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PART II.

MAGNETIC DISTURBANCE

AND ITS RELATIONS TO

AURORA

BY

CHARLES CHREE, M.A., Sc.D., LL.D., F.R.S.

WITH FIFTY-SIX TABLES.

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CHARLES CHREE, Sc.D., LL.D., F.R.S.

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CHAPTER I.—DAILY CHARACTER FIGURES.

§ 1. As is well known, magnetic disturbance is not in general a local phenomenon. A day that is highly disturbed anywhere in ordinary latitudes is highly disturbed everywhere, and similar remarks apply to specially quiet conditions. An international scheme exists for the characterisation of days, and for the selection for each month of the five days most representative of quiet conditions, and the five days most representative of disturbance. Each of the co-operating observatories, some forty at present, sends to De Bilt, Netherlands, its estimate of the disturbance shown by its magnetic curves on the scale 0 quiet, 1 moderately disturbed, 2 highly disturbed. The arithmetic mean of these estimates, as calculated at De Bilt, is regarded as a character figure measuring the disturbance of the day. These character figures run from 0·0, representing the quietest of conditions, to 2·0, the most highly disturbed. A selected quiet day seldom has a character figure exceeding 0·2, and the character figure of a selected disturbed day usually exceeds 1·0, but in a quiet year like 1913 it may be as small as 0·8 or even 0·7. At the year's end a list is issued from De Bilt which gives the character figure for each day, with particulars of the selected quiet and disturbed days.

The mode of attaching character figures is not the same at all stations. The quickest plan, though it may not tend to the maintenance of a uniform standard, is to be guided by the greater or less general irregularity of the trace. The daily range of any magnetic element varies with the season of the year, being usually much smaller at mid-winter than at mid-summer. Speaking generally, disturbance increases the daily range, and if allowance can be made for the annual variation, the range can be used as a criterion of disturbance. A method of doing this is considered later. But the method, the results of which we shall first consider, was to assign character figures 0, 1, 2 according to the general appearance of the trace, 0 representing few irregular short period oscillations, and none of them large at any time of the day, and 2 representing large irregular oscillations during part at least of the day. 1 represented intermediate conditions. As the object was partly to descriminate between the days of the month, the standard would naturally vary somewhat, the tendency being for 1 to represent more disturbed conditions in a disturbed than in a quiet month.

The character figures thus arrived at for each (Greenwich) day from March 22 1912, to August 7, 1913, appear in Table XVIII. Up to November 18, 1912, three character figures are given for each day. The first is that assigned at Cape Denison and the third is that assigned at Cape Evans (the base station of the Scott Expedition), both on the scale 0, 1, 2 just described. The intermediate figure is the international character assigned at De Bilt. For example, the international figure for March 22, 1912, was 0·8, while the character figures, based on the Cape Denison and Cape Evans curves, were respectively 1 and 2. Subsequent to November 18, 1912, only the Cape Denison and international figures are given.

Occasions are numerous when one hesitates between a 0 and a 1, or between a 1 and a 2. The Cape Denison and Cape Evans figures were both assigned by myself, but years elapsed between the two operations, and I thought it best not to consult the Cape Evans curves or the Cape Evans statistics whilst making the choice for Cape Denison. One's choice is no doubt influenced by the sensitiveness of the magnetographs. Short period oscillations which appear imposing on a highly sensitive trace, *e.g.*, one in which 1 mm. of ordinate answers to 1γ (0·00001 C.G.S.), may look trifling on a trace in which 1 mm. represents 10γ. Scale values in the H (horizontal force) and V (vertical force) instruments at Cape Denison were a good deal more variable than those of any of the Cape Evans instruments. This would naturally tend to make the magnetic character standard more variable at the former station than at the latter.

There was only one common element, V, at the two stations. In September to November, 1912, the two V instruments had much the same sensitiveness. At other times the Cape Denison instrument was the more sensitive, and at times its sensitiveness was double that of the other. The two other Cape Evans instruments measured two rectangular horizontal components of force, one N′ departing some $7\frac{1}{2}°$ from geographical north, the other E′ departing an equal amount from geographical east. The sensitiveness in both these instruments was very similar to that of the H instrument at Cape Denison from July to November, 1912, but in May and June, 1912, the H instrument was much more sensitive than the Cape Evans instruments. The D (declination) instrument at Cape Denison, regarded as a measurer of changes of force, was much the most sensitive of all the instruments. On the ordinary day the D oscillations at Cape Denison looked enormous as compared with the synchronous oscillations in any of the Cape Evans curves. This would naturally have led to larger character figures for Cape Denison than for Cape Evans if I had allowed as much weight to the D curves as to the others. As a matter of fact, when good H and V curves were available—the behaviour of the V magnetograph was not always satisfactory—I allowed very little weight to the D curves, but during December, 1912, and the early part of January, 1913, they alone existed.

§ 2. Table XIX gives the dates of the international quiet days, and of the days which according to the international character figures were the five most disturbed days of each month. For brevity these latter days will be described as the international disturbed days, though the practice of a formal international choice of disturbed days was not adopted until subsequent to 1913. Table XIX also contains the Cape Denison character figures for the international quiet and disturbed days. A glance suffices to show how thoroughly representative the international days are even in high southern latitudes. Of the 46 international disturbed days of 1912 included, 43 got character 2. Of the 35 disturbed days of 1913, 10 got character 1. But in the two last months, June and July, only two days were assigned character 2, and both days are included in Table XIX. No international disturbed day, it will be observed, got a 0. Of the 83 international quiet days included in Table XIX, 43 were awarded 0, and only one, December 2, was awarded a 2. Only D curves, it will be remembered, were available for December, and as 18 of the 30 days for which records existed got a 2, and none got a 0, much significance cannot be attached to this one exception. Still it shows that occasionally considerable disturbance may prevail in high latitudes on days which in ordinary latitudes are more than usually quiet.

There are several examples in Table XIX of the tendency to runs of successive disturbed or quiet days. March and May, 1913, show sequences of disturbed days, while July, 1912, and April and May, 1913, show sequences of quiet days.

Table XIX also affords examples of the 27-day recurrence interval in magnetic conditions. An example of the recurrence of a magnetic storm at the 27-day interval is afforded by the sequence December 23, 1912, and January 19, February 15, March 14, April 10, May 7 and June 3, 1913. An apparent 27-day recurrence of quiet conditions is afforded by June 15, July 12 and August 8, 1912. This subject is considered further presently.

§ 3. Table XX gives the monthly means of the Cape Denison and the international character figures for all days of the month, and for the international quiet and disturbed days. According to the international figures the 16 months included in Table XX did not differ much as regards disturbance. April, 1913, had the highest character figure 0·54, and July, 1912, the lowest, 0·41. According to the international figures November, 1912, to January, 1913, was not a specially disturbed time, and there was little difference between May, June and July, 1912, and May, June and July, 1913. The Cape Denison figures, on the other hand, show a large apparently seasonal fluctuation, mid-summer—November to January—having much larger character figures than mid-winter—May to July. Also from April to July, the mean characters are much larger for 1912 than for 1913.

Table XXI aims at showing more minutely how the relation between the Cape Denison and the international character figures varied with the season of the year. Results are given for all the days available (A), and for the days falling in three seasons Winter (W), May to August, 1912, and 1913, Equinox (E) represented by September and October, 1912, and March and April, 1913, and Summer (S) consisting of the four months, November, 1912, to February, 1913. March and April days in 1912 were included in "All" days, but not in the "Equinox," where they were omitted with a view to having as nearly as possible the same mean date for the three seasons. What Table XXI gives is the number of occasions when a specified Cape Denison character figure, 2, 1, or 0, was associated with certain international character figures. The international figures were collected into seven groups, so as to include a moderate number of days in each group. The first group, including all days with characters 0·0 or 0·1, contained in all 139 days. The character figures assigned to these days at Cape Denison were on 5 days 2, on 63 days 1, and on 71 days, being a clear majority 0.

Of these 139 days, 59 were winter days, and of these 17 got a 1, and 42 a 0 at Cape Denison. Of the balance of 139 — 59 or 80 days, 31 occurred in the equinoctical season, 36 in the summer season, and the remainder in March or April, 1912. As the international figure goes up, the proportion of days getting a 0 at Cape Denison diminishes. No summer day with international character exceeding 0·1 gets a 0 at Cape Denison, and no day with international character exceeding 0·7 gets a 0 at any season. The majority of days with international characters exceeding 0·7 get a 2 at Cape Denison, and all days of the final group, *i.e.*, international character 1·5 or more, get a 2.

The last four columns of Table XXI give the arithmetic means of the Cape Denison character figures for each of the seven groups of international characters. For example, if we take the days when the international figure was 0·2 or 0·3, the corresponding mean Cape Denison character figure was 0·91 for all days, 0·62 for the eight winter months, 0·97 for the four equinoctical months, and 1·53 for the four summer months. The difference between the figures for the equinoctical months and for all months is usually small. The difference between the summer and winter seasons is pronounced only when the international character figure does not exceed 0·7, but for the lower classes it is very large indeed.

§ 4. Table XXII in its last six columns shows another aspect of the picture presented by Table XXI. Dividing the days of each month into three groups according as the Cape Denison character figure was 2, 1 or 0, it gives for each group the corresponding mean international character figure. The first three columns give the corresponding means of the Cape Evans character figures for the seven complete months for which there were records from both stations.

It will be seen that the mean international character figure for the days which were assigned character 0 at Cape Denison shows only minor fluctuations from month to month, and is practically the same for 1912 and 1913. But the mean international character figure answering to 1 or to 2 at Cape Denison shows a conspicuous seasonal variation, and the value for 1913 notably exceeds that for 1912. The exact significance of these differences is open to a certain amount of doubt. Compare, for example, November, 1912, and April, 1913. The average day getting a 2 at Cape Denison in November, 1912, had an international character figure of 0·66, while the average day getting a 2 at Cape Denison in April, 1913, had an international character figure of 1·17. The result might mean a change in the standard at Cape Denison, 2 being awarded for much smaller disturbance in November, 1912, than in April, 1913. Or it might mean a change in the international standard, the same amount of disturbance getting a higher character figure in 1913 than in 1912. But it might mean that, relative to the world at large, Cape Denison was much more highly disturbed during November, 1912, than during April, 1913. There may have been other contributory causes, but the last is, I think, essentially the real explanation. Disturbance has a very pronounced seasonal variation in the Antarctic, summer being the time of maximum. This being winter in the northern hemisphere is a decidedly less disturbed time than the equinoctical season at the great majority of the stations which take part in the international scheme. As to a difference between 1912 and 1913, no one with the Cape Denison curves before him could fail to see the relative quietness of the winter months of 1913.

The figures in Table XXII for Cape Denison and Cape Evans show only irregular variations in the mean Cape Evans figure corresponding to character 2 at Cape Denison. But the mean Cape Evans figures answering to 1 and to 0 at Cape Denison show a decided tendency to be larger in the later months. More light is thrown on this subject by Table XXIII which represents the facts in a different way. Take April, for example. The 14 days awarded 2 at Cape Denison obtained seven 2's, four 1's and three 0's at Cape Evans. The 11 days awarded 1 at Cape Denison obtained three 1's and eight 0's at Cape Evans, and finally the 5 days awarded 0 at Cape Denison obtained one 1 and four 0's at Cape Evans.

The most outstanding result in Table XXII was the high value 0·75 of the Cape Evans figure in October corresponding to character 0 at Cape Denison. But Table XXIII tells us that in October, 0 was awarded to only four days at Cape Denison and one day at Cape Evans, so the significance of that particular figure is not great.

Returning to a consideration of Table XXIII we see that fully two thirds of the days which got a 0 at Cape Denison also got a 0 at Cape Evans, the remainder getting a 1. Of the 83 days awarded 2 at Cape Denison fully half also got 2 at Cape Evans; the rest obtained 1 at Cape Evans, with the exception of three April days, the 4th, 13th, and 23rd, which got 0. These were days of international character 0·2 or 0·3, so that what we should have expected at both Antarctic stations is a 1. Inspection of the curves shows in fact that it was a toss up between a 0 and a 1 at Cape Evans, and between a 1 and a 2 at Cape Denison. Even in the horizontal components the Cape Denison range was decidedly greater on all three days, but it was the excess of the V range at Cape Denison that was really decisive. The associations in Table XXIII of 1 at Cape Denison with 0 at Cape Evans are twice as numerous as the associations of 0 at Cape Denison with 1 at Cape Evans, and the associations of 2 at Cape Denison with 1 at Cape Evans are immensely more numerous than the associations of 1 at Cape Denison with 2 at Cape Evans. It is thus clearly apparent that either Cape Denison was a decidedly more disturbed station than Cape Evans, or else the standard of disturbance applied to the former station was decidedly the lower.

§ 5. The character figures were utilised for the purpose of seeing whether the 27-day interval in magnetic conditions manifested itself at Cape Denison. The international disturbed and quiet days were accepted as representative of disturbed and quiet conditions. The Cape Denison character figures for each of these disturbed days and for the two immediately preceding and immediately succeeding days were entered in five columns headed $n-2$, $n-1$, n, $n+1$, and $n+2$. Thus the entries in columns $n - 1$ and $n + 1$ referred to days which were respectively one day earlier and one day later than a representative disturbed day, the character of which was entered in column n. This was done for each of the 75 international disturbed days of the 15 months, April, 1912, to June, 1913. The sum of the 75 entries in each column furnished the primary disturbance pulse. The secondary disturbance pulse was obtained from the sums of the characters of the associated days in the six columns headed $n + 25$ to $n + 30$. The 75 days, for example, which contributed to column $n + 25$ were each 25 days later than one of the selected disturbed days. Take for instance the earliest of the disturbed days, April 5, 1912. The days whose character figures appeared in the columns headed $n - 2$ to $n + 2$ were April 3, 4, 5, 6 and 7; while the days whose character figures appeared in the columns headed $n + 25$ to $n + 30$ were April 30, and May 1, 2, 3, 4 and 5.

The selected quiet days and the days associated with them were treated in a precisely similar fashion, thus supplying primary and secondary quiet day pulses. The selected days ceased with June, 1913, because the days associated with selected July days would mostly have been August days for which no Cape Denison figures existed. The results of the operations appear in Table XXIV. The mean Cape Denison character figure for the whole 16 months was 1·08 and the corresponding sum for 75 days is 81. Thus difference from 81 in the figures in Table XXIV may be regarded as indicative of more than normal disturbance or of more than normal quietness, according as their sign is positive or negative. In strictness, however, the days in the primary pulse all come from the first 15 months for which the mean character figure was 1·12 while the days from the secondary pulse with three exceptions come from the last 15 months for which the mean character figure was 1·07. Thus 81 is only an approach to the figure appropriate to the average day. This uncertainty is practically avoided by taking the difference pulse.

The crest of the primary difference pulse, like the crests of the primary disturbed and quiet day pulses, necessarily comes in day n. The crest of the secondary difference pulse occurs unmistakeably on day $n + 27$. The amplitudes of the primary and secondary difference pulses are respectively 101 and 42, so that the latter is 42 per cent. of the former. In the case of the Cape Evans character figures for 1911 and 1912, the amplitude of the secondary difference pulse was 43 per cent. of that of the primary pulse. Thus the results from the two stations are remarkably similar. If we may judge by 1911, 1912 and 1913, the 27-day interval is at least as prominent in the Antarctic as in ordinary latitudes.

Table XVIII.—Daily Character, Cape Denison, International and Cape Evans Figures.

Date.	1912. March.			April.			May.			June.			July.			August.			September.			October.			November.			December.		1913. January.		February.		March.		April.		May.		June.		July.		August.	
1				1	0·1	0	1	0·1	1	2	1·0	2	2	0·3	1	2	0·9	2	1	0·3	1	2	1·0	2	2	0·4	1	2	0·3	1	0·0	1	0·3	0	0·0	2	0·9		[illegible]	1	1·4	1	0·6	0	0·1
2				1	0·3	0	1	0·5	1	2	0·8	2	0	0·2	–	1	0·3	1	0	0·1	0	1	0·0	1	1	0·5	2	2	1·0	1	1·0	1	0·1	0	0·0	1	0·2	1	0·4	2	1·0	0	0·3	0	0·2
3				2	0·4	1	1	0·6	1	2	0·8	2	2	0·9	1	1	0·2	1	1	0·6	0	1	0·6	1	1	0·0	1	2	0·7	2	1·4	0	0·0	0	0·4	1	0·4	1	0·6	1	0·8	1	0·4	1	0·3
4				2	0·3	0	1	0·5	1	1	0·2	0	2	1·3	2	0	0·0	0	2	0·7	1	1	0·3	1	1	0·1	1	2	0·0	2	0·8	0	0·0	1	0·3	1	0·6	2	1·4	1	0·8	0	0·1	0	0·5
5				2	1·3	2	2	1·3	2	1	0·0	0	2	1·2	2	2	0·9	1	1	0·5	1	0	0·0	1	2	0·7	2	1	0·0	1	0·4	1	0·0	1	0·1	1	0·2	2	1·4	0	0·2	0	0·2	0	0·2
6				2	1·0	2	2	0·9	1	0	0·1	1	2	0·7	1	2	1·7	1	1	0·4	1	1	0·1	1	1	0·6	–	2	1·0	2	0·1	1	0·2	1	0·1	0	0·1	2	1·3	1	0·0	0	0·3	0	0·5
7				2	0·8	1	2	0·8	1	0	0·6	0	2	0·6	1	1	0·5	1	0	0·1	1	1	0·4	2	1	0·1	1	2	1·4	1	0·0	1	0·6	1	0·6	0	0·2	2	1·1	0	0·0	0	0·4	1	0·6
8				0	0·1	0	2	0·7	1	2	1·2	2	1	0·5	1	0	0·0	0	0	0·6	1	2	0·3	2	1	0·4	1	2	0·6	1	0·3	1	0·6	1	0·8	1	0·9	1	0·7	0	0·0	0	0·2		
9				1	0·1	0	0	0·1	0	2	0·9	2	1	0·1	1	0	0·0	1	1	0·7	1	1	0·2	1	1	0·3	–	2	0·5	2	0·7	2	0·7	1	0·3	2	1·9	1	0·5	0	0·1	0	0·0		
10				2	1·0	2	1	0·2	1	2	0·9	2	0	0·1	0	1	0·3	1	1	0·2	1	2	0·4	1	2	1·2	2	2	0·2	2	1·0	1	0·2	0	0·0	2	1·1	1	0·4	0	0·2	0	0·5		
11				1	0·1	0	1	0·6	0	2	0·6	1	0	0·0	0	1	0·2	0	1	0·4	1	2	1·2	2	2	1·0	2	2	0·4	1	0·1	0	0·1	1	0·9	2	0·8	0	0·1	1	0·1	0	0·2		
12				1	0·2	1	2	1·3	2	1	0·3	1	0	0·0	0	0	0·0	0	1	0·6	2	1	0·8	1	1	0·0	1	1	0·1	1	0·1	2	1·0	1	0·3	1	1·3	0	0·1	0	0·0	1	1·3		
13				2	0·2	0	2	1·4	2	1	0·1	0	0	0·1	0	0	0·0	0	2	0·3	1	1	0·9	1	1	0·2	1	2	0·8	1	0·3	2	1·0	0	0·3	1	0·7	0	0·3	0	0·4	1	0·9		
14				1	0·8	1	2	1·0	2	1	0·2	1	0	0·6	0	0	0·5	1	1	0·3	1	2	1·6	2	2	1·4	–	1	0·4	2	0·6	2	1·6	2	1·6	1	0·6	0	0·0	0	0·5	1	0·9		
15				2	1·3	2	1	0·3	1	1	0·1	0	1	0·0	0	1	0·4	1	0	0·0	0	2	1·3	2	2	1·8	2	1	0·1	2	0·6	2	1·2	2	1·2	1	0·9	0	0·5	1	0·7	1	0·9		
16				2	1·0	2	1	0·1	0	0	0·1	–	1	0·5	1	1	0·4	1	1	0·0	1	2	0·9	2	2	0·9	2	1	0·0	1	0·1	1	0·9	2	1·3	1	1·0	0	0·1	1	0·4	1	0·2		
17				2	1·0	2	1	0·2	1	0	0·3	0	2	0·5	1	2	0·9	2	2	1·8	2	2	0·7	1	2	0·6	2	1	0·0	1	0·5	1	0·9	2	1·2	1	0·9	1	0·2	0	0·2	1	0·1		
18				2	0·6	1	1	0·2	0	1	0·2	0	1	0·2	1	2	1·0	2	2	1·1	2	1	0·0	1	2	0·4	2	1	0·3	2	1·3	2	0·5	1	0·4	0	0·1	0	0·7	0	0·1	1	0·1		
19				2	0·6	1	1	0·4	1	1	0·1	0	0	0·1	0	2	0·9	2	2	0·4	1	0	0·0	0	2	0·2	–	1	0·1	2	1·0	1	0·8	1	0·3	1	0·2	1	0·5	1	0·9	0	0·1		
20				2	0·5	2	1	0·3	0	1	0·1	0	1	0·7	1	1	0·2	1	2	0·5	1	2	0·7	1	2	0·3	–	1	0·0	2	0·8	1	0·4	1	0·1	1	0·0	0	0·1	1	0·2	2	1·1		
21				1	0·0	0	0	0·2	0	1	0·2	0	1	0·4	1	2	0·6	1	1	0·1	1	2	0·3	1	1	0·0	–	1	0·0	2	0·3	1	0·6	1	0·9	0	0·0	0	0·0	1	0·5	1	0·8		
22	1	0·8	2	1	0·1	1	0	0·1	0	1	0·6	1	1	0·1	0	2	1·1	2	2	0·7	1	0	0·4	1	1	0·8	–	2	1·2	2	0·4	1	0·4	1	0·5	1	0·1	0	0·0	0	0·2	1	0·3		
23	1	0·1	–	2	0·3	0	0	0·1	0	2	0·9	1	0	0·1	1	2	0·9	2	2	0·9	1	1	0·3	1	2	0·6	–	2	1·3	2	0·2	1	0·1	2	1·0	1	0·5	0	0·0	1	0·6	1	0·2		
24	0	0·0	1	1	0·2	0	0	0·3	0	1	0·6	1	0	0·0	0	1	0·4	1	2	1·6	2	1	0·2	1	2	0·0	–	2	0·9	1	0·1	0	0·0	1	0·4	0	0·3	0	0·3	1	0·7	0	0·5		
25				1	0·3	0	0	0·1	0	1	0·2	0	1	0·3	1	1	0·3	1	2	0·3	1	1	0·3	1	0	0·1	–	2	0·5	2	0·8	2	1·1	0	0·2	0	0·1	1	0·5	0	0·1	1	1·1		
26	2	0·6	1	0	0·1	0	1	0·1	1	1	0·2	1	1	0·7	1	1	0·1	1	1	0·6	1	0	0·0	1	2	0·8	–	2	0·2	2	0·2	2	1·1	1	0·1	0	0·1	0	0·2	1	0·7	0	0·5		
27	2	0·0	1	0	0·2	1	0	0·2	0	2	0·8	2	1	0·8	1	2	0·8	1	1	0·0	0	1	0·3	1	2	0·3	–			1	0·3	1	0·4	1	0·2	1	0·9	1	0·7	0	0·1	1	0·2		
28	1	0·7	1	0	0·1	0	0	0·0	1	2	0·9	1	0	0·1	0	2	0·7	1	0	0·0	0	2	0·7	2	2	0·0	–	1	0·0	1	0·6	0	0·0	1	0·3	1	0·7	1	0·5	1	0·9	0	0·1		
29	2	1·1	1	0	0·1	0	1	0·8	1	2	0·8	1	0	0·0	0	1	0·4	1	0	0·2	1	1	0·1	1	1	0·0	–	2	0·2	1	0·3			1	0·8	0	0·1	1	0·5	1	1·0	1	0·2		
30	1	0·1	1	1	0·3	0	1	0·6	1	1	0·3	1	1	0·3	1	1	0·3	1	1	0·3	1	1	0·2	1	1	0·0	–	2	0·5	2	1·3			2	0·9	0	0·0	0	0·2	1	0·5	0	0·2		
31	0	0·1	0				1	0·8	1				2	1·1	1	1	0·3	1				1	0·1	1				1	0·1	2	0·7			2	0·9			0	0·2			0	0·1		

TABLE XIX.—Dates of Selected Disturbed and Quiet Days, and Cape Denison Character Figures thereon.

Month.	Dates of the 5 Disturbed Days.					Dates of the 5 Quiet Days.					Cape Denison "Character" Figures on the 5 Disturbed Days.					Cape Denison "Character" Figures on the 5 Quiet Days.				
1912.																				
March ...	...	...	...	...	29	...	...	...	...	24	...	...	...	...	2	...	...	...	...	0
April ...	5	6	10	15	16	1	8	11	21	28	2	2	2	2	2	1	0	1	1	0
May ...	5	6	12	13	14	1	16	22	23	26	2	2	2	2	2	1	1	0	0	1
June ...	1	8	9	10	28	5	6	15	19	20	2	2	2	2	2	1	0	1	1	1
July ...	3	4	5	27	31	10	11	12	15	24	2	2	2	1	2	0	0	0	1	0
August ...	5	6	18	19	22	4	8	12	13	26	2	2	2	2	2	0	0	0	0	1
September ...	4	17	18	23	24	2	15	16	27	28	2	2	2	2	2	0	0	1	1	0
October ...	1	11	13	14	15	2	5	18	19	31	2	2	1	2	2	1	0	1	0	1
November ...	10	11	14	16	22	3	12	21	29	30	2	2	2	2	1	1	1	1	1	1
December ...	2	6	7	22	23	4	5	17	20	21	2	2	2	2	2	2	1	1	1	1
1913.																				
January ...	3	10	18	19	30	1	7	12	16	24	2	2	2	2	2	1	1	1	1	1
February ...	12	14	15	25	26	3	4	23	24	28	2	2	2	2	2	0	0	1	0	0
March ...	14	15	16	17	23	1	2	10	26	27	2	2	2	2	2	0	0	0	1	1
April ...	1	9	10	12	16	6	20	21	22	26	2	2	2	1	1	0	1	0	1	0
May ...	4	5	6	7	8	14	20	21	22	23	2	2	2	2	1	0	0	0	0	0
June ...	1	2	3	28	29	7	8	11	12	27	1	2	1	1	1	0	0	1	0	0
July ...	12	13	14	20	25	4	9	17	19	28	1	1	1	2	1	0	0	1	0	0
August ...	...	...	...	...	...	1	5	...	...	...	...	...	...	...	...	0	0	...	...	...

TABLE XX.—International & Cape Denison Character Figures. Mean Monthly Values.

Month.	1912. International Character Figures. Disturbed Days.	1912. International Character Figures. All Days.	1912. International Character Figures. Quiet Days.	1912. Cape Denison Character Figures. Disturbed Days.	1912. Cape Denison Character Figures. All Days.	1912. Cape Denison Character Figures. Quiet Days.	1913. International Character Figures. Disturbed Days.	1913. International Character Figures. All Days.	1913. International Character Figures. Quiet Days.	1913. Cape Denison Character Figures. Disturbed Days.	1913. Cape Denison Character Figures. All Days.	1913. Cape Denison Character Figures. Quiet Days.
January	...	...	...	...	...	...	1·20	0·51	0·06	2·0	1·55	1·0
February	...	...	...	...	...	...	1·20	0·53	0·02	2·0	1·11	0·2
March	...	...	...	...	...	...	1·26	0·53	0·06	2·0	1·03	0·4
April	1·12	0·45	0·08	2·0	1·3	0·6	1·24	0·54	0·06	1·6	0·83	0·4
May	1·18	0·47	0·10	2·0	0·97	0·6	1·18	0·45	0·02	1·8	0·63	0·0
June	0·98	0·47	0·08	2·0	1·23	0·8	1·02	0·45	0·04	1·2	0·60	0·2
July	1·06	0·41	0·02	1·8	0·90	0·2	1·06	0·42	0·08	1·2	0·55	0·2
August	1·12	0·49	0·02	2·0	1·16	0·2	...	...	...	...	...	...
September	1·22	0·47	0·02	2·0	1·13	0·4	...	...	...	...	...	...
October	1·20	0·46	0·02	1·8	1·23	0·6	...	...	...	...	...	...
November	1·06	0·45	0·00	1·8	1·50	1·0	...	...	...	...	...	...
December	1·18	0·43	0·00	2·0	1·60	1·2	...	...	...	...	...	...
Means	1·12	0·46	0·04	1·93	1·22	0·62	1·17	0·49	0·05	1·69	0·90	0·34

TABLE XXI.—Analysis of International and Cape Denison Character Figures.

International Character.	Cape Denison. 2's. A	W	E	S	Cape Denison. 1's. A	W	E	S	Cape Denison. 0's. A	W	E	S	Cape Denison. Mean Character. A	W	E	S
0·0 and 0·1 ...	5	0	0	4	63	17	14	26	71	42	17	6	0·53	0·29	0·45	0·94
0·2 and 0·3 ...	18	1	4	10	66	32	20	9	28	22	5	0	0·91	0·62	0·97	1·53
0·4 and 0·5 ...	14	1	3	7	39	22	9	8	12	10	2	0	1·03	0·73	1·07	1·47
0·6 and 0·7 ...	24	6	5	10	32	16	10	5	4	3	1	0	1·33	1·12	1·25	1·67
0·8 and 0·9 ...	31	17	6	7	28	11	10	5	0	0	0	0	1·53	1·61	1·38	1·58
1·0 to 1·4 ...	51	17	9	18	7	4	2	1	0	0	0	0	1·88	1·81	1·82	1·95
1·5 to 1·9 ...	8	1	5	2	0	0	0	0	0	0	0	0	2·00	2·00	2·00	2·00

TABLE XXII.—Cape Evans & International Character Figures (Mean Monthly Values) associated with Cape Denison Characters, 2, 1 and 0.

	Cape Evans Character Figures. 1912.			International Character Figures. 1912.			1913.		
Cape Denison Figure.	2	1	0	2	1	0	2	1	0
January	...	...	...	...	...	...	0·72	0·29	...
February	...	...	...	...	...	...	1·03	0·43	0·02
March	...	...	...	...	...	...	1·16	0·41	0·15
April	1·29	0·27	0·20	0·74	0·23	0·12	1·17	0·59	0·11
May	1·57	0·75	0·13	1·06	0·39	0·14	1·30	0·50	0·19
June	1·64	0·40	0·33	0·87	0·23	0·27	1·00	0·64	0·16
July	1·25	0·83	0·10	0·82	0·38	0·12	1·10	0·55	0·25
August	1·55	0·93	0·33	0·95	0·31	0·08	...	...	...
September	1·30	0·93	0·50	0·83	0·36	0·17	...	...	...
October	1·64	1·06	0·75	0·83	0·30	0·10	...	...	...
November	...	...	...	0·66	0·27	0·10	...	...	...
December	...	...	...	0·65	0·09	...	...	...	...
Means	1·46	0·74	0·33	0·82	0·28	0·14	1·07	0·49	0·15

TABLE XXIII.—Association of Magnetic Characters at Cape Denison and Cape Evans.

Character at Cape Denison / Cape Evans	2			1			0			Total Days.
	2	1	0	2	1	0	2	1	0	
March	0	3	0	1	2	0	0	1	1	8
April	7	4	3	0	3	8	0	1	4	30
May	4	3	0	0	12	4	0	1	7	31
June	7	4	0	0	6	9	0	1	2	29
July	2	6	0	0	10	2	0	1	9	30
August	6	5	0	0	13	1	0	2	4	31
September	3	7	0	1	11	2	0	3	3	30
October	7	4	0	1	15	0	0	3	1	31
November	7	1	0	1	6	0	0	0	0	15
Total	43	37	3	4	78	26	0	13	31	235

TABLE XXIV.—27-day Interval. Sums of Cape Denison Character Figures.

Nature of Primary Pulse.	Primary Pulse.					Secondary Pulse.					
	n−2	n−1	n	n+1	n+2	n+25	n+26	n+27	n+28	n+29	n+30
75 Disturbed and Associated Days	82	108	140	126	103	80	93	111	101	86	86
75 Quiet and Associated Days ...	77	65	39	53	83	69	68	69	76	77	81
Difference Pulse	5	43	101	73	20	11	25	42	25	9	5

CHAPTER II.—SQUARES OF DAILY AND HOURLY RANGES AS DISTURBANCE CRITERIA.

§6. As we have seen, the character figures arrived at from general inspection of the Cape Denison curves show differences between 1912 and 1913, and between summer and winter, of which there is no suggestion in the international character figures. Further inquiry appears desirable. To arrive at a definite result, it is necessary to employ some criterion of disturbance independent of the personal element. Various such criteria have been suggested, of some of which I have had considerable experience. Perhaps the simplest criterion is the absolute daily range (*i.e.*, the difference between the highest and lowest instantaneous values of the day) of one or more of the magnetic elements. If only one element is to be used, H seems to have superior claims at most stations, because in lower latitudes disturbance is more pronounced in H than in D or V. Another suggestion is to employ H Δ H, where Δ H is the absolute daily range in H. At the ordinary station H as a multiplier of Δ H may be treated as constant for many years at a time. Thus the addition of H as a factor has no significance when it is merely a question of comparing adjacent years at a single station.

As the magnetic latitude increases, the pre-eminence of H as the disturbed element diminishes, and in England disturbance in D or in W. (West component of force) is of the same order as disturbance in H or in N. (North component). Unless in exceptional cases, disturbance in V remains small in England compared with disturbance in H, but as the dip (*i.e.*, magnetic latitude) further increases, there is a rise in the relative importance of disturbance in V. Thus it is fairly obvious that any criterion of disturbance, which can be fairly applied the whole world over, should take account of the vertical as well as the horizontal components.

Of the criteria suggested, the one which theoretically regarded seems to have most to recommend it is Bidlingmaier's magnetic "activity," by which was meant practically the mean value for the day of $\alpha^2 + \beta^2 + \gamma^2$, where α, β, γ are the instantaneous departures of three rectangular components of magnetic force from their normal values.

Difficulty arises unfortunately when it comes to assigning a normal value to a magnetic element. H, for example, in low and mean latitudes is usually lower after a magnetic storm than before. It may be argued that the normal value of H is that prior to the storm, and that the depression should be considered part of the disturbance. It would often make an enormous difference to the mean value of $\alpha^2 + \beta^2 + \gamma^2$ for the day if this view were accepted. We might have a very large value for a day the traces of which showed no large oscillations. We do not know exactly what the depression means. It might result from temporary electric currents induced in the earth by the magnetic storm. It might mean a temporary modification of the earth's magnetism. If the depression is, as has been suggested, an after-effect (Nachwirkung) it is practically certain that it depends partly on the intensity of the preceding disturbance and partly on the condition of the earth when the disturbance was experienced. A disturbance which has been preceded at short intervals by disturbances of like magnitude might well have a small after-effect, as compared with an equal disturbance preceded by a long quiet time. In our present state of ignorance the only practical course seems to be to accept the mean value for the day as the normal value. It is the only plan on which there seems any reasonable chance of securing such agreement as is required for any international scheme.

The use of Bidlingmaier's "activity" might become a practical proposition if a suitable mechanical integrator could be constructed at a moderate price, but if the measurements it implies are made individually with an ordinary scale it entails an amount of labour which no ordinary observatory could undertake. This conclusion has been arrived at independently by several investigators after actual trial, and several alternatives have been suggested which entail less labour.

The simplest of these is to employ the square of one or more of the absolute daily ranges. If Bidlingmaier's "activity" is of the right dimensions, then it is the square not the first power of the range we ought to employ. The square of the range will certainly not vanish however quiet the day, no more will the first power. Whether we use the square or the first power of the daily range by itself, we obviously include something other than what is ordinarily meant by disturbance. We can only expect to get something which waxes and wanes with disturbance.

