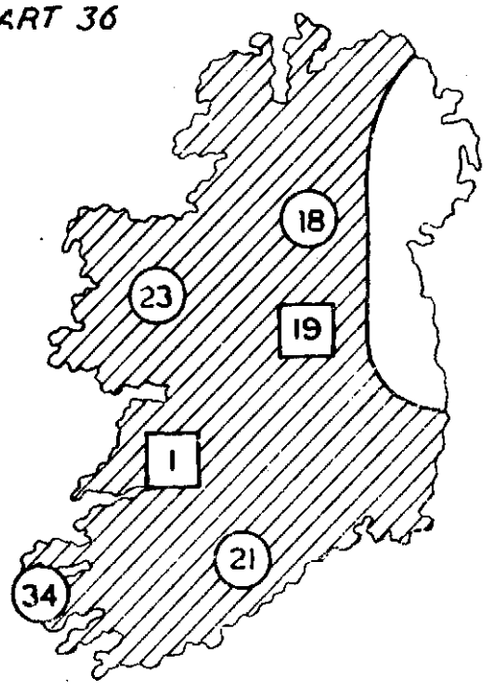
August 28th

CHART 35



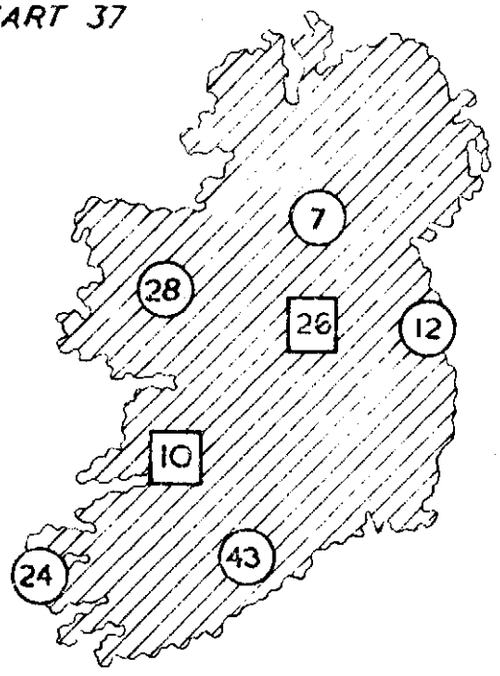
August 29th-30th

CHART 36



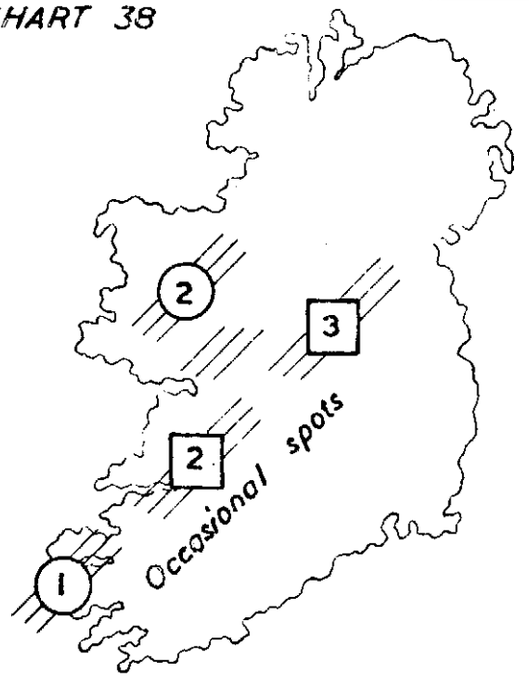
August 31st – September 2nd

CHART 37



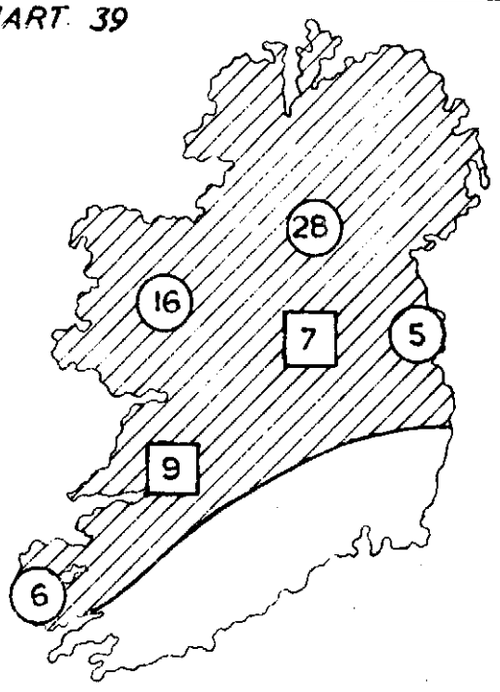
Sept. 4th – 6th

CHART 38



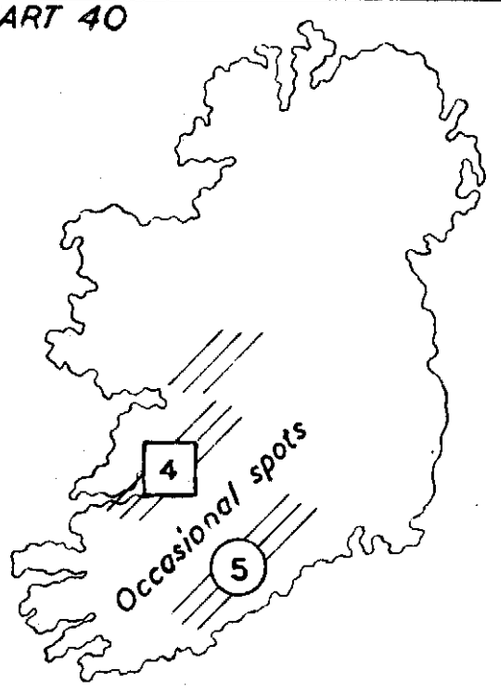
Sept. 7th – 9th

CHART 39



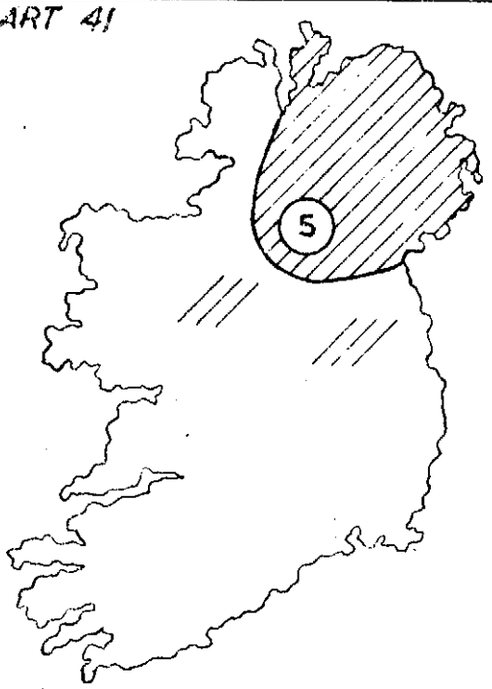
Sept. 11th – 13th

CHART 40



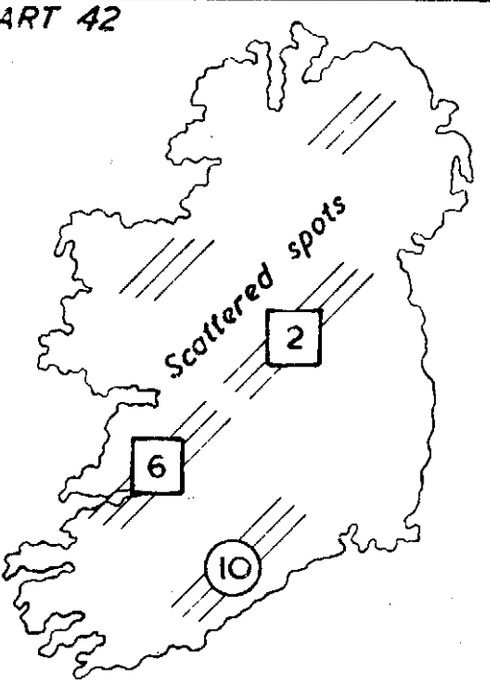