It is further obvious that the square (or the first power) of the daily range cannot be an *exact* measure of any physical characteristic of the day, because two days of very different characteristics may have equal ranges. One day, for example, might show considerable disturbance during each of the 24 hours, while another was very quiet during the first 23 hours. This explains another proposal, developed in particular by Dr. A. Crichton Mitchell, to employ the sum (or mean) of the squares of the 24-hourly ranges. A criterion based on the 24-hourly ranges ought *a priori* to be from the theoretical point of view superior to a criterion based on the daily range. But it entails of course much more labour, and the more the labour the smaller the hope of securing the co-operation of a large number of observatories. It is thus of practical importance to ascertain the extent of agreement between the two criteria. If they lead to large differences on may occasions, the case for the less onerous criterion is weakened. As compared with the ordinary station, Cape Denison was an extremely disturbed station, and it is obviously of special interest to have results from it.

§7. It has been explained that disturbance in V is usually very small in low latitudes. Even in mean latitudes, such as the south of England, the V trace often appears quiet on days when the other magnetic elements show considerable disturbance, and it is only on rare occasions that the disturbance in V is comparable with that in D or H. The allotment of magnetic characters, 0, 1, 2, at an English observatory is seldom influenced by the V trace. A day the V trace of which is highly disturbed at the ordinary station would be certain to show so much disturbance in D and H that a "2" would in any case be allotted to it. On the other hand, uniformly good behaviour is unfortunately not a universal characteristic of V magnetographs, a fact which discourages the use of V traces. In short, if only ordinary observatories are considered, there is a good deal to be said for leaving V out of account in any practical criterion of disturbance.

There are thus reasons, irrespective of any special local phenomenon, for obtaining a measure of disturbance at Cape Denison based on the horizontal components only, as well as one based like Bidlingmaier's "activity" on three components. But there is an additional reason for doing this, viz., the unexpectedly large difference between the V ranges recorded at Cape Denison and Cape Evans. The range at Cape Denison is almost invariably much the larger. This may be a natural phenomenon. Changes regular and irregular in the vertical force may, for some as yet unknown reason, increase rapidly as we approach the magnetic pole; and, if this is the case, the phenomenon is obviously a fundamental one, the further investigation of which is of the utmost importance. Something perhaps may be learned from the records of the Amundsen expedition near the north magnetic pole when these are published. But it is conceivable that instrumental causes may be at least partly responsible. My first idea, I must confess, was that some error might have been made in the scale value determinations either at Cape Denison or at Cape Evans. If one multiplied the daily range at Cape Evans by 2, or divided that at Cape Denison by 2, the results would be more in accordance with one's *a priori* ideas. But the methods employed at the two stations, although different, appear both sound. The method employed at Cape Denison was really that devised by J. A. Broun. The H and V scale values depend on deflections of the D magnet, as well as on deflections of the H and V magnets. The only exceptional feature was that owing to the difference in type and size of the D and V magnets, special allowance had to be made for the difference in the "distribution constants" in the deflections of these magnets. As explained by Major E. N. Webb, this correction was undesirably large in the case of the V magnet. Still it was only 10 per cent. at the most, so that even if the correction had itself been 50 per cent. in error, it would have gone but a small way to explaining the difference between the ranges at Cape Denison and Cape Evans. Any large mistake in the Cape Evans scale value seems equally improbable. In this case, the curves were re-measured and the calculations were repeated independently by myself.

The above remarks will explain why use was made of two criteria for Cape Denison $(\Delta H)^2 + (H\,\Delta D)^2$ and $(\Delta H)^2 + (H\,\Delta D)^2 + (\Delta V)^2$ where ΔH, ΔD, and ΔV are the absolute ranges of H, D, and V in the (Greenwich) day. At Cape Evans, as already explained, two rectangular horizontal components, N^1 and W^1, were recorded. The two criteria employed for it are $(\Delta N^1)^2 + (\Delta W^1)^2$ and $(\Delta N^1)^2 + (\Delta W^1)^2 + (\Delta V)^2$. It appeared desirable to employ a third station of a more ordinary kind. As Kew suffered sensibly even in 1913 from artificial disturbance, use was made of Eskdalemuir, the data from which were available. The horizontal components recorded there being N. (to true north) and W. (to true west), the two criteria employed were $\Delta N^2 + \Delta W^2$ and $\Delta N^2 + \Delta W^2 + \Delta V^2$. The comparison of the three stations was limited to the months April to October, 1912, because registration at Cape Evans ceased in November, 1912.

A comparison of the daily range criteria with hourly range criteria also seemed expedient, but it was limited to June and September, 1912. It was also limited to two elements, H and V at Cape Denison, N^1 and V at Cape Evans. There were two mirrors in the D magnetograph at Cape Denison, so that during disturbed times there were traces both at the top and the bottom of the sheet. The maximum might come on the one trace, the minimum on the other. Consequently the labour of finding hourly ranges would have been exceptionally great in this element, and even with a single trace the measurement of hourly ranges calls for labour one is apt to grudge, when not fully persuaded of its necessity.

The values of the absolute daily ranges of D, H, and V on Greenwich days are given in Scientific Reports, Series B, Vol. I, Tables XVIIa to XVIIIc, pp. 101 to 197. The calculations on which the tables given here are based were made before Tables XVIIa to XVIIIc had appeared in print. They employed ranges given in manuscript received from New Zealand, with corrections received from time to time. On receipt of the printed volume, the values which had been used for the ranges were compared with the values printed. In some cases the values which had been used were consistent with the printed values of the maximum and minimum, while the printed ranges were not. In such cases the printed value was assumed to suffer from a misprint. But in general the printed value was accepted, and any correction thus necessitated was made. Some difficulty was, however, experienced in the case of days when the record was incomplete. The treatment of these days varies in Tables XVIIa to XVIIc. For example, the limits of registration in the D curve were exceeded on April 5, 6, and 10, 1912. Ranges are assigned on the 5th and 6th, but not on the 10th. When the limits of registration are exceeded, the range recorded is necessarily an underestimate. But the limits of registration are not usually exceeded unless the range is exceptionally large, and in such a case it may be better to employ an under-estimate of the range than to omit the day altogether. This point is discussed in Vol. I, p. 264. As is explained there, a + was attached in the tables of mean monthly values of the absolute ranges on p. 266 "to any value supposed to be sensibly too small." But the defect in the mean monthly values had to be *sensible* before it was expressly indicated, and the number of occasions when the plus sign was added may give an inadequate idea of the number of individual days when an under-estimate was known to have been made. An under-estimate of 20′ or 20γ in the range of a particular day has but a trifling effect on the mean monthly value at Cape Denison, but when we are considering individual days it is a different matter. The fact that the range is an under-estimate is only sometimes indicated explicitly in Tables XVIIa to XVIIc.

§8. In general, when a range had been assigned in Tables XVIIa to XVIIc to a day of incomplete trace, it was accepted, but on a few occasions, when a large number of hours' trace had been lost, it was thought better to disregard the day. The results appear in Tables XXV to XXXIV. In Tables XXV to XXXI, relating to the period April to October, 1912, corresponding results are given for Cape Denison (C.D.), Cape Evans (C.E.), and Eskdalemuir (E). To facilitate reference, the columns are distinguished by numerals as well as by headings. Take, for example, Table XXV relating to April, 1912. Column 1, not counting the date column, gives $(\Delta H)^2 + (H\,\Delta D)^2$ for Cape Denison; col. 2 $(\Delta N^1)^2 + (\Delta W^1)^2$ for Cape Evans; and col. 3 $\Delta N^2 + \Delta W^2$ for Eskdalemuir. In like manner, cols. 4, 5, and 6 give respectively $(\Delta H)^2 + (H\,\Delta D)^2 + (\Delta V)^2$ for Cape Denison, $(\Delta N^1)^2 + (\Delta W^1)^2 + (\Delta V)^2$ for Cape Evans and $\Delta N^2 + \Delta W^2 + \Delta V^2$ for Eskdalemuir. These six columns deal with the squares of absolute daily ranges, and the unit in each case is $(10\,\gamma)^2$. Columns 7 to 16, on the other hand, are character *ratios*, the ratios borne by figures in columns 1 to 6 to their mean values for the month. For comparison with these, column 17 gives the international character figure for the day (I).

Cols. 7 and 8, and again cols. 10 and 11, are intended to give comparative results for Cape Denison and Cape Evans. At Cape Denison there were data for only 22 days for the horizontal components, and for only 20 days for all three components. Cols. 7, 8 and 9 devoted to the horizontal components make use of the 22 days, while cols. 10, 11 and 12, which include all three components, make use of only 20 days. The 22-day mean value of $(\Delta H)^2 + (H\,\Delta D)^2$ at Cape Denison, 638 $(10\,\gamma)^2$, is given in one of the lines at the foot of the table. On April 1, the value of $(\Delta H)^2 + (H\,\Delta D)^2$ was 130 $(10\,\gamma)^2$. The ratio borne by this to the monthly mean, 130/638, or 0·2, is the first entry in col. 7. The first entries in cols. 8 and 9 are similarly the values of 111/540 and 42/86, being the ratios borne by the April 1 values of $(\Delta N^1)^2 + (\Delta W^1)^2$ at Cape Evans and of $\Delta N^2 + \Delta W^2$ at Eskdalemuir, to their mean values for the 22 days. Two of these 22 days, viz., the 1st and 2nd, were days for which satisfactory V ranges were not available at Cape Denison. The mean values of $(\Delta H)^2 + (H\,\Delta D)^2 + (\Delta V)^2$ at

Cape Denison, of $(\Delta N^1)^2 + (\Delta W^1)^2 + (\Delta V)^2$ at Cape Evans, and of $\Delta N^2 + \Delta W^2 + \Delta V^2$ at Eskdalemuir for the remaining 20 days, were respectively 1189, 732 and 97 in terms of the unit $(10\ \gamma)^2$. The entries in cols. 10, 11 and 12 are the ratios borne to these monthly values by the daily values of the quantities. April 1 and 2 were considerably less disturbed than the average day of the month, and to bring out this fact the mean value of $(\Delta H)^2 + (H\ \Delta D)^2$ at Cape Denison for the 20 days, 686, is given in the same line with the means 1189, 732 and 97 just mentioned, but it is enclosed in brackets to show that it was not a quantity used in any of the calculations.

In view of the considerable number of days for which data were lacking at Cape Denison, it appeared well to give in cols. 13 to 16 results for Cape Evans and Eskdalemuir based on all 30 days of April. This also illustrates one important aspect of the method employed, viz., that the character ratio depends not merely on the value of the criterion for the day, but also on the mean value of the criterion for the available days of the month. Thus the character ratio for April 5 at Cape Evans based on the horizontal components appears as 2·8 in col. 8, but as 3·2 in col. 13. The criterion for the day is 1496 in either case, but the mean value of the criterion for the 22 days was 540, whereas for the whole 30 days it was only 465. The idea is that the mean value of the criterion for the days used would be communicated to the central station, as well as the values of the character ratios for the individual days of the month. These mean absolute values would serve for intercomparison of different months or years, while the character ratios would serve for the intercomparison of the days of the month. It might, of course, be decided to utilise only those stations which had a complete record for the month. But the method would afford an alternative to this. If the missing days happened to be nearly average days of the month at the station, their loss would make little difference to the character ratios. For example, in Table XXV the 22 days serving primarily for the intercomparison of Cape Denison and Cape Evans gave 86 $(10\ \gamma)^2$ as the mean value of $\Delta N^2 + \Delta W^2$ at Eskdalemuir, while the corresponding mean for the whole 30 days was 82 $(10\ \gamma)^2$, a difference of only some 5 per cent. It will be seen that the two corresponding sets of character ratios in cols. 9 and 14 are in most cases identical, and in no case differ by more than 0·2. On the other hand, the differences between corresponding character ratios for Cape Evans in cols. 8 and 13 are very sensible when the ratio is large.

§9. Before commenting on the general physical results, it will be convenient to explain peculiarities in the several tables.

In May, 1912, as in April, data were lacking only at Cape Denison. Thus Table XXVI follows the same lines as Table XXV. In June, 1912, data were lacking at Cape Evans as well as at Cape Denison, and the days involved were different. Cols. 7 to 10 give comparative data for Cape Denison and Cape Evans for the twenty-two days represented at both stations, while cols. 11 to 14 give comparative data for the twenty-five days common to Cape Denison and Eskdalemuir. Finally, cols. 15 and 16 give data for Eskdalemuir employing all thirty days.

In July, 1912, the position was similar to that in June, except that there were no V data for Eskdalemuir, and a similar procedure was followed. Columns 10 and 11 apply to 29, but column 12 to thirty-one days. In August, 1912, data were lacking at Cape Evans for two days, one being a day of very large disturbance. Comparative data are given in cols. 7 to 10 for Cape Denison and Cape Evans, for the twenty-nine days represented at Cape Evans. Data were also lacking for one day at Eskdalemuir, but it was a day the inclusion or omission of which must have been pretty well immaterial. Thus, the Cape Denison ratios in cols. 11 and 13 are based on all thirty-one days, though the Eskdalemuir ratios in cols. 12 and 14 are based on only thirty days.

In September, 1912, the only item missing was the vertical force range at Eskdalemuir on the 26th. It was again a case where the inclusion or omission of the day could make little difference, and only one set of ratios is given, being based in each case on all the days available.

In October, 1912, data were lacking at Cape Evans and Eskdalemuir, but not at Cape Denison. Columns 7 to 10 give Cape Denison and Cape Evans ratios for the twenty-nine days represented at Cape Evans, while cols. 11 to 14 give Cape Denison and Eskdalemuir ratios for the days represented at Eskdalemuir. Finally, cols. 15 and 16 give Cape Denison ratios based on all thirty-one days.

In the three following tables XXII to XXIV, there are data for Cape Denison only. The only point calling for remark is that in November, 1912, satisfactory V ranges were lacking for four days, so that the ratios derived from the horizontal components and from all three components are not strictly comparable. But, so far as can be judged from the horizontal components, the inclusion or omission of the four days could have little effect on the monthly mean and the character ratios.

§10. To simplify the situation, attention may be called at once to the fact that in the great majority of days the character ratios for Eskdalemuir from the horizontal components and from all three components are identical. There are in all only eleven days in which the two character ratios differ by more than 0·1, and only four in which they differ by more than 0·3. On May 13, the two ratios in cols. 14 and 16 are 4·8 and 5·6, and on August 6th in cols. 12 and 14 they are 6·8 and 7·6; these were the only two days during the whole seven months when the V range at Eskdalemuir exceeded 100 γ. The period was of course more than usually quiet. On the other hand, disturbance is larger at Eskdalemuir than at most European stations. But the inference certainly is that it would make little difference to character ratios at the average observatory, or to character figures calculated therefrom at a central station, whether the V range were included or not. But, on the whole, the inclusion of V ranges at Eskdalemuir tends to increase character ratios on the days of largest disturbance, with consequent slight decline in character ratios on quiet days. September 17th and October 14th are, however, rather notable exceptions to this rule.

The inclusion of V is of considerably greater importance at Cape Evans. But, even there during the whole seven months, there are only thirty-two days in which the character ratios from the horizontal components and those from all three components differ by more than 0·1, and only six days in which the difference exceeds 0·5. Relatively considered, one of the most important exceptions was October 21st, a comparatively quiet day of international character 0·3. On that day the V range at Cape Evans was 125 γ, while the ranges of the horizontal components were each only 80 γ. Cape Denison was, however, on that day somewhat highly disturbed in the horizontal as well as the vertical components, the range in H. being 316 γ. Of the more highly disturbed days when the difference between the two character ratios at Cape Evans was large, one of the most notable was April 16, when the character ratios in cols. 13 and 15 were 3·0 from the horizontal components, and 4·6 from the three components. The V range at Cape Evans, 356 γ, was more than double the next highest range of the month, and it considerably exceeded the corresponding V. range at Cape Denison, a rare event.

The employment of the V ranges had at Cape Evans no definite tendency to influence the character ratio in different directions on disturbed and quiet days. Thus, putting first in each case the ratio derived from the two horizontal components, we have 6·7 and 7·6 for May 5, 5·2 and 4·4 for May 12, 4·6 and 4·0 for July 4, and 6·4 and 7·5 for July 5.

Even at Cape Denison the retention of the vertical force range makes less difference to the character ratios than might have been anticipated. But there are 79 days in the fifteen months of Cape Denison records in which the difference between the two character ratios exceeds 0·2, and 26 days in which it exceeds 0·5. The number of days in which the two ratios absolutely agree and the number in which they differ by more than 0·1 are approximately equal. It seems pretty much a matter of chance whether the two horizontal components or the three components supply the larger value for the character ratio. The most outstanding cases of difference seem to merit special consideration.

April 15 *and* 16, 1912.—There is a curious contrast between these two days and between the two stations, Cape Denison and Cape Evans. At Cape Denison the 3-component ratio is the higher on the 15th, and the lower on the 16th; at Cape Evans it is exactly the other way about. On the 15th the V range at Cape Denison was 490 γ, as compared with 261 γ in H and 304 γ in D; but the corresponding V range at Cape Evans was only 153 γ, as compared with ranges of 245 γ and 317 γ in the two horizontal components. On the 16th, on the other hand, the V range at Cape Denison was only 289 γ, as compared with 275 γ in H and 366 γ in D, while at Cape Evans the V range was 356 γ, as against 268 γ and 258 γ in the two horizontal components. Thus, at Cape Denison the V range was relatively high on the 15th, and low on the 16th, while at Cape Evans the exact opposite occurred. At Eskdalemuir the V range was decidedly higher on the 15th than on the 16th, but on both days it was less than half the N. range.

May 7th and 17th, 1912.—On both these days the Cape Denison character ratios especially the 3-component ones were large compared with the Cape Evans ratios. The V range on the 7th at Cape Denison was one of the largest of the month and nearly double the range in H; it was nearly four times the corresponding V range at Cape Evans, which was little over half the range in N^1. The 17th was a quiter day but presented analagous features, the excess of the 3-component ratio being conspicuous. The V ranges at Eskdalemuir on both these days were below the average and small compared with the ranges of the horizontal components.

June 3, 1912, is an interesting example of the diametrically opposite phenomenon. The V range at Cape Denison was relatively small, being less than two-thirds of that in H, and the 3-component ratio was less by 0·6 than the 2-component ratio.

July 4 *and* 6, 1912.—On the 4th the 3-component ratio at Cape Denison is 50 per cent. larger than the 2-component ratio, although the V range was an underestimate, the limits of registration being exceeded. The V range actually recorded was fully double that in H, whereas the corresponding V range at Cape Evans was considerably less than half that in N^1. Thus, like May 7 and 17, it was a case of a special development of V disturbance in a limited area. The phenomena on July 6th appear to be the exact opposite of those on the 4th. On the 6th the 2-component ratio had the exceptionally high value 9·4, exceeding the 3-component ratio by 50 per cent. But the limits of registration were exceeded in all the elements during a brief violent storm near noon G.M.T., so the results for the day are somewhat uncertain.

August 6, 18 *and* 22, 1912.—Of the outstanding cases in August, 1912, the 6th was a case where the V range at Cape Denison was relatively small, being much less than the D range, while the 18th and 22nd were cases in which the V range was very large both absolutely and relatively. On the 18th the V range at Cape Denison was more than 6 times that at Cape Evans, while on the 22nd it was nearly three times as great. So both days are examples of exceptional local development of V disturbance

September 17, *and November* 16, 1912, are examples of the opposite phenomenon, the 3-component ratio at Cape Denison being on each occasion less than the 2-component ratio by 0·6. On September 17 the V range was unusually small compared with the D range, while on November 16, the H range was exceptionally large.

Of the exceptional cases in 1913 when the 2-component and 3-component ratios at Cape Denison differed by 0·6 or more, March 14 and 16, April 9, May 6, and July 15 were occasions when V disturbance was exceptionally large as compared with that in the horizontal components. On January 18, May 5, and July 12, on the other hand, it was the disturbance in D that was relatively large; while on March 30 it was special disturbance in H that led to the 2-component ratio being the larger.

§11. Before considering how the results from the three stations are inter-related on individual days, an idea of their general relationships is desirable. Table XXXV gives the ratios borne by the mean monthly values of $(\Delta N^1)^2 + (\Delta W^1)^2$ at Cape Evans and $\Delta N^2 + \Delta W^2$ at Eskdalemuir to the corresponding mean monthly values of $\Delta H^2 + (H\,\Delta D)^2$ at Cape Denison, and also the ratios borne by the mean monthly values of $(\Delta N^1)^2 + (\Delta W^1)^2 + (\Delta V)^2$ at Cape Evans and $\Delta N^2 + \Delta W^2 + \Delta V^2$ at Eskdalemuir to the corresponding monthly values of $\Delta H^2 + (H\,\Delta D)^2 + \Delta V^2$ at Cape Denison. In each case the monthly means used were derived from the same days at the three stations. The results are confined to the seven months April to October, 1912. There were in July no V data for Eskdalemuir.

The sum of the squares of the horizontal components at Cape Evans is in May slightly in excess of the sum at Cape Denison, but on the average of the seven months the former sum is only 81 per cent. of the latter. The sum of the squares of the three rectangular components is invariably much less at Cape Evans than at Cape Denison, the mean of the ratios being only 0·55. On the average $\Delta N^2 + \Delta W^2$ at Eskdalemuir is less than a fifth of $\Delta H^2 + (H\,\Delta D)^2$ at Cape Denison, while $\Delta N^2 + \Delta W^2 + \Delta V^2$ at Eskdalemuir is only about a ninth of $\Delta H^2 + (H\,\Delta D)^2 + (\Delta V)^2$ at Cape Denison. Thus the contribution to the magnetic activity of the whole world made by an Antarctic station is almost of a different order from that made by the average station in temperate latitudes.

§12. In view of the large difference between the mean values of the daily measures of activity at the three stations it is clearly to the character ratios we must look when considering whether the disturbance on a particular day was exceptional at one of the stations.

A phenomenon which is readily recognised is the tendency for character ratios on very quiet days to be smaller at the Antarctic stations than at Eskdalemuir, especially near Antarctic mid-winter. The most prominent examples of this phenomenon during April, 1912 (Table XXV), were perhaps the 21st, 28th, and 29th. It will be simplest to consider the absolute ranges on these days, which were as follows (unit 1γ):—

	Cape Denison.			Cape Evans.			Eskdalemuir.		
	ΔH	ΔD	ΔV	ΔN^1	ΔW^1	ΔV	ΔN	ΔW	ΔV
21 April ...	73	110	114	66	60	47	60	44	17
28 ,, ...	80	...	76	50	49	27	63	48	21
29 ,, ...	45	...	113	36	46	22	38	6822	

On the 21st the Eskdalemuir character ratios were double those at Cape Denison and three or more times those at Cape Evans, while on the 28th and 29th the Eskdalemuir character ratios were seven or eight times those at Cape Evans. It is true that the ranges of the components in the horizontal plane were on the whole larger at Eskdalemuir than at Cape Evans on the 28th and 29th, but the prime cause of the relative smallness of the Antarctic character ratios is the large size of the disturbance criteria in the average day of the month. If we regard the average day as the normal, then quiet conditions reduce the range in the Antarctic to an extent that they never do at Eskdalemuir. Even on the quietest days the range of the horizontal components at Eskdalemuir does not become very small compared with the range of the average day. The natural consequence of this is that when the majority of the days of a month are quiet, while a minority are fairly disturbed, the Antarctic character ratios tend to be lower on the quiet days and higher on the disturbed days than at Eskdalemuir. But while this is the usual phenomenon, exceptions are not uncommon. Thus on April 5, a day of international character 1·3, the Eskdalemuir character ratios are decidedly the largest. Their excess over the Cape Denison ratios is specially pronounced, but that may be partly due to loss of trace at Cape Denison. The excess was mainly due to the large range in W at Eskdalemuir.

On April 10, 16, and 17—days of international character 1·0—the differences between the character ratios at the Antarctic stations and at Eskdalemuir are in the more usual direction. On the 16th the V range at Cape Evans considerably exceeded that at Cape Denison—an unusual event—and was more than double the next highest range at Cape Evans during the whole month of April. This explains the outstanding 3-component ratio 4·6 at Cape Evans in column 15.

May 2 affords an example of a large difference between Cape Denison and Cape Evans character ratios, the latter being double the former. This arose from a large W^1 range at Cape Evans, 200 γ as compared with 107 γ in H and 104 γ in D at Cape Denison. On May 7th, on the other hand, the Cape Denison character ratios are pre-eminent, especially in the case of the 3 components; the V range at Cape Denison was nearly four times that at Cape Evans. On May 9th, a quiet day of international character 0·1, there was a very decided difference between the two Antarctic stations. The Cape Evans ranges were only a trifle larger than those at Eskdalemuir, but the ranges of the horizontal components at Cape Denison were nearly double, and that of the vertical component nearly four times the corresponding ranges at Cape Evans. On May 12, 13 and 14 there was a considerable amount of disturbance everywhere, and the Eskdalemuir character ratios are in general the lowest. The character ratios are exceptionally large on the 13th at Cape Evans. On that occasion the ranges of the horizontal components at Cape Evans exceeded those at Cape Denison, and the Cape Denison V range was only a little the larger. On May 17, a quiet day of international character 0·2, the character ratios at the three stations are fairly similar, with the exception of the

3-component ratio at Cape Denison, which is much larger than the others. On this occasion the V range at Cape Denison was 12 times that at Eskdalemuir, and more than 5 times that at Cape Evans.

May 18, 22, 23 and 27 are days with international character figures of from 0·0 to 0·2 on which the Eskdalemuir character ratios are large compared with the Antarctic ones. The V range was invariably largest at Cape Denison, and with one exception was larger at Cape Evans than at Eskdalemuir; but the horizontal components were of similar size at the three stations. They were absolutely larger at Eskdalemuir than at Cape Evans on the 18th and 23rd.

June 1 and 2 displayed markedly different characteristics at Cape Denison and Cape Evans. The 1st was a day of international character 1·0, the 2nd of character 0·8, and in harmony with this the horizontal component ranges on the 1st were decidedly the greater at Eskdalemuir. At Cape Denison the two days differed in the direction suggested by the international character figures, but to a much greater extent than these character figures would suggest, the range in all three components on the 1st, being more than double the corresponding range on the 2nd. At Cape Evans, on the other hand, two of the three components had larger ranges on the 2nd than on the 1st. The difference between the two Antarctic stations was largely due to the special development at Cape Evans of a smart disturbance between 6h. and 9h. G.M.T. on the 2nd.

June 8 and 9 were days of considerable disturbance in which the Cape Denison and Cape Evans ratios are exceptionally large as compared with those at Eskdalemuir. The V ranges at Eskdalemuir were respectively only 41 γ and 34 γ, whereas the V ranges at Cape Denison on both days exceeded 500 γ. At Cape Evans the disturbance in the horizontal components was very similar to that at Cape Denison on both days, but the disturbance in V was much less.

June 6, 13, 15, 16, 17, 18, 19, 20 and 21 were all days with international characters from 0·0 to 0·3, in which the ranges of the horizontal components at Eskdalemuir were very similar in size to those at Cape Denison and Cape Evans. The character ratios on these days are all much larger at Eskdalemuir than in the Antarctic. The V ranges on these nine days were invariably largest at Cape Denison and least at Eskdalemuir. But the ranges of the horizontal components were larger at Eskdalemuir than at Cape Evans on the 17th, 18th, and 20th.

The international character figures for June 21 and 22 were respectively 0·2 and 0·6, implying that the 22nd was in general much the more disturbed day. But this is not the conclusion to which we should have been led by the ranges or the character ratios at Eskdalemuir or the Antarctic stations. According to these criteria, disturbance in the horizontal components was only a trifle, if at all, greater on the 22nd than on the

21st. At Eskdalemuir the N. and W. ranges on the 22nd did not exceed those on the 15th and 16th, days of international character 0·1, while the V range on the 22nd was, with one exception, the smallest of the month.

July 4 and 5, as their international figures 1·3 and 1·2 indicate, were at most stations the two most disturbed days of the month. Eskdalemuir agrees with the majority of stations in making the 4th the more disturbed day of the two, but at Cape Denison and Cape Evans the character ratios were larger on the 5th than on the 4th. At most stations, Eskdalemuir included, the 5th was much more disturbed than the 6th, the international character of which was only 0·7. While six of the stations co-operating with De Bilt awarded a "2" to the 5th, and only one station awarded "0," fourteen stations awarded "0" to the 6th, and none awarded "2." Cape Evans agrees with Eskdalemuir in making the 6th much less disturbed than the 4th or 5th, but Cape Denison gives it a much higher character ratio than either of these days. The large ratio at Cape Denison on the 6th arose mainly from a very large H range—in reality an underestimate, as the trace went off the sheet—which was principally due to a short period disturbance near 12h. G.M.T. This disturbance was presumably of an unusually local character. It will be noticed that at Eskdalemuir the 2-component ratio was the same on the 6th as on the 9th, a day of international character 0·1.

July 2, 10, 13, 15, 18, 19, 24 and 28 were quiet days, with international characters 0·0, 0·1 or 0·2, on which the ranges of the horizontal components at Cape Denison and Cape Evans were only of the same order as those at Eskdalemuir, resulting in the character ratios at Eskdalemuir being much the largest. On the 10th, 15th, and 24th the Eskdalemuir horizontal component ranges exceeded those at either Antarctic station, and on the 13th they were considerably the largest.

July 14 had 0·6 for its international character, but its horizontal component ranges were notably less at Cape Denison and Cape Evans than at Eskdalemuir. The Antarctic ranges on the 14th, it is true, were very decidedly larger than those of the 13th, a day of international character 0·1, but they were rather smaller than on the 15th, a day of international character 0·0. Thus the 14th would seem to have been a much quieter day in the Antarctic than elsewhere. It would be interesting to know its character in the Arctic.

On July 20, the 2-component charcter ratio at Cape Evans was double that at Cape Denison. This was due to the large W^1 range at Cape Evans. The V range at Cape Denison showed its usual excess over that at Cape Evans.

On August 1 and 2 there is a marked contrast between the phenomena at Cape Denison and Cape Evans. The international character figures were respectively 0·9 and 0·3, and at Eskdalemuir the excess of the character ratios for the 1st over those for the 2nd is in harmony with these figures. But at Cape Evans the character ratios on the 1st are much larger than we should have expected, the 3-component ratio there being fully thrice that at Cape Denison. On the 2nd, on the other hand, the 2-component ratio at Cape Evans is less than a third of that at Cape Denison, and the ratios at the latter station are both much larger than we should have expected. Thus the incidence of disturbance throughout the Antarctic on the 1st and 2nd must have varied greatly with the locality.

As its international character figure shows, August 6 was, in general, much the most disturbed day of the month, and the character ratios for that day at Eskdalemuir are amongst the highest of the seven months. The Cape Denison character ratios are a good deal smaller, and it is noteworthy that the deficiency is greatest in the 3-component ratio. The V range at Cape Denison on the 6th was much less than the V ranges on the 18th, 22nd and 23rd, days of international character figures 1·0, 1·1 and 0·9 respectively. The D range on the 6th at Cape Denison was somewhat the highest of the month, but the H range was considerably less than that of the 23rd.

August 17th, 18th and 19th afford a contrast. Their international character figures, 0·9, 1·0 and 0·9 respectively, indicate approximate equality, with the 18th slightly the most disturbed day. This is quite in harmony with the character ratios at Eskdalemuir. At Cape Evans the character ratios of the 17th and 19th closely resembled one another, but were decidedly *greater* than those of the 18th, while at Cape Denison the character ratios on the 19th were much the least of the three, and little more than half those of the 17th. At Cape Denison the V range on the 18th was the largest of the month; it was six times the corresponding range at Cape Evans.

Another contrast is afforded by August 22 and 23, days of international characters 1·1 and 0·9 respectively. The excess of disturbance on the 22nd is borne out by the character ratios at Eskdalemuir and Cape Evans. But at Cape Denison the character ratios for the 23rd are much the larger and are more than double the corresponding ratios at Cape Evans. The V range at Cape Denison was only slightly larger on the 23rd than on the 22nd, but the H range on the 23rd was much the larger, being in fact the largest H range of the month.

August does not present so many examples as May, June or July of quiet days with character ratios much smaller in the Antarctic than at Eskdalemuir. Still there are a few such examples, including the 4th, 8th, 12th and 13th, all days of international character 0·0. The horizontal component ranges at Eskdalemuir were greater than those of either Antarctic station on the 4th and 12th, and exceeded those at Cape Evans on the 13th as well. The V range on these four days was invariably much the largest at Cape Denison, but the Eskdalemuir range came next on the 4th, 12th and 13th.

September 17 and 18 present a striking contrast between the phenomena in the Antarctic and elsewhere. As the international character figures 1·8 and 1·1 indicate, the 17th was in general much the more disturbed day. At Eskdalemuir the character ratios on the 17th were the second highest of the seven months; those of the 18th were each only 1·0. In the Antarctic, on the other hand, there was little difference between the two days. At Cape Evans, disturbance was greater on the 17th than on the 18th, but the excess was slight. At Cape Denison the ranges of the horizontal components were slightly larger on the 17th than on the 18th, but the V range on the 18th was more than double that on the 17th. The comparatively low value of the V range on the 17th was a notable feature at Eskdalemuir as well as in the Antarctic.

As its international character 1·6 shows, September 24 was also in general a highly disturbed day. In this case the character ratios are much the same at the Antarctic stations as at Eskdalemuir. So far as the horizontal components were concerned, disturbance at Eskdalemuir was much less on the 24th than on the 17th; whereas at Cape Denison and Cape Evans the 24th was much the more disturbed day. At both Antarctic stations each of the three rectangular components had a much larger range on the 24th than on any other day of the month. Even at Eskdalemuir the V range of the 24th was the largest of the month, but it was only 90 γ.

Partly in consequence of the relatively large amplitudes at Eskdalemuir on September 17, the character ratios for the really quiet days of the month make a closer approach to equality than usual at the three stations. There were, however, a few quiet days when the excess of the Eskdalemuir character ratios was considerable. This excess on the 29th arose from a large range in N, which exceeded the range in either horizontal component at either Antarctic station.

October 14 and 15 present a somewhat parallel case to September 17 and 18. The international characters 1·6 and 1·3 mark the 14th as the more disturbed day of the two, and this is borne out by the character ratios at the Antarctic stations as well as at Eskdalemuir. But the Eskdalemuir ratios for the 14th are the largest of the seven months, and are out of all proportion greater than those at the Antarctic. Their excess however over the ratio for September 17th is due to the fact that the mean squares of the daily ranges were considerably smaller for October than for September. On October 14th the character ratios are notably greater at Cape Evans than at Cape Denison. This arises from the large size of ΔW^1; it exceeded the range in any component at Cape Denison, and was nearly double the next largest W^1 range of the month, that of the 15th. The dominant element at Eskdalemuir on the 14th was W, and at Cape Denison D was considerably more disturbed than H. On the 15th the character ratios at the three stations did not differ much, and on this occasion the horizontal components as well as the vertical had their largest ranges at Cape Denison.

In view of the enhanced difference between the 14th and 15th at Eskdalemuir, it is curious that the excess of the international character figure on the 14th was largely due to the more southern co-operating stations. If we take the fifteen stations north of 50°N which reported to De Bilt, twelve assigned a "2" to the 14th and ten to the 15th; but twenty-six stations in all assigned a "2" to the 14th and only thirteen to the 15th.

The character ratios at Eskdalemuir on October 20, 21, 27 and 28 are all much alike, in spite of the fact that the international character figure was only 0·3 on the 21st and 27th, as against 0·7 on the 20th and 28th. With only the Eskdalemuir ranges to guide us, we should have regarded the four days as almost equally quiet. According to the Cape Evans character ratios the 21st was much the quietest day of the four, but at Cape Denison it was similar to the 20th and 28th, and much more disturbed than the 27th. The low character ratios at Cape Evans on the 21st were due entirely to the quietness of the horizontal components; the V range exceeded those of the other three days. This was the exact opposite of what occurred at Cape Denison, where the V range on the 21st was slightly less than on the 27th, and much less than on 27th and 28th. It was in fact the V range at Cape Denison which showed the closest parallelism to the international character figures.

While there were several days of international character 0·0 in October, there seems no case of a quiet day with a character ratio much larger at Eskdalemuir than in the Antarctic. The tendency seems now rather the other way. Thus on the 29th, 30th and 31st, with international characters of 0·1 or 0·2, the Eskdalemuir character ratios are markedly the smallest. Absolutely considered the ranges on these days at Eskdalemuir are quite insignificant, as compared with those at the Antarctic stations.