Sept. 14th – 15th

CHART 41



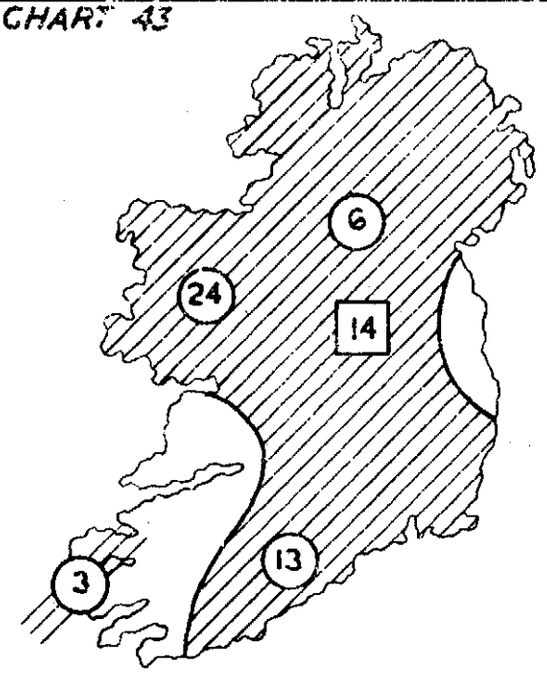
Sept. 16th

CHART 42



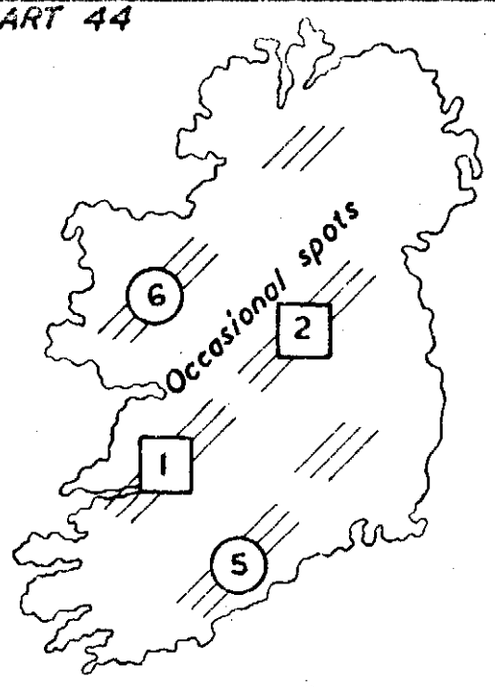
Sept. 17th – 18th

CHART 43



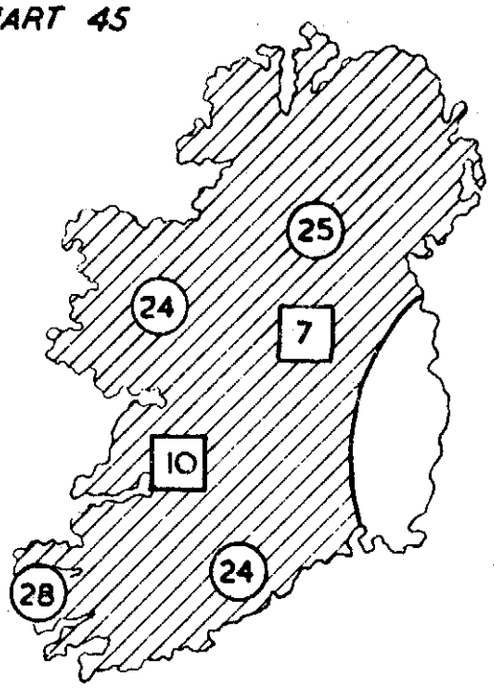
Sept. 19th – 20th

CHART 44



Sept. 22nd–24th

CHART 45

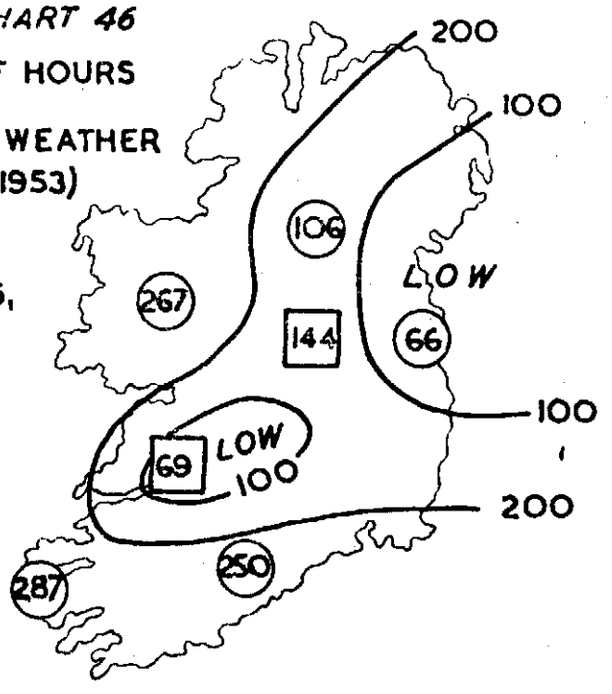


Sept. 25th – 27th

CHART 46

TOTAL NUMBER OF HOURS
OF
EFFECTIVE BLIGHT WEATHER
(MAY – AUGUST 1953)

Note: This covers cases 1 to 36, inclusive.