§ 13. Table XXXVI summarises the results obtained for the monthly means of the sums of the squares of the daily ranges. The results for the horizontal components and the three rectangular components at Cape Denison in columns 1 and 2 refer to the days available, the numbers of which are specified in columns 3 and 4 respectively. In April, July and November 1912, when V ranges were lacking for some days for which horizontal components existed, a second value is given in column 5 for the horizontal components for the days when all three components were represented. In all cases the ratios in column 7 borne by the three rectangular components to the horizontal components are derived from common days. In the case of Cape Evans, columns 8 and 9, and Eskdalemuir, columns 10 and 11, the data are for all days available, and not as in Table XXXV for days common to the stations compared. The days lacking at Cape Evans numbered three in June, one in July and two each in August and October. The June and July days lacking were amongst the quietest of the month; the August days were amongst the most disturbed, and the October days were fairly average. Thus the figures in Table XXXVI in columns 8 and 9 should be a trifle high for June and July, and somewhat low for August. At Eskdalemuir one rather quiet day was lacking in August. In October V range was lacking for four days, for three of which horizontal components were also lacking. But in this case, as in August, the effect on the mean monthly values was presumably trifling. Column 7 under I gives monthly mean international character figures.

Several interesting conclusions follow from Table XXXVI. If we compare Cape Denison results for corresponding months of 1912 and 1913, we see that in every month the figure for 1913 is much the lower. The extreme case is June. The mean international character figures for June, 1912, and June, 1913, are practically identical, the latter being the larger by 0·01; but ΣR^2 (the sums of the squares of the daily ranges) from horizontal components is fully thrice, and ΣR^2 from three rectangular components is nearly four times as large for June, 1912, as for June, 1913. April and July show nearly as large a decline in 1913 as June, and while the difference between the two years in May is not so outstanding it is still decisive. The result suggested by the daily character figures in Table XX, that 1913 in the Antarctic was a considerably quieter year than 1912, seems undoubtedly true, if the square of the daily range—or for the matter of that its first power—is a satisfactory criterion of disturbance.

The annual variation of ΣR^2 at Cape Denison is obviously very large, but the lack of data for December, and the gradual decline of disturbance apparently in progress in 1912–13, necessarily obscure details. The maximum clearly occurs near midsummer, probably in December, if we may judge by the D daily ranges. The equinoctial months occupy an intermediate position between winter and summer, and are in no way outstanding as they are in mean latitudes.

The low values assigned to May, 1912, at Cape Denison are due in part to the fact that one of the two days lacking was about the most disturbed of the month. If it had been available, Cape Denison would probably have agreed with Cape Evans in making July the quietest month of 1912. Apart from May, Cape Denison and Cape Evans agree as to the order of the months as regards disturbance. July would seem to have been the quietest month at Eskdalemuir as well, but the annual variation there is naturally of quite a different character from that in the Antarctic.

The ratio borne by ΣR^2 from the three rectangular components to ΣR^2 from the horizontal components at Cape Denison in Table XXXVI, col. 6, is on the average 1·7. It is sensibly above the mean in June and July, 1912, and in March, 1913, but this may be accidental. The fact that it had the same value for July, 1913, as for November, 1912, suggests that it is not sensitive to disturbance.

§14. Table XXXVII supplies an analysis of the values of ΣR^2 at Cape Denison according to the values of the international character figure. The results in each case appear under five headings: A refers to the three summer months, November, 1912, January and February, 1913; B to the equinoctial months, April, September and October of 1912; B^1 to the equinoctial months, March and April of 1913; C to the winter months, May, June, July and August of 1912; and finally C^1 to the winter months, May, June and July of 1913. If international character figures had the same meaning (for the Antarctic) in 1912 and 1913, we should expect a close similarity between the entries under B and B^1, and between the entries under C and C^1. In view of the small number of occurrences of the higher international character figures-groups were formed. But results are given for the four lowest character figures 0·0, 0·1, 0·2 and 0·3 separately, as well as for the two groups composed of days of characters 0·0 and 0·1, and days of characters 0·2 and 0·3. It will be seen that in every single case, whether for the horizontal components or the three rectangular components, the entry under B largely exceeds that under B^1, and the entry under C largely exceeds that under C^1. The concensus in favour of the view that, so far as the Antarctic is concerned, a given international character figure implied much less disturbance in 1913 than in 1912 seems overwhelming.

The number of days was rather small in some of the groups especially that with character figures exceeding 1·4. Thus irregularities were to be expected. But the rise of ΣR^2 with increasing international character figure is on the whole regular, especially in cols. B and C which included the largest number of days. If we took a mean from cols. B and B^1, and a mean from cols. C and C^1, we should largely eliminate the effect of any progressive decline in Antarctic disturbance, and obtain results fairly comparable with those in col. A. The result would be to show how widely different are the activities which answer to the same international character figure at different seasons of the year in the Antarctic.

§15. Table XXXVIII compares character figures at different seasons with the character ratios derived from the squares of the daily ranges at Cape Denison given in Tables XXV to XXXIV. The days were grouped according to the international character figure exactly as in Table XXXVII, and A, B, B^1, C, and C^1 denote the same combinations of months as in that table. The 2-component ratios and the 3-component ratios are treated separately.

In the four earliest classes with international characters 0·0 to 0·3, the entries in col. A. are on the whole the largest, and those in cols. C and C^1 the smallest. Thus the relation between the international character figures and the Cape Denison ratios is not wholly independent of the season of the year. But in the case of the higher international character figures, the entries in the several columns differ in rather a haphazard way, and the same is true of the difference between cols. B and B^1 and the differences between cols. C and C^1. This supports the view that in the Antarctic the international character figures have mainly a relative value like the character ratios.

§16. Tables XXXIX and XL supply some data bearing on the question whether disturbance in vertical force is more or less local in its incidence than disturbance in the horizontal components. Table XXXIX employs the sum of the squares of the two horizontal components considering the cases in which the sum is above or below its mean value for the month. Take, for example, the month of May, and the two stations Cape Denison and Cape Evans. There were 29 days when ΣR^2 was known at both stations. On 4 of these, ΣR^2 was above its mean value at both stations, on 3 it was above its mean at Cape Denison, but below it at Cape Evans, on 1 it was below its mean at Cape Denison, but above it at Cape Evans, and finally on 21 days it was below its mean at both stations. This gave 25 agreements as against 4 disagreements.

Taking the whole seven months, April to October, 1912, there were between Cape Denison and Cape Evans 166 agreements out of a total of 189 days, or 88 per cent. Similarly between Cape Denison and Eskdalemuir there were 158 agreements out of 193 occasions, or 82 per cent., and between Cape Evans and Eskdalemuir 176 agreements out of 203 occasions, or 87 per cent. The agreement between Cape Denison and Cape Evans was decidedly less good in September and October than in the earlier months. The fact that the agreement between Cape Evans and Eskdalemuir is very nearly as good as between Cape Denison and Cape Evans is rather surprising.

Table XL employs the vertical force range in an exactly analogous way to that followed in the previous table. Taking the whole seven months, there were 76 days on which the vertical force range at Cape Denison was above its mean value for the month. On 53 of these days it was also above its mean value at Cape Evans, but on the remaining 23 days it was below. Again, of the 127 days when the V range at Cape Denison was below its mean value for the month, there were 112 on which it was also below its mean value at Cape Evans. Thus on the whole there were between Cape Denison and Cape Evans 165 agreements out of a total of 203 occasions, or 81 per cent. Similarly between Cape Denison and Eskdalemuir there were 127 agreements out of 176 occasions, or 72 per cent., and between Cape Evans and Eskdalemuir 130 agreements out of 173 occasions, or 75 per cent. In the case of Cape Denison and Cape Evans the agreement was decidedly better in the winter months, May to August, than in the more disturbed equinoctial months. In this case the agreement between Cape Evans and Eskdalemuir, while rather better than that between Cape Denison and Eskdalemuir, is markedly inferior to that between Cape Denison and Cape Evans. It will be observed that in both Tables XXXIX and XL, if we consider separately the days which were above and the days which were below the mean at one of the stations, a larger percentage of the latter fell in the same category at the other station than of the former. Also the number of days below the mean was greater for Table XL than for Table XXXIX, as was to be expected seeing that the quantity used was in the one case the square and in the other case the first power of ranges. Thus some excess in agreements might be expected in Table XXXIX as compared with Table XXIII, even if vertical force disturbance were no more local than disturbance in the horizontal components. But the excess of agreements in Table XXXIX cannot be fully accounted for in this way and the natural inference appears to be that disturbance is sensibly more local in its incidence in the case of the vertical force than in the case of the horizontal components. It will be understood that the non-agreements in both Tables XXXIX and XL represent, in the main, occasions when disturbance was moderate at both the stations compared. Days highly disturbed at any one station were in general highly disturbed at all, and days conspicuously quiet at any one station were nearly always conspicuously quiet at the other two.

§17. As already mentioned, hourly ranges were measured at Cape Denison and Cape Evans for two months June and September, 1912, measurements being confined to H and V at Cape Denison, and to N[1] and V at Cape Evans. Tables XLI and XLII compare the squares of the daily ranges and the sums of the squares of the hourly ranges for each element separately. Throughout the unit is $(10\gamma)^2$. The ratio borne by the sum of the squares of the hourly ranges to the square of the daily range is given for each day for each element. The ratios at the foot of the table are calculated from the monthly means of the two criteria, and do not represent the arithmetic means of the ratios for the individual days of the month. The fluctuations in the ratio from day to day must be ascribed in greater part to variations in the incidence of disturbance throughout the day. Occurrences of a purely fortuitous character may be expected to exercise a comparatively trifling influence on the ratios at the foot of the table, but it by no means follows that these ratios should be approximately the same for all months of the year. In a quiet month the ratio would naturally depend on the type of the regular diurnal variation, and that is often considerably different in different seasons of the year. In the present case, however, the differences between the final ratios for the two months are very small at both stations. Thus at Cape Denison in the case of H we have 1·61 in June and 1·60 in September, while in the case of V we have 1·24 in June and 1·34 in September. At Cape Evans in the case of N[1] we have 1·13 in June and 1·18 in September, while we have 1·11 in the case of V in both months.

The principal use of the absolute value of the criterion of disturbance, whatever that criterion might be, would naturally be as a measure of disturbance for the *month*. So far as two months at two stations enable us to judge, if the sum of the squares of the hourly ranges is a satisfactory criterion for this purpose, so too is the square of the daily range.

In judging of the relative disturbance of individual days within a month, we should naturally be guided by the results from all the elements at a number of stations. We know *a priori* that the square of the daily range of one element at one station cannot be an exact measure of the disturbance at that station, and if an *exact* measure is wanted for any purpose, a minute study of details within the day cannot be avoided. Still the extent to which the daily ratios vary in Tables XLI and XLII is of interest. Before considering actual details, a glance at possibilities is desirable. The extreme possibility on the one hand is that the maximum and minimum values should each be the same for each hour of the 24. In this event the sum of the squares of the hourly ranges would be 24 times the square of the daily range. At the other extreme is the case where the element rises, or falls, at a uniform rate throughout the whole 24 hours. Each hourly range is then 1/24 of the daily range, and the sum of the squares of the hourly ranges would then be only 1/24 of the square of the daily range. Thus the limiting values possible to the ratios in Tables XLI and XLII are respectively 24 and 1/24.

While the daily ratios show a considerable variation in the course of the two months, it is nothing like what is theoretically possible. At Cape Denison the highest and the lowest of the actual values are 3·8 and 0·6 for H, and 3·4 and 0·6 for V; while at Cape Evans they are 3·5 and 0·5 for N^1, and 3·2 and 0·5 for V. Out of sixty days at Cape Denison the number which gave values for the ratio which departed by more than 0·5 from the final monthly mean was 25 in the case of H and 14 in the case of V; while out of 57 days at Cape Evans the number was 16 for N^1 and 14 for V. In the case more especially of the horizontal components the great majority of the days which gave values for the ratio which differed by more than 0·5 from the mean were days of small range which made but a slight contribution to the value of ΣR^2 for the month.

Tables XLIII and XLIV compare the results from the squares of the daily and hourly ranges in a different way. The columns are again numbered for convenience of reference. The figures are really character ratios. Thus in Table XLIII, col. 1 gives the ratio borne by the square of the daily range of H at Cape Denison to the mean value for June, 228 $(10\gamma)^2$. Similarly col. 2 gives the ratio borne by the sum of the squares of the hourly ranges of H at Cape Denison to their monthly mean, 367 $(10\gamma)^2$. Cols. 3 and 4 deal in similar fashion with the daily and hourly ranges of V at Cape Denison. Col. 5 gives the arithmetic mean of the entries in cols. 1 and 3, while col. 6 gives the arithmetic mean of the entries in cols. 1 and 3, while col. 6 gives the arithmetic mean of the entries in cols. 2 and 4. Thus cols. 5 and 6 give the character ratio for the day based on the two components H and V at Cape Denison, the criterion being the square of the daily range in col. 5, and the sum of the squares of the hourly ranges in col. 6. Cols. 7 to 12 deal in exactly similar fashion with the N^1 and V daily and hourly ranges at Cape Evans. Col. 13 gives the mean of the character ratios from the daily ranges in cols. 5 and 11, while col. 14 gives the mean of the character ratios from the hourly ranges in cols. 6 and 12. In the event of an international scheme being developed on these lines, instead of means from two stations only, as in cols. 13 and 14, we should have means from thirty or forty stations.

The illustration of the method in Table XLIII suffers a little from the lack of data for three days at Cape Evans. All three happened to be very quiet days. If we had omitted these days at Cape Denison also, we should have obtained somewhat higher mean values than we actually did for all the mean monthly criteria, and consequently slightly lower character ratios for the twenty-seven days common to both stations. This explains why the sums of the character ratios in cols. 13 and 14 are respectively 28·2 and 28·1 instead of (approximately) 27·0.

This defect should not introduce a difference between cols. 13 and 14, so we may compare them without any reservation. It will be seen that out of the twenty-seven entries in the two columns 14 are identical, including every case except two where the character ratios do not exceed 0·5. There are only nine cases in which the entries differ by more than 0·1, and in seven of these the international character figure is 0·8 or higher.

To see exactly how far the two criteria agree between themselves as to the choice of quiet and disturbed days for the month, and how far they agree with the choice which had been made at De Bilt, it is necessary to employ the character ratios actually got out, which went to one place of decimals beyond that retained in Table XLIII.

The De Bilt quiet days were the 5th, 6th, 15th, 19th and 20th. Unfortunately the 6th and 15th are days for which data were missing at Cape Evans. The daily and hourly range criteria agree in putting the 19th and 20th amongst the five quietest days, but neither would include the 5th, while both make it quieter than the average day.

The De Bilt choice of disturbed days included the 1st, 8th, 9th, 10th and 28th. The daily range criterion would give the 1st, 2nd, 8th, 9th and 27th; while the hourly range criterion would give the 1st, 8th, 9th, 10th and 29th.

All the choices include the 1st, 8th and 9th, the international characters of which were respectively 1·0, 1·2 and 0·9. Of the other days mentioned, the 10th and 28th had the international figure 0·9, while the 2nd, 27th and 29th had the international figure 0·8. There is thus, in reality, a close agreement in the results. The chief departure from the international choice is as regards the 28th. The daily range and hourly range criteria both place it only 10th on the list, when the days are arranged in order of disturbance.

Table XLIV for September follows exactly the same lines as the previous table. In this case fortunately the month was complete at both stations. The agreement between the entries in columns 13 and 14 is not quite as close as in June, the difference exceeding 0·1 in fourteen out of the thirty days. There is, however, not at all a bad agreement as to the order in which the days come as regards disturbance. The international quiet days in September were the 2nd, 15th, 16th, 27th and 28th. This is the exact choice given by the hourly range criterion. The daily range criterion agrees as to the 2nd, 15th and 28th, but places next to these the 3rd and 7th, the 27th coming next.

The international disturbed days for September were the 4th, 17th, 18th, 23rd, and 24th. The daily range criterion suggests the 4th, 17th, 18th, 22nd and 24th, while the hourly range criterion suggests the 17th, 18th, 22nd, 23rd, and 24th. There is thus agreement as to the 17th, 18th, and 24th, the international characters of which were respectively 1·8, 1·1 and 1·6. Of the other days mentioned the 4th and 22nd had international character 0·7, and the 23rd, character 0·9. There is thus again little real difference in the results.

Summarising the results for the two months, we may say that both daily and the hourly range criteria agreed that the international quiet days were amongst the quietest days of the month, and that all the international disturbed days were amongst the most disturbed. The days suggested as international quiet days for the two months by one or other criterion numbered in all twelve. Of these eight had international characters 0·0 or 0·1; the other four days having characters 0·2, 0·3 and 0·6 (two). The last two days June 7 and September 3, are thus a little outstanding. June 7 was the quietest day of the month according to the hourly range criterion, and there were only two quieter days according to the daily range criterion. It was conspicuously quiet at both Cape Denison and Cape Evans.

According to the hourly range criterion, there were eight days quieter than September 3rd, and according to the daily range there were three quieter. Thus it is a less outstanding case. The day, moreover, was less conspicuously quiet at Cape Denison than at Cape Evans, still it was a distinctly quiet day. We must allow that an occasional day may be a good deal quieter in the Antarctic than the international character figure would suggest. It would be interesting to know what the magnetic conditions were in the Arctic on June 7th and September 3rd.

TABLE XXV.—April, 1912. Squares of Daily Ranges (Unit 100 γ^2) and Ratios.

	2 Components.			3 Components.			Days common to 3 stations.						Days common to C.E. and E.				
							2 Components.			3 Components.			2 Components.		3 Components.		
	C.D.	C.E.	E.	C.D.	C.E.	E.	C.D.	C.E.	E.	C.D.	C.E.	E.	C.E.	E.	C.E.	E.	I.
Column...	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Date.																	
1	130	111	42	...	135	44	0·2	0·2	0·5	...	...	...	0·2	0·5	0·2	0·5	0·1
2	194	106	56	...	141	62	0·3	0·2	0·7	...	...	...	0·2	0·7	0·2	0·7	0·3
3	463	365	58	1,108	430	66	0·7	0·7	0·7	0·9	0·6	0·7	0·8	0·7	0·7	0·7	0·4
4	342	191	40	699	228	45	0·5	0·4	0·5	0·6	0·3	0·5	0·4	0·5	0·4	0·5	0·3
5	1,307	1,496	316	1,719	1,635	334	2·0	2·8	3·7	1·4	2·2	3·4	3·2	3·9	2·8	3·7	1·3
6	...	1,096	258	...	1,152	313	...	...	...	...	...	...	2·4	3·1	2·0	3·5	1·0
7	929	785	140	1,243	902	148	1·5	1·5	1·6	1·0	1·2	1·5	1·7	1·7	1·6	1·6	0·8
8	101	74	45	197	112	46	0·2	0·1	0·5	0·2	0·2	0·5	0·2	0·5	0·2	0·5	0·1
9	202	167	56	563	208	59	0·5	0·3	0·7	0·5	0·3	0·6	0·4	0·7	0·4	0·7	0·1
10	1,326	1,088	110	1,888	1,364	115	2·1	2·0	1·3	1·6	1·9	1·2	2·3	1·3	2·4	1·3	1·0
11	118	148	24	206	173	26	0·2	0·3	0·3	0·2	0·2	0·3	0·3	0·3	0·3	0·3	0·1
12	260	168	41	660	193	45	0·4	0·3	0·5	0·6	0·3	0·5	0·4	0·5	0·3	0·5	0·2
13	405	225	30	829	282	32	0·6	0·4	0·3	0·7	0·4	0·3	0·5	0·4	0·5	0·4	0·2
14	264	211	84	463	256	90	0·4	0·4	1·0	0·4	0·3	0·9	0·5	1·0	0·4	1·0	0·8
15	1,605	1,605	202	4,006	1,839	228	2·5	3·0	2·3	3·4	2·5	2·3	3·5	2·5	3·2	2·5	1·3
16	2,096	1,384	155	2,931	2,651	163	3·3	2·6	1·8	2·5	3·6	1·7	3·0	1·9	4·6	1·8	1·0
17	974	1,315	105	2,495	1,546	111	1·5	2·4	1·2	2·1	2·1	1·1	2·8	1·3	2·7	1·2	1·0
18	1,136	826	85	1,520	1,045	92	1·8	1·5	1·0	1·3	1·4	0·9	1·8	1·0	1·8	1·0	0·6
19	615	467	77	766	530	80	1·0	0·9	0·9	0·6	0·7	0·8	1·0	0·9	0·9	0·9	0·6
20	771	728	68	1,468	781	76	1·2	1·3	0·8	1·2	1·1	0·8	1·6	0·8	1·4	0·8	0·5
21	174	80	55	304	102	58	0·3	0·1	0·6	0·3	0·1	0·6	0·2	0·7	0·2	0·6	0·0
22	...	232	52	...	319	56	...	...	...	...	...	...	0·5	0·6	0·6	0·6	0·1
23	286	222	52	378	242	59	0·4	0·4	0·6	0·3	0·3	0·6	0·5	0·6	0·4	0·7	0·3
24	...	281	29	...	338	31	...	...	...	...	...	...	0·6	0·4	0·6	0·3	0·2
25	...	222	42	...	261	45	...	...	...	...	...	...	0·5	0·5	0·5	0·5	0·3
26	...	64	28	...	82	31	...	...	...	...	...	...	0·1	0·3	0·1	0·3	0·1
27	...	90	43	...	131	48	...	...	...	...	...	...	0·2	0·5	0·2	0·5	0·2
28	...	49	63	...	56	67	...	...	...	...	...	...	0·1	0·8	0·1	0·7	0·1
29	...	34	61	...	39	66	...	...	...	...	...	...	0·1	0·7	0·1	0·7	0·1
30	251	112	57	332	123	60	0·4	0·2	0·7	0·3	0·2	0·6	0·2	0·7	0·2	0·7	0·3
Means— 22 days.	638	540	86	...	...	...											
20 days.	(686)	...	...	1,189	732	97											
All days available.	(638)	465	82	(1,189)	577	90											

TABLE XXVI.—May, 1912. Squares of Daily Ranges (Unit $100\gamma^2$) and Ratios.

	2 Components.			3 Components.			Days common to 3 stations.						Days common to C.E. and E.				
	C.D.	C.E.	E.	C.D.	C.E.	E.	C.D.	C.E.	E.	C.D.	C.E.	E.	C.E.	E.	C.E.	E.	I.
Column ...	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Date.																	
1	89	107	45	134	122	52	0·3	0·3	0·6	0·2	0·3	0·6	0·3	0·5	0·2	0·5	0·1
2	223	471	61	293	521	68	0·7	1·4	0·8	0·5	1·2	0·8	1·1	0·7	1·0	0·7	0·5
3	382	325	84	463	373	88	1·2	1·0	1·1	0·8	0·9	1·0	0·8	1·0	0·7	0·9	0·6
4	311	250	57	462	286	60	0·9	0·7	0·7	0·8	0·7	0·7	0·6	0·7	0·5	0·6	0·5
5	...	2,812	321	...	4,066	334	...	...	...	...	...	...	6·7	3·7	7·6	3·5	1·3
6	...	412	75	...	531	84	...	...	...	...	...	...	1·0	0·9	1·0	0·9	0·9
7	810	464	156	1,879	538	160	2·5	1·4	2·0	3·2	1·3	1·8	1·1	1·8	1·0	1·7	0·8
8	459	337	52	1,016	439	58	1·4	1·0	0·7	1·7	1·1	0·7	0·8	0·6	0·8	0·6	0·7
9	157	45	32	281	54	34	0·5	0·1	0·4	0·5	0·1	0·4	0·1	0·4	0·1	0·4	0·1
10	132	210	35	244	236	38	0·4	0·6	0·4	0·4	0·6	0·4	0·5	0·4	0·4	0·4	0·2
11	133	110	67	210	127	74	0·4	0·3	0·8	0·4	0·3	0·8	0·3	0·8	0·2	0·8	0·6
12	1,870	2,203	235	3,095	2,345	256	5·7	6·5	3·0	5·2	5·7	2·9	5·2	2·7	4·4	2·7	1·3
13	2,067	2,595	418	3,429	3,544	537	6·3	7·7	5·3	5·8	8·6	6·1	6·2	4·8	6·6	5·6	1·4
14	814	960	100	1,289	1,337	115	2·5	2·8	1·3	2·2	3·3	1·3	2·3	1·1	2·5	1·2	1·0
15	437	289	37	866	322	40	1·3	0·9	0·5	1·5	0·8	0·5	0·7	0·4	0·6	0·4	0·3
16	120	85	43	267	111	47	0·4	0·3	0·5	0·4	0·3	0·5	0·2	0·5	0·2	0·5	0·1
17	213	135	33	633	150	36	0·6	0·4	0·4	1·1	0·4	0·4	0·3	0·4	0·3	0·4	0·2
18	81	42	66	206	48	71	0·2	0·1	0·8	0·3	0·1	0·8	0·1	0·8	0·1	0·7	0·2
19	208	201	64	371	220	68	0·6	0·6	0·8	0·6	0·5	0·8	0·5	0·7	0·4	0·7	0·4
20	95	101	61	286	114	66	0·3	0·3	0·8	0·5	0·3	0·8	0·2	0·7	0·2	0·7	0·3
21	103	81	57	236	98	60	0·3	0·2	0·7	0·4	0·2	0·7	0·2	0·7	0·2	0·6	0·2
22	61	55	52	108	59	56	0·2	0·2	0·7	0·2	0·1	0·6	0·1	0·6	0·1	0·6	0·1
23	20	7	32	54	9	35	0·1	0·0	0·4	0·1	0·0	0·4	0·0	0·4	0·0	0·4	0·1
24	29	29	43	60	35	46	0·1	0·1	0·5	0·1	0·1	0·5	0·1	0·5	0·1	0·5	0·3
25	51	22	32	120	28	37	0·2	0·1	0·4	0·2	0·1	0·4	0·1	0·4	0·1	0·4	0·1
26	88	88	49	132	115	52	0·3	0·3	0·6	0·2	0·3	0·6	0·2	0·6	0·2	0·5	0·1
27	42	49	51	82	57	55	0·1	0·1	0·6	0·1	0·1	0·6	0·1	0·6	0·1	0·6	0·2
28	43	101	43	87	109	48	0·1	0·3	0·5	0·1	0·3	0·5	0·2	0·5	0·2	0·5	0·0
29	158	74	108	351	92	114	0·5	0·2	1·4	0·6	0·2	1·3	0·2	1·2	0·2	1·2	0·8
30	179	164	72	321	186	79	0·5	0·5	0·9	0·5	0·5	0·9	0·4	0·8	0·3	0·8	0·6
31	130	234	104	246	250	108	0·4	0·7	1·3	0·4	0·6	1·2	0·6	1·2	0·5	1·1	0·8
Means—																	
29 days.	328	330	79	594	411	88											
31 days.	...	421	87	...	533	96											

TABLE XXVII.—June, 1912. Squares of Daily Ranges (Unit 100γ^2) and Ratios.

	2 Components.			3 Components.			2 Components.		3 Components.		2 Components.		3 Components.		Components. 2	Components. 3	
	C.D.	C.E.	E.	C.D.	C.E.	E.	C.D.	C.E.	C.D.	C.E.	C.D.	E.	C.D.	E.	E.	E.	I.
Column...	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Date.																	
1	2,009	499	95	3,781	687	97	4·6	1·3	4·0	1·5	5·1	1·3	4·5	1·3	1·2	1·2	1·0
2	431	742	80	769	1,122	84	1·0	1·9	0·8	2·4	1·1	1·1	0·9	1·1	1·1	1·0	0·8
3	602	662	82	795	826	86	1·4	1·7	0·8	1·8	1·5	1·1	0·9	1·1	1·1	1·1	0·8
4	104	82	57	265	89	61	0·2	0·2	0·3	0·2	0·3	0·8	0·3	0·8	0·8	0·8	0·2
5	60	61	54	251	67	55	0·1	0·2	0·3	0·1	0·2	0·7	0·3	0·7	0·7	0·7	0·0
6	47	...	46	118	...	49	...	...	...	...	0·1	0·6	0·1	0·6	0·6	0·6	0·1
7	59	65	56	99	71	59	0·1	0·2	0·1	0·2	0·2	0·8	0·1	0·8	0·7	0·7	0·6
8	2,103	2,410	203	4,965	2,699	220	4·8	6·2	5·3	5·9	5·4	2·8	5·9	2·8	2·7	2·7	1·2
9	1,768	1,591	135	4,328	1,712	146	4·0	4·1	4·6	3·7	4·5	1·9	5·1	1·9	1·8	1·8	0·9
10	616	951	124	1,589	1,027	136	1·4	2·4	1·7	2·2	1·6	1·7	1·9	1·7	1·6	1·7	0·9
11	487	310	61	1,030	370	64	1·1	0·8	1·1	0·8	1·2	0·8	1·2	0·8	0·8	0·8	0·6
12	145	199	64	367	263	67	0·3	0·5	0·4	0·6	0·4	0·9	0·4	0·9	0·8	0·8	0·3
13	71	63	64	203	80	68	0·2	0·2	0·2	0·2	0·2	0·9	0·2	0·9	0·8	0·9	0·1
14	190	190	54	486	209	57	0·4	0·5	0·5	0·5	0·5	0·7	0·6	0·7	0·7	0·7	0·2
15	55	...	60	111	...	64	...	...	...	...	0·1	0·8	0·1	0·8	0·8	0·8	0·1
16	42	...	74	90	...	79	...	...	...	...	0·1	1·0	0·1	1·0	1·0	1·0	0·1
17	91	49	81	123	65	83	0·2	0·1	0·1	0·1	0·2	1·1	0·1	1·1	1·1	1·0	0·3
18	102	40	67	274	46	70	0·2	0·1	0·3	0·1	0·3	0·9	0·3	0·9	0·9	0·9	0·2
19	28	49	31	67	61	37	0·1	0·1	0·1	0·1	0·1	0·4	0·1	0·5	0·4	0·5	0·1
20	43	19	34	68	22	36	0·1	0·0	0·1	0·0	0·1	0·5	0·1	0·5	0·4	0·4	0·1
21	65	51	55	84	63	60	0·1	0·1	0·1	0·1	0·2	0·8	0·1	0·8	0·7	0·8	0·2
22	72	63	59	131	92	60	0·2	0·2	0·1	0·2	0·2	0·8	0·2	0·8	0·8	0·8	0·6
23	294	175	77	499	196	84	0·7	0·4	0·5	0·4	0·7	1·1	0·6	1·1	1·0	1·0	0·9
24	212	205	75	384	248	79	0·5	0·5	0·4	0·5	0·5	1·0	0·5	1·0	1·0	1·0	0·6
25	...	63	53	...	69	55	...	...	...	...	...	...	...	...	0·7	0·7	0·2
26	111	86	42	195	97	43	0·3	0·2	0·2	0·2	0·3	0·6	0·2	0·6	0·6	0·5	0·2
27	...	789	149	...	1,052	152	...	...	...	...	...	...	...	...	2·0	1·9	0·8
28	...	416	82	...	507	89	...	...	...	...	...	...	...	...	1·1	1·1	0·9
29	...	516	114	...	582	122	...	...	...	...	...	...	...	...	1·5	1·5	0·8
30	...	127	45	...	167	48	...	...	...	...	...	...	...	...	0·6	0·6	0·3
Means— 22 days.	439	389	...	943	460	...											
25 days.	392	...	73	843	...	78											
All days available.	(392)	(388)	76	(843)	(463)	80											

TABLE XXVIII.—July, 1912. Squares of Daily Ranges (Unit $100\gamma^2$) and Ratios.

	2 Components.			3 Components.		2 Components.		3 Components.		2 Components.			
	C.D.	C.E.	E.	C.D.	C.E.	C.D.	C.E.	C.D.	C.E.	C.D.	E.	E.	I.
Column. ...	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
Date.													
1	289	338	81	879	390	0·8	1·3	1·2	1·2	0·8	1·1	1·1	0·3
2	50	...	51	83	...	...	...	...	...	0·1	0·7	0·7	0·2
3	262	218	136	493	272	0·7	0·8	0·7	0·8	0·7	1·8	1·9	0·9
4	1,006	1,214	240	2,907	1,363	2·6	4·6	3·9	4·0	2·7	3·2	3·3	1·3
5	1,461	1,686	149	3,142	2,533	3·8	6·4	4·2	7·5	4·0	2·0	2·0	1·2
6	3,564	410	52	4,640	528	9·4	1·5	6·2	1·6	9·7	0·7	0·7	0·7
7	155	167	72	271	191	0·4	0·6	0·4	0·6	0·4	1·0	1·0	0·6
8	535	355	71	1,308	383	1·4	1·3	1·7	1·1	1·5	0·9	1·0	0·5
9	209	110	52	305	126	0·5	0·4	0·4	0·4	0·6	0·7	0·7	0·1
10	41	26	44	143	36	0·1	0·1	0·2	0·1	0·1	0·6	0·6	0·1
11	...	54	31	...	57	...	...	...	...	...	...	0·4	0·0
12	...	19	41	...	23	...	...	...	...	...	...	0·6	0·0
13	9	5	41	143	6	0·0	0·0	0·2	0·0	0·0	0·5	0·6	0·1
14	40	31	84	...	37	0·1	0·1	...	...	0·1	1·1	1·2	0·6
15	41	53	59	55	61	0·1	0·2	0·1	0·2	0·1	0·8	0·8	0·0
16	182	219	48	...	317	0·5	0·8	...	...	0·5	0·6	0·7	0·5
17	184	253	78	703	290	0·5	1·0	0·9	0·9	0·5	1·0	1·1	0·5
18	68	82	59	122	85	0·2	0·3	0·2	0·3	0·2	0·8	0·8	0·2
19	49	71	73	113	81	0·1	0·3	0·2	0·2	0·1	1·0	1·0	0·1
20	214	325	75	436	370	0·6	1·2	0·6	1·1	0·6	1·0	1·0	0·7
21	226	194	71	303	210	0·6	0·7	0·4	0·6	0·6	0·9	1·0	0·4
22	86	74	44	167	82	0·2	0·3	0·2	0·2	0·2	0·6	0·6	0·1
23	82	96	49	231	114	0·2	0·4	0·3	0·3	0·2	0·7	0·7	0·1
24	27	25	42	91	30	0·1	0·1	0·1	0·1	0·1	0·6	0·6	0·0
25	147	92	73	228	105	0·4	0·4	0·3	0·3	0·4	1·0	1·0	0·3
26	360	249	61	531	278	0·9	0·9	0·7	0·8	1·0	0·8	0·8	0·7
27	317	360	66	678	404	0·8	1·4	0·9	1·2	0·9	0·9	0·9	0·8
28	54	37	28	90	44	0·1	0·1	0·1	0·1	0·1	0·4	0·4	0·1
29	61	63	39	125	70	0·2	0·2	0·2	0·2	0·2	0·5	0·5	0·0
30	171	170	36	328	193	0·5	0·6	0·4	0·6	0·5	0·5	0·5	0·3
31	792	486	214	1,071	571	2·1	1·8	1·4	1·7	2·2	2·9	2·9	1·1
Means— 26 days.	380	265	...	750	339								
29 days.	368	...	75	...	...								
All days available.	(368)	(258)	73	(725)	(308)								

TABLE XXIX.—August, 1912. Squares of Daily Ranges (Unit $100\gamma^2$) and Ratios.