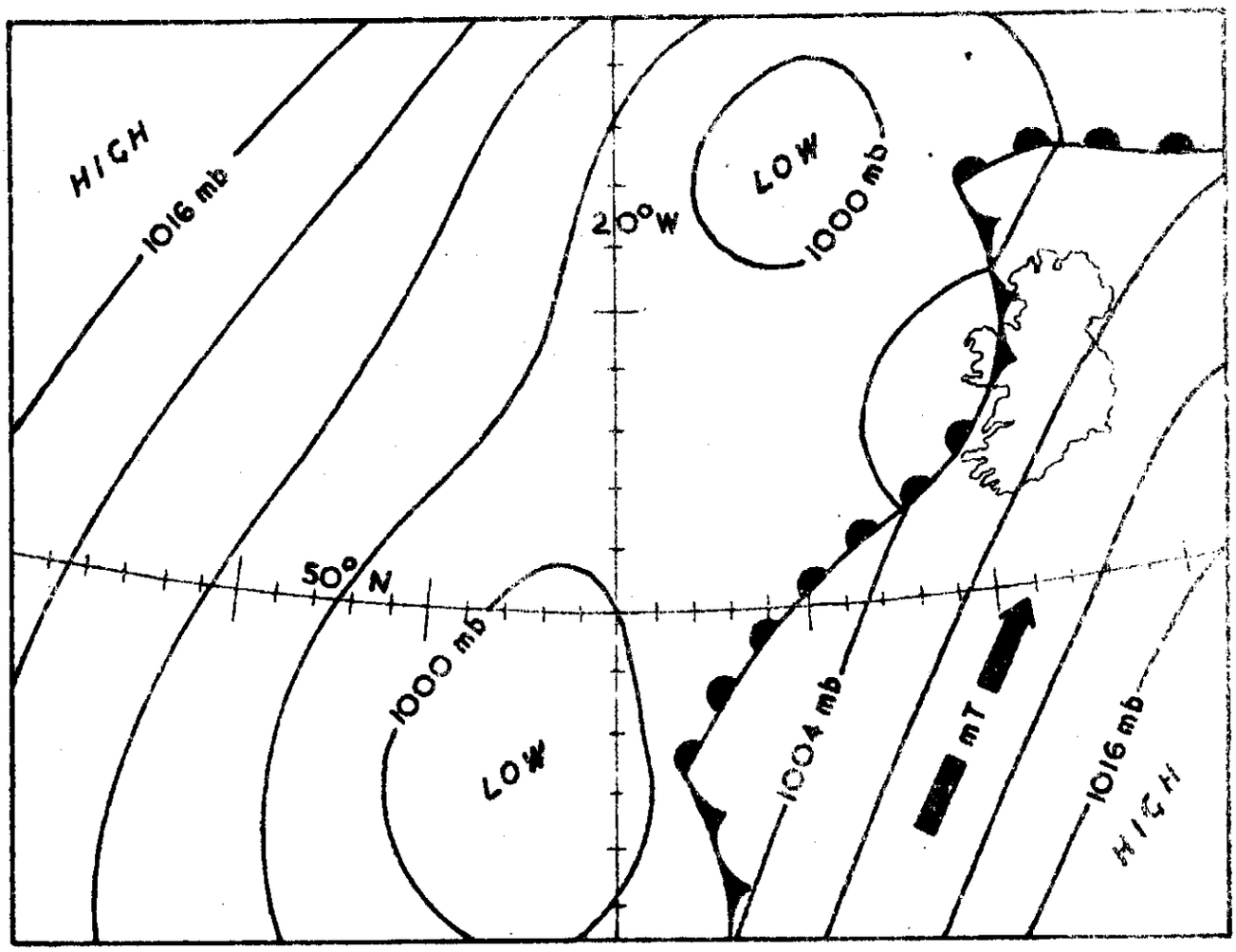


CHART 47: 0600 GMT MAY 23rd.

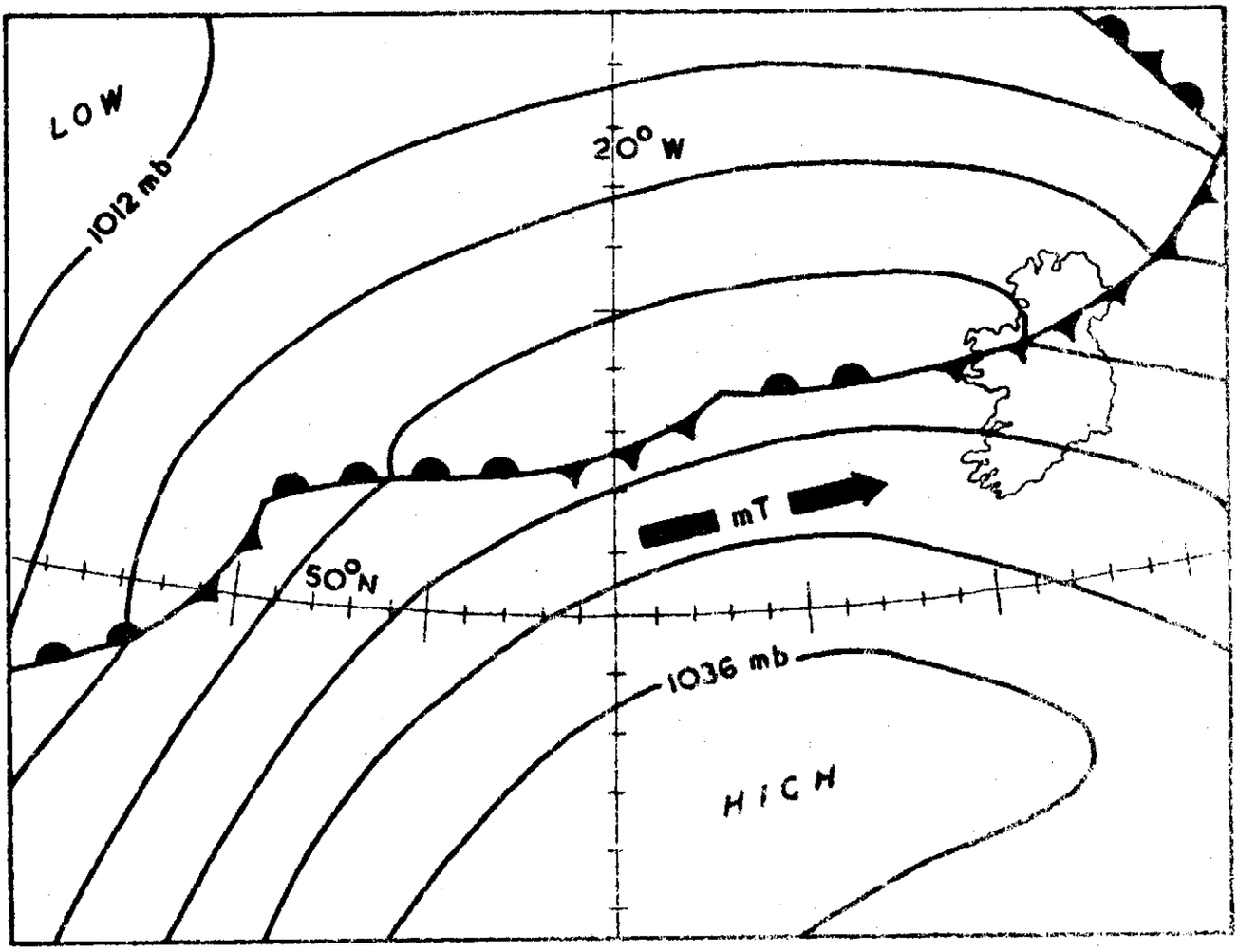


CHART 48: 0000 GMT MAY 27th.

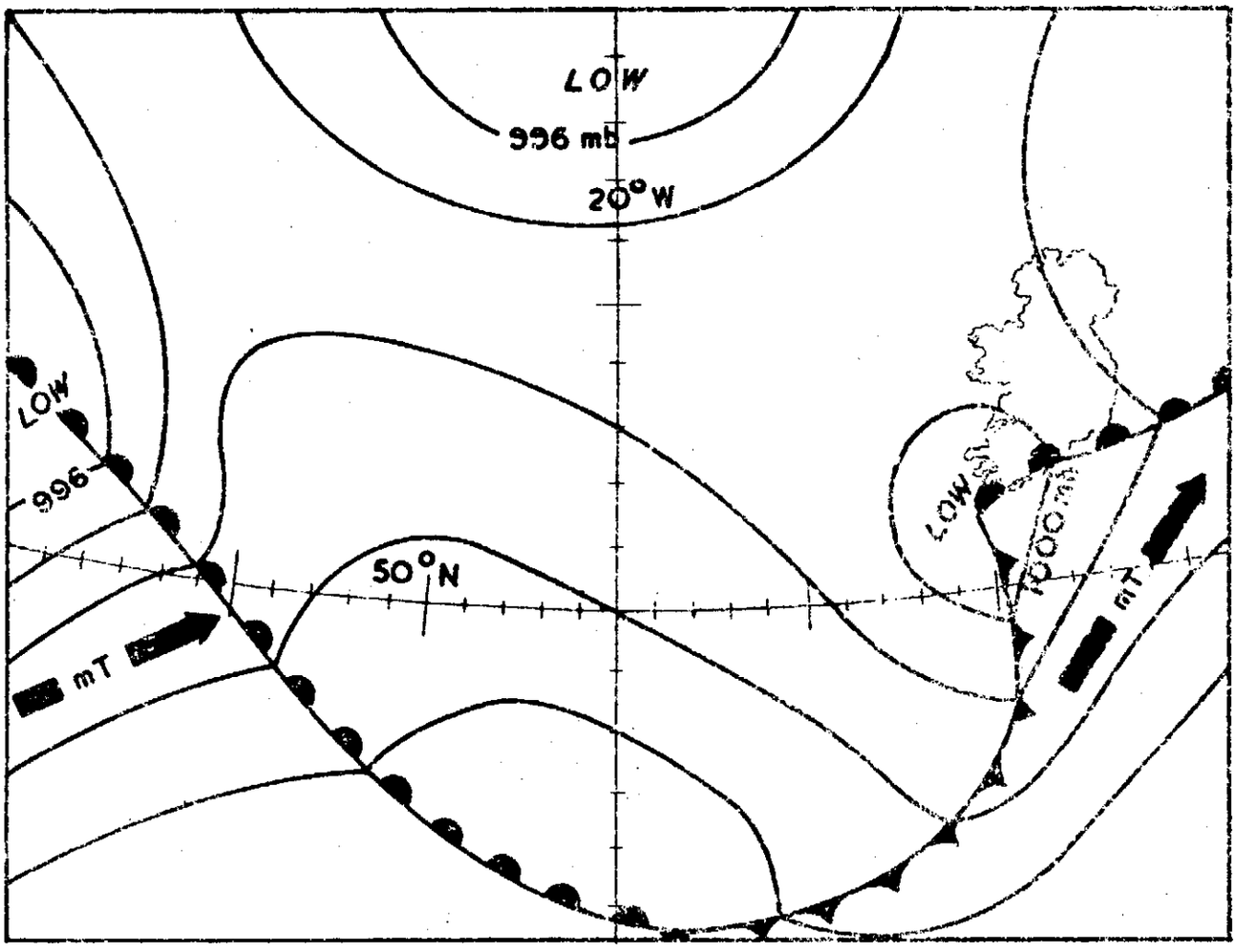


CHART 49: 0600 GMT JUNE 21st.