	2 Components.			3 Components.			2 Components.		3 Components.		2 Components.		3 Components.		
	C.D.	C.E.	E.	C.D.	C.E.	E.	C.D.	C.E.	C.D.	C.E.	C.D.	E.	C.D.	E.	I.
Column.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
Date.															
1	914	1,245	108	1,253	2,151	131	1·7	2·9	1·4	4·3	1·5	1·0	1·3	1·1	0·9
2	675	183	55	1,137	228	59	1·3	0·4	1·3	0·5	1·1	0·5	1·2	0·5	0·3
3	393	228	36	672	275	38	0·7	0·5	0·8	0·5	0·7	0·3	0·7	0·3	0·2
4	41	34	55	90	42	63	0·1	0·1	0·1	0·1	0·1	0·5	0·1	0·5	0·0
5	464	...	143	636	...	147	...	...	...	...	0·8	1·4	0·7	1·2	0·9
6	2,525	...	719	3,156	...	918	...	...	...	...	4·3	6·8	3·3	7·6	1·7
7	357	194	54	463	229	57	0·7	0·5	0·5	0·5	0·6	0·5	0·5	0·5	0·5
8	98	67	41	136	83	44	0·2	0·2	0·2	0·2	0·2	0·4	0·1	0·4	0·0
9	132	77	38	271	91	41	0·2	0·2	0·3	0·2	0·2	0·4	0·3	0·3	0·0
10	131	162	72	341	174	76	0·2	0·4	0·4	0·3	0·2	0·7	0·4	0·6	0·3
11	128	61	49	190	76	52	0·2	0·1	0·2	0·2	0·2	0·5	0·2	0·4	0·2
12	27	20	55	50	23	64	0·1	0·0	0·1	0·0	0·0	0·5	0·1	0·5	0·0
13	55	30	53	124	35	58	0·1	0·1	0·1	0·1	0·1	0·5	0·1	0·5	0·0
14	210	176	91	302	196	96	0·4	0·4	0·3	0·4	0·4	0·9	0·3	0·8	0·5
15	161	92	51	202	95	54	0·3	0·2	0·2	0·2	0·3	0·5	0·2	0·4	0·4
16	448	275	104	522	290	112	0·8	0·6	0·6	0·6	0·8	1·0	0·5	0·9	0·4
17	1,602	1,525	140	2,386	1,621	150	3·0	3·5	2·7	3·2	2·7	1·3	2·5	1·2	0·9
18	1,334	1,007	173	3,040	1,053	191	2·5	2·3	3·4	2·1	2·2	1·6	3·2	1·6	1·0
19	948	1,369	121	1,233	1,454	164	1·8	3·2	1·4	2·9	1·6	1·1	1·3	1·4	0·9
20	293	168	46	614	191	51	0·6	0·4	0·7	0·4	0·5	0·4	0·6	0·4	0·2
21	885	573	81	1,209	654	87	1·7	1·3	1·4	1·3	1·5	0·8	1·3	0·7	0·6
22	1,184	1,360	204	2,445	1,506	241	2·2	3·2	2·8	3·0	2·0	1·9	2·6	2·0	1·1
23	2,748	970	136	4,125	1,046	151	5·2	2·3	4·7	2·1	4·6	1·3	4·3	1·2	0·9
24	421	528	79	619	615	87	0·8	1·2	0·7	1·2	0·7	0·8	0·7	0·7	0·4
25	410	378	54	617	429	58	0·8	0·9	0·7	0·9	0·7	0·5	0·6	0·5	0·3
26	178	197	67	377	211	71	0·3	0·5	0·4	0·4	0·3	0·6	0·4	0·6	0·1
27	632	476	144	949	574	159	1·2	1·1	1·1	1·1	1·1	1·4	1·0	1·3	0·8
28	336	396	75	612	424	81	0·6	0·9	0·7	0·8	0·6	0·7	0·6	0·7	0·7
29	214	288	61	849	311	65	0·4	0·7	1·0	0·6	0·4	0·6	0·9	0·5	0·4
30	165	188	...	352	218	...	0·3	0·4	0·4	0·4	0·3	...	0·4	...	0·3
31	278	220	57	463	236	63	0·5	0·5	0·5	0·5	0·5	0·5	0·5	0·5	0·3
Means—29 days.	531	431	...	884	501	...									
All days available.	593	(431)	105	950	(501)	121									

TABLE XXX.—September, 1912. Squares of Daily Ranges (Unit $100\gamma^2$) and Ratios

	2 Components.			3 Components.			2 Components.			3 Components.			
	C.D.	C.E.	E.	C.D.	C.E.	E.	C.D.	C.E.	E.	C.D.	C.E.	E.	I.
Column.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
Date.													
1	284	229	69	729	245	72	0·5	0·5	0·5	0·8	0·5	0·5	0·3
2	52	88	43	146	105	47	0·1	0·2	0·3	0·2	0·2	0·3	0·1
3	214	76	101	286	96	105	0·4	0·2	0·8	0·3	0·2	0·7	0·6
4	931	492	112	1,424	536	120	1·6	1·1	0·9	1·6	1·1	0·9	0·7
5	611	457	75	870	516	77	1·1	1·1	0·6	1·0	1·0	0·5	0·5
6	459	337	51	647	388	54	0·8	0·8	0·4	0·7	0·8	0·4	0·4
7	195	137	40	344	153	44	0·3	0·3	0·3	0·4	0·3	0·3	0·1
8	441	301	73	580	351	76	0·8	0·7	0·6	0·7	0·7	0·5	0·6
9	707	352	90	1,064	376	95	1·2	0·8	0·7	1·2	0·8	0·7	0·7
10	538	228	35	734	267	39	0·9	0·5	0·3	0·8	0·5	0·3	0·2
11	478	207	33	709	245	35	0·8	0·5	0·3	0·8	0·5	0·2	0·4
12	631	722	69	871	791	73	1·1	1·7	0·5	1·0	1·6	0·5	0·6
13	452	408	54	910	491	59	0·8	0·9	0·4	1·0	1·0	0·4	0·3
14	286	250	43	409	295	46	0·5	0·6	0·3	0·5	0·6	0·3	0·3
15	127	57	44	178	66	49	0·2	0·1	0·3	0·2	0·1	0·3	0·0
16	247	180	40	421	211	43	0·4	0·4	0·3	0·5	0·4	0·3	0·0
17	1,585	1,534	1,340	1,831	1,675	1,399	2·7	3·6	10·2	2·1	3·4	9·9	1·8
18	1,208	1,307	126	2,297	1,391	138	2·1	3·0	1·0	2·6	2·8	1·0	1·1
19	484	550	53	819	598	60	0·8	1·3	0·4	0·9	1·2	0·4	0·4
20	559	435	84	772	488	93	1·0	1·0	0·6	0·9	1·0	0·7	0·5
21	647	280	34	949	345	36	1·1	0·6	0·3	1·1	0·7	0.3	0·1
22	939	380	122	1,626	499	126	1·6	0·9	0·9	1·8	1·0	0·9	0·7
23	708	371	83	1,092	410	93	1·2	0·9	0·6	1·2	0·8	0·7	0·9
24	2,749	2,623	660	3,981	3,112	741	4·8	6·1	5·0	4·5	6·3	5.3	1·6
25	546	154	61	723	219	71	0·9	0·4	0·5	0·8	0·4	0·5	0·3
26	420	251	107	582	289	...	0·7	0·6	0·8	0·7	0·6	...	0·6
27	163	104	56	242	133	58	0·3	0·2	0·4	0·3	0·3	0·4	0·0
28	108	64	47	240	91	48	0·2	0·1	0·4	0·3	0·2	0·3	0·0
29	151	160	144	219	202	148	0·3	0·4	1·1	0·2	0·4	1·0	0·2
30	422	203	51	880	261	54	0·7	0·5	0·4	1·0	0·5	0·4	0·3
Means—All days.	578	431	131	886	495	141							

TABLE XXXI.—October, 1912. Squares of Daily Ranges (Unit $100\gamma^2$) and Ratios.

	2 Components.			3 Components.			2 Components.		3 Components.		2 Components.		3 Components.		Components. 2	3	
	C.D.	C.E.	E.	C.D.	C.E.	E.	C.D.	C.E.	C.D.	C.E.	C.D.	E.	C.D.	E.	C.D.	C.D.	I.
Column.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
Date.																	
1	2,627	1,136	156	3,736	1,421	186	3·3	2·1	2·9	2·3	3·5	2·0	3·0	2·1	3·4	3·0	1·0
2	273	172	25	375	209	...	0·3	0·3	0·3	0·3	0·4	0·3	...	...	0·3	0·3	0·0
3	544	370	45	916	443	46	0·7	0·7	0·7	0·7	0·7	0·6	0·7	0·5	0·7	0·7	0·6
4	351	...	42	708	...	44	...	...	...	...	0·5	0·5	0·6	0·5	0·4	0·6	0·3
5	189	148	45	388	184	46	0·2	0·3	0·3	0·3	0·3	0·6	0·3	0·5	0·2	0·3	0·0
6	319	113	54	544	153	55	0·4	0·2	0·4	0·2	0·4	0·7	0·4	0·6	0·4	0·4	0·1
7	342	350	57	527	411	62	0·4	0·7	0·4	0·7	0·5	0·7	0·4	0·7	0·4	0·4	0·4
8	763	552	54	1,094	600	56	1·0	1·0	0·9	1·0	1·0	0·7	0·9	0·6	1·0	0·8	0·3
9	510	347	30	837	376	31	0·6	0·7	0·7	0·6	0·7	0·4	0·7	0·3	0·7	0·7	0·2
10	736	...	...	1,136	...	...	...	...	...	...	...	...	...	...	0·9	0·9	0·4
11	1,245	523	...	1,760	721	...	1·6	1·0	1·4	1·1	...	...	...	...	1·6	1·4	1·2
12	1,134	865	...	1,601	990	...	1·4	1·6	1·3	1·6	...	...	...	...	1·4	1·3	0·8
13	990	734	73	1,333	853	106	1·2	1·4	1·0	1·4	1·3	0·9	1·1	1·2	1·3	1·1	0·9
14	2,424	2,895	822	4,248	3,155	905	3·0	5·4	3·3	5·0	3·2	10·5	3·4	10·1	3·1	3·4	1·6
15	2,174	1,573	238	3,309	1,705	302	2·7	3·0	2·6	2·7	2·9	3·1	2·6	3·4	2·8	2·6	1·3
16	852	835	113	1,367	933	124	1·1	1·6	1·1	1·5	1·1	1·4	1·1	1·4	1·1	1·1	0·9
17	882	519	59	1,327	591	75	1·1	1·0	1·0	0·9	1·2	0·8	1·1	0·8	1·1	1·1	0·7
18	290	134	16	501	173	16	0·4	0·3	0·4	0·3	0·4	0·2	0·4	0·2	0·4	0·4	0·0
19	198	140	22	347	198	23	0·2	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·0
20	951	426	36	1,917	568	38	1·2	0·8	1·5	0·9	1·3	0·5	1·5	0·4	1·2	1·5	0·7
21	1,150	128	36	1,542	284	38	1·4	0·2	1·2	0·5	1·5	0·5	1·2	0·4	1·5	1·2	0·3
22	605	309	27	1,144	483	28	0·8	0·6	0·9	0·8	0·8	0·3	0·9	0·3	0·8	0·9	0·4
23	586	330	38	1,079	411	38	0·7	0·6	0·8	0·7	0·8	0·5	0·9	0·4	0·7	0·9	0·3
24	252	273	34	431	333	35	0·3	0·5	0·3	0·5	0·3	0·4	0·3	0·4	0·3	0·3	0·2
25	618	315	30	1,030	384	31	0·8	0·6	0·8	0·6	0·8	0·4	0·8	0·3	0·8	0·8	0·3
26	334	279	25	513	311	26	0·4	0·5	0·4	0·5	0·4	0·3	0·4	0·3	0·4	0·4	0·0
27	424	548	34	832	631	36	0·5	1·0	0·7	1·0	0·6	0·4	0·7	0·4	0·5	0·7	0·3
28	1,279	565	33	1,992	649	34	1·6	1·1	1·6	1·0	1·7	0·4	1·6	0·4	1·6	1·6	0·7
29	586	203	20	1,120	244	20	0·7	0·4	0·9	0·4	0·8	0·3	0·9	0·2	0·7	0·9	0·1
30	367	358	19	598	427	20	0·5	0·7	0·5	0·7	0·5	0·2	0·5	0·2	0·5	0·5	0·2
31	269	330	12	698	434	13	0·3	0·6	0·5	0·7	0·4	0·2	0·6	0·1	0·3	0·6	0·1
Means— 29 days.	799	533	...	1,280	630	...											
28 days.	755	...	78	...	...	...											
27 days.	...	...	...	1,262	...	90											
All days available.	783	(533)	(78)	1,256	(630)	(90)											

TABLE XXXII.—Squares of Daily Ranges at Cape Denison (Unit $100\gamma^2$) and Ratios.

	November, 1912.					January, 1913.					February, 1913.				
	Number of Components.				I.	Number of Components.				I.	Number of Components.				I.
	2.	3.	2.	3.		2.	3.	2.	3.		2.	3.	2.	3.	
Date.															
1	1,233	1,957	1·0	0·9	0·4	...	...	...	...	...	410	600	0·8	0·7	0·3
2	930	1,813	0·7	0·9	0·5	...	...	...	...	...	198	417	0·4	0·5	0·1
3	284	500	0·2	0·2	0·0	...	...	...	...	...	98	267	0·2	0·3	0·0
4	305	920	0·2	0·4	0·1	...	...	...	...	...	215	379	0·4	0·4	0·0
5	565	1,140	0·4	0·5	0·7	...	...	...	...	...	191	365	0·4	0·4	0·0
6	407	641	0·3	0·3	0·6	...	...	...	...	...	304	468	0·6	0·5	0·2
7	653	1,238	0·5	0·6	0·1	...	...	...	...	...	289	965	0·5	1·1	0·6
8	805	1,221	0·6	0·6	0·4	...	...	...	...	...	275	494	0·5	0·5	0·6
9	1,175	1,637	0·9	0·8	0·8	...	...	...	...	...	572	1,449	1·1	1·6	0·7
10	2,344	3,788	1·9	1·8	1·2	...	...	...	...	...	259	555	0·5	0·6	0·2
11	2,297	3,550	1·8	1·7	1·0	...	...	...	...	...	152	329	0·3	0·4	0·1
12	631	1,197	0·5	0·6	0·0	...	...	...	...	...	1,104	1,980	2·1	2·2	1·0
13	429	793	0·3	0·4	0·2	228	552	0·3	0·4	0·3	797	1,161	1·5	1·3	1·0
14	3,978	5,734	3·1	2·8	1·4	614	1,551	0·7	1·1	0·6	1,486	2,833	2·8	3·1	1·6
15	1,216	1,851	1·0	0·9	1·8	387	920	0·4	0·6	0·6	1,456	2,571	2·8	2·8	1·2
16	3,995	5,409	3·2	2·6	0·9	...	...	...	...	...	648	962	1·2	1·1	0·9
17	1,386	2,876	1·1	1·4	0·6	...	...	...	...	...	529	831	1·0	0·9	0·9
18	1,196	2,421	0·9	1·2	0·4	2,065	2,494	2·3	1·7	1·3	772	1,213	1·5	1·3	0·5
19	1,277	1,668	1·0	0·8	0·2	2,831	3,919	3·1	2·7	1·0	723	1,119	1·4	1·2	0·8
20	1,393	1,932	1·1	0·9	0·3	2,077	2,638	2·3	1·8	0·8	359	709	0·7	0·8	0·4
21	334	...	0·3	...	0·0	1,412	1,828	1·6	1·3	0·3	265	484	0·5	0·5	0·6
22	1,072	...	0·8	...	0·8	585	935	0·6	0·6	0·4	285	492	0·5	0·5	0·4
23	1,818	...	1·4	...	0·6	973	1,423	1·1	1·0	0·2	272	358	0·5	0·4	0·1
24	1,721	...	1·4	...	0·0	334	568	0·4	0·4	0·1	169	223	0·3	0·2	0·0
25	468	681	0·4	0·3	0·1	697	1,498	0·8	1·0	0·8	1,870	2,485	3·5	2·7	1·1
26	2,640	4,338	2·1	2·1	0·8	1,084	1,786	1·2	1·2	0·2	679	945	1·3	1·0	1·1
27	1,044	2,074	0·8	1·0	0·3	298	864	0·3	0·6	0·3	250	391	0·5	0·4	0·4
28	1,638	3,190	1·3	1·5	0·0	244	547	0·3	0·4	0·6	188	337	0·4	0·4	0·0
29	267	563	0·2	0·3	0·0	267	801	0·3	0·5	0·3	...	...	...	...	...
30	455	948	0·4	0·5	0·0	928	1,404	1·0	1·0	1·3	...	...	...	...	...
31	...	...	...	...	...	424	1,039	0·5	0·7	0·7	...	...	...	...	...
Means.	1,268	2,080	From 26 days.			909	1,457	From 17 days.			529	906	From 28 days.		
Means.	1,264	...	From 30 days.			...	...	...	...	...	...	...	...	...	...

TABLE XXXIII.—Squares of Daily Ranges at Cape Denison (Unit $100\gamma^2$) and Ratios.

Date.	March, 1913.					April, 1913.					May, 1913.				
	Number of Components.				I.	Number of Components.				I.	Number of Components.				I.
	2.	3.	2.	3.		2.	3.	2.	3.		2.	3.	2.	3.	
1	80	144	0·2	0·2	0·0	274	459	1·0	1·0	0·9	...	...	...	...	...
2	83	107	0·2	0·1	0·0	186	272	0·7	0·6	0·2	145	211	0·5	0·4	0·4
3	144	216	0·4	0·3	0·4	219	285	0·8	0·6	0·4	201	517	0·7	1·1	0·6
4	265	407	0·7	0·5	0·3	196	398	0·7	0·8	0·6	486	974	1·8	2·1	1·4
5	179	277	0·5	0·4	0·1	241	324	0·9	0·7	0·2	1,186	1,615	4·4	3·4	1·4
6	346	674	0·9	0·9	0·1	39	68	0·1	0·1	0·1	2,651	5,072	9·9	10·7	1·3
7	282	498	0·7	0·7	0·6	33	47	0·1	0·1	0·2	1,196	2,207	4·4	4·7	1·1
8	402	639	1·1	0·8	0·8	247	413	0·9	0·9	0·9	288	430	1·1	0·9	0·7
9	153	276	0·4	0·4	0·3	1,575	3,347	5·7	7·1	1·9	175	357	0·7	0·8	0·5
10	112	229	0·3	0·3	0·0	669	1,144	2·4	2·4	1·1	169	275	0·6	0·6	0·4
11	384	603	1·0	0·8	0·9	655	927	2·4	2·0	0·8	136	187	0·5	0·4	0·1
12	230	429	0·6	0·6	0·3	559	912	2·0	1·9	1·3	77	159	0·3	0·3	0·1
13	61	301	0·2	0·4	0·3	213	342	0·8	0·7	0·7	98	206	0·4	0·4	0·3
14	1,544	4,084	4·1	5·4	1·6	248	376	0·9	0·8	0·6	27	39	0·1	0·1	0·0
15	1,376	2,559	3·6	3·4	1·2	448	707	1·6	1·5	0·9	96	139	0·4	0·3	0·5
16	749	2,555	2·0	3·3	1·3	369	715	1·3	1·5	1·0	37	77	0·1	0·2	0·1
17	610	1,162	1·6	1·5	1·2	378	755	1·4	1·6	0·9	103	152	0·4	0·3	0·2
18	304	780	0·8	1·0	0·4	157	205	0·6	0·4	0·1	22	32	0·1	0·1	0·7
19	313	745	0·8	1·0	0·3	136	223	0·5	0·5	0·2	143	172	0·5	0·4	0·5
20	116	241	0·3	0·3	0·1	68	109	0·2	0·2	0·0	61	85	0·2	0·2	0·1
21	437	810	1·2	1·1	0·9	50	68	0·2	0·1	0·0	51	70	0·2	0·1	0·0
22	309	537	0·8	0·7	0·5	218	280	0·8	0·6	0·1	14	23	0·1	0·0	0·0
23	482	962	1·3	1·3	1·0	194	313	0·7	0·7	0·5	6	10	0·0	0·0	0·0
24	275	377	0·7	0·5	0·4	79	171	0·3	0·4	0·3	57	75	0·2	0·2	0·3
25	140	272	0·4	0·4	0·2	140	208	0·5	0·4	0·1	86	173	0·3	0·4	0·5
26	138	230	0·4	0·3	0·1	69	108	0·3	0·2	0·1	49	61	0·2	0·1	0·2
27	217	303	0·6	0·4	0·2	157	261	0·6	0·6	0·9	133	251	0·5	0·5	0·7
28	333	467	0·9	0·6	0·3	270	368	1·0	0·8	0·7	63	123	0·2	0·3	0·5
29	381	758	1·0	1·0	0·8	136	222	0·5	0·5	0·1	187	329	0·7	0·7	0·5
30	739	1,018	2·0	1·3	0·9	61	100	0·2	0·2	0·0	88	166	0·3	0·4	0·2
31	538	987	1·4	1·3	0·9	...	...	...	...	...	32	47	0·1	0·1	0·2
Means all available days.	378	763	...	...	...	276	471	...	...	...	269	474	...	...	...

TABLE XXXIV.—Squares of Daily Ranges at Cape Denison (Unit $100\gamma^2$) and Ratios.

Date.	June, 1913.					July, 1913.				
	Number of Components.				I.	Number of Components.				I.
	2.	3.	2.	3.		2.	3.	2.	3.	
1	392	559	3·1	2·6	1·4	116	228	0·8	1·0	0·6
2	498	923	3·9	4·3	1·0	48	90	0·3	0·4	0·3
3	353	474	2·8	2·2	0·8	159	218	1·1	1·0	0·4
4	734	1,240	5·7	5·7	0·8	28	37	0·2	0·2	0·1
5	58	118	0·5	0·5	0·2	23	52	0·2	0·2	0·2
6	73	145	0·6	0·7	0·0	25	55	0·2	0·3	0·3
7	17	45	0·1	0·2	0·0	47	128	0·3	0·6	0·4
8	25	48	0·2	0·2	0·0	30	50	0·2	0·2	0·2
9	69	94	0·5	0·4	0·1	26	34	0·2	0·2	0·0
10	66	117	0·5	0·5	0·2	45	58	0·3	0·3	0·5
11	47	122	0·4	0·6	0·1	45	68	0·3	0·3	0·2
12	17	28	0·1	0·1	0·0	616	785	4·4	3·6	1·3
13	23	49	0·2	0·2	0·4	577	820	4·1	3·7	0·9
14	22	28	0·2	0·1	0·5	258	350	1·8	1·6	0·9
15	53	95	0·4	0·4	0·7	533	995	3·8	4·5	0·9
16	55	124	0·4	0·6	0·4	374	528	2·7	2·4	0·2
17	35	78	0·3	0·4	0·2	71	110	0·5	0·5	0·1
18	21	37	0·2	0·2	0·1	98	217	0·7	1·0	0·1
19	260	473	2·0	2·2	0·9	33	62	0·2	0·3	0·1
20	49	77	0·4	0·4	0·2	372	559	2·6	2·6	1·1
21	201	343	1·6	1·6	0·5	145	190	1·0	0·9	0·8
22	23	48	0·2	0·2	0·2	91	160	0·6	0·7	0·3
23	100	146	0·8	0·7	0·6	75	91	0·5	0·4	0·2
24	64	107	0·5	0·5	0·7	77	134	0·5	0·6	0·5
25	28	37	0·2	0·2	0·1	176	284	1·2	1·3	1·1
26	135	328	1·1	1·5	0·7	58	113	0·4	0·5	0·5
27	52	76	0·4	0·4	0·1	76	127	0·5	0·6	0·2
28	59	92	0·5	0·4	0·9	27	38	0·2	0·2	0·1
29	183	250	1·4	1·2	1·0	53	101	0·4	0·5	0·2
30	129	180	1·0	0·8	0·5	24	43	0·2	0·2	0·2
31	...	...	...	...	...	37	62	0·3	0·3	0·1
Means all days.	128	216	...	...	...	141	219	...	...	...

TABLE XXXV.—Activity Ratios from Mean Monthly Values.

Month.	Two Components.		Three Components.	
	C.E/C.D.	E/C.D.	C.E/C.D.	E/C.D.
April	0·85	0·13	0·61	0·08
May	1·03	0·24	0·69	0·15
June	0·89	0·19	0·49	0·09
July	0·70	0·20	0·45	......
August	0·81	0·18	0·57	0·13
September	0·75	0·23	0·56	0·16
October	0·70	0·10	0·49	0·07
Means	0·81	0·18	0·55	0·11

TABLE XXXVI.—Sums of Squares of Daily Ranges. Monthly Means (Unit $100\gamma^2$).

	Cape Denison.						I.	Cape Evans.		Eskdalemuir.	
	2 Comps.	3 Comps.	2 Comps.	3 Comps.	2 Comps.	3 Comps./2 Comps.		2 Comps.	3 Comps.	2 Comps.	3 Comps.
Column.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1912.											
April	638	1,189	22	20	686	1·7	0·54	465	577	82	90
May	328	594	29	29	...	1·8	0·43	421	533	87	96
June	392	843	25	25	...	2·2	0·44	388	463	76	80
July	368	725	29	27	387	2·0	0·42	249	308	73	...
August	593	950	31	31	...	1·6	0·49	431	501	105	121
September	578	886	30	30	...	1·5	0·47	431	495	131	141
October	783	1,256	31	31	...	1·6	0·46	533	630	78	90
November	1,264	2,080	30	26	1,268	1·6	0·49	...	...	...	...
1913.											
January	909	1,457	17	17	...	1·6	0·58	...	...	...	...
February	529	906	28	28	...	1·7	0·53	...	...	...	...
March	378	763	31	31	...	2·0	0·53	...	...	...	...
April	276	471	30	30	...	1·7	0·54	...	...	...	...
May	269	474	30	30	...	1·8	0·45	...	...	...	...
June	128	216	30	30	...	1·7	0·45	...	...	...	...
July	141	219	31	31	...	1·6	0·42	...	...	...	...

TABLE XXXVII.—International Character Figures and Values of ΣR^2 at Cape Denison.

International Character.	Two Horizontal Components.					Three Rectangular Components.				
	A	B	B[1]	C	C[1]	A	B	B[1]	C	C[1]
0·0	516	210	76	58	28	797	351	126	128	49
0·1	340	271	154	75	55	644	530	251	158	93
0·2	713	355	159	138	71	1,115	615	240	292	113
0·3	722	464	205	236	64	1,236	810	399	465	117
0·0 & 0·1	451	241	124	70	45	734	436	204	148	77
0·2 & 0·3	717	429	184	184	69	1,180	745	326	373	114
0·4 & 0·5	713	551	241	283	104	1,239	920	418	533	175
0·6 & 0·7	604	745	242	509	124	1,101	1,144	396	811	237
0·8 & 0·9	1,506	813	420	793	365	2,304	1,183	695	1,388	579
1·0 to 1·4	1,850	1,618	688	1,464	776	2,730	2,682	1,430	2,916	1,323
>1·4	1,351	2,253	1,560	2,525	...	2,342	3,353	3,715	3,156	...

TABLE XXXVIII.—International Character Figures and Cape Denison Character Ratios.

International Character.	Two Horizontal Components. A	B	B¹	C	C¹	Three Rectangular Components. A	B	B¹	C	C¹
0·0	·50	·29	·22	·13	·18	·48	·33	·18	·15	·18
0·1	·39	·40	·49	·20	·32	·43	·49	·41	·21	·35
0·2	·78	·51	·53	·34	·48	·75	·54	·45	·39	·47
0·3	·74	·67	·56	·52	·34	·77	·75	·56	·58	·40
0·0 & 0·1	0·5	0·3	0·4	0·2	0·3	0·5	0·4	0·3	0·2	0·3
0·2 & 0·3	0·8	0·6	0·5	0·4	0·4	0·8	0·7	0·5	0·5	0·4
0·4 & 0·5	0·8	0·8	0·7	0·6	0·5	0·8	0·9	0·6	0·6	0·6
0·6 & 0·7	0·6	1·1	0·8	1·3	0·7	0·8	1·1	0·8	1·1	0·7
0·8 & 0·9	1·5	1·1	1·3	1·7	2·7	1·4	1·0	1·2	1·6	2·6
1·0 to 1·4	2·2	2·3	2·0	3·8	3·7	2·0	2·3	2·0	3·9	3·6
$>$1·4	1·9	3·5	4·9	4·3	...	2·0	3·3	6·2	3·3	...

TABLE XXXIX.—Cases when ΣR^2 from Horizontal Components Above and Below the Mean at Pairs of Stations.

Stations Compared.		April.	May.	June.	July.	August.	September.	October.	All months.
Cape Denison—	Cape Evans—								
Above	Above	8	4	5	5	8	6	7	43
Above	Below	0	3	1	0	1	4	4	13
Below	Above	0	1	1	3	1	2	2	10
Below	Below	14	21	15	20	19	18	16	123
Cape Denison—	Eskdalemuir—								
Above	Above	6	5	6	3	8	2	4	34
Above	Below	2	2	1	2	2	8	6	23
Below	Above	0	2	4	4	1	1	0	12
Below	Below	14	20	14	20	19	19	18	124
Cape Evans—	Eskdalemuir—								
Above	Above	8	5	9	4	7	2	4	39
Above	Below	1	1	0	4	2	6	4	18
Below	Above	1	2	1	2	2	1	0	9
Below	Below	20	23	17	20	17	21	19	137

TABLE XL.—Cases when Vertical Force Range Above and Below the Mean at Pairs of Stations compared.

Stations Compared.		April.	May.	June.	July.	August.	September.	October.	All months.
Cape Denison—	Cape Evans—								
Above	Above	6	7	7	8	10	6	9	53
Above	Below	7	2	1	1	3	5	4	23
Below	Above	2	0	4	1	1	5	2	15
Below	Below	13	22	16	18	15	14	14	112
Cape Denison—	Eskdalemuir—								
Above	Above	7	5	4	...	8	5	5	34
Above	Below	6	4	4	...	6	6	5	31
Below	Above	2	4	7	...	0	3	2	18
Below	Below	13	18	15	...	17	15	15	93
Cape Evans—	Eskdalemuir—								
Above	Above	5	5	5	...	7	5	5	32
Above	Below	3	2	6	...	4	6	4	25
Below	Above	4	4	5	...	0	3	2	18
Below	Below	18	20	12	...	18	15	15	98

TABLE XLI.—Squares of Daily and Hourly Ranges. June, 1912.

Date.	Cape Denison.						Cape Evans.					
	H.			V.			N'.			V.		
	Daily.	Hourly.	Ratio.	Daily.	Hourly.	Ratio.	Daily.	Hourly.	Ratio.	Daily.	Hourly.	Ratio.
1	1,452	1,854	1·3	1,772	1,353	0.8	210	273	1·3	188	145	0·8
2	320	387	1·2	339	506	1·5	199	308	1·5	380	291	0·8
3	458	540	1·2	193	394	2·0	114	188	1·6	164	125	0·8
4	72	84	1·2	161	171	1·1	23	48	2·1	6	13	2·2
5	41	75	1·8	190	186	1·0	13	43	3·3	7	16	2·3
6	22	56	2·5	71	59	0·8	...	...	...	...	...	...
7	18	30	1·7	40	43	1·1	24	16	0·7	6	5	0·8
8	1,197	1,742	1·5	2,862	3,204	1·1	1,011	1,114	1·1	289	316	1·1
9	967	2,373	2·5	2,560	3,123	1·2	1,089	733	0·7	121	383	3·2
10	313	606	1·9	973	1,441	1·5	380	405	1·1	76	131	1·7
11	240	454	1·9	543	1,343	2·5	166	264	1·6	59	103	1·7
12	74	192	2·6	222	302	1·4	135	199	1·5	64	94	1·5
13	40	80	2·0	132	142	1·1	17	38	2·2	17	21	1·2
14	144	192	1·3	296	354	1·2	58	75	1·3	19	22	1·2
15	22	53	2·4	56	85	1·5	...	...	...	...	...	...
16	12	35	2·9	48	63	1·3	...	...	...	...	...	...
17	18	44	2·4	32	54	1·7	20	42	2·1	16	12	0·8
18	67	70	1·0	172	115	0·7	13	29	2·2	6	10	1·7
19	12	35	2·9	38	49	1·3	29	25	0·9	12	11	0·9
20	32	63	2·0	25	38	1·5	4	14	3·5	3	8	2·7
21	18	54	3·0	19	41	2·2	12	24	2·0	12	10	0·8
22	44	67	1·5	59	78	1·3	42	42	1·0	28	18	0·6
23	48	126	2·6	204	265	1·3	104	109	1·0	21	20	1·0
24	85	156	1·8	172	206	1·2	144	163	1·1	44	44	1·0
25	41	54	1·3	58	61	1·1	31	43	1·4	7	10	1·4
26	72	78	1·1	85	122	1·4	69	54	0·8	12	13	1·1
27	502	280	0·6	166	189	1·1	246	283	1·2	262	178	0·7
28	130	422	3·2	259	306	1·2	117	167	1·4	90	82	0·9
29	306	675	2·2	713	1,139	1·6	213	338	1·6	66	120	1·8
30	64	141	2·2	169	255	1·5	48	100	2·1	40	33	0·8
Means...	228	367	1·61	421	522	1·24	168	190	1·13	75	83	1·11

TABLE XLII.—Squares of Daily and Hourly Ranges. September, 1912.

Date.	Cape Denison.						Cape Evans.					
	H.			V.			N[1].			V.		
	Daily.	Hourly.	Ratio.	Daily.	Hourly.	Ratio.	Daily.	Hourly.	Ratio.	Daily.	Hourly.	Ratio.
1	151	193	1·3	445	266	0·6	117	58	0·5	16	19	1·2
2	29	103	3·5	94	84	0·9	22	37	1·7	17	23	1·4
3	146	345	2·4	72	224	3·1	23	36	1·6	19	16	0·8
4	250	297	1·2	493	695	1·4	392	277	0·7	44	38	0·9
5	77	169	2·2	259	304	1·2	243	270	1·1	59	64	1·1
6	193	379	2·0	188	281	1·5	121	147	1·2	50	59	1·2
7	67	140	2·1	149	224	1·5	49	91	1·8	15	28	1·9
8	292	365	1·3	139	258	1·9	102	195	1·9	50	58	1·2
9	282	377	1·3	357	383	1·1	237	243	1·0	24	34	1·4
10	259	267	1·0	196	280	1·4	139	157	1·1	40	37	0·9
11	282	253	0·9	231	214	0·9	86	125	1·4	37	35	0·9
12	219	264	1·2	240	249	1·0	246	277	1·1	69	88	1·3
13	276	460	1·7	458	416	0·9	98	143	1·5	83	119	1·4
14	139	283	2·0	123	252	2·0	104	190	1·8	45	71	1·6
15	37	103	2·8	50	62	1·2	26	27	1·0	9	10	1·1
16	156	181	1·2	174	170	1·0	119	78	0·7	31	21	0·7
17	462	761	1·6	246	759	3·1	681	963	1·4	142	203	1·4
18	462	1,764	3·8	1,089	1,238	1·1	692	686	1·0	85	167	2·0
19	231	335	1·5	335	511	1·5	204	244	1·2	48	97	2·0
20	182	382	2·1	213	253	1·2	250	236	0·9	53	57	1·1
21	286	528	1·8	303	276	0·9	100	178	1·8	66	70	1·1
22	650	747	1·1	686	980	1·4	149	215	1·4	119	139	1·2
23	376	734	2·0	384	1,075	2·8	146	257	1·8	38	102	2·7
24	1,149	1,027	0·9	1,232	911	0·7	1,232	1,288	1·0	488	268	0·5
25	404	701	1·7	177	605	3·4	96	137	1·4	66	74	1·1
26	269	501	1·9	161	461	2·9	55	156	2·8	38	97	2·6
27	55	184	3·3	79	196	2·5	64	68	1·1	29	19	0·7
28	56	137	2·4	132	199	1·5	18	39	2·2	27	23	0·9
29	76	175	2·3	67	191	2·9	41	59	1·4	42	39	0·9
30	276	333	1·2	458	379	0·8	86	105	1·2	58	57	1·0
Means..	260	416	1·60	308	413	1·34	198	233	1·18	64	71	1·11

TABLE XLIII.—Antarctic Daily and Hourly Character Ratios and International Characters. June, 1912.

	Cape Denison.						Cape Evans.						Means from two Antarctic Stations.		I.
	H.		V.		Means.		N¹.		V.		Means.				
	Daily.	Hourly.	Daily.	Hourly.	Daily.	Hourly.	Daily	Hourly.	Daily.	Hourly.	Daily.	Hourly.	Daily.	Hourly.	
Column ...	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
Date.															
1	6·4	5·0	4·2	2·6	5·3	3·8	1·3	1·4	2·5	1·8	1·9	1·6	3·6	2·7	1·0
2	1·4	1·1	0·8	1·0	1·1	1·0	1·2	1·6	5·1	3·5	3·1	2·6	2·1	1·8	0·8
3	2·0	1·5	0·5	0·8	1·2	1·1	0·7	1·0	2·2	1·5	1·4	1·2	1·3	1·2	0·8
4	0·3	0·2	0·4	0·3	0·3	0·3	0·1	0·3	0·1	0·2	0·1	0·2	0·2	0·2	0·2
5	0·2	0·2	0·5	0·4	0·3	0·3	0·1	0·2	0·1	0·2	0·1	0·2	0·2	0·2	0·0
6	0·1	0·2	0·2	0·1	0·1	0·1	...	...	...	...	...	...	...	...	0·1
7	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·6
8	5·3	4·7	6·8	6·1	6·0	5·4	6·0	5·9	3·9	3·8	5·0	4·8	5·5	5·1	1·2
9	4·2	6·5	6·1	6·0	5·2	6·2	6·5	3·9	1·6	4·6	4·1	4·2	4·6	5·2	0·9
10	1·4	1·7	2·3	2·8	1·8	2·2	2·3	2·1	1·0	1·6	1·6	1·9	1·7	2·0	0·9
11	1·1	1·2	1·3	2·6	1·2	1·9	1·0	1·4	0·8	1·2	0·9	1·3	1·0	1·6	0·6
12	0·3	0·5	0·5	0·6	0·4	0·5	0·8	1·0	0·9	1·1	0·8	1·1	0·6	0·8	0·3
13	0·2	0·2	0·3	0·3	0·2	0·2	0·1	0·2	0·2	0·3	0·2	0·2	0·2	0·2	0·1
14	0·6	0·5	0·7	0·7	0·7	0·6	0·3	0·4	0·3	0·3	0·3	0·3	0·5	0·5	0·2
15	0·1	0·1	0·1	0·2	0·1	0·2	...	...	...	...	...	...	...	...	0·1
16	0·1	0·1	0·1	0·1	0·1	0·1	...	...	...	...	...	...	...	...	0·1
17	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·2	0·2	0·1	0·2	0·2	0·1	0·1	0·3
18	0·3	0·2	0·4	0·2	0·4	0·2	0·1	0·2	0·1	0·1	0·1	0·1	0·2	0·2	0·2
19	0·1	0·1	0·1	0·1	0·1	0·1	0·2	0·1	0·2	0·1	0·2	0·1	0·1	0·1	0·1
20	0·1	0·2	0·1	0·1	0·1	0·1	0·0	0·1	0·0	0·1	0·0	0·1	0·1	0·1	0·1
21	0·1	0·1	0·0	0·1	0·1	0·1	0·1	0·1	0·2	0·1	0·1	0·1	0·1	0·1	0·2
22	0·2	0·2	0·1	0·1	0·2	0·2	0·3	0·2	0·4	0·2	0·3	0·2	0·2	0·2	0·6
23	0·2	0·3	0·5	0·5	0·3	0·4	0·6	0·6	0·3	0·2	0·5	0·4	0·4	0·4	0·9
24	0·4	0·4	0·4	0·4	0·4	0·4	0·9	0·9	0·6	0·5	0·7	0·7	0·6	0·6	0·6
25	0·2	0·1	0·1	0·1	0·2	0·1	0·2	0·2	0·1	0·1	0·1	0·2	0·1	0·2	0·2
26	0·3	0·2	0·2	0·2	0·3	0·2	0·4	0·3	0·2	0·2	0·3	0·2	0·3	0·2	0·2
27	2·2	0·8	0·4	0·4	1·3	0·6	1·5	1·5	3·5	2·2	2·5	1·8	1·9	1·2	0·8
28	0·6	1·2	0·6	0·6	0·6	0·9	0·7	0·9	1·2	1·0	1·0	0·9	0·8	0·9	0·9
29	1·3	1·8	1·7	2·2	1·5	2·0	1·3	1·8	0·9	1·4	1·1	1·6	1·3	1·8	0·8
30	0·3	0·4	0·4	0·5	0·3	0·4	0·3	0·5	0·5	0·4	0·4	0·5	0·4	0·4	0·3

TABLE XLIV.—Antarctic Daily and Hourly Character Ratios and International Characters. September, 1912.

	Cape Denison.						Cape Evans.						Means from two Antarctic Stations.		I.
	H.		V.		Means.		N¹.		V.		Means.				
	Daily.	Hourly.	Daily.	Hourly.	Daily.	Hourly.	Daily.	Hourly.	Daily.	Hourly.	Daily.	Hourly.	Daily.	Hourly.	
Column ...	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
Date.															
1	0·6	0·5	1·4	0·6	1·0	0·6	0·6	0·3	0·3	0·3	0·4	0·3	0·7	0·4	0·3
2	0·1	0·2	0·3	0·2	0·2	0·2	0·1	0·2	0·3	0·3	0·2	0·2	0·2	0·2	0·1
3	0·6	0·8	0·2	0·5	0·4	0·7	0·1	0·2	0·3	0·2	0·2	0·2	0·3	0·4	0·6
4	1·0	0·7	1·6	1·7	1·3	1·2	2·0	1·2	0·7	0·5	1·3	0·9	1·3	1·0	0·7
5	0·3	0·4	0·8	0·7	0·6	0·6	1·2	1·2	0·9	0·9	1·1	1·0	0·8	0·8	0·5
6	0·7	0·9	0·6	0·7	0·7	0·8	0·6	0·6	0·8	0·8	0·7	0·7	0·7	0·8	0·4
7	0·3	0·3	0·5	0·5	0·4	0·4	0·2	0·4	0·2	0·4	0·2	0·4	0·3	0·4	0·1
8	1·1	0·9	0·5	0·6	0·8	0·8	0·5	0·8	0·8	0·8	0·7	0·8	0·7	0·8	0·6
9	1·1	0·9	1·2	0·9	1·1	0·9	1·2	1·0	0·4	0·5	0·8	0·8	1·0	0·8	0·7
10	1·0	0·6	0·6	0·7	0·8	0·7	0·7	0·7	0·6	0·5	0·7	0·6	0·7	0·6	0·2
11	1·1	0·6	0·8	0·5	0·9	0·6	0·4	0·5	0·6	0·5	0·5	0·5	0·7	0·5	0·4
12	0·8	0·6	0·8	0·6	0·8	0·6	1·2	1·2	1·1	1·2	1·2	1·2	1·0	0·9	0·6
13	1·1	1·1	1·5	1·0	1·3	1·1	0·5	0·6	1·3	1·7	0·9	1·1	1·1	1·1	0·3
14	0·5	0·7	0·4	0·6	0·5	0·6	0·5	0·8	0·7	1·0	0·6	0·9	0·5	0·8	0·3
15	0·1	0·2	0·2	0·2	0·2	0·2	0·1	0·1	0·1	0·1	0·1	0·1	0·1	0·2	0·0
16	0·6	0·4	0·6	0·4	0·6	0·4	0·6	0·3	0·5	0·3	0·5	0·3	0·6	0·4	0·0
17	1·8	1·8	0·8	1·8	1·3	1·8	3·4	4·1	2·2	2·9	2·8	3·5	2·1	2·7	1·8
18	1·8	4·2	3·5	3·0	2·7	3·6	3·5	2·9	1·3	2·4	2·4	2·7	2·5	3·1	1·1
19	0·9	0·8	1·1	1·2	1·0	1·0	1·0	1·0	0·7	1·4	0·9	1·2	0·9	1·1	0·4
20	0·7	0·9	0·7	0·6	0·7	0·8	1·3	1·0	0·8	0·8	1·0	0·9	0·9	0·8	0·5
21	1·1	1·3	1·0	0·7	1·0	1·0	0·5	0·8	1·0	1·0	0·8	0·9	0·9	0·9	0·1
22	2·5	1·8	2·2	2·4	2·4	2·1	0·8	0·9	1·9	2·0	1·3	1·4	1·8	1·8	0·7
23	1·4	1·8	1·2	2·6	1·3	2·2	0·7	1·1	0·6	1·4	0·7	1·3	1·0	1·7	0·9
24	4·4	2·5	4·0	2·2	4·2	2·3	6·2	5·5	7·7	3·8	7·0	4·7	5·6	3·5	1·6
25	1·6	1·7	0·6	1·5	1·1	1·6	0·5	0·6	1·0	1·0	0·8	1·8	0·9	1·2	0·3
26	1·0	1·2	0·5	1·1	0·8	1·2	0·3	0·7	0·6	1·4	0·4	1·0	0·6	1·1	0·6
27	0·2	0·4	0·3	0·5	0·2	0·5	0·3	0·3	0·5	0·3	0·4	0·3	0·3	0·4	0·0
28	0·2	0·3	0·4	0·5	0·3	0·4	0·1	0·2	0·4	0·3	0·3	0·2	0·3	0·3	0·0
29	0·3	0·4	0·2	0·5	0·3	0·4	0·2	0·3	0·7	0·5	0·4	0·4	0·3	0·4	0·2
30	1·1	0·8	1·5	0·9	1·3	0·9	0·4	0·5	0·9	0·8	0·7	0·6	1·0	0·7	0·3

CHAPTER III.—HOURLY CHARACTERS. DIURNAL VARIATION OF DISTURBANCE.

§18. Character figures 0 (quiet), 1 (moderately disturbed), 2 (highly disturbed) can obviously be assigned to intervals shorter or longer than a day. The scheme was applied to individual hours, primarily with a view to studying the diurnal variation of disturbance. The figures were assigned as the result of general inspection, not of any exact measurement of amplitude. They thus suffer from similar uncertainties to the daily character figures. An hour might get a 2 in a quiet time for disturbance which in a disturbed time would have received a 1. This ought not, however, to prejudice discrimination between the different hours of the day.

Before considering this principal object, we shall consider another use of hourly character figures. A daily character 2 may mean active disturbance throughout the whole day, or large disturbance confined to part of the day, possibly to a single hour. In the former case, every hour might receive a 2, in the latter case twenty three hours might conceivably receive 0's. Thus a day of daily character 2 might have for the mean of the hourly character figures anything from 2·0 to 0·1, and a comparison of daily and mean hourly character figures may thus throw a valuable light on the ordinary duration of disturbance. Such a comparison is made in Table XLV for each day for which the requisite data existed. The columns headed H give the mean of the 24 hourly characters; the columns headed D give the daily character. The last three lines give the mean value of the mean hourly character for days of which the daily characters were respectively 0, 1 and 2. Table XLVI gives for each month the lowest and highest mean hourly characters obtained by days having daily character figures 0, 1 and 2 respectively.

At the one extreme we have May 18, May 23 and June 12, 1913, for which the mean of the hourly characters was 0·1. May 18 was a very exceptional kind of day. Its daily character figure as given in Table I was 0, and the character ratios assigned to it in Table XXXIII were 0·1, both for the horizontal and all three components, but its international character was 0·7. May 23 and June 12, on the other hand, were international quiet days, and were thus very probably quiet all over the world; each had 0 assigned to 22 hours out of the 24. There was no day every hour of which got a 0.

At the other extreme, we have July 5 and November 10, 1912, each of which had 2·0 as the mean of the hourly character figures. On July 5 one hour got a 1, but on November 10 every hour got a 2. In fact 34 consecutive hours from November 9, 10 and 11 got 2's.

While it is possible for a day of daily character 2 to have the mean of its hourly characters as low as 0·1, there were, as Table XLVI shows, only three months out of the fifteen in which a day of daily character 2 had the mean of its hourly characters smaller than 1·0, and there were in all only five such days. All included a number of hours of character 0, but in each group of hours, either at the beginning or end of the day, were of character 2. Days quiet except for one or two hours of very large disturbance were practically non-existent. The most outstanding cases of difference between the two sets of figures in Table XLV are discussed individually below.

April 11, 1912, daily character 1, mean hourly character 0·5, was mainly very quiet, fifteen successive hours getting 0's, but active disturbance in the earlier hours justified a 1.

April 13, 1912, has already attracted attention owing to the difference between the character figures 2 at Cape Denison and 0 at Cape Evans. The mean 0·8 of its hourly character figures arose from four 2's, ten 1's and ten 0's. The two adjacent days, with somewhat larger mean hourly character figures, got only 1. But while the 13th had more quiet hours than the 12th, its disturbed hours were the more disturbed. The fact that the 14th got only a 1 might be partly explained by the contrast between it and the 15th, which was a somewhat highly disturbed day.

April 27, 1912, was the exact opposite of April 11. Its daily character was 0, while the mean of the hourly characters was 0·9. The day was really on the border line between a 0 and a 1. There was a good deal of unquietness, but no single large movement.

May 3, 1912, daily character 1, mean of hourly characters 1·5, fourteen hours getting 2's. This was a case in which a number of consecutive hours were so similarly disturbed that they had to get the same character figure. They got 2's, but the disturbance was on the border line between 1 and 2.

May 25, 1912, was a similar case to April 27. The daily character was 0, while the mean of the hourly characters was 0·8. A good many hours, closely alike as regards disturbance, got 1's, while they might perhaps equally well have got 0's.

June 12, 1912 had a daily character 1, while the mean of the hourly characters was 1·4, ten hours getting 2's. Disturbance was persistent rather than large during the six earliest hours, which got 2's. The day's getting a 1 rather than a 2 may have arisen from the contrast with the four immediately preceding days, which were considerably more disturbed.

June 19, 1912, daily character 1, mean of the hourly characters 0·5. After 6h., the day was very quiet, but three of the earlier hours got 2's, and the disturbance fairly justified a 1 for the day.

June 20, 1912, daily character 1, mean of hourly characters 0·5 was on the border line between a 0 and a 1.

June 24, 1912, daily character 1, had a mean hourly character 1·3, arising from two 0's, fourteen 1's and eight 2's supplied by the eight earliest hours. This was a border-line case where the early part of the day merited a 2, while the last part merited a 1, if not a 0.

June 25, 1912, daily character 1, mean hourly character 0·5. After 4h., the day was certainly of character 0, but the disturbance earlier in the day appeared incompatible with a 0.

July 15, 1912, daily character 1, mean hourly character 0·5. Eleven hours got 0's and thirteen got 1's. The day was on the border-line between 0 and 1.

August 5, 1912, daily character 2, mean hourly character 0·7, arising from ten 0's, eleven 1's and three 2's, was really on the border line between 1 and 2. The first half of the day was so quiet it might have got a 0, but there was continuous disturbance after 14h.

August 11, 1912, daily character 1, mean hourly character 0·4. After 6h. the day was decidedly of character 0, but the disturbance in the earlier hours precluded a 0 for the day.

September 3, 1912, daily character 1, mean hourly character 0·5. Up to 21h. the day was unmistakably of character 0, but an S.C. (sudden commencement) intervened. The last three hours got 2's but the disturbance appeared insufficient to justify a 2 for the day.

September 25, 1912, daily character 2, mean hourly character 0·8, arising from twelve 0's, five 1's and seven 2's. The greater part of the day was really quiet, but there was disturbance in both the early and the late hours, and that in the early morning was large enough to call for a 2 for the day.

October 22, 1912, daily character 0, mean hourly character 1·0, arising from six 0's, eleven 1's and seven 2's. If this day had occurred during a quiet season it would have got at least a 1, but it was decidedly quieter than the adjacent days, and part of the day was unusually quiet for October.

February 11, 1913, daily character 0, mean hourly character 1·0, arising from three 0's, eighteen 1's, and three 2's. In a quiet month this day would probably have got a 1, but there was no really large movement, and 1's were awarded to a number of hours which might perhaps with equal justice have got 0's.

March 25, 1913, daily character 0, mean hourly character 0·9, arising from four 0's, nineteen 1's and one 2. This was a border-line case between a 0 and a 1. The hourly 1's in a good many cases might perhaps equally well have been 0's. The one 2 arose from a short " Bay " of no great amplitude.

April 12, 1913, daily character 1, mean hourly character 1·4, arising from fifteen 1's and nine 2's. The day was quieter than the three preceding days which got 2's, and the contrast might be partly responsible for its getting a 1.

May 19, 1913, daily character 1, mean hourly character 0·4, arising from fourteen 0's and ten 1's. After 12h. the day certainly merited a 0, but the oscillations during the early hours fairly justified a 1.

May 27, 1913, daily character 1, mean hourly character 0·4, arising from sixteen 0's, seven 1's and one 2. A somewhat prominent bay between 13h. and 14h. ruled out the 0 which otherwise the day might have got.

June 11, 1913, daily character 1, mean hourly character 0·2, arising from twenty 0's and four 1's. Most of the day was conspicuously quiet, but between 12h. and 14h., there were two well marked though not deep bays.

June 15, 1913, daily character 1, mean hourly character 0·4, arising from fifteen 0's and nine 1's. This was a doubtful case. The disturbance between 2h. and 5h. seemed incompatible with a daily character 0.

June 16, 1913, daily character 1, mean hourly character 0·4, arising from fourteen 0's and ten 1's. This again was a borderline case. After 13h. the day was decidedly of character 0.

July 2, 1913, daily character 0, mean hourly character 0·7, arising from eight 0's, fifteen 1's and one 2. If the disturbance during the hour awarded a 2 had been at all prominent the day whould have got a 1; it was rather a doubtful case.

July 18, 1913, daily character 1, mean hourly character 0·4, arising from fifteen 0's and nine 1's. A considerable part of the day was very quiet, but two well marked though not deep bays turned the scale in favour of a 1.

July 23, 1913, daily character 1, mean hourly character 0·4, arising from fifteen 0's, and nine 1's. After 8h. the day was very quiet, but the disturbance prior to 6h. precluded a 0 for the day.

As appears from Table XLV, the means of the hourly characters for the groups of days with daily characters 0, 1 and 2 are decidedly lower for the months April to July, 1913 than for the corresponding months of 1912. This suggests that besides a reduction in the amplitude of disturbance in 1913, there was an increased duration of quiet conditions. The study of exceptional cases in Table XLV left the impression that less disturbance sufficed to secure a daily character 1 in 1913 than in 1912.

§19. As already explained, the primary object in view in assigning hourly characters was the determination of the diurnal variation of disturbance. If character figures were directly proportional to disturbance, there could be no question that the proper way of determining the diurnal variation for a particular month would be to take the mean for each of the 24 hours of the hourly character figures assigned throughout the month. This is the course adopted in Table XLVII, which gives the results so obtained for Cape Denison from each of the fifteen months for which data existed. But on special occasions character 2 may imply ten times as much disturbance as the ordinary character 1. Thus results from the treatment of character figures as mere numbers have to be accepted with caution. For instance, in a month of 30 days we could get the same mean character figure for two hours, one of which received a 1 on every day of the month, while the other received a 0 on 15 days and a 2 on the other fifteen days. This makes it desirable to examine the incidence of 0's and 2's, as well as the variation of the mean character figures. Tables XLVIII and XLIX supply statistics as to the diurnal variation of 0's and 2's at Cape Denison. They should be studied conjointly with Table XLVII.

At the foot of the tables results are given separately for the whole fifteen months, for the seven months April to October, 1912, for which comparable data were available for Cape Evans, for the seven winter months May to August, 1912, and May to July, 1913, for the five equinoctial months April, September, October, 1912, and March, April, 1913, and finally for the three summer months November, 1912, and January and February, 1913. In Tables XLVIII and XLIX the results for the groups of months are expressed as percentages of the mean from the whole 24 hours. The highest and lowest values of the day, whether absolute sums or percentages of the mean, are in heavy type.

Tables XLVII to XLIX all show a prominent diurnal variation. Considering first the results from the whole fifteen months, we observe for the hour ending at 2h. G.M.T. a conspicuous principal maximum in Tables XLVII and XLIX, and a conspicuous minimum in Table XLVIII. In other words, 1h.—2h. G.M.T. (*i.e.*, practically the 60 minutes centering at 11h. L.M.T.) provides the smallest number of quiet hours, the greatest number of hours of character 2, and the highest mean character figure, and thus according to all the criteria it is in the average month the most disturbed hour of the 24. The maximum is not of a peaked kind, the difference between the hours ending at 2h. and at 3h. G.M.T. being trifling.

Tables XLVII and XLIX show a much smaller but still decided secondary maximum in the hour ending at 14h., and Table XLVIII has a secondary minimum at the same hour. Thus the tables agree in a slight recrudescence of disturbance, with its maximum shortly before local midnight. Tables XLVII to XLIX suggest the division of the day into a more disturbed ten hours ending at 6h. G.M.T. ($15\frac{1}{2}$ hours L.M.T.), and a less disturbed fourteen hours ending at 20h. G.M.T.

The results from the seven months April to October, 1912, are in remarkable accordance with those from the whole fifteen months. The principal difference is that while the fifteen months show a somewhat poorly-defined principal minimum of disturbance in Table XLVII, the values for 9h. and 11h. being identical, the seven months show a clearly-defined minimum at 10h. In both cases, however, there is a minimum at 17h. very little behind the earlier one. Tables XLVII and XLIX show little, if any dependence of the time of maximum disturbance on the season of the year. In the equinoctial season in Table XLVIII there are two hours, and in the summer season seven, when character 0 was unrepresented. In either case the hour ending at 2h. was one of those without 0's.

A double diurnal oscillation is recognisable in each of the three seasons in all three tables, but it is decidedly more conspicuous in winter than in the other seasons, and is best seen in Table XLIX. In that table the percentage figures at 14h. and 15h. in winter both exceed 100, and are more than half the percentage at 2h., whereas in the summer season the entry under 14h. is less than a quarter of the principal maximum. The minimum in the number of 0's at 14h. is prominent in Table XLVIII in the equinoctial as well as the winter season.

If we compare the monthly means of the hourly character figures in Table XLVII with the corresponding means of the daily character figures in Table III, we see that they agree in making January slightly more disturbed than November, and in making each month of 1913 much quieter than the corresponding month of 1912. But Table XLVII makes June, 1913, the quietest month, and May, 1913, rather quieter than July, 1913, while Table XX makes July, 1913, the quietest month.

In considering the monthly totals in Tables XLVIII and XLIX, it must be remembered that the months are of unequal lengths, and that some months, *e.g.*, January, were not quite complete. The two tables are equally affected, and should be studied together. It will be seen that January was more conspicuous for the fewness of 0's than for the number of 2's, and that what distinguished November from February was the increased number of 2's in the former month.

As regards the figures for the different seasons, some allowance must be made for the fact that disturbance was clearly on the decline, and the three seasons have not the same mean date. It was earlier for the seven winter months than for the five equinoctial months, and earlier for the equinoctial than for the summer months. The differences in mean time were, however, small, and they were in the direction which we should expect to lead to an underestimate of the differences between the three seasons. We may thus infer with considerable assurance that winter is the quietest time, and that summer is considerably more disturbed than equinox. The latter phenomenon is not a usual one, but it was also conspicuous at Cape Evans in 1911–12.

§20. Tables L to LII give the data for Cape Evans which correspond with the seven-month data in Tables XLVII to XLIX.

Tables L and LII agree in putting the maximum of disturbance at Cape Evans in the hour ending at 22h. and Table LI puts the minimum of 0's at 21h., with 22h. almost identical. The excess of the entries at 22h. in Tables L and LII over the entries at 2h. are large, and equally decisive is the excess of the entries at 2h. over the entries at 22h. in Tables XLVII and XLIX. Thus it seems established beyond a doubt that the diurnal variation of disturbance in terms of Greenwich or universal time is not the same at Cape Evans and Cape Denison. The maximum occurs some four hours later at the latter station, the difference in the times of occurrence exceeding the difference in local time (about 1½ hours). It may be added that at Cape Evans, as at Cape Denison, the hour of maximum disturbance seemed practically independent of the season of the year. Thus the difference between the two stations appears to be fundamental.

The results as regards the hour of minimum disturbance are much less decisive. Table L gives 11h. as the hour of least mean character, and it is also the hour when 0's are most numerous in Table LI. But Table LII contains a good many hours with fewer 2's than 11h., and it shows a conspicuous minimum at 17h. If, however, we take all the 1911 and 1912 data available for Cape Evans, we find that the hour for which 2's are least numerous varied with the season of the year. It was 17h. or 18h. for the equinoctial and winter seasons, but for the year as a whole it was 8h., and in winter the number of 2's was so small that accident might play a considerable part.

The hour when 0's were most in evidence at Cape Evans was 11h. for the whole year and the equinoctial season, 10h. for winter, and 9h. for summer (a season not represented in Table LI). If we divide the day as at Cape Denison into a quieter fourteen hours and a less quiet ten hours, the former period would commence at 3h., the latter at 17h.; *i.e.*, three hours earlier than at Cape Denison. At Cape Evans, as at Cape Denison, there was a decided double daily oscillation of disturbance in the equinoctial and winter months.

§ 21. Tables LIII to LV show results for Eskdalemuir corresponding to those for Cape Denison in Tables XLVII to XLIX, except that what was summer at the one station was winter at the other. There is, however, one difference between the two stations which calls for mention. The hour of stopping and starting registration at Cape Denison varied a good deal. At Eskdalemuir the changing of papers took place almost invariably between 9h. and 10h. Thus the character for the hour ending at 10h. depended on the judgment passed on two detached short pieces of curve, with of course a few minutes missing. If this peculiarity influenced the decision, and it is not improbable that it did, we should expect it to lead to an underestimate of disturbance.

Where Tables LIII and LV are in best agreement is as regards the hour of minimum disturbance. In winter the lowest mean character figure and the largest number of 0's appear at 6h., but with that exception 10h. appears as the hour of least disturbance, rivalled only by 11h. in the equinoctial and winter seasons in Table LV. For the reason already stated, disturbance at 10h. may be underestimated, but the figures for 9h. in Table LIII and for 11h. in Table LV strongly support the view that except in the winter months the minimum of disturbance occurs within an hour of 10h.

The results as regards the hour of maximum disturbance are more conflicting. In Table LIII 16h. or 17h. supplies the largest mean character figures for the whole fifteen months and the summer season; but in either case there is a plateau of high values extending from 15h. to 21h. in the case of the fifteen months, and from 15h. to 19h. in the case of the summer months. In the equinoctial season the mean character figure at 24h. is slightly in excess of those for the adjacent hours or for 16h. or 17h. In the winter season the entry under 21h. is decidedly the highest. But even in summer the prominence of the mean character figure at 16h. represents not an excess of 2's but a deficiency of 0's. The summer season agrees with the winter season and the whole fifteen months in putting the maximum number of 2's at 21h. The extraordinary pre-eminence of this hour in winter is probably largely accidental, but obviously so far as large disturbance is concerned, 16h. and 17h. are very ordinary hours as compared with the five hours commencing at 20h.

When comparing Eskdalemuir and Cape Evans, data were got out for 22 months commencing with February, 1911. The months of 1911 and of 1912 treated separately agreed with the present investigation in making the hour ending at 21h. contain the greatest number of 2's, the smallest number appearing in the hours ending at 10h. and 11h. Both years also agreed in making the hour ending at 16h., the time when 0's were fewest and the mean character figure was greatest. Thus it seems fairly clear that at Eskdalemuir on the whole the hour ending at 21h. is that when large disturbance is most prominent, but quiet conditions are distinctly more common at this and later hours than they are earlier in the afternoon about 16h. The contrast at Eskdalemuir is between a more disturbed twelve hours commencing about 14h. and a less disturbed twelve hours commencing about 2h. The resemblance between the diurnal variation of disturbance at Cape Evans and Eskdalemuir in 1911 and 1912 was rather close when Greenwich or universal time was used, and I called attention to the possibility that disturbance over the whole earth might follow universal time, pointing out of course that such a conclusion would not be justified without much more extensive investigation. It seems now clear from the decided difference between the hours of maximum disturbance at Cape Denison and Cape Evans that disturbance does not follow universal time. But at all the three stations which we have considered here, Cape Denison, Cape Evans and Eskdalemuir, eight hours 6h.–14h. appear to be relatively quiet and six hours 20h. to 2h. appear to be relatively disturbed. It seems curious that when universal time is used, the incidence of disturbance should be closest between the two stations, Cape Evans and Eskdalemuir, which differ most as regards local time.

The mean monthly values in Table LIII agree with those in Table XLVII in May, June and July, quieter in 1913 than in 1912, but the difference between the two years seems much smaller at Eskdalemuir than at Cape Denison. Otherwise there is no resemblance between the two sets of figures. November, January and February were quieter than the average month at Eskdalemuir, where they were winter months, whereas at Cape Denison, where they were summer months, they were the most disturbed months.

§ 22. Table LVI investigates the parallelism between the hourly character figures at Cape Denison and Cape Evans. It includes data from November, 1912, though registration ceased at Cape Evans before the end of the month. What the table gives is the number of occasions during each hour of the 24 when a given character figure 0, 1 or 2 at Cape Denison is associated with a given character 0, 1 or 2 at Cape Evans. The Cape Denison character appears in the top line, the Cape Evans character in the line below. For example, in April, 1912, during the hour ending at 1h. G.M.T., character 0 was assigned only once at Cape Denison, the corresponding character at Cape Evans being also 0; character 1 was assigned 14 times at Cape Denison, the corresponding Cape Evans figure being 0 on four occasions, 1 on nine occasions, and 2 on one occasion; finally character 2 was assigned 15 times at Cape Denison, the corresponding Cape Evans figure being 1 on eleven occasions and 2 on four occasions.

Table LVII makes a similar comparison of Cape Denison and Eskdalemuir hourly character figures, limited to the seven months, January to July, 1913.

Table LVIII in the first half of its columns combines the results from the eight months treated separately in Table LVI. The second half of the columns expresses the results in the earlier columns as percentages. For example, for the hour ending at 1h. G.M.T. there were 106 occasions when character 1 was assigned at Cape Denison. Of these 44 occasions, or 41 per cent., got 0 at Cape Evans, 60 or 57 per cent. got 1, and 2 or 2 per cent. got 2.

In addition to the results for the individual 24 hours of the day and the 24 hours combined, Table LVIII gives percentage results for eight 3-hour groups and for two 6-hour groups. The grouping was arranged to bring out more clearly the salient features, which the irregularities in the figures for single hours tend to conceal. A striking contrast is presented by the two 6-hour groups. If we take the group ending at 21h., of the hours which got a 0 at Cape Denison nearly half got a 1 at Cape Evans, of the hours which got a 1 at Cape Denison only one in ten got a 0 at Cape Evans and nearly one in seven got a 2, and of the hours which got a 2 at Cape Denison more than half got a 2 at Cape Evans. On the other hand, if we take the group ending at 6h., of the hours which got a 0 at Cape Denison only about a ninth got 1 at Cape Evans, of the hours which got a 1 at Cape Denison nearly half got a 0 at Cape Evans, and of the hours which got a 2 at Cape Denison barely a third got a 2 at Cape Evans. All these results point to the conclusion that, as compared with Cape Evans, Cape Denison was exceptionally disturbed from 0h. to 6h. G.M.T., and exceptionally quiet from 15h. to 21h. If we may judge by the fate of the hours awarded 0 at Cape Denison, the three hours ending at 3h. were relatively to Cape Evans the most disturbed at Cape Denison, and the three hours ending at 21h. the least disturbed. The fact that there are groups of 3 or 6 consecutive hours which afford so considerable a contrast between Cape Denison and Cape Evans is entirely in accordance with the conclusions reached above as to a difference between the diurnal variation of disturbance at the two stations.

Table LIX does for Cape Denison and Eskdalemuir what Table LVIII did for Cape Denison and Cape Evans. In this case the two 6-hour intervals which afford the greatest contrast end at 6h. and 18h. respectively. The former 6-hours includes the time when Cape Denison is most disturbed, the latter 6-hours the time when it is least disturbed as compared with Eskdalemuir. The three hours ending at 6h. include the time when Cape Denison relatively considered is most disturbed, and the three hours ending at 18h. the time when it is least disturbed as compared with Eskdalemuir.

One aspect of the case as regards the two Antarctic stations is best considered by taking Table LVIII in conjunction with Table LX. The latter table takes the groups under characters 0, 1 and 2 at Cape Evans as fundamental, and shows what percentage of each of these groups were awarded characters 0, 1 and 2 at Cape Denison. For example, 1,653 hours in all were awarded a 0 at Cape Evans, and of these 935 or 57 per cent. got a 0 at Cape Denison, 686 or 41 per cent. got a 1 at Cape Denison and 32 or 2 per cent. got a 2 at Cape Denison. If the standards of disturbance applied at the two stations had been alike, and the stations had been equally disturbed, the percentage figures in Table LVIII and LX would have been identical. This is far from true, even of the 24-hour results. The percentage of hours assigned 0 at Cape Denison which get 1 or 2 at Cape Evans is lower than the percentage of hours assigned 0 at Cape Evans which get 1 or 2 at Cape Denison. Of hours assigned 1 at Cape Denison more get 0 than 2 at Cape Evans; whereas of hours assigned 1 at Cape Evans more get 2 than 0 at Cape Denison. The results in short all point to the conclusion that either Cape Denison was the more disturbed station, or else that the standard of disturbance applied at Cape Denison was lower than that applied at Cape Evans. The contrast between the two 6-hour groups in Table LX is quite as striking as in Table LVIII, and conveys the same implication, viz., that as compared with Cape Denison, Cape Evans was relatively quiet from 0h. to 6h. and relatively disturbed from 15h. to 21h.

Table LXI does for Eskdalemuir and Cape Denison what Table LX did for Cape Evans and Cape Denison. It should be considered in conjunction with Table LIX. The two tables bear one another out in the conclusion that as compared with Cape Denison, Eskdalemuir was relatively quiet from 0h. to 6h. and relatively disturbed from 12h. to 18h. It is certainly noteworthy that of the 1,617 hours awarded a 0 at Cape Denison only 8, *i.e.*, less than 0·5 per cent., got a 2 at Eskdalemuir. Of the 2,523 hours which got a 0 at Eskdalemuir, 215 or 8 per cent. got a 2 at Cape Denison. But in the six hours 1–6h., when Cape Denison was relatively highly disturbed, this percentage rose to 20, whereas for the six hours 13–18h., when Cape Denison was relatively quiet it fell to 0 (or more exactly to 0·27).

§23. Besides their use for statistical purposes, hourly character figures serve to call attention to cases where disturbance was notably different at the different stations. It must be remembered that many hours are on the borderline between 0 and 1, or between 1 and 2. In such cases a good deal may depend on the contrast between the particular hour and adjacent hours. Again, if disturbance is increasing or diminishing very gradually, one may assign the same character figure to a long sequence of hours, the first and last of which if juxtaposed would certainly have got different characters. Thus consideration may be restricted to cases in which a 0 was assigned at the one station a 2 at the other. Even in that event it must be borne in mind that the 0 at the one station may have been on the borderline for a 1, and the 2 at the other station also on the border line.

There were in all only ten hours which were awarded a 0 at Cape Denison but a 2 at Cape Evans. These are the most worthy of consideration, because character figures were on the whole higher at Cape Denison than at Cape Evans. Table XLV enumerates the ten cases, and gives the hourly ranges at the two stations, the D range at Cape Denison being given in terms of the equivalent force. In considering the ranges it should be remembered that they were not taken into account when assigning the character figures. Also a large hourly range may arise from a gradual movement in one direction, or from a single large oscillation, or it may be derived from a highly irregular hour's trace, in which several large oscillations are included. We shall consider the ten cases individually. The year in all cases was 1912, and the hour stated represents the end of the 60-minute interval.

August 3, 8h.—At Cape Denison the hour was decidedly quieter except in D than the adjacent hours which got 1's, and its getting a 0 was partly a contrast effect. At Cape Evans there was no striking movement, but 2 was quite the appropriate character, especially in E^1.

September 14, 12h.—At Cape Denison the hour was very similar to the subsequent hours, which also got 0's. V was particularly quiet, D less so. At Cape Evans there was quite a well marked "bay" disturbance, and the hour was much more disturbed than the subsequent hours.