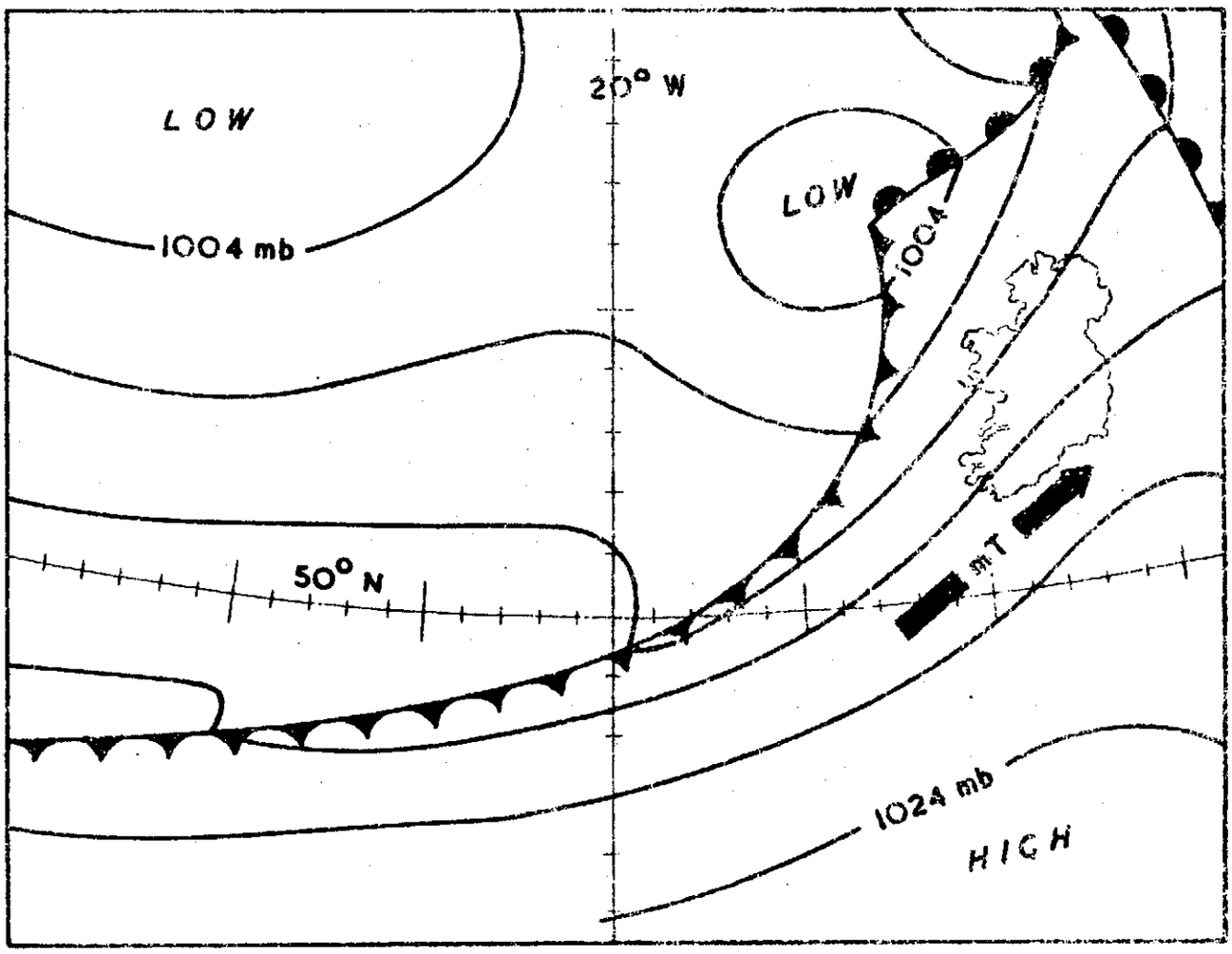


CHART 50: 1200 GMT JULY 5th.

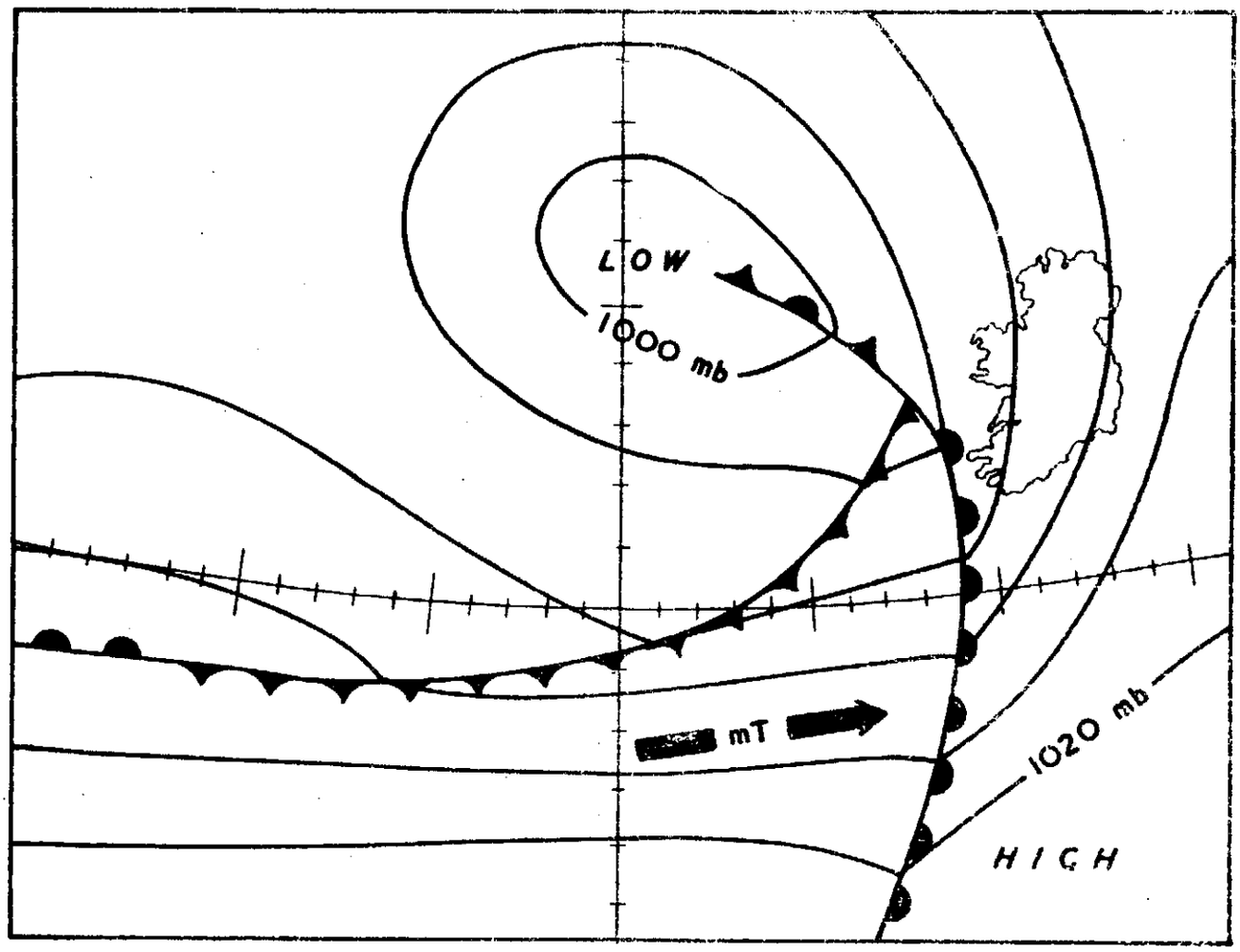


CHART 51: 0600 GMT JULY 11th.