September 17, 13h.—At Cape Denison, it was rather a borderline case. D merited a 1, while V merited 0, and H was much quieter than during the subsequent hours. The contrast was probably partly accountable for the award of 0 rather than 1. At Cape Evans E^1 and V merited a 1, but the N^1 movement was conspicuous. This was the beginning of a very considerable disturbance, which lasted for a number of hours.

September 20, 20h.—At Cape Denison this was a doubtful case between a 0 and a 1. The hour did not differ much from the two adjacent hours, one awarded a 0 the other a 1. At Cape Evans a 2 was fairly due. All three elements were decidedly more disturbed than during the adjacent hours which got 1's.

October 30, 17h.—At Cape Denison character was a fair 0. The hour resembled the adjacent hours, which also got 0's. At Cape Evans 2 was quite the appropriate character. The movements were decidedly larger than in the adjacent hours which got 1's.

November 2, 18h.—At Cape Denison 0 was fairly appropriate. The hour was decidedly quieter than the two adjacent hours which got 1's. At Cape Evans the disturbance in E^1 was clearly up to character 2, but in N^1 and V the character was rather 1. The hour was distinctly quieter than the previous hour, but similarly disturbed to the subsequent hour, which also got a 2.

November 5, 15h.—At Cape Denison character was fairly 0, H and V being decidedly quieter than in the adjacent hours which got 1's. At Cape Evans N^1 was only of character 1, but E^1 and V were decidedly of character 2.

November 12, 16h.—At Cape Denison character was fairly 0. The hour was less quiet, at least in D, than the previous hour, which also got a 0, but it was quieter at least in V than the subsequent hour which got a 1. At Cape Evans there were no very large movements, but the character was fairly 2, especially in E^1.

November 13, 18h.—At Cape Denison the character was unmistakably 0, H and V being both very quiet. At Cape Evans all three elements fairly deserved 2. Disturbance was decidedly greater than during the previous hour which got a 1, and was similar to that of the subsequent hour which also got a 2.

November 16, 17h.—At Cape Denison character was fairly 0, H being particularly quiet. At Cape Evans 2 was clearly appropriate, the movement in E^1 being prominent. The adjacent hours which were similarly disturbed also got 2's.

It will be observed that of the ten occurrences in Table LXII, seven are included within the six hours ending at 21h., during which disturbance at Cape Denison was a minimum as compared with disturbance at Cape Evans, and nine are included within the six hours ending at 6h. during which disturbance at Cape Denison relatively considered was at its maximum. It will be noticed that the D change is the largest at Cape Denison in seven cases, and the E^1 change the largest at Cape Evans in eight cases, and that the V change is in no case the largest at either station. Also on the average the change in E^1 is more than double that in D, and the change in N^1 more than double that in H. The average change in V at Cape Evans is less than double that at Cape Denison. But on the average day the changes in V at Cape Denison are much larger relative to those at Cape Evans than are the changes in the horizontal components. Thus the excess of the V changes at Cape Evans is really one of the most outstanding features of Table LXII, especially in the case of November 5, 12 and 16.

The thirty-two cases in which a 2 at Cape Denison was associated with a 0 at Cape Evans are enumerated in Table LXIII, which gives the hourly ranges in all the elements. There was no D trace on April 28, and that occasion was omitted entirely when calculating the mean hourly ranges at the foot of the table. While the mean H and V ranges at Cape Denison in Table LXIII are fully two and a half times the corresponding mean ranges in Table LXII, the D range in Table LXIII is the larger only in the ratio 4 : 3. In assigning character figures at Cape Denison minor attention was paid to the D trace. This may have led to the inclusion in Table LXII of one or two cases, *e.g.*, September 17, 13h., when 0 was rather an underestimate of disturbance in D at Cape Denison, and so have increased the mean D range somewhat unduly, but it could not have prejudiced the D range in Table LXIII, nor account for its being smaller than the ranges in H and V.

The reduction in the V range at Cape Evans in Table LXIII as compared with Table LXII is no greater than the reduction in the E^1 range, but the generally small size of the V range at Cape Evans is one of the most striking features of Table LXIII; there are only seven cases out of the whole thirty-two in which it is not smaller than both the E^1 and N^1 ranges. There are twenty-one occasions in which the V range at Cape Evans is less than a quarter of the corresponding V range at Cape Denison, and seven occasions on which the former range is less than a tenth of the latter. The seven occasions include May 29, June 5 (both hours), June 14, June 26, July 21 and October 29; all fall in the early morning hours G.M.T. The most outstanding of them is June 5. The V trace at Cape Evans was nearly dead quiet, much quieter than the E^1 and N^1 traces; but at Cape Denison it was very highly disturbed, much more disturbed than the D or H traces. On the remaining six of the seven occasions mentioned above, the V range at Cape Denison exceeded the D and H ranges, but not in most cases conspicuously.

While the V range at Cape Evans in Table LXIII was usually much less than the E^1 and N^1 ranges, it was the largest of the three on four occasions, viz., May 15, June 10, September 22 and November 2. On the first two and the last of these occasions, the V range at Cape Denison was less—on two occasions conspicuously less—than the D and H ranges. On the remaining occasion though large it was exceeded by the H range.

The eight cases in which a 0 at Cape Denison was associated with a 2 at Eskdalemuir are enumerated in Table LXIV. All fall, it will be noticed, between 15h. and 19h. G.M.T. No satisfactory V data unfortunately were available for Eskdalemuir. In view of the enormous excess of the average hourly range at Cape Denison over that at Eskdalemuir, it is interesting to notice that in all except the first case in Table LXIV the Eskdalemuir ranges are unmistakably the larger. On March 21, the D range at Cape Denison slightly exceeds the W range at Eskdalemuir. The fact is that if attention had not been mainly concentrated on the H and V curves the hour might have got a 1 at Cape Denison. There was a fair bay movement west-east in the D trace, the prominent movement at Eskdalemuir being also a bay, but east-west. The bay movement did not commence at either station until after 18½h., lasting until nearly 20h., and the first half-hour was very decidedly of character 0, except perhaps in the Eskdalemuir N trace. On the other seven occasions character was fairly 0 for all three elements at Cape Denison, though on April 14 and June 28 conditions were decidedly less quiet in D than in H and V. June 29 was rather a poor 2 at Eskdalemuir. On this, as on all the other occasions except the first the N trace was decidedly more disturbed than the W trace.

On the last occasion in Table LXIV, July 24, the N and the W traces at Eskdalemuir showed a sharp double movement resembling an S.C. In N a small fall of short duration was followed by a larger rise up to the crest which lasted for some 40 minutes. But at Cape Denison there was nothing resembling an S.C., and conditions were very quiet during the whole hour.

The cases in which a 2 at Cape Denison was associated with a 0 at Eskdalemuir are numerous. They form in fact 25 per cent, of the whole number of cases in which a 2 was awarded at Cape Denison. Their main features, their concentration between 20h. and 7h. G.M.T. and their avoidance of the early (Greenwich) afternoon hours, are sufficiently indicated in Table LIX.

§ 24. The measurements of the hourly ranges in June and September, 1912, at the Antarctic stations have already been employed in Tables LXI to LXIV in connection with the suggestions made for a numerical measure of the magnetic activity of the day. Other uses are illustrated in Tables LXV to LXIX. Tables LXV and LXVI give for each day of the two months at the two Antarctic stations the largest of the hourly ranges, the mean of the whole 24, and the ratio borne to it by the absolute daily range.

The absolute daily range of one of the elements, notably H, or a combination of the daily ranges of two or of three of the elements has been suggested as a criterion of the day's disturbance. It is obviously exposed to the same principal objection as the square of the range, viz., that it supplies the same measure of disturbance whether the whole day or only a single hour of the day is disturbed, so long as the extreme limits reached by the element are the same. This objection naturally leads to the alternative suggestion to take the arithmetic mean of the 24 hourly ranges as the criterion. It is thus of interest to know whether the ratio borne by the daily range to the mean hourly range is highly variable or not. The more highly variable it is, the less is the weight we should naturally attach to the main objection to hourly ranges, the great labour which their measurement entails. The extreme values possible to the ratio are 24 and 1, the former answering to the case when any sensible change of force is limited to a single hour of the day, the latter to the case when every hour has the same maximum and minimum, and so a range equal to the range for the day. In the case of an absolutely quiet day, with a regular diurnal variation represented by a 24-hour Fourier wave, the value of the ratio would be 12, and values larger than these seem unlikely to be encountered.

There is comparatively little difference between the mean values obtained for the ratio in Tables LXV and LXVI. If we take a mean from the four means for the same month, we obtain 5·25 for June and 5·23 for September; while if we take a mean from the four means for the same station, we obtain 5·13 for Cape Denison and 5·35 for Cape Evans. V gives slightly the larger mean values for the ratio at both stations. Inspection of individual cases in Tables LXV and LXVI failing to show any marked influence of disturbance on the ratio, the days of the two months were divided into three groups, according as the daily character figure awarded at the station was 0, 1 or 2, and the following mean values of the ratio were found :—

	Character. 0	1	2
Cape Denison H	4·2	4·8	5·1
Cape Evans N^1	4·7	5·1	5·5
Cape Denison V	5·25	5·6	5·2
Cape Evans V	5·6	5·4	6·3

There would thus seem to be a slight rise in the ratio as disturbance increases, at least in the case of the horizontal components. On seven occasions, on June 1, 9, 20 and 21, and September 18, 21 and 28, the maximum and minimum values of H for the day at Cape Denison occurred in the same hour. On June 9, in fact, they occurred within five minutes of one another. There was, however, nothing very outstanding in the values of the H ratio on those occasions, the mean of the seven values being 4·8 The extreme values of the ratio occurred on other days. They were at Cape Denison 8·5 and 3·1 for H, and 9·5 and 3·5 for V; while at Cape Evans they were 8·4 and 3·0 for N^1, and 9·8 and 3·4 for V. Two of the four largest ratios occurred on days of character 1, and two of the four lowest ratios also occurred on days of character 1. Thus the character of the day is not much of a clue to the size of the ratio, at least in the Antarctic.

If we take the monthly means in Tables LXV and LXVI we see that on the average the largest hourly range is about thrice the mean hourly range for the day, rather more at Cape Denison, rather less at Cape Evans. In individual days, if we multiply the mean hourly range by 3, we usually make a fair approach to the maximum hourly range. The extreme cases seem to be June 1 at Cape Denison when the largest H range is 7·9 times the mean range, and June 13 at Cape Evans when the largest N^1 range is only 1·6 times the mean range. This is practically what we should get in an absolutely quiet day with a regular diurnal variation given by a pure 24-hour Fourier wave. Roughly speaking, in June and September, 1912, the largest hourly range bore to the mean hourly range in the average day a ratio about double what we should expect in the ideal quiet day with the 24-hour wave largely dominant.

§ 25. Table L gives for each hour of the day the mean of the absolute hourly ranges from all available days of June and September, 1912, at the two Antarctic stations, and for comparison the (numerical) difference between the corresponding values in the mean diurnal inequality from all days. For example, 26·9γ was the arithmetic mean of the ranges between 0h. and 1h. of H. at Cape Denison during June while 3·6γ was the difference between the figures at 1h. and 0h. in the diurnal inequality. The relatively small size of the latter quantity implies of course great diversity in the sign of the contribution made by different days of the month. The size of the absolute range has obviously little to do with the size of the inequality change. Taking the mean of the values for the 24 hours we see that the ratio borne by the absolute hourly range to the inequality change varied at Cape Denison from 10·2 for H in June to 5·1 for V in September; while at Cape Evans it varied only from 6·5 for N^1 in June to 4·5 for V in June.

At stations as disturbed as Cape Denison and Cape Evans a number of months must be combined to give a smooth diurnal inequality, but the mean hourly ranges in Table L show on the whole fairly regular diurnal variations, especially at Cape Denison. In June at Cape Denison both H and V ranges have their highest values in the early morning, but in both cases there is a conspicuous double oscillation, a second maximum appearing about 14h. This is in accordance with what we should expect from the hourly character data, especially those for the incidence of 2's in Table XLIX. In September at Cape Denison there is only a trace of a double daily oscillation, the ranges during the five hours ending at 4h. being clearly the largest, and none of them either in H or V falling short of 50γ. This again is fairly in accord with Tables XLVII to XLIX.

At Cape Evans in June the diurnal variation in Table L is not well marked; but in September there is a well marked principal maximum before midnight G.M.T., and a somewhat inconspicuous secondary maximum about 12h. This again is fairly in accord with the results from the hourly character figures in Tables L to LII.

For comparison with Table LXVII the diurnal variation as derived from the *squares* of the hourly ranges is given in Tables LXVIII and LXIX for Cape Denison and Cape Evans. In each case two series of values are given. The first utilises all the hourly data available, the second omits the largest individual contribution to the hour in question. Supposing, for example, ranges available from thirty days, the entry in the first series represents the mean of the squares of thirty ranges, while the corresponding entry in the second series represents the mean of the squares of twenty-nine ranges, the range disregarded being the largest one irrespective of the day to which it belonged. The reason for giving the second series as well as the first lies in the extraordinary differences which the two series present in June. In that month what the all-day data for Cape Denison suggest is a principal maximum in the early afternoon G.M.T., and a secondary maximum, of a much less conspicuous kind especially in H., in the early morning. But the extreme prominence of the early afternoon hours was due to a few short period disturbances, especially three occurring respectively on the 1st, 9th and 8th. These contributed much more to the sum of the squares of the hourly ranges for the hours ending at 12h., 13h., and 14h. respectively than did the other twenty-nine days combined. The H. maximum and minimum for the day occurred within five minutes of one another in one of these occasions, and within fifteen minutes on a second occasion. The occurrence of an event of this kind in one hour rather than another *may* be a pure accident. If we had 100 years' data we should perhaps be able to form a judgment, but it is impossible to say *a priori* what is a normal distribution of exceptional incidents throughout the day. In the present case the fact that only one such extreme incident occurred in a particular hour of the day rendered it possible to give an alternative picture, more representative perhaps of the average day, by omitting only one range for each hour; but during a disturbed year there might not unlikely be several such occurrences in some particular hours of the day.

The tendency in a single day to swamp the others for a whole month is of course more pronounced when we take the square than when we take the first power of a range, whether hourly or daily; but it is perhaps needless to say that the pronounced maximum in the early afternoon hours in the H. figures for June at Cape Denison in Table LXVII was also largely due to the few outstanding hourly ranges just referred to.

In September, which was on the whole a much more disturbed month than June, there was only one hour, viz., 12h. at Cape Denison in which a single range was very dominant.

The second series of figures in Table LXVIII, both in June and September, indicate a diurnal variation with maxima and minima closely corresponding in time with those shown by the first power ranges in Table LXVII. But the diurnal variation is more emphasised in Table LXVIII than in Table LXVII.

There is less difference between the two series of results for Cape Evans in Table LXIX. Still some of the hourly data are much affected, *e.g.*, the N^1 results for 15h. in June and the V. results for 3h. in June. The diurnal variation shown by either series of June figures appears somewhat irregular, but for September we get from either series a well marked diurnal variation with a principal maximum occurring prior to midnight G.M.T.

Tables LXVII to LXIX should help to explain the uncertainties that attend estimates of the diurnal or annual variation of magnetic disturbance. In a scheme dependent on magnetic characters 0, 1, 2, the most disturbed of days or hours contributes to any statistical sum or more than twice as much as the moderately disturbed day hour. The frequency of disturbance rather than its magnitude is the thing that counts. When we take for our criterion of disturbance the first power of the range one day or hour of a first order magnetic storm may count as much as ten days or hours of minor disturbance, and when we take the second power one outstanding day or hour may count as much as 100 days or hours of moderate disturbance. In the latter case one outstanding disturbance may completely alter the diurnal variation based on the results of a single month. This may seem to some people a conclusive argument against the use of the square of an hourly or daily range as a criterion of disturbance. But there is no *a priori* reason why the contribution of a single day or hour should not equal the contribution of 100 or 1,000 average days or hours. Such is certainly the case sometimes in seismology. Until disturbance has been defined in such a way that an exact numerical measure is forthcoming, we cannot pass a final judgment as to what is the best criterion.

It is, however, fairly obvious that diurnal variations of disturbance based on only one or two years' observations are less likely to differ markedly from diurnal variations based on a long series of years when the criterion adopted follows a scale 0, 1, 2 than when it is the first or still more the second power of the hourly range.

TABLE XLV.—Daily and Mean of Hourly Characters at Cape Denison.

Date.	1912.															
	April.		May.		June.		July.		August.		September.		October.		November.	
	H.	D.	H.	D.	H.	D.	H.	D.	H.	D.	H.	D.	H.	D.	H.	D.
1.	0·8	1	0·7	1	1·2	2	1·3	2	0·8	2	0·7	1	1·2	2	1·3	2
2	0·7	1	1·2	1	1·3	2	0·3	0	0·6	1	0·4	0	0·6	1	1·3	1
3.	1·1	2	1·5	1	1·2	2	1·1	2	0·7	1	0·5	1	1·0	1	0·9	1
4.	1·0	2	1·0	1	0·8	1	2·0	2	0·3	0	1·1	2	1·0	1	0·9	1
5.	1·6	2	1·5	2	0·8	1	2·0	2	0·7	2	0·8	1	0·7	0	1·1	2
6	1·3	2	1·3	2	0·5	0	1·8	2	1·2	2	0·9	1	0·9	1	0·8	1
7	1·2	2	1·5	2	0·5	0	1·2	2	0·5	1	0·6	0	1·3	1	1·2	1
8	0·6	0	1·4	2	1·8	2	1·0	1	0·4	0	0·6	0	1·3	2	1·5	1
9.	0·9	1	0·5	0	1·8	2	0·8	1	0·5	0	1·0	1	1·1	1	1·3	1
10.	1·3	2	0·7	1	1·8	2	0·2	0	0·4	1	0·8	1	1·2	2	2·0	2
11.	0·5	1	0·7	1	1·8	2	0·3	0	0·4	1	0·6	1	1·5	2	1·7	2
12	1·0	1	1·6	2	1·4	1	0·3	0	0·3	0	1·0	1	1·3	1	1·0	1
13.	0·8	2	1·7	2	0·8	1	0·1	0	0·3	0	1·0	2	1·2	1	1·0	1
14.	1·0	1	1·5	2	1·1	1	0·3	0	0·5	0	0·6	1	1·9	2	1·8	2
15.	1·7	2	1·3	1	0·7	1	0·5	1	0·4	1	0·3	0	1·8	2	1·5	2
16.	1·7	2	1·0	1	0·5	0	0·8	1	0·6	1	0·5	1	1·5	2	1·5	2
17	1·7	2	1·0	1	0·5	0	1·2	2	1·3	2	1·0	2	1·3	2	1·5	2
18	1·5	2	0·7	1	0·7	1	0·5	1	1·4	2	1·3	2	0·8	1	1·3	2
19	1·3	2	1·0	1	0·5	1	0·6	0	1·3	2	1·0	2	0·7	0	1·3	2
20	1·1	2	0·7	1	0·5	1	1·3	1	1·1	1	0·8	2	1·0	2	1·1	2
21	0·5	1	0·7	0	0·8	1	1·1	1	1·0	2	0·9	1	1·1	2	0·8	1
22.	1·2	1	0·4	0	1·0	1	0·6	1	1·5	2	1·0	2	1·0	0	1·2	1
23	1·2	2	0·3	0	1·3	2	0·5	0	1·4	2	1·1	2	1·1	1	1·5	2
24	0·8	1	0·5	0	1·3	1	0·4	0	0·9	1	1·5	2	1·2	1	1·1	2
25	0·8	1	0·8	0	0·5	1	0·5	1	1·0	1	0·8	2	1·1	1	0·8	0
26	0·5	0	0·8	1	0·9	1	1·0	1	0·6	1	0·8	1	0·8	0	1·6	2
27	0·9	0	0·7	0	1·0	2	1·2	1	1·3	2	0·6	1	1·0	1	1·5	2
28	0·8	0	0·5	0	1·5	2	0·4	0	1·3	2	0·5	0	1·5	2	1·2	2
29	0·4	0	0·9	1	1·5	2	0·5	0	1·0	1	0·5	0	1·2	1	1·0	1
30	0·6	1	0·8	1	1·2	1	0·7	1	0·5	1	0·8	1	0·9	1	1·0	1
31	...	...	1·0	1	...	...	1·1	2	0·8	1	...	...	1·1	1	...	...
Means from—																
Daily ... 0	0·64	...	0·55	...	0·50	...	0·35	...	0·38	...	0·48	...	0·80	...	0·80	...
„ ... 1	0·80	...	0·94	...	0·87	...	0·83	...	0·68	...	0·75	...	1·05	...	1·07	...
„ ... 2	1·32	...	1·50	...	1·47	...	1·46	...	1·20	...	1·06	...	1·39	...	1·44	...

Date.	1913.													
	January.		February.		March.		April.		May.		June.		July.	
	H.	D.	H.	D.	H.	D.	H.	D.	H.	D.	H.	D.	H.	D.
1.	...	...	1·1	1	0·5	0	1·1	2	...	...	1·1	1	0·9	1
2	1·2	1	1·0	1	0·6	0	0·8	1	0·6	1	1·1	2	0·7	0
3.	1·7	2	0·5	0	0·6	0	0·8	1	0·7	1	1·0	1	0·6	1
4.	1·4	2	0·7	0	0·8	1	1·0	1	1·2	2	1·0	1	0·3	0
5.	1·3	1	1·0	1	0·8	1	0·7	1	1·3	2	0·4	0	0·2	0
6	1·2	2	0·9	1	0·9	1	0·5	0	1·7	2	0·5	1	0·3	0
7	1·2	1	1·2	1	0·7	1	0·3	0	1·4	2	0·3	0	0·5	0
8	1·0	1	1·3	1	1·1	1	0·8	1	0·9	1	0·3	0	0·5	0
9.	1·5	2	1·4	2	1·0	1	1·7	2	0·6	1	0·2	0	0·4	0
10.	1·6	2	0·8	1	0·7	0	1·4	2	0·5	1	0·3	0	0·6	0
11.	1·1	1	1·0	0	0·6	1	1·3	2	0·4	0	0·2	1	0·4	0
12	1·0	1	1·4	2	0·6	1	1·4	1	0·4	0	0·1	0	0·9	1
13.	1·0	1	1·3	2	0·7	0	1·0	1	0·3	0	0·3	0	1·0	1
14.	1·6	2	1·7	2	1·7	2	1·0	1	0·3	0	0·3	0	1·1	1
15.	1·6	2	1·7	2	1·5	2	1·1	1	0·5	0	0·4	1	1·0	1
16.	0·6	1	1·4	1	1·3	2	1·2	1	0·4	0	0·4	1	0·7	1
17	1·1	1	1·4	1	1·7	2	1·1	1	0·5	1	0·5	0	0·6	1
18	1·8	2	1·1	2	1·1	1	0·7	0	0·1	0	0·2	0	0·4	1
19	1·7	2	1·5	1	1·1	1	0·8	1	0·4	1	0·6	1	0·4	0
20	1·5	2	1·1	1	1·2	1	0·6	1	0·4	0	0·5	1	1·0	2
21	1·6	2	1·2	1	1·1	1	0·4	0	0·4	0	0·7	1	0·6	1
22.	1·6	2	1·0	1	1·0	1	0·9	1	0·2	0	0·3	0	0·8	1
23	1·3	2	0·9	1	1·3	2	0·9	1	0·1	0	0·5	1	0·4	1
24	1·2	1	0·6	0	1·1	1	0·6	0	0·3	0	0·5	1	0·5	0
25	1·5	2	1·5	2	0·9	0	0·6	0	0·5	1	0·3	0	1·0	1
26	1·3	2	1·6	2	1·0	1	0·7	0	0·3	0	0·7	1	0·6	0
27	1·1	1	1·0	1	0·9	1	1·1	1	0·4	1	0·2	0	0·6	1
28	1·3	1	0·8	0	0·9	1	0·9	1	0·5	1	0·2	1	0·4	0
29	1·0	1	...	...	1·2	1	0·8	0	0·5	1	0·9	1	0·5	1
30	1·6	2	...	...	1·3	2	0·5	0	0·5	0	0·8	1	0·5	0
31	1·4	2	...	...	1·1	2	...	...	0·3	0	...	...	0·3	0
Means from—														
Daily ... 0	...	...	0·72	...	0·67	...	0·57	...	0·33	...	0·28	...	0·44	...
„ ... 1	1·08	...	1·12	...	0·95	...	0·95	...	0·55	...	0·63	...	0·74	...
„ ... 2	1·52	...	1·46	...	1·41	...	1·38	...	1·40	...	1·20	...	1·00	...

Table XLVI.—Least and Greatest Values of Mean Hourly Character for Days of Daily Characters 0, 1 and 2.

Daily Character.	Mean Hourly Character.	1912.								1913.						
		April.	May.	June.	July.	August.	September.	October.	November.	January.	February.	March.	April.	May.	June.	July.
0	Least value ...	0·4	0·3	0·5	0·2	0·3	0·3	0·7	0·8	......	0·5	0·5	0·3	0·1	0·1	0·2
	Greatest value ...	0·9	0·8	0·5	0·6	0·5	0·6	1·0	0·8	......	1·0	0·9	0·8	0·5	0·5	0·7
1	Least value ...	0·5	0·7	0·5	0·5	0·4	0·5	0·6	0·8	0·6	0·8	0·6	0·6	0·4	0·2	0·4
	Greatest value ...	1·2	1·5	1·4	1·3	1·1	1·0	1·3	1·5	1·3	1·5	1·2	1·4	0·9	1·1	1·1
2	Least value ...	0·8	1·3	1·0	1·1	0·7	0·8	1·0	1·1	1·2	1·1	1·1	1·1	1·2	1·1	1·0
	Greatest value ...	1·7	1·7	1·8	2·0	1·5	1·5	1·9	2·0	1·8	1·7	1·7	1·7	1·7	1·1	1·0

Table XLVII.—Cape Denison Mean Hourly Character Figures.

Hour G.M.T. ending at	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	24h.	Mean.
1912.																									
April	1·47	1·55	1·55	1·52	1·29	1·21	0·86	0·81	0·52	0·72	0·80	0·80	0·97	0·90	0·60	0·47	0·63	0·83	0·90	0·97	0·97	1·20	1·27	1·47	1·01
May	1·26	1·45	1·52	1·39	1·23	1·10	0·81	0·71	0·57	0·43	0·58	0·68	0·81	0·81	0·94	0·77	0·68	0·63	0·90	0·87	1·13	1·23	1·23	1·29	0·96
June	1·20	1·40	1·30	1·40	1·20	1·23	0·90	0·87	0·59	0·72	0·73	0·87	1·03	1·10	1·17	1·00	0·67	0·72	0·86	1·07	1·10	1·20	1·33	1·20	1·04
July	1·10	1·39	1·29	1·26	1·10	0·84	0·55	0·45	0·43	0·53	0·55	0·58	0·77	0·81	0·77	0·68	0·74	0·67	0·74	0·74	0·77	0·97	1·03	1·06	0·83
August	1·29	1·32	1·29	1·26	1·39	1·13	0·77	0·65	0·55	0·48	0·35	0·39	0·48	0·48	0·58	0·48	0·42	0·40	0·57	0·65	0·77	0·97	1·13	1·26	0·80
September	1·50	1·47	1·47	1·43	1·20	1·00	0·70	0·62	0·59	0·31	0·53	0·63	0·53	0·43	0·23	0·33	0·23	0·41	0·38	0·57	0·80	1·17	1·23	1·30	0·80
October	1·90	1·84	1·87	1·81	1·48	1·39	0·90	0·90	0·80	0·63	0·74	0·77	0·77	0·77	0·65	0·61	0·68	0·57	0·97	1·06	1·29	1·52	1·52	1·81	1·14
November	1·90	1·87	1·93	1·87	1·60	1·57	1·20	1·00	1·00	0·90	0·63	0·73	0·77	0·87	0·67	0·73	0·80	0·93	1·14	1·37	1·43	1·80	1·70	1·77	1·26
1913.																									
January	1·86	1·79	1·82	1·89	1·67	1·52	1·30	1·11	0·96	1·07	0·89	0·85	0·89	1·00	1·07	0·89	1·00	1·04	1·11	1·23	1·50	1·57	1·70	1·90	1·32
February	1·71	1·75	1·75	1·71	1·57	1·43	1·25	0·96	0·82	0·75	0·64	0·61	0·71	0·82	0·82	0·79	0·79	0·75	0·79	0·96	1·18	1·43	1·61	1·64	1·14
March	1·45	1·55	1·55	1·52	1·52	1·13	0·97	0·81	0·58	0·70	0·55	0·55	0·68	0·81	0·65	0·61	0·77	0·65	0·71	0·97	1·06	1·23	1·39	1·45	0·99
April	1·27	1·50	1·47	1·47	1·37	1·00	0·97	0·60	0·37	0·47	0·43	0·43	0·67	0·87	0·93	0·57	0·53	0·63	0·73	0·70	0·83	1·10	1·17	1·37	0·89
May	0·79	1·03	1·00	0·70	0·83	0·47	0·27	0·27	0·33	0·40	0·47	0·40	0·57	0·60	0·43	0·30	0·23	0·30	0·30	0·50	0·67	0·63	0·87	0·87	0·55
June	0·57	0·77	0·80	0·73	0·70	0·47	0·43	0·30	0·20	0·30	0·40	0·33	0·43	0·57	0·50	0·30	0·23	0·20	0·30	0·53	0·53	0·70	0·73	0·60	0·48
July	0·87	1·00	0·87	1·00	0·81	0·61	0·42	0·26	0·32	0·42	0·39	0·23	0·42	0·68	0·55	0·52	0·45	0·52	0·48	0·52	0·61	0·74	0·81	0·84	0·60
Means from all 15 months	1·34	1·44	1·43	1·40	1·26	1·07	0·82	0·69	0·58	0·59	0·58	0·59	0·70	0·77	0·70	0·60	0·59	0·62	0·73	0·85	0·98	1·16	1·25	1·32	0·92
April-October, 1912	1·39	1·49	1·47	1·44	1·27	1·13	0·78	0·73	0·58	0·55	0·61	0·69	0·77	0·76	0·71	0·62	0·58	0·60	0·76	0·85	0·98	1·18	1·25	1·34	0·94
7 Winter months	1·02	1·19	1·15	1·11	1·04	0·84	0·59	0·50	0·43	0·47	0·50	0·50	0·64	0·72	0·71	0·58	0·49	0·49	0·59	0·70	0·80	0·92	1·02	1·02	0·75
5 Equinoctial months	1·52	1·58	1·58	1·55	1·37	1·15	0·88	0·75	0·57	0·57	0·61	0·64	0·72	0·76	0·61	0·52	0·57	0·62	0·74	0·85	0·99	1·24	1·32	1·48	0·97
3 Summer months	1·82	1·80	1·83	1·82	1·61	1·51	1·25	1·02	0·93	0·91	0·72	0·73	0·79	0·90	0·85	0·80	0·86	0·91	1·01	1·19	1·37	1·60	1·67	1·77	1·24

‡ 2032—K

TABLE XLVIII.—Cape Denison. Hourly Characters. Number of 0's.

Hour G.M.T. ending at	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	24h.	Total.
1912.																									
April	1	0	0	1	1	2	7	6	15	14	12	10	6	7	13	18	14	10	8	8	9	3	2	0	167
May	2	0	0	0	4	5	10	14	16	18	16	16	12	9	5	9	11	11	7	7	6	2	1	1	182
June	3	3	2	0	4	2	9	9	14	13	13	12	8	7	8	9	10	12	8	4	4	1	1	2	158
July	4	1	2	1	4	9	16	19	19	17	17	17	12	13	13	15	15	15	13	14	13	8	6	6	269
August	2	2	2	4	1	4	10	13	15	19	21	21	17	16	15	19	19	19	16	15	12	6	1	1	270
September	0	0	0	0	2	2	10	12	12	21	18	16	15	17	23	21	23	19	19	14	11	2	1	1	259
October	0	0	0	0	1	0	6	6	8	12	13	14	13	12	14	15	11	15	7	6	2	0	1	0	156
November	0	0	0	0	1	1	3	5	4	10	15	11	12	9	12	11	10	7	1	2	1	0	0	0	115
1913.																									
January	0	0	0	0	0	1	0	1	5	1	5	10	8	6	6	7	4	4	2	1	0	0	0	0	61
February	0	0	0	0	0	0	0	5	8	10	12	13	11	10	9	9	8	8	7	4	3	0	0	0	117
March	1	0	0	0	0	1	4	7	13	12	16	15	11	10	13	15	14	13	11	4	2	0	0	1	163
April	1	0	0	0	0	2	2	12	19	17	19	19	12	8	7	15	16	13	10	10	7	1	1	0	191
May	8	3	3	11	7	16	22	23	21	20	19	20	16	16	19	23	24	23	22	17	13	15	7	6	374
June	13	8	7	9	10	17	17	22	24	21	18	21	18	15	18	22	23	24	21	14	14	10	9	13	388
July	4	3	5	3	7	12	18	23	22	19	20	25	19	15	18	16	17	16	17	15	13	9	6	5	327
Sum	39	20	21	29	42	74	134	177	215	224	234	240	190	170	193	224	219	209	169	135	110	57	36	36	3197
Percentages from all 15 months	29	15	16	22	31	56	101	133	161	168	176	180	143	127	145	168	164	157	127	101	83	43	27	27	...
April-October, 1912	20	10	10	10	28	39	112	130	163	187	181	174	136	133	149	174	169	166	128	112	94	36	21	18	...
7 Winter months	44	24	26	34	45	79	124	150	160	155	151	161	124	111	117	138	145	146	127	105	91	62	38	41	...
5 Equinoctial months	8	0	0	3	8	18	74	111	172	195	200	190	147	136	180	216	200	180	141	108	80	15	13	5	...
3 Summer months	0	0	0	0	8	16	25	90	139	172	262	278	254	205	221	221	180	156	82	57	33	0	0	0	...

TABLE XLIX.—Cape Denison. Hourly Characters. Number of 2's.

Hour G.M.T. ending at	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	24h.	Total.
1912.																									
April	15	16	16	16	9	8	3	1	2	6	6	4	5	4	1	2	3	5	5	7	8	9	10	14	175
May	10	14	16	12	11	8	4	5	3	1	3	6	6	3	3	2	1	0	4	3	10	9	8	10	152
June	10	15	10	12	11	8	6	5	3	5	5	8	9	10	13	8	0	4	4	7	7	7	10	8	185
July	7	13	11	9	7	4	2	2	2	3	3	4	5	7	6	5	7	5	5	6	6	7	7	8	141
August	11	12	11	12	13	8	3	2	1	3	1	2	1	0	2	3	1	1	3	4	5	5	5	9	118
September	15	14	14	13	8	2	1	1	0	1	4	5	1	0	0	1	0	2	1	1	5	7	8	10	114
October	28	26	27	25	17	12	3	3	2	1	5	7	6	6	3	3	1	2	6	8	11	16	17	25	260
November	27	26	28	26	19	18	9	6	4	7	4	3	5	5	2	3	4	5	5	13	14	24	21	23	301
1913.																									
January	25	23	23	25	18	15	8	4	4	3	2	6	5	6	8	4	4	5	5	8	15	17	21	27	281
February	20	21	21	20	16	12	7	4	3	3	2	2	3	5	4	3	2	1	1	3	8	12	17	18	208
March	15	17	17	16	16	5	3	1	0	3	2	1	1	4	2	3	7	2	2	3	4	7	12	15	158
April	9	15	14	14	11	2	1	0	0	1	2	2	2	4	5	2	2	2	2	1	2	4	6	11	114
May	2	4	3	2	2	0	0	1	1	2	3	2	3	4	2	2	1	2	1	2	3	4	3	2	51
June	0	1	1	1	1	1	0	1	0	0	0	1	1	2	3	1	0	0	0	0	0	1	1	1	17
July	0	3	1	3	1	0	0	0	1	1	1	1	1	5	4	1	0	1	1	0	1	1	0	0	27
Sum	194	220	213	206	160	103	50	36	26	40	43	54	54	65	58	43	33	37	45	66	99	130	146	181	2302
Percentage from all 15 months	202	229	222	215	167	107	52	38	27	42	45	56	56	68	60	45	34	39	47	69	103	136	152	189	...
April-October, 1912 ...	201	231	220	207	159	105	46	40	27	42	57	76	69	63	59	50	27	40	59	75	109	126	136	176	...
7 Winter months ...	139	215	184	177	160	101	52	56	38	52	56	83	90	108	115	76	35	45	63	76	111	118	118	132	...
5 Equinoctial months ...	240	257	257	246	178	85	32	17	12	35	56	56	44	53	32	32	38	38	47	58	88	126	155	219	...
3 Summer months ...	219	213	219	216	161	137	73	43	33	39	24	33	39	49	43	30	30	33	33	73	112	161	179	207	...

1912. TABLE L.—Cape Evans. Mean Hourly Character Figures.

Hour G.M.T. ending at	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	24h.	Mean.
April	1·04	0·89	0·93	0·82	0·61	0·61	0·68	0·54	0·68	0·89	0·71	0·82	0·75	0·75	0·61	0·71	0·61	0·75	0·96	0·96	0·82	1·00	1·00	1·00	0·80
May	0·77	0·83	0·77	0·60	0·67	0·70	0·67	0·70	0·73	0·70	0·50	0·67	0·77	0·63	0·73	0·77	0·77	0·77	0·77	0·83	0·83	0·83	0·67	0·73	0·73
June	0·64	0·71	0·68	0·71	0·61	0·86	0·79	0·86	0·75	0·75	0·75	0·71	0·64	0·75	0·75	0·71	0·54	0·61	0·64	0·79	1·00	0·89	0·82	0·75	0·74
July	0·56	0·76	0·68	0·56	0·64	0·64	0·64	0·68	0·56	0·40	0·48	0·48	0·56	0·68	0·76	0·72	0·68	0·60	0·80	0·64	0·68	0·68	0·48	0·56	0·62
August	0·96	0·89	0·93	0·89	0·89	0·82	0·68	0·68	0·64	0·54	0·61	0·54	0·64	0·61	0·68	0·79	0·75	0·75	0·86	0·89	0·96	1·11	1·00	0·93	0·79
September	0·93	1·00	0·89	0·89	0·89	0·78	0·78	0·78	0·78	0·67	0·70	0·78	0·70	0·74	0·85	0·74	0·67	0·81	0·96	1·30	1·26	1·30	1·37	1·41	0·92
October	1·41	1·05	1·14	0·95	1·00	0·95	0·64	0·77	0·64	0·68	0·64	0·73	0·91	1·00	0·91	1·00	1·00	1·14	1·36	1·45	1·36	1·50	1·41	1·27	1·04
Mean	0·90	0·88	0·85	0·77	0·76	0·77	0·70	0·73	0·68	0·66	0·63	0·68	0·71	0·74	0·76	0·78	0·72	0·78	0·91	0·98	0·99	1·04	0·96	0·95	0·81

1912. TABLE LI.—Cape Evans. Hourly Characters. Number of 0's.

Hour G.M.T. ending at	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	24h.	Total.
April	4	8	8	11	16	15	12	14	12	10	14	9	11	10	12	10	12	10	6	3	9	6	4	4	230
May	11	11	12	14	11	13	14	14	13	13	18	13	12	14	11	10	8	9	9	10	6	9	14	12	281
June	14	10	12	13	14	11	8	8	9	12	10	12	14	10	10	11	14	12	10	8	4	7	9	11	253
July	13	9	11	12	11	12	11	10	13	16	14	14	14	12	10	8	9	10	8	9	9	9	16	13	273
August	4	7	6	6	5	7	10	12	12	15	14	15	11	12	11	11	10	8	6	5	4	2	4	6	203
September	4	5	7	6	6	8	9	9	8	13	12	11	10	10	7	9	10	8	4	2	2	2	1	0	163
October	0	3	1	3	3	3	8	5	9	10	10	8	5	6	5	3	2	2	0	1	0	0	1	1	89
Sum	50	53	57	65	66	69	72	72	76	89	92	82	77	74	66	62	65	59	43	38	34	35	49	47	1,492
Percentages	80	85	92	105	106	111	116	116	122	143	148	132	124	119	106	100	105	95	69	61	55	56	79	75	...

1912. TABLE LII.—Cape Evans. Hourly Characters. Number of 2's.

Hour G.M.T. ending at	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	24h.	Total.
April	5	5	6	6	5	4	3	1	3	7	6	4	4	3	1	2	1	3	5	2	4	6	4	4	94
May	4	6	5	2	1	4	4	5	5	4	3	3	5	3	3	3	1	2	2	5	1	4	4	4	83
June	4	2	3	5	3	7	2	4	2	5	3	4	4	3	3	3	1	1	0	2	4	4	4	4	77
July	2	3	1	1	2	3	2	2	2	1	1	1	3	4	4	1	1	0	3	0	1	1	3	2	44
August	3	4	4	3	2	2	1	3	2	2	3	2	1	1	2	5	3	1	2	2	3	5	4	4	64
September	2	5	4	3	3	2	3	3	2	4	4	5	2	3	3	2	1	3	3	10	9	10	11	11	108
October	9	4	4	2	3	2	0	0	1	3	2	2	3	6	3	3	2	5	8	11	8	11	10	7	109
Sum	29	29	27	22	19	24	15	18	17	26	22	21	22	23	19	19	10	15	23	32	30	41	40	36	579
Percentages	120	120	112	91	79	100	62	75	71	108	91	87	91	95	79	79	41	62	95	133	124	170	166	149	...

Table LIII.—Eskdalemuir. Mean Hourly Character Figures.

Hour G.M.T. ending at	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	24h.	Mean.
1912.																									
April	0·47	0·53	0·43	0·50	0·40	0·33	0·40	0·33	0·37	0·40	0·57	0·60	0·67	0·70	0·73	0·83	0·80	0·80	0·73	0·80	0·73	0·63	0·70	0·63	0·59
May	0·58	0·55	0·45	0·29	0·29	0·45	0·39	0·52	0·35	0·26	0·45	0·68	0·84	0·77	0·84	0·90	0·77	0·90	0·97	0·84	0·90	0·71	0·55	0·65	0·62
June	0·53	0·53	0·50	0·47	0·40	0·43	0·53	0·63	0·43	0·33	0·43	0·53	0·67	0·83	0·97	0·97	0·87	0·80	0·93	0·70	0·87	0·60	0·60	0·80	0·64
July	0·58	0·55	0·55	0·35	0·16	0·39	0·35	0·55	0·35	0·35	0·42	0·48	0·74	0·71	0·90	0·94	0·87	0·77	0·81	0·68	0·65	0·68	0·55	0·61	0·58
August	0·81	0·81	0·48	0·71	0·58	0·52	0·65	0·61	0·48	0·32	0·48	0·55	0·52	0·71	0·74	0·97	0·90	0·97	1·06	0·87	0·68	0·87	0·87	0·74	0·70
September	0·87	0·63	0·60	0·43	0·53	0·40	0·60	0·50	0·50	0·33	0·53	0·70	0·57	0·73	0·63	0·83	0·70	0·60	0·57	0·67	0·63	0·80	0·70	0·87	0·62
October	0·72	0·76	0·48	0·48	0·41	0·45	0·31	0·59	0·45	0·24	0·48	0·62	0·59	0·66	0·48	0·59	0·66	0·66	0·59	0·52	0·66	0·66	0·48	0·45	0·54
November	0·60	0·47	0·50	0·50	0·50	0·33	0·47	0·53	0·33	0·37	0·50	0·57	0·63	0·50	0·60	0·47	0·53	0·50	0·40	0·67	0·87	0·70	0·67	0·67	0·54
1913.																									
January	0·65	0·42	0·39	0·45	0·35	0·29	0·19	0·32	0·32	0·29	0·39	0·52	0·58	0·42	0·55	0·65	0·58	0·65	0·68	0·55	0·61	0·61	0·42	0·61	0·48
February	0·89	0·64	0·46	0·43	0·46	0·39	0·39	0·39	0·46	0·50	0·68	0·61	0·64	0·54	0·64	0·54	0·61	0·50	0·50	0·71	0·82	0·82	0·75	0·75	0·59
March	0·67	0·63	0·57	0·53	0·57	0·43	0·40	0·40	0·43	0·40	0·47	0·73	0·83	0·87	0·70	0·60	0·67	0·60	0·67	0·80	0·70	0·80	0·80	0·80	0·63
April	0·79	0·68	0·57	0·57	0·50	0·54	0·46	0·46	0·39	0·39	0·36	0·64	0·71	0·54	0·68	0·68	0·75	0·71	0·64	0·57	0·79	0·71	0·86	0·89	0·62
May	0·58	0·52	0·48	0·55	0·48	0·42	0·39	0·32	0·35	0·26	0·35	0·65	0·61	0·68	0·74	0·71	0·68	0·77	0·68	0·74	0·61	0·45	0·45	0·74	0·55
June	0·43	0·40	0·47	0·23	0·17	0·37	0·47	0·43	0·30	0·23	0·40	0·47	0·57	0·73	0·80	0·60	0·73	0·77	0·60	0·43	0·57	0·60	0·47	0·27	0·48
July	0·55	0·48	0·35	0·32	0·35	0·32	0·39	0·22	0·32	0·29	0·35	0·48	0·65	0·52	0·77	0·74	0·87	0·77	0·61	0·61	0·45	0·39	0·48	0·58	0·49
Means from all 15 months	0·65	0·57	0·49	0·45	0·41	0·40	0·43	0·45	0·39	0·33	0·46	0·59	0·65	0·66	0·72	0·73	0·73	0·72	0·70	0·68	0·70	0·67	0·62	0·67	0·58
7 Summer months	0·58	0·55	0·47	0·42	0·35	0·41	0·45	0·47	0·37	0·29	0·41	0·55	0·66	0·71	0·82	0·83	0·81	0·82	0·81	0·70	0·68	0·61	0·59	0·63	0·58
5 Equinoctial months	0·70	0·65	0·53	0·50	0·48	0·43	0·43	0·46	0·43	0·35	0·48	0·66	0·67	0·70	0·64	0·71	0·72	0·67	0·64	0·67	0·70	0·72	0·71	0·73	0·60
3 Winter months	0·71	0·51	0·45	0·46	0·44	0·34	0·35	0·41	0·37	0·39	0·52	0·57	0·62	0·49	0·60	0·55	0·57	0·55	0·53	0·64	0·77	0·71	0·61	0·68	0·54

TABLE LIV.—Eskdalemuir. Hourly Characters. Number of 0's.

Hour G.M.T. ending at	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	24h.	Total,
1912.																									
April	18	16	19	17	20	23	20	21	21	19	13	12	11	10	10	7	10	8	9	9	10	13	11	13	340
May	15	16	19	23	23	20	20	17	23	23	17	14	8	9	6	6	8	5	4	11	9	14	16	13	339
June	17	17	18	18	19	17	16	14	20	21	18	17	12	9	6	5	7	8	5	11	9	14	14	11	323
July	16	15	16	22	26	19	20	15	22	20	19	18	10	12	8	6	6	11	10	11	15	12	17	16	362
August	12	12	18	14	15	17	12	13	16	21	16	14	15	10	11	4	8	6	3	9	12	9	8	13	288
September	9	14	15	19	15	19	14	15	16	21	15	10	14	10	14	9	12	15	15	15	15	10	12	8	331
October	13	12	16	16	18	16	21	13	17	22	15	11	13	11	16	15	14	14	15	16	13	12	16	17	362
November	14	16	16	16	16	20	17	17	21	19	15	14	13	15	14	17	17	18	20	13	11	13	12	14	378
1913.																									
January	13	18	20	17	21	23	26	22	22	22	19	15	13	18	16	13	15	12	12	15	17	15	19	15	418
February	8	14	17	18	15	18	17	17	15	15	10	12	10	14	12	13	12	14	15	10	11	8	10	10	315
March	14	14	16	16	14	18	18	18	17	18	16	9	7	7	11	13	12	12	13	11	13	10	11	11	319
April	11	12	12	13	15	13	15	15	17	17	19	11	9	14	11	11	10	11	13	14	11	12	8	8	302
May	16	17	19	15	19	18	19	21	21	23	20	11	12	11	9	11	12	9	11	10	14	18	18	11	365
June	18	19	17	25	26	20	18	18	21	23	18	17	14	12	9	14	10	9	15	18	16	17	19	22	415
July	15	17	21	23	22	22	19	24	22	22	21	16	14	16	11	10	10	12	14	14	18	20	17	14	414
Sum	209	229	259	272	284	283	272	260	291	306	251	201	175	178	164	154	163	164	174	187	194	197	208	196	5271
Percentage from all 15 months	95	104	118	124	129	129	124	118	133	139	114	92	80	81	75	70	74	75	79	85	88	90	95	89	...
7 Summer months ...	104	108	123	134	144	128	118	116	139	146	124	103	82	76	57	54	58	57	59	81	89	100	104	96	...
5 Equinoctial months ...	94	99	113	118	119	129	128	119	128	141	113	77	78	75	90	80	84	87	94	94	90	83	84	83	...
3 Winter months ...	76	104	114	110	112	132	130	121	125	121	95	89	78	101	91	93	95	95	101	82	84	78	89	84	...

TABLE LV.—Eskdalemuir. Hourly Characters. Number of 2's.

Hour G.M.T. ending at	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	24h.	Total.
1912.																									
April	2	2	2	2	2	3	2	1	2	1	0	0	1	1	2	2	4	2	1	3	2	2	2	2	43
May	2	2	2	1	1	3	1	2	3	0	0	4	3	2	1	3	1	2	3	6	6	5	2	2	57
June	3	3	3	2	1	0	2	3	3	1	1	3	2	4	5	4	3	2	3	2	5	2	2	5	64
July	3	1	2	2	0	0	0	1	2	0	1	2	2	3	5	4	2	4	4	1	4	2	3	4	52
August	6	6	2	5	2	2	1	1	0	0	0	0	0	1	3	3	5	5	5	5	2	5	4	5	68
September	5	3	3	2	1	1	2	0	1	1	1	1	1	2	3	4	3	3	2	5	4	4	3	4	59
October	5	5	1	1	1	0	1	1	1	0	0	0	1	1	1	3	4	4	3	2	3	2	1	1	42
November	2	0	1	1	1	0	1	3	1	0	0	1	2	0	2	1	3	3	2	3	7	4	2	4	44
1913.																									
January	2	0	1	0	1	1	1	1	1	0	0	0	0	0	2	2	2	1	2	1	5	3	1	3	30
February	5	4	2	2	0	1	0	0	0	1	1	1	0	1	2	0	1	0	1	2	6	3	3	3	39
March	4	3	3	2	1	1	0	0	0	0	0	1	2	3	2	1	2	0	3	5	4	4	5	5	51
April	5	3	0	1	1	0	0	0	0	0	1	1	1	1	2	2	3	3	3	2	5	4	4	5	47
May	3	2	3	1	3	0	0	0	1	0	0	0	0	1	1	2	2	2	1	2	2	1	1	3	31
June	1	1	1	2	1	1	1	1	0	0	0	1	1	4	3	2	2	2	3	1	3	5	3	0	39
July	1	1	1	2	2	1	0	0	1	0	1	0	3	1	4	2	6	5	2	2	1	1	1	1	39
Sum	49	36	27	26	18	14	12	14	16	4	6	15	19	25	38	35	43	38	38	42	59	47	37	47	705
Percentages from all 15 months	167	123	92	89	61	48	41	48	54	14	20	51	65	85	129	119	146	129	129	143	201	160	126	160	...
7 Summer months ...	130	110	96	103	69	48	34	55	69	7	20	69	75	110	151	137	144	151	144	130	158	144	110	137	...
5 Equinoctial months ...	208	159	89	79	59	50	50	20	40	20	20	30	59	79	99	119	159	119	119	169	178	159	149	169	...
3 Winter months ...	191	85	85	64	42	42	42	85	42	21	21	42	42	21	128	64	128	85	106	128	382	213	128	213	...

TABLE LVI.—Hourly Characters at Cape Denison and Cape Evans. Occurrences.

	1 h.									2 h.									3 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Cape Evans ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1912.																											
April	1	0	0	4	9	1	0	11	4	0	0	0	9	4	0	0	11	5	0	0	0	7	6	0	1	9	6
May	2	0	0	9	10	0	0	5	4	0	0	0	10	7	0	1	6	6	0	0	0	10	4	0	2	9	5
June	3	0	0	12	5	0	0	5	4	3	0	0	7	4	0	1	12	2	2	0	0	9	7	0	2	6	3
July	4	0	0	13	5	0	0	5	2	1	0	0	12	4	0	0	10	3	2	0	0	11	5	0	1	9	1
August ...	2	0	0	2	15	1	0	6	4	2	0	0	4	13	0	1	6	4	2	0	0	4	13	0	0	6	5
September ...	0	0	0	4	11	0	0	13	2	0	0	0	5	9	2	0	11	3	0	0	0	5	10	1	2	8	4
October ...	0	0	0	0	3	0	0	16	11	0	0	0	3	1	1	1	20	4	0	0	0	1	2	0	0	21	5
November ...	0	0	0	0	2	0	0	8	4	0	0	0	0	1	0	1	6	5	0	0	0	0	1	0	0	9	3

	4 h.									5 h.									6 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Cape Evans ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1912.																											
April	0	1	0	10	2	0	1	9	6	1	0	0	16	2	0	0	5	4	2	0	0	15	3	0	0	4	4
May	0	0	0	11	7	0	3	7	2	3	1	0	8	6	1	0	11	0	4	1	0	9	7	2	0	6	2
June	0	0	0	12	5	0	2	5	5	3	0	0	11	5	0	1	6	3	1	0	0	11	7	1	0	3	6
July	1	0	0	13	6	0	1	7	1	4	0	0	10	8	0	0	5	2	9	0	0	6	10	0	0	1	3
August ...	3	1	0	3	12	0	0	7	4	0	1	0	6	11	1	0	9	3	2	2	0	5	14	0	0	5	2
September ...	0	0	0	7	9	1	0	10	3	1	1	0	5	14	1	0	6	2	2	0	0	7	17	2	0	2	0
October ...	0	0	0	1	5	0	2	18	3	1	0	0	2	11	0	1	10	4	0	0	0	3	14	0	0	9	2
November ...	0	0	0	0	2	0	1	6	4	0	0	0	0	4	0	0	5	4	0	0	0	1	4	0	0	6	3

	7 h.									8 h.									9 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Cape Evans ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1912.																											
April	5	2	0	8	9	1	0	1	2	3	2	0	9	10	0	0	1	0	9	5	0	2	8	0	0	0	2
May	7	3	0	7	8	2	0	2	2	11	3	0	4	7	1	0	1	4	13	3	0	1	8	2	0	1	2
June	7	1	0	2	13	0	0	4	2	4	4	0	5	11	0	0	1	4	8	5	0	2	10	1	0	1	1
July	11	4	0	3	9	1	0	1	1	10	8	0	2	7	1	0	1	1	11	6	0	2	7	0	0	1	1
August ...	6	4	0	3	14	1	1	1	0	9	3	1	3	11	2	0	1	0	10	5	0	2	10	3	0	0	0
September ...	5	5	0	5	12	2	0	0	1	6	6	0	4	10	2	0	0	1	7	5	0	2	13	2	0	0	0
October ...	5	0	0	4	17	0	0	2	1	1	3	0	6	15	0	0	2	1	6	1	0	5	13	1	0	1	1
November ...	0	0	0	3	6	1	0	2	2	0	1	0	4	5	1	0	1	2	2	0	0	2	6	1	0	0	3

TABLE LVI.—*Continued.*

	10 h.									11 h.									12 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Cape Evans ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1912.																											
April	10	4	0	1	8	0	0	0	6	11	1	0	5	6	1	0	1	5	6	4	0	4	11	1	0	1	3
May	12	6	0	2	6	3	0	0	1	15	1	0	4	7	1	0	1	2	12	4	0	2	7	0	0	3	3
June	10	2	0	3	7	1	0	1	4	10	2	0	1	10	1	0	3	2	10	1	0	2	7	1	0	5	3
July	15	0	0	2	8	0	0	1	2	14	2	0	0	10	0	0	2	1	14	2	0	2	7	0	0	3	1
August ...	13	6	0	2	6	0	0	0	3	14	7	0	0	6	2	0	0	1	16	5	0	0	6	1	0	1	1
September ...	15	6	0	0	4	3	0	0	1	15	3	0	0	7	1	0	0	4	11	4	1	1	7	1	0	1	4
October ...	9	3	0	4	7	3	0	0	1	10	3	0	2	9	0	0	2	3	9	5	0	1	7	0	0	4	3
November ...	1	4	0	0	5	1	0	1	2	2	7	0	0	1	2	0	1	1	3	4	0	0	4	1	0	0	2

	13 h.									14 h.									15 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Cape Evans ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1912.																											
April	4	2	0	7	11	1	0	1	4	5	2	0	6	12	1	0	2	2	8	5	0	4	11	1	0	1	0
May	9	3	0	4	8	1	0	3	3	8	1	0	5	12	2	0	2	1	5	0	0	6	14	3	0	3	0
June	7	0	0	6	6	1	1	5	3	6	0	0	5	8	0	0	7	3	7	0	0	4	5	0	0	10	3
July	9	2	0	6	8	0	0	1	3	10	2	0	4	7	0	0	3	4	9	3	0	2	9	1	0	3	3
August ...	10	7	0	3	8	1	0	1	0	12	4	0	2	11	1	0	0	0	9	6	0	2	10	1	0	1	1
September ...	8	6	1	3	11	0	0	0	1	7	10	0	3	7	3	0	0	0	9	14	0	1	3	3	0	0	0
October ...	6	6	0	1	10	1	0	3	2	5	6	0	1	7	5	0	2	2	5	7	0	1	11	1	0	1	2
November	2	3	0	0	4	2	0	0	3	3	1	0	0	3	4	0	2	1	2	5	1	0	1	4	0	0	1

	16 h.									17 h.									18 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Cape Evans ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1912.																											
April	10	8	0	1	9	0	0	0	2	9	5	0	2	11	0	0	2	1	6	4	0	4	10	0	0	2	3
May	7	2	0	3	15	2	0	1	1	6	5	0	2	17	0	0	0	1	7	4	0	2	15	2	0	0	0
June	7	2	0	4	7	0	0	6	3	10	0	0	5	13	1	0	0	0	9	2	0	3	10	0	0	3	1
July	8	6	0	2	9	0	0	4	1	9	5	0	1	8	0	0	6	1	10	4	0	0	10	0	0	5	0
August ...	11	8	0	0	5	3	0	0	3	11	8	0	0	7	3	0	0	1	7	11	0	0	10	0	0	0	1
September ...	12	9	0	0	7	1	0	0	1	11	12	0	0	6	1	0	0	0	12	7	0	0	7	1	0	0	2
October	4	9	0	0	9	2	0	2	1	2	7	1	0	15	1	0	0	1	2	9	0	0	8	5	0	1	1
November ...	2	3	1	0	5	2	0	1	0	0	4	1	0	4	3	0	0	2	0	2	2	0	1	4	0	0	4

TABLE LVI.—*Continued.*

	19 h.									20 h.									21 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Cape Evans ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1912.																											
April	5	3	0	2	13	1	0	2	3	3	5	0	1	14	0	0	5	2	6	3	0	2	11	0	2	2	4
May	6	1	0	2	15	2	0	4	0	6	1	0	4	15	2	0	0	3	4	2	0	1	14	0	0	7	2
June	6	2	0	4	12	0	0	4	0	3	1	0	6	13	0	0	4	2	2	2	0	2	16	0	0	4	3
July	8	4	0	1	11	1	0	2	3	8	5	0	2	9	0	0	6	0	7	5	0	3	7	1	0	5	1
August ...	4	12	0	1	9	0	0	2	1	5	10	0	0	10	1	0	2	2	4	7	0	0	14	0	0	2	3
September ...	6	12	0	0	7	2	0	0	1	4	8	1	0	7	8	0	0	1	4	7	0	0	8	4	0	0	5
October ...	0	4	0	0	10	6	0	2	4	1	3	0	0	9	6	0	1	7	0	2	0	0	9	4	0	4	7
November ...	0	0	0	0	1	10	0	0	2	0	0	0	0	2	3	0	0	9	0	1	0	0	0	4	0	0	8

	22 h.									23 h.									24 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Cape Evans ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1912.																											
April	2	1	0	6	10	1	0	4	5	0	2	0	6	11	0	0	6	4	0	0	0	3	12	1	0	11	3
May	2	0	0	5	13	2	1	4	3	1	0	0	12	10	0	0	2	5	1	0	0	11	9	0	0	5	4
June	1	0	0	5	16	0	1	3	3	1	0	0	8	9	0	0	8	3	2	0	0	9	10	0	0	4	4
July	7	1	0	6	9	0	0	5	2	6	0	0	13	4	0	1	2	4	5	0	0	12	4	0	0	5	3
August ...	1	5	0	1	18	1	0	0	3	0	1	0	4	20	1	0	1	3	1	0	0	5	15	1	0	4	4
September ...	1	1	0	1	14	5	0	0	6	0	1	0	1	14	6	0	2	5	0	1	0	0	15	4	0	3	7
October ...	0	0	0	0	12	2	0	3	13	1	0	0	0	11	1	0	3	13	0	0	0	1	5	0	0	13	10
November ...	0	0	0	0	2	0	0	1	10	0	0	0	0	2	0	0	2	9	0	0	0	0	1	0	0	3	8

TABLE LVII.—Hourly Characters at Cape Denison and Eskdalemuir. Occurrences.

	1 h.									2 h.									3 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Eskdalemuir ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1913.																											
January ...	0	0	0	3	1	0	8	15	2	0	0	0	5	1	0	11	12	0	0	0	0	5	0	0	14	8	1
February ...	0	0	0	6	2	0	2	13	5	0	0	0	6	1	0	8	9	4	0	0	0	5	2	0	12	7	2
March	1	0	0	11	3	1	2	10	3	0	0	0	10	4	0	5	9	3	0	0	0	10	4	0	6	8	3
April	1	0	0	10	8	1	1	4	4	0	0	0	11	3	0	2	10	3	0	0	0	12	3	0	1	13	0
May	6	2	0	9	8	2	0	1	1	3	0	0	13	9	0	0	2	2	2	1	0	15	7	1	0	1	2
June	11	2	0	7	9	1	0	0	0	5	3	0	14	7	0	0	0	1	6	1	0	11	11	0	0	0	1
July	4	0	0	11	15	1	0	0	0	3	0	0	14	10	1	0	3	0	3	2	0	18	6	1	1	1	0

TABLE LVII.—*Continued.*

	4 h.									5 h.									6 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Eskdalemuir ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1913.																											
January ...	0	0	0	3	0	0	12	13	0	0	0	0	7	2	0	11	6	1	1	0	0	10	1	0	8	6	1
February ...	0	0	0	8	0	0	10	8	2	0	0	0	9	3	0	6	10	0	0	0	0	16	0	0	2	9	1
March	0	0	0	13	1	1	4	11	1	0	0	0	12	3	0	3	12	1	1	0	0	15	8	1	2	3	0
April	0	0	0	10	4	1	4	10	0	0	0	0	13	5	0	3	7	1	2	0	0	11	14	0	1	1	0
May	8	3	0	6	10	1	0	2	0	7	0	0	11	8	2	0	1	1	12	4	0	5	9	0	0	0	0
June	8	1	0	17	2	1	0	0	1	10	0	0	16	3	0	0	0	1	15	2	0	5	7	0	0	0	1
July	3	0	0	20	3	2	0	3	0	6	1	0	15	6	2	1	0	0	12	0	0	10	8	1	0	0	0

	7 h.									8 h.									9 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Eskdalemuir ...	0	1	2	0	1	2	0	1	2		1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1913.																											
January ...	0	0	0	18	1	0	5	2	1	1	0	0	18	4	0	1	2	1	4	1	0	14	5	0	1	2	1
February ...	0	0	0	14	7	0	3	4	0	5	0	0	11	8	0	1	3	0	7	1	0	8	9	0	0	3	0
March	3	1	0	14	9	0	1	2	0	6	1	0	12	10	0	0	1	0	11	2	0	6	11	0	0	0	0
April	1	1	0	14	12	0	1	0	0	9	2	0	7	11	0	0	0	0	15	3	0	3	8	0	0	0	0
May	16	6	0	3	5	0	0	0	0	18	5	0	2	4	0	0	1	0	17	4	0	3	4	1	0	1	0
June	13	4	0	4	8	1	0	0	0	17	5	0	1	5	1	0	1	0	21	3	0	0	6	0	0	0	0
July	15	3	0	4	9	0	0	0	0	20	3	0	4	4	0	0	0	0	18	4	0	4	3	1	0	1	0

	10 h.									11 h.									12 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Eskdalemuir ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1913.																											
January ...	1	0	0	17	7	0	1	2	0	5	0	0	11	10	0	1	1	0	7	3	0	6	8	0	2	4	0
February ...	7	3	0	7	8	0	1	1	1	10	2	0	0	14	0	0	1	1	10	3	0	2	11	0	0	1	1
March	9	3	0	9	5	0	0	3	0	12	4	0	4	9	0	0	2	0	6	9	0	4	11	0	0	0	1
April	12	4	0	6	6	0	0	1	0	16	3	0	5	4	0	0	1	1	10	9	0	2	7	0	0	1	1
May	18	2	0	4	4	0	0	2	0	15	4	0	4	4	0	0	3	0	11	9	0	0	8	0	0	2	0
June	19	2	0	4	5	0	0	0	0	13	5	0	5	7	0	0	0	0	17	4	0	0	7	1	0	1	0
July	16	3	0	6	5	0	0	1	0	15	5	0	5	4	1	1	0	0	15	10	0	1	4	0	0	1	0

TABLE LVII.—*Continued.*

	13 h.									14 h.									15 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Eskdalemuir ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1913.																											
January ...	8	0	0	5	9	0	0	5	0	6	0	0	10	5	0	1	5	0	6	0	0	6	8	0	3	4	1
February ...	6	5	0	4	10	0	0	3	0	8	2	0	6	7	0	0	4	1	6	3	0	6	9	0	0	2	2
March	5	6	0	2	15	2	0	1	0	4	6	0	3	13	1	0	2	2	8	5	0	3	12	1	0	1	1
April	7	5	0	2	14	0	0	1	1	5	3	0	10	8	0	0	3	1	5	2	0	7	10	1	0	4	1
May	10	6	0	2	9	0	0	3	0	9	7	0	2	8	0	0	3	1	6	13	0	3	5	1	0	2	0
June	12	6	0	2	8	1	0	1	0	9	6	0	3	7	3	0	1	1	7	11	0	2	6	1	0	1	2
July	12	7	0	2	7	2	0	0	1	11	4	0	5	6	0	0	4	1	9	9	0	2	5	2	0	2	2

	16 h.									17 h.									18 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Eskdalemuir ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1913.																											
January ...	7	0	0	5	12	0	0	3	1	3	1	0	10	9	1	0	3	1	4	0	0	7	12	0	0	4	1
February ...	7	2	0	6	10	0	0	3	0	7	1	0	5	13	0	0	1	1	6	2	0	8	11	0	0	1	0
March	10	5	0	3	10	0	0	2	1	10	4	0	3	7	0	0	5	2	8	5	0	4	12	0	0	2	0
April	9	6	0	3	10	0	0	0	2	8	8	0	2	8	2	0	1	1	9	3	1	2	12	1	0	1	1
May	11	11	1	0	5	0	0	1	1	12	12	0	0	4	1	0	0	1	9	14	0	0	5	0	0	0	2
June	13	8	1	0	6	1	1	0	0	10	12	1	0	6	1	0	0	0	9	14	1	0	5	1	0	0	0
July	8	7	1	2	11	1	0	1	0	10	7	0	0	8	6	0	0	0	9	7	0	3	7	4	0	0	1

	19 h.									20 h.									21 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Eskdalemuir ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1913.																											
January ...	2	0	0	6	14	1	2	3	0	1	0	0	12	18	1	1	7	0	0	0	0	10	4	1	5	6	4
February ...	6	1	0	9	10	1	0	1	0	4	0	0	6	14	1	0	2	1	3	0	0	7	8	2	1	3	4
March	9	1	1	4	13	1	0	1	1	2	2	0	10	12	2	0	0	3	2	0	0	11	13	1	1	0	3
April	8	2	0	5	12	1	0	0	2	10	0	0	5	13	1	0	0	1	5	2	0	7	10	4	0	1	1
May	11	11	0	0	6	1	0	1	0	9	8	0	1	9	1	0	1	1	10	3	0	3	10	1	0	2	1
June	14	6	1	1	6	2	0	0	0	13	1	0	5	10	1	0	0	0	11	3	0	5	8	3	0	0	0
July	10	7	0	4	7	2	0	1	0	9	6	0	5	9	2	0	0	0	10	3	0	8	8	1	0	1	0

	22 h.									23 h.									24 h.								
Cape Denison ...	0			1			2			0			1			2			0			1			2		
Eskdalemuir ...	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
1913.																											
January ...	0	0	0	8	5	0	7	7	3	0	0	0	9	0	0	9	11	1	0	0	0	1	2	0	13	11	3
February ...	0	0	0	7	9	0	1	8	3	0	0	0	7	4	0	3	11	3	0	0	0	5	4	1	5	11	2
March	0	0	0	11	10	3	0	6	1	0	0	0	10	7	2	2	7	3	1	0	0	10	5	0	0	10	5
April	1	0	0	12	12	1	0	1	3	0	0	0	9	13	1	0	3	3	0	0	0	7	10	1	2	5	4
May	13	2	0	4	7	0	0	3	1	5	2	0	12	8	0	0	2	1	4	2	0	7	14	1	0	0	2
June	8	2	0	9	6	4	0	0	1	9	0	0	10	8	2	0	0	1	12	1	0	10	6	0	0	1	0
July	7	2	0	13	7	1	0	1	0	5	1	0	12	12	1	0	0	0	4	1	0	10	15	1	0	0	0

TABLE LVIII.—Hourly Characters at Cape Denison and Cape Evans.

Cape Denison.	Number of Occurrences. 0			1			2			Occurrences as Percentages. 0			1			2		
Cape Evans.	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
h.																		
1	12	0	0	44	60	2	0	69	35	100	0	0	41	57	2	0	66	34
2	6	0	0	50	43	3	5	82	32	100	0	0	52	45	3	4	69	27
3	6	0	0	47	48	1	8	77	32	100	0	0	49	50	1	7	66	27
4	4	2	0	57	48	1	10	69	28	67	33	0	54	45	1	9	65	26
5	13	3	0	58	61	2	2	57	22	81	19	0	48	50	2	3	70	27
6	20	3	0	57	76	5	0	36	22	87	13	0	41	55	4	0	62	38
7	46	19	0	35	88	8	1	13	11	71	29	0	27	67	6	4	52	44
8	44	30	1	37	76	7	0	8	13	59	40	1	31	63	6	0	38	62
9	66	30	0	18	75	10	0	4	10	69	31	0	17	73	10	0	29	71
10	85	31	0	14	51	11	0	3	20	73	27	0	19	67	14	0	13	87
11	91	26	0	12	56	8	0	10	19	78	22	0	16	74	10	0	34	66
12	81	29	1	12	56	5	0	18	20	73	26	1	16	77	7	0	47	53
13	55	29	1	30	66	7	1	14	19	65	34	1	29	64	7	3	41	56
14	56	26	0	26	67	16	0	18	13	68	32	0	24	61	15	0	58	42
15	54	40	1	29	64	14	0	19	10	57	42	1	20	66	14	0	66	34
16	61	47	1	10	66	10	0	14	12	56	43	1	12	76	12	0	54	46
17	58	46	2	10	81	9	0	8	7	55	43	2	10	81	9	0	53	47
18	53	43	2	9	71	12	0	11	12	54	44	2	10	77	13	0	48	52
19	35	38	0	10	78	22	0	16	14	48	52	0	9	71	20	0	53	47
20	30	33	1	13	79	20	0	18	26	47	51	2	12	70	18	0	41	59
21	27	29	0	8	79	13	2	24	33	48	52	0	8	79	13	3	41	56
22	14	8	0	24	94	11	2	20	45	64	36	0	19	73	8	3	30	67
23	9	4	0	44	81	8	1	26	46	69	31	0	33	61	6	1	36	63
24	9	1	0	41	71	6	0	48	43	90	10	0	35	60	5	0	53	47
24 hours ...	935	517	10	686	1,635	211	32	682	544	64	35	1	27	65	8	3	54	43
Hours 1–3	24	0	0	141	151	6	13	228	99	100	0	0	47	51	2	4	67	29
4–6	37	8	0	172	185	8	12	162	72	82	18	0	47	51	2	5	66	29
7–9	156	79	1	90	239	25	1	25	34	66	34	0	25	68	7	2	42	56
10–12	257	86	1	38	163	24	0	31	59	75	25	0	17	72	11	0	34	66
13–15	165	95	2	76	197	37	1	51	42	63	36	1	24	64	12	1	54	45
16–18	172	136	5	29	218	31	0	33	31	55	43	2	10	79	11	0	52	48
19–21	92	100	1	31	236	55	2	58	73	47	52	1	10	73	17	2	43	55
22–24	32	13	0	109	246	25	3	94	134	71	29	0	29	65	6	1	41	58
Hours 1–6	61	8	0	313	336	14	25	390	171	88	12	0	47	51	2	4	67	29
Hours 16–21	264	236	6	60	454	86	2	91	104	52	47	1	10	76	14	1	46	53

TABLE LIX.—Hourly Characters at Cape Denison and Eskdalemuir.