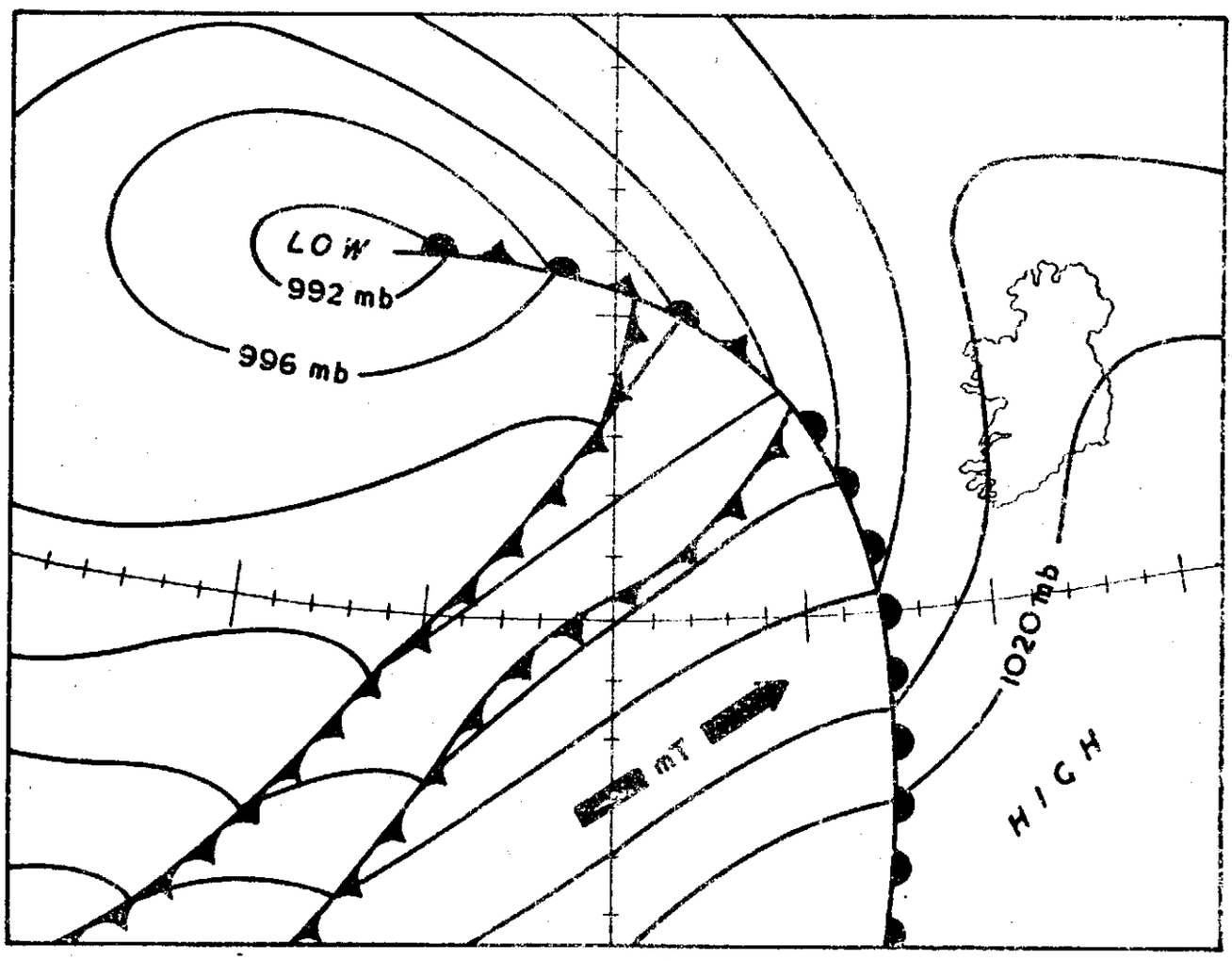


CHART 52: 1200 GMT JULY 19th.

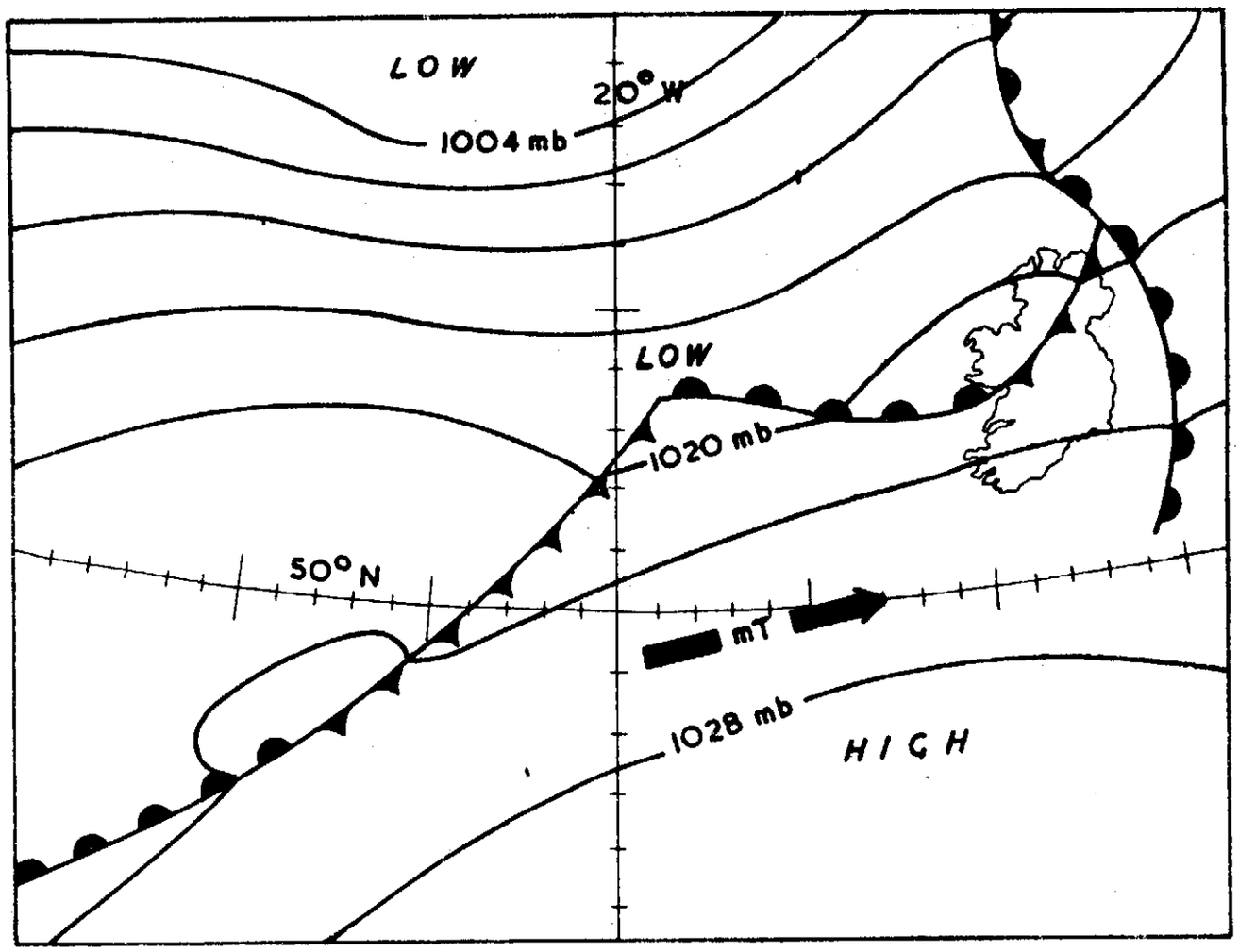


CHART 53: 0000 GMT AUGUST 4th.

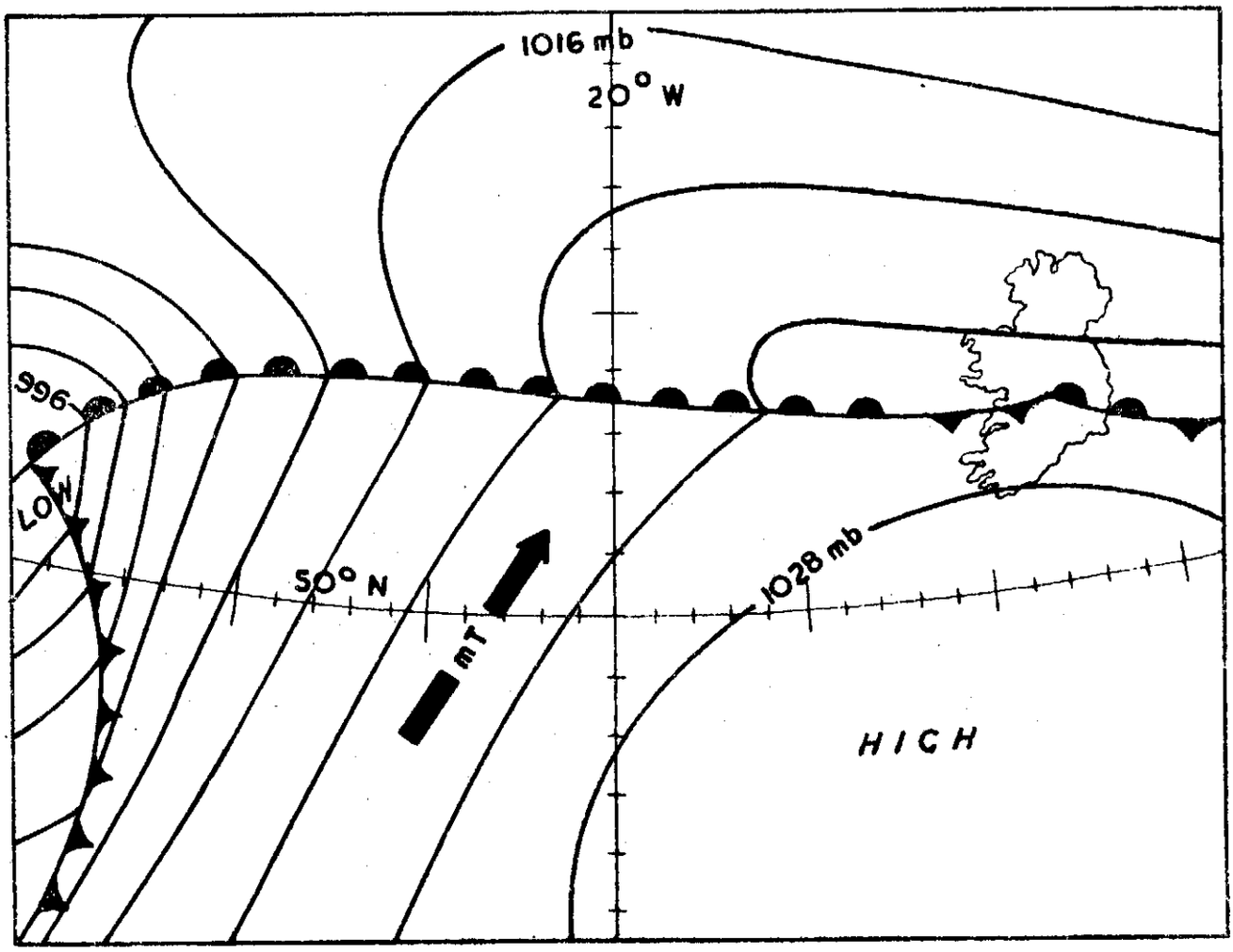
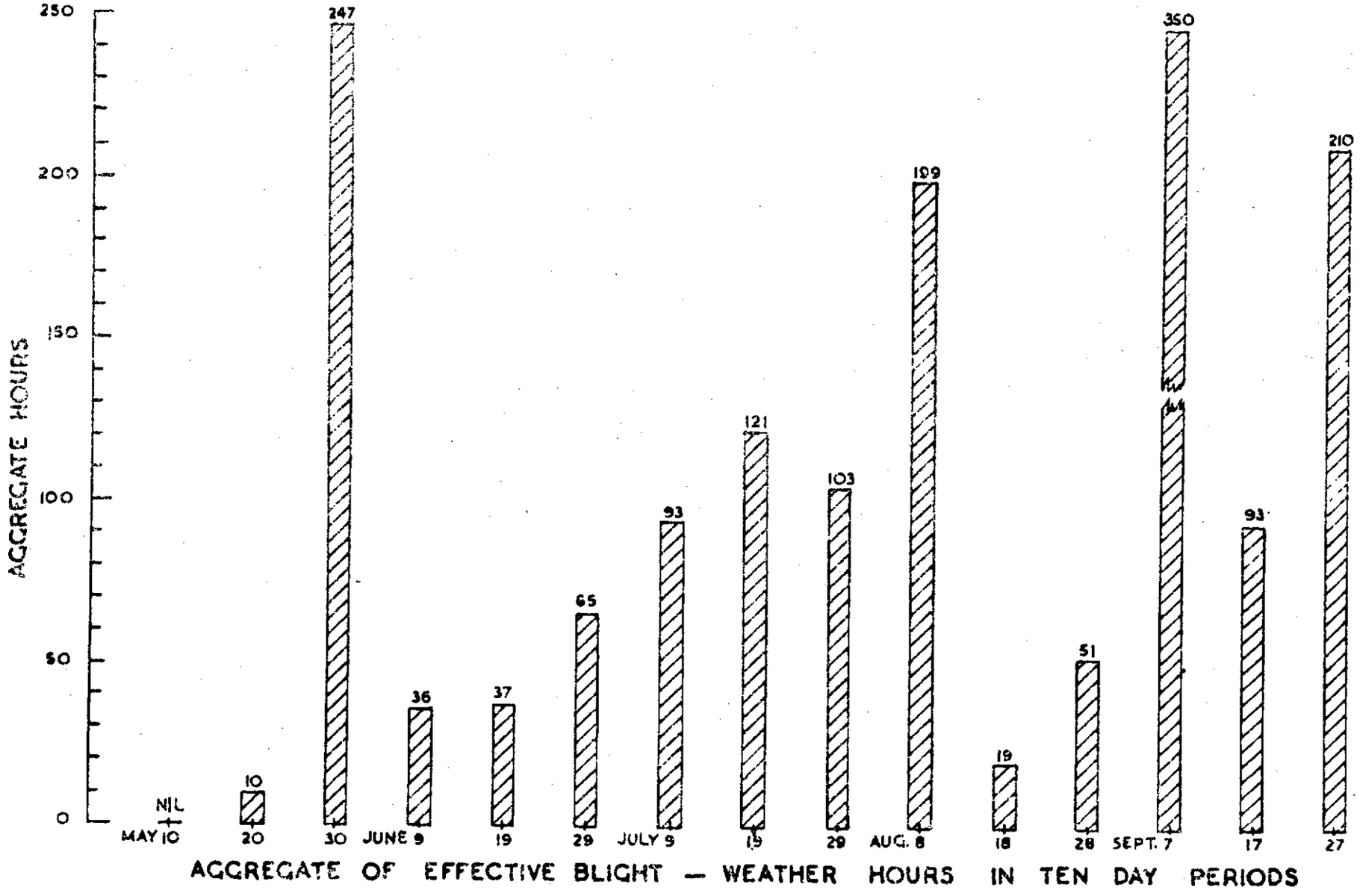
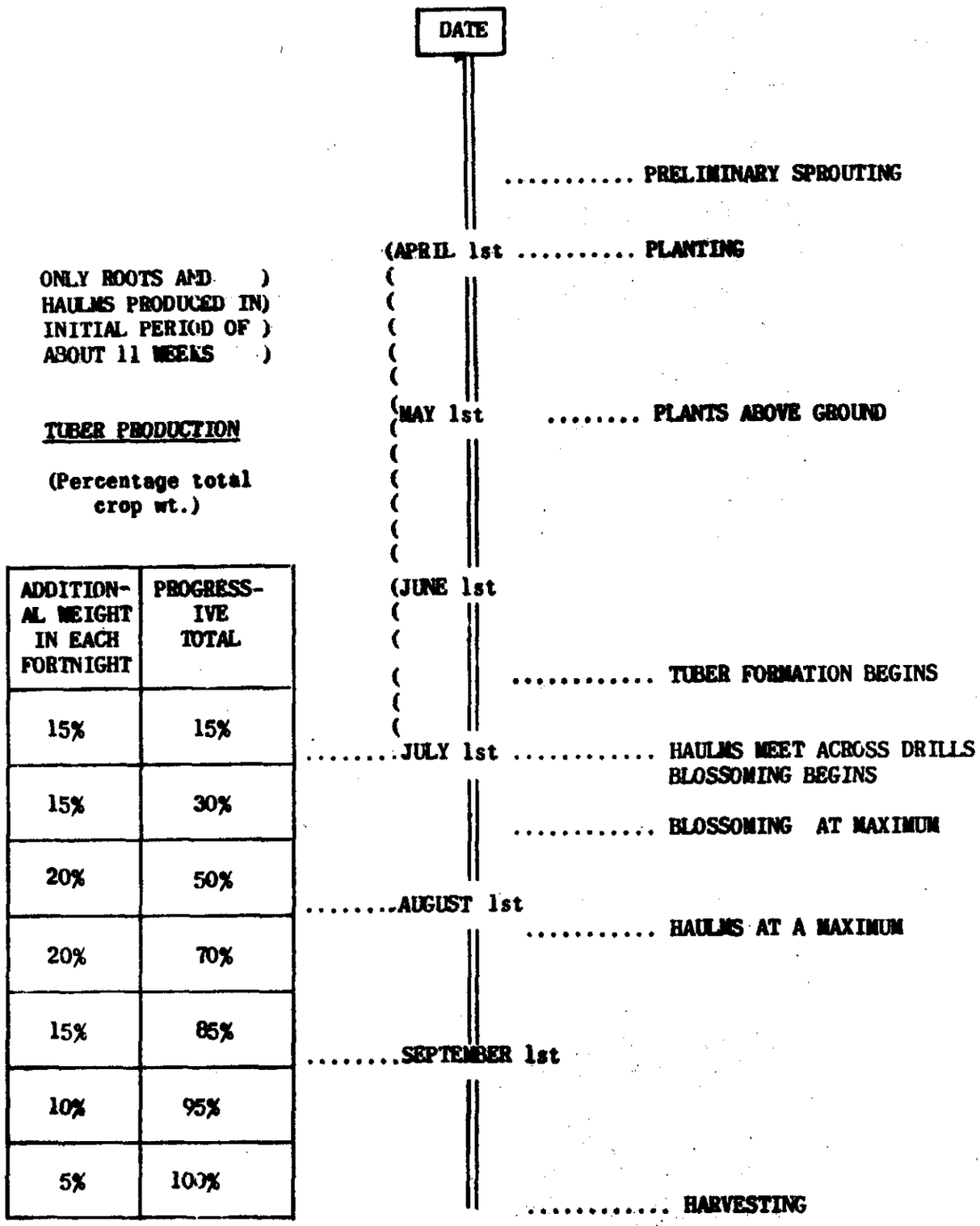


CHART 54: 1200 GMT AUGUST 5th.



The columns represent the total number of hours of blight-weather experienced at the seven observing stations in the ten-day periods ending on the date in 1953 shown at the foot of the column

CHART 55



ADDITIONAL WEIGHT IN EACH FORTNIGHT	PROGRESSIVE TOTAL
15%	15%
15%	30%
20%	50%
20%	70%
15%	85%
10%	95%
5%	100%

Chart 56: IDEALISED DIAGRAM OF SEASONAL GROWTH OF MAINCROP POTATOES IN IRELAND