	Number of Occurrences.									Occurrences as Percentages.								
Cape Denison.	0			1			2			0			1			2		
Eskdalemuir.	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
h.																		
1	23	4	0	57	46	6	13	43	15	85	15	0	52	42	6	18	61	21
2	11	3	0	73	35	1	26	45	13	79	21	0	67	32	1	31	54	15
3	11	4	0	76	33	2	33	38	9	73	27	0	68	30	2	41	48	11
4	19	4	0	77	20	6	30	47	4	83	17	0	75	19	6	37	58	5
5	23	1	0	83	30	4	24	36	5	96	4	0	71	26	3	37	55	8
6	43	6	0	72	47	2	13	19	3	88	12	0	59	39	2	37	54	9
7	48	15	0	71	51	1	10	8	1	76	24	0	58	41	1	53	42	5
8	76	16	0	55	46	1	2	8	1	83	17	0	54	45	1	18	73	9
9	93	18	0	38	46	2	1	7	1	84	16	0	44	54	2	11	78	11
10	82	17	0	53	40	0	2	10	1	83	17	0	57	43	0	15	77	8
11	86	23	0	34	52	1	2	8	2	79	21	0	39	60	1	17	66	17
12	76	47	0	15	53	1	2	10	3	62	38	0	22	76	2	13	67	20
13	60	35	0	19	72	5	0	14	2	63	37	0	20	75	5	0	88	12
14	52	28	0	39	54	4	1	22	7	65	35	0	40	56	4	3	74	23
15	47	43	0	29	55	6	3	16	9	52	48	0	32	61	7	11	57	32
16	65	39	3	19	64	2	1	10	5	61	36	3	22	75	3	6	63	31
17	60	45	1	20	55	11	0	10	6	57	42	1	23	64	13	0	63	37
18	54	45	2	24	64	6	0	8	5	53	45	2	26	68	6	0	62	38
19	60	28	2	29	68	9	2	7	3	67	31	2	27	64	9	17	58	25
20	48	17	0	44	75	9	1	10	6	74	26	0	34	59	7	6	59	35
21	41	11	0	51	61	13	7	13	13	79	21	0	41	49	10	22	39	39
22	29	6	0	64	56	9	8	26	12	83	17	0	50	43	7	17	57	26
23	19	3	0	69	52	6	14	34	12	86	14	0	54	41	5	23	57	20
24	21	4	0	50	56	4	20	38	16	84	16	0	45	51	4	27	51	22
24 hours	1,147	462	8	1,161	1,231	111	215	487	154	71	29	0	46	49	5	25	57	18
Hours 1–3	45	11	0	206	114	9	72	126	37	80	20	0	62	35	3	30	54	16
4–6	85	11	0	232	97	12	67	102	12	89	11	0	68	28	4	37	56	7
7–9	217	49	0	164	143	4	13	23	3	82	18	0	53	46	1	33	59	8
10–12	244	87	0	102	145	2	6	28	6	74	26	0	41	58	1	15	70	15
13–15	159	106	0	87	181	15	44	52	18	60	40	0	31	64	5	6	70	24
16–18	179	129	6	63	183	19	1	28	16	57	41	2	24	69	7	2	62	36
19–21	149	56	2	124	204	31	10	30	22	72	27	1	34	57	9	16	48	36
22–24	69	13	0	183	164	19	42	98	40	84	16	0	50	45	5	23	55	22
Hours 1–6	130	22	0	438	211	21	139	228	49	86	14	0	65	32	3	33	55	12
Hours 13–18	338	235	6	150	364	34	5	80	34	58	41	1	27	67	6	4	67	29

TABLE LX.—Hourly Characters at Cape Evans and Cape Denison.

	Number of Occurrences.									Occurrences as Percentages.								
Cape Evans Character.	0			1			2			0			1			2		
Cape Denison Character.	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
24 hours	935	686	32	517	1,635	682	10	211	544	57	41	2	18	58	24	1	28	71
Hours 1–6	61	313	25	8	336	390	0	14	171	15	79	6	1	46	53	0	8	92
Hours 16–21	264	60	2	236	454	91	6	86	104	81	18	1	30	58	12	3	44	53

TABLE LXI.—Hourly Characters at Eskdalemuir and Cape Denison.

	Number of Occurrences.									Occurrences as Percentages.								
Eskdalemuir Character.	0			1			2			0			1			2		
Cape Denison Character.	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
24 hours	1,147	1,161	215	462	1,231	487	8	111	154	46	46	8	21	57	22	3	41	56
Hours 1–6	130	438	139	22	211	228	0	21	49	18	62	20	5	46	49	0	30	70
Hours 13–18	338	1,510	5	235	364	80	6	34	34	18	82	0	35	53	12	8	46	46

TABLE LXII.—Ranges during Hours when Character 0 at Cape Denison, but 2 at Cape Evans.

Date.	Hour ending at	Cape Denison.			Cape Evans.		
		D.	H.	V.	E¹.	N¹.	V.
1912.		γ	γ	γ	γ	γ	γ
August 3	8 h.	36	17	19	46	40	17
September 14	12 h.	25	13	12	50	31	23
September 17	13 h.	60	21	13	19	72	12
September 20	20 h.	15	22	20	67	36	23
October 30	17 h.	23	20	16	45	54	29
November 2	18 h.	13	19	16	46	31	11
November 5	15 h.	16	7	10	50	14	40
November 12	16 h.	25	17	8	58	33	23
November 13	18 h.	9	9	12	46	27	27
November 16	17 h.	15	5	11	90	28	38
Means	......	24	15	14	52	37	24

Table LXIII.—Ranges during Hours when Character 2 at Cape Denison, but 0 at Cape Evans.

Date.	Hour ending at—	Cape Denison.			Cape Evans.		
		D.	H.	V.	E¹.	N¹.	V.
1912.	h.	γ	γ	γ	γ	γ	γ
April 11	3	41	30	30	12	14	8
April 22	21	14	21	21	12	11	6
April 23	21	38	27	18	15	13	8
April 28	4	...	58	18	12	11	4
May 1	3	22	50	11	9	7	6
May 1	4	41	44	6	19	5	4
May 3	2	40	39	18	17	13	6
May 15	22	45	45	18	15	6	16
May 25	3	35	37	38	8	11	4
May 25	4	28	31	30	12	14	3
May 29	4	26	37	42	3	7	4
June 5	3	29	32	79	12	18	3
June 5	4	28	25	74	13	12	3
June 10	22	41	47	29	10	10	15
June 14	2	35	19	43	7	18	3
June 19	5	25	28	28	11	16	6
June 20	4	25	57	36	8	10	5
June 22	13	14	35	40	14	13	5
June 26	3	16	25	42	13	14	4
July 17	23	23	23	43	21	13	7
July 21	3	29	30	33	25	14	3
July 22	4	30	33	51	12	17	6
August 18	2	28	29	35	12	10	10
August 20	7	22	47	26	13	12	5
September 5	3	54	60	58	14	11	11
September 22	3	64	89	77	14	14	17
October 7	4	18	35	40	19	7	5
October 8	5	23	36	36	17	17	8
October 9	4	33	65	47	17	13	12
October 29	2	46	26	64	19	12	5
November 2	2	38	32	29	10	10	13
November 8	4	28	42	36	19	15	7
Means...	...	32	38	38	14	12	7

Table LXIV.—Ranges during Hours when Character 0 at Cape Denison but 2 at Eskdalemuir.

Date.	Hour ending at—	Cape Denison.			Eskdalemuir.	
		D.	H.	V.	N.	W.
1913.	h.	γ	γ	γ	γ	γ
March 21	19	38	5	19	10	37
April 14	18	23	12	11	35	15
May 18	16	6	7	8	32	19
June 21	18	9	7	8	37	17
June 24	17	4	6	6	23	11
June 28	19	18	8	8	42	18
June 29	16	14	7	10	19	12
July 24	16	5	6	7	25	11
Means	...	15	7	10	28	18

TABLE LXV.—Hourly Range Data at Cape Denison and Cape Evans, June, 1912.

Date.	Cape Denison.						Cape Evans.					
	H.			V.			N^1.			V.		
	Hourly Range.		Daily. / Hourly.	Hourly Range.		Daily. / Hourly.	Hourly Range.		Daily. / Hourly.	Hourly Range.		Daily. / Hourly.
	Largest.	Mean.		Largest.	Mean.		Largest.	Mean.		Largest.	Mean.	
1 ...	381	48·5	7·9	248	49·8	8·5	70	29·0	5·0	57	19·2	7·1
2 ...	94	33·9	5·3	85	40·0	4·6	101	29·8	4·7	152	19·9	9·8
3 ...	140	34·4	6·2	120	32·0	4·3	74	24·3	4·4	57	17·1	7·5
4 ...	40	16·4	5·2	88	19·9	6·3	25	13·2	3·6	14	6·8	3·7
5 ...	32	16·0	4·0	79	21·2	6·5	...	...	...	17	7·3	3·6
6 ...	43	11·7	4·0	53	11·6	7·2	...	...	...	20	5·3	5·5
7 ...	30	9·5	4·5	37	11·0	5·7	29	5·9	8·3	10	4·0	6·2
8 ...	338	59·5	5·8	358	82·5	6·5	191	57·8	5·5	99	28·3	6·0
9 ...	311	72·6	4·3	315	84·6	6·0	150	48·2	6·8	138	30·0	3·7
10 ...	101	45·8	3·9	160	65·8	4·7	75	36·2	5·4	55	19·4	4·5
11 ...	105	35·3	4·4	199	61·7	3·8	69	29·9	4·3	44	18·5	4·2
12 ...	63	24·7	3·5	84	31·7	4·7	72	24·4	4·8	61	14·3	5·6
13 ...	35	16·5	3·8	57	20·3	5·7	19	11·8	3·5	28	7·7	5·3
14 ...	76	22·5	5·3	123	28·5	6·0	31	16·0	4·8	24	8·5	5·2
15 ...	36	12·7	3·7	43	16·0	4·7	...	...	...	...	...	...
16 ...	24	10·1	3·5	29	13·2	5·2	...	...	...	...	...	...
17 ...	32	11·6	3·7	41	12·5	4·6	26	11·4	3·9	18	5·5	7·3
18 ...	58	13·4	6·1	92	13·8	9·5	22	10·3	3·5	10	5·9	4·1
19 ...	23	10·0	3·4	44	10·3	6·0	27	8·8	6·1	12	6·1	5·7
20 ...	57	11·4	5·0	36	9·9	5·1	18	6·6	3·0	16	4·8	3·8
21 ...	43	12·1	3·6	24	11·8	3·7	21	8·7	3·9	13	5·6	6·1
22 ...	35	14·5	4·6	40	15·5	5·0	30	11·4	5·7	21	7·4	7·2
23 ...	62	18·6	3·7	80	26·1	5·5	48	17·5	5·9	21	7·7	6·0
24 ...	46	22·3	4·1	69	24·5	5·3	55	21·8	5·5	29	12·2	5·4
25 ...	30	12·5	5·1	41	12·5	6·1	35	11·3	5·0	17	5·7	4·6
26 ...	49	13·7	6·2	54	17·0	5·4	36	12·1	6·9	19	5·9	5·8
27 ...	77	26·5	8·5	75	22·1	5·8	94	24·6	6·4	93	17·6	9·2
28 ...	72	36·7	3·1	84	31·8	5·1	50	24·3	4·4	37	16·2	5·9
29 ...	121	45·3	3·9	164	56·2	4·8	89	33·2	4·4	63	17·8	4·6
30 ...	40	22·5	3·6	74	26·2	5·0	35	18·1	3·8	24	9·9	6·4
Mean ...	86·5	24·7	4·7	99·9	29·3	5·6	57·4	21·0	5·0	41·8	12·0	5·7

TABLE LXVI.—Hourly Range Data at Cape Denison and Cape Evans, September, 1912.

Date.	Cape Denison.						Cape Evans.					
	H.			V.			N¹.			V.		
	Hourly Range. Largest.	Hourly Range. Mean.	Daily Hourly.	Hourly Range. Largest.	Hourly Range. Mean.	Daily Hourly.	Hourly Range. Largest.	Hourly Range. Mean.	Daily Hourly.	Hourly Range. Largest.	Hourly Range. Mean.	Daily Hourly.
1 ...	81	20·6	6·0	84	28·1	7·5	39	12·8	8·4	28	7·2	5·6
2 ...	46	17·5	3·1	35	17·2	5·6	33	10·5	4·5	33	7·5	5·5
3 ...	120	21·4	5·7	98	19·3	4·4	38	7·8	6·2	29	5·0	8·8
4 ...	73	29·8	5·3	148	41·0	5·4	82	27·6	7·2	24	11·7	5·6
5 ...	60	21·8	4·0	74	30·0	5·4	92	25·4	6·1	30	14·5	5·2
6 ...	108	30·0	4·6	81	28·1	4·9	44	23·0	4·8	32	13·8	5·1
7 ...	60	20·0	4·1	98	24·8	4·9	33	17·7	4·0	21	9·8	4·0
8 ...	111	27·4	6·2	95	25·0	4·7	61	24·7	4·1	33	13·3	5·3
9 ...	103	32·2	5·2	131	30·6	6·2	48	28·2	5·5	20	11·0	4·5
10 ...	78	26·0	6·2	96	26·0	5·4	43	22·4	5·3	27	10·7	5·9
11 ...	85	23·8	7·1	74	22·9	6·6	38	21·4	4·3	20	11·3	5·4
12 ...	71	29·2	5·1	74	27·7	5·6	68	30·5	5·1	45	16·1	5·2
13 ...	101	34·7	4·8	97	33·4	6·4	53	20·8	4·8	66	14·8	6·1
14 ...	95	27·2	4·3	87	25·9	4·3	51	25·2	4·0	30	15·7	4·3
15 ...	50	15·7	3·9	37	12·3	5·8	27	9·2	5·5	17	5·0	6·0
16 ...	56	23·0	5·4	63	22·2	5·9	38	16·7	6·5	17	8·4	6·7
17 ...	117	47·5	4·5	122	45·2	3·5	150	47·6	5·5	64	23·3	5·1
18 ...	175	62·2	3·5	226	53·1	6·2	123	46·8	5·6	48	23·8	3·9
19 ...	77	31·9	4·8	93	38·4	4·8	64	27·5	5·2	60	15·4	4·5
20 ...	134	30·6	4·4	61	30·3	4·8	60	28·8	5·5	27	14·2	5·1
21 ...	167	34·1	5·0	54	31·5	5·5	48	24·7	4·0	51	13·9	5·8
22 ...	116	45·8	5·6	148	51·6	5·1	58	26·5	4·6	55	18·3	6·0
23 ...	168	42·8	4·5	185	51·3	3·8	65	28·8	4·2	44	18·3	3·4
24 ...	176	50·0	6·8	112	54·7	6·4	165	61·4	5·7	63	30·0	7·4
25 ...	168	34·4	5·8	142	34·2	3·9	55	19·2	5·1	61	13·4	6·0
26 ...	116	34·6	4·7	101	33·7	3·8	48	22·4	3·3	48	15·8	3·9
27 ...	62	22·7	3·3	59	24·1	3·7	33	15·0	5·3	17	7·6	7·1
28 ...	67	17·8	4·2	57	22·5	5·1	33	10·4	4·0	26	7·7	6·8
29 ...	60	19·9	4·4	63	22·0	3·7	33	13·6	4·7	30	10·0	6·5
30 ...	101	27·4	6·1	104	29·2	7·3	55	18·1	5·1	55	10·7	7·1
Mean ...	100·1	30·1	5·0	96·6	31·2	5·2	59·3	23·8	5·1	37·4	13·2	5·6

‡ 2032—M

Table LXVII.—Hourly Range and Inequality Change at Cape Denison and Cape Evans.

Hour (G.M.T.) ending at—	Mean Hourly Range.								Hourly Change in Diurnal Inequality.							
	Cape Denison.				Cape Evans.				Cape Denison.				Cape Evans.			
	June.		September.		June.		September.		June.		September.		June.		September.	
	H	V	H	V	N^1	V	N^1	V	H	V	H	V	N^1	V	N^1	V
h.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
1	26·9	27·8	54·9	62·2	20·5	7·7	28·8	15·6	3·6	2·0	12·8	14·5	1·4	0·1	9·1	2·1
2	31·8	45·2	55·1	62·4	23·2	9·4	29·3	12·6	3·8	4·8	10·1	13·9	3·6	2·6	4·4	1·8
3	32·6	51·3	57·6	50·0	24·4	13·3	25·6	11·6	2·2	0·7	8·4	11·2	1·8	4·3	1·6	2·4
4	36·1	44·0	57·8	50·1	24·8	12·3	27·9	11·6	0·6	1·1	4·4	5·5	1·1	2·2	4·3	5·2
5	32·1	30·6	47·2	38·8	20·8	11·3	23·3	10·7	1·1	0·4	5·9	2·4	3·6	4·4	8·4	2·1
6	28·9	25·3	36·1	27·7	20·8	14·1	20·0	9·6	1·8	3·3	2·0	12·0	4·1	3·4	11·0	5·2
7	22·3	20·6	26·7	22·6	19·1	12·0	15·5	9·2	1·5	3·3	2·8	5·0	5·5	5·4	7·2	5·2
8	21·9	18·6	20·3	22·5	23·0	18·2	18·4	9·1	2·5	4·4	5·2	12·8	5·1	2·0	9·4	3·9
9	14·3	13·2	16·0	20·7	17·7	15·2	20·3	9·6	1·6	1·1	5·4	4·4	6·0	4·2	7·0	3·9
10	17·2	18·8	14·5	16·7	19·0	12·2	20·4	9·2	4·3	4·5	3·9	4·4	2·3	1·2	4·0	2·3
11	18·2	19·7	18·0	20·4	18·0	14·4	21·8	8·2	5·6	6·0	8·4	4·4	5·6	4·8	5·3	0·7
12	29·9	33·0	25·0	30·8	19·2	8·8	24·5	10·8	4·0	10·3	2·2	6·0	1·8	2·3	0·1	0·2
13	33·2	41·2	16·5	21·8	22·1	10·3	21·2	10·1	4·4	3·9	3·3	5·9	0·6	0·5	5·7	2·1
14	33·2	44·1	13·6	18·5	22·4	13·1	17·8	11·4	0·8	5·4	0·2	1·9	0·7	2·4	2·6	2·3
15	28·8	41·4	12·4	15·8	23·0	15·1	21·7	12·1	1·0	2·2	2·6	1·3	3·0	0·1	0·3	1·7
16	27·8	38·6	13·8	15·8	22·3	13·2	22·9	11·4	1·6	7·7	0·3	1·2	3·9	5·5	2·9	3·4
17	11·9	17·4	11·0	14·9	18·2	12·0	20·9	8·9	2·6	7·1	0·3	0·9	1·3	5·2	2·0	1·6
18	13·8	19·2	13·9	19·6	20·5	9·7	23·7	10·8	0·4	0·3	0·9	2·6	2·0	1·8	0·5	1·3
19	13·8	23·1	17·4	20·7	17·4	8·6	21·1	13·5	0·5	4·9	1·0	3·3	1·6	1·6	4·5	2·9
20	15·9	25·4	22·7	23·2	14·0	9·3	24·8	20·0	0·4	2·8	1·6	1·8	5·9	2·8	7·6	0·1
21	21·9	24·9	29·4	33·6	16·3	10·8	25·4	24·0	2·4	5·1	3·4	7·9	2·0	1·3	8·0	2·2
22	26·2	24·2	38·8	41·7	19·2	12·7	26·8	24·6	0·3	1·4	1·5	5·9	1·2	1·9	2·4	9·0
23	27·0	31·3	45·1	47·5	22·1	11·7	35·2	23·8	3·4	13·8	0·9	10·1	4·6	2·3	9·4	2·6
24	27·1	27·1	57·8	51·1	22·6	9·9	34·6	20·3	7·8	9·3	10·3	6·3	6·9	0·5	1·3	1·4
Mean ...	24·7	29·3	30·1	31·2	20·4	11·8	23·8	13·3	2·4	4·4	4·1	6·1	3·2	2·6	5·0	2·7
Hourly Range / Inequality Change.	10·2	6·7	7·4	5·1	6·5	4·5	4·8	4·9								

TABLE LXVIII.—Diurnal Variation from Squares of Hourly Ranges at Cape Denison.

Hour (G.M.T.) ending at	All Data available.				One Hourly Value omitted.			
	June.		September.		June.		September.	
	H.	V.	H.	V.	H.	V.	H.	V.
h.								
1	1,110	1,120	4,584	5,419	883	916	3,686	4,425
2	1,591	3,107	3,900	5,101	1,141	2,287	3,415	4,383
3	1,493	4,138	3,984	3,028	1,289	3,387	3,657	2,794
4	2,040	3,615	4,616	3,273	1,730	2,374	3,707	2,630
5	1,437	1,602	2,673	1,922	1,142	1,127	2,420	1,556
6	1,463	1,088	1,753	1,054	838	780	1,502	829
7	777	933	1,013	673	605	469	749	555
8	952	655	523	626	680	429	464	572
9	363	316	356	505	239	176	310	414
10	554	842	318	473	427	560	243	305
11	758	1,102	581	833	389	415	427	652
12	5,601	3,895	2,871	2,616	789	1,908	474	945
13	4,217	5,483	552	962	1,027	2,251	260	515
14	5,011	6,392	274	461	1,244	2,193	190	407
15	2,084	5,290	248	370	1,100	2,307	170	289
16	2,204	4,354	369	421	1,048	1,953	258	320
17	194	462	161	353	171	401	141	265
18	301	642	399	853	226	475	229	457
19	286	1,449	612	778	229	617	396	568
20	497	1,065	859	808	304	736	615	695
21	748	1,129	1,626	2,036	605	809	1,210	1,593
22	962	874	2,020	2,781	817	730	1,737	2,122
23	1,031	1,627	2,576	2,839	835	1,081	2,313	2,542
24	1,057	1,101	4,757	3,141	889	929	3,959	2,744

TABLE LXIX.—Diurnal Variation from Squares of Hourly Ranges at Cape Evans.

Hour (G.M.T.) ending at	All Data available.				One Hourly Value omitted.			
	June.		September.		June.		September.	
	N¹.	V.	N¹.	V.	N¹.	V.	N¹.	V.
h.								
1	642	73	1,117	311	523	67	876	275
2	924	117	1,092	193	665	105	1,001	169
3	1,395	825	897	160	613	175	696	148
4	1,194	365	1,470	238	1,024	246	796	122
5	763	273	766	148	566	200	656	132
6	680	420	496	140	593	327	455	109
7	585	280	350	156	460	182	275	92
8	1,093	1,283	522	170	755	503	395	97
9	580	614	661	154	431	327	538	95
10	630	358	887	144	472	211	453	113
11	662	260	931	140	359	173	714	72
12	639	132	1,204	261	481	90	873	133
13	947	188	1,028	185	715	137	542	133
14	1,013	301	510	189	543	195	373	166
15	1,657	565	943	231	367	235	487	146
16	808	378	1,229	230	646	250	495	162
17	502	294	680	99	435	167	505	90
18	644	132	848	161	556	115	678	142
19	393	95	624	274	354	83	513	227
20	297	128	1,041	637	243	89	692	541
21	416	144	1,085	878	328	127	722	781
22	601	216	1,056	877	446	187	771	753
23	725	217	1,951	737	565	142	1,243	617
24	742	131	1,979	500	618	113	1,108	465

CHAPTER IV.—AURORA AND MAGNETIC DISTURBANCE.

§ 26. The relation of magnetic disturbance to aurora has long been a subject of interest, and that interest has increased with the development of wireless and the advance of theories which suggest that a conducting layer in the upper atmosphere plays an important part in geophysics. A consideration which should be borne in mind is that ordinary magnetographs are not capable of showing changes of force of very short period. An ordinary magnetograph can show oscillations of force of considerable size if the period is a minute or more, but when the period is much reduced, the spot of light being of finite width, the successive to and from movements are not separated, and the result is a blur. Large irregular changes of force such as those produced by neighbouring electric railways set the magnets of an ordinary magnetograph swinging in their own period. To show changes of force which occupy only a fraction of a second or a few seconds calls for a different type of instrument, differently damped, and with a more open time scale. Now auroral displays when brilliant are usually by no means static phenomena, so far as the eye can judge. When we have in Sir Douglas Mawson's words "a vortex of colour and motion" crossing the zenith, changes are presumably in progress in the electromagnetic field which an ordinary magnetograph can show only very imperfectly, if at all. The eye itself is a very imperfect instrument for observing phenomena of very short duration, and there may be auroral phenomena, the true sequence of which the unaided eye is quite inadequate to disclose. When comparing visual auroral phenomena and corresponding magnetic records we are thus dealing with two sources of information, both of which are necessarily imperfect.

A further complication is that the visibility of aurora is largely determined by conditions which vary immensely from one occasion to another. Cloud, twilight and moonlight are all obstacles. The impression of brightness or faintness which an auroral display makes on the observer is largely a matter of contrast. The intelligent observer, no doubt, realises at the time that an aurora which he sees in twilight or bright moonlight must be of considerable natural brilliancy, and this probably influences his descriptive language. It is impossible for a stranger to make full allowance for the personal element in drawing conclusions from the language employed. But some kind of a scale of intensity seemed essential if any but the most superficial conclusions were to be drawn. Accordingly I went carefully through Sir Douglas Mawson's descriptions and assigned characters 0, 0·5, 1, 1·5 and 2, intended to represent gradations from a total absence of aurora to the most brilliant. The time employed in Sir Douglas' auroral records at Cape Denison is the local time, 9h. 31m. fast on Greenwich, but for comparison with the magnetic records for which Greenwich time had been used it appeared desirable to replace local time by Greenwich time. The auroral character of the hour (G.M.T.) was regarded as given by the highest character which had been assigned to any observation made during the 60 minutes in question. Records of no aurora taken under conditions when only the most brilliant aurora could have been detected were disregarded. There were many nights when the sky was largely or wholly covered by clouds, or obscured by drifting snow, and many hours of bright moonlight, and on such occasions ordinary faint aurora might have existed without detection. The absence of a record of aurora at times highly unfavourable to the detection of aurora is not satisfactory evidence that aurora did not exist.

§ 27. In assigning the auroral characters the magnetic curves were not consulted. The magnetic and auroral characters were indeed assigned by the same individual, but at entirely different times, and quite independently of one another.

Table LXX contains an analysis of the results, omitting March, 1912, and August, 1913, months for which only a few days' magnetic curves existed. It gives the number of times during each of twelve months when each auroral character 0, 0·5, 1, 1·5 or 2 was associated with the magnetic characters 0, 1 and 2. For example, during April, 1912, auroral character 1·0 was assigned to 27 hours. Of these eight had magnetic character 0, thirteen had character 1, and six had character 2. There must inevitably be much that is accidental in the figures assigned to a particular month in Table LXX, but anything that is clearly apparent in the final figures should possess a substantial physical basis. The percentage figures in the last line of the table show in the clearest possible way a large rise in the magnetic character as the auroral character rises from 0·5 to 2. But an equally significant fact is that the percentage figures for the two auroral categories 0 and 0·5 are absolutely identical. This implies that, so far as magnetic phenomena are concerned, there is no practical difference between the case when aurora is very faint and the case when no visual phenomenon can be detected. It is clear, however, that the absence of aurora does not necessarily imply the absence of magnetic disturbance, even during the hours most favourable for the detection of aurora. There are, as Table LXX shows, quite a considerable number of occasions when auroral characters 0 and 0·5 appear associated with magnetic character 2. They form it is true a much smaller proportion of the total number of cases in these two auroral categories than they do in the auroral categories 1·5 and 2, but their number absolutely considered is not insignificant.

At the other end of the scale, there are a good many instances when auroral character 1·5 appears associated with magnetic character 0. This was especially the case during July, 1913, and in that month there was even one association of magnetic character 0 and auroral character 2. This may suggest that the standard in vogue for magnetic characters during July, 1913, was higher than usual, but I do not think this was the case. The natural tendency is for the standard to fall rather than rise as magnetic conditions become quieter, and from all points of view July, 1913, was a very quiet month. The particular occasion when magnetic character 0 and auroral character 2 were associated was the hour ending at 17h. G.M.T. on July 26th. Magnetic character 0 was assigned to every hour from 11h. to 17h., and 1 to each of the subsequent hours of the day. As usual, in assigning the magnetic character, chief weight was given to the H and V traces. According to these, 17h. was the natural hour at which to draw the line between a more quiet and less quiet portion of the day. But if the D trace had been given most weight, the line would naturally have been drawn at 16h. and 17h. would have got a 1. This does not, however, really explain the phenomenon because up to 16h. 30m. even the D trace fully deserved magnetic character 0, while the note which led to auroral character 2 being assigned was that belonging to 27d. 1h. 38m. L.M.T. (*i.e.*, 26d. 16h. 7m. G.M.T.). It was as follows ; "A very bright band from the horizon in the N. to that in the E. by N. reaching altitude 6°. . ." In this case of course the aurora was low down and distant. The subsequent entries during the hour mention only faint aurora, and the auroral character 2 may not have been fully deserved. It may be added that magnetic character 1 was assigned on July 26, 1913, to each of the four hours 14h. to 17h. at Eskdalemuir, so the time of the brightest aurora at Cape Denison was at least not universally quiet.

It may be well to explain that the analysis embodied in Table LXX was completed before I saw the published volume "Records of the Aurora Polaris." It was based on an early proof confined to the auroral log, sent me by Sir Douglas Mawson. In his Table I, p. 144, Sir Douglas explains that in arriving at his percentages of the number of hours when aurora was seen out of the total number possible, he included "all hours of moderate twilight and darkness and including all moonlight hours." The percentage he arrived at, 52, is obviously lower than we should obtain from Table LXX if we supposed it to include all the hours when aurora might be seen. The difference arises apparently from my omitting a number of hours when there was very bright moonlight, or when the lower part of the sky—where aurora was most often seen—was obscured by cloud, haze or snow drift. It did not seem worth while to repeat the calculations as there was no reason to suppose that the hours I had accepted as of auroral character 0 were not magnetically a fair sample of the larger number accepted by Sir Douglas Mawson. The employment of G.M.T. instead of L.M.T. precluded in any case an exact agreement with Sir Douglas' figures.

§ 28. At a later stage, at the suggestion of Sir Douglas Mawson, a special investigation was made of auroral occurrences in the zenith. In all there were 180 (Greenwich) hours, which contained at least one observation of zenithal aurora, for which there were corresponding magnetic records. These 180 occurrences were distributed as follows :—

Hour ending (G.M.T.)	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.
Occurrences	3	3	4	1	2	4	2	6	3	2	5	11	24	32	40	30	8

There is thus a very conspicuous maximum of frequency in the hour ending 21h. G.M.T. ($6\frac{1}{2}$ h. L.M.T.), which is in good accordance with Sir Douglas Mawson's*

*Records of the Aurora Polaris, Part I, Vol. II, p. 168, of this Series.

conclusions. The great concentration of the occurrences between 18h. and 22h. G.M.T. is all the more striking because of the limitation of the night by daylight. May, June and July between them supplied 149 of the occurrences. Except in these months there was no practical possibility of seeing aurora after 21h. G.M.T.

The occurrence of magnetic characters during the 180 hours of zenithal aurora was as follows, the form of Table LXX being adopted :—

Auroral character	0·5			1·0			1·5			2·0		
Magnetic character	0	1	2	0	1	2	0	1	2	0	1	2
Total occurrences	8	5	2	39	59	10	10	29	8	0	2	8
As percentages	54	33	13	36	55	9	21	62	17	0	20	80

Comparing the percentage figures with those in the last line of Table LXX, we observe that the difference is not large, but that in each auroral class there is a smaller percentage of occurrences of magnetic character 0 when the aurora is in the zenith than when its altitude is lower. If we calculate the mean magnetic character for the several auroral classes we find—

Auroral character	0·5	1·0	1·5	2·0
Mean magnetic character for zenithal auroras ...	0·60	0·73	0·96	1·80
Mean magnetic character for all auroras	0·46	0·67	0·90	1·71

These figures also support the view that zenithal auroras have a slightly greater influence on the magnetic character than auroras of equal luminous intensity at lower altitudes. It should, however, be remembered that during the 180 hours considered, zenithal auroras were not the only ones, nor were they always the brightest ones. It may also be mentioned that aurora may have been in the zenith in an appreciable number of occasions not included. Occasions when the aurora was certainly near the zenith, but was not explicitly said to have reached the zenith, were disregarded.

§ 29. When compiling Table LXX the impression produced in my mind was that magnetic character 2 was surprisingly scarce. This led to the investigation on which Table LXXI is based. To explain it, take the case of April, 1912. Aurora was recorded at least once in 13 hours of the day, the last ending at 21h. G.M.T. and there was no occurrence during the remaining 11 hours of the day. Accepting the 13 hours as hours during which aurora could be seen, we should have 13 x 30 or 390 hours. Magnetic trace was, however, lacking for six of these. The 384 hours' trace available included 58 which obtained magnetic character 2. Of the 11 x 30 or 330 hours representing the time of day when daylight prevented aurora from being seen, 13 had no magnetic trace. The remaining 317 hours included 117 to which character 2 was awarded. For the whole day we have 384 + 317 or 701 hours of magnetic trace, of which 58 + 117 or 175 got character 2. If we take 100 to represent the chance which the average hour of the day had of getting magnetic character 2, the chance of obtaining a 2 possessed by an hour in the part of the day when aurora could be seen was 100 x (58/175) x (701/384), or 61; while the chance of obtaining a 2 possessed by an hour in the part of the day when aurora could not be seen was 100 x (117/175) x (701/317), or 148. The calculation is only a rough one, because the number of hours which daylight permitted aurora to be visible was naturally less at the beginning than at the end of April. Also there might have been towards the end of the month an hour of the day during which the absence of record meant the absence of aurora, and not the mere impossibility of seeing it. The difference, however, between the figures for the hours during which aurora could and could not be seen is in most months so large that the above mentioned limitations hardly matter.

The only months in which the hours during which aurora could be seen were at all as disturbed as the daylight hours were the last three, May to July, 1913. These months showed an enormous fall in the number of disturbed hours as compared with the corresponding months of 1912, and this fall was less conspicuous in the night than in the day hours. In June and July, 1913, the total number of hours of magnetic character 2 was so small that much weight cannot be assigned to the percentage figures.

Taking the whole twelve months included in Table LXXI, we see that the expectation that a particular hour of the day will be of magnetic character 2 was nearly 2·7 times as great for a day hour, when aurora could not be seen, as for a night hour.

1913 was everywhere an exceptionally quiet year, and 1912 though much quieter than the average year, may at least be regarded as the more normal year. If we confine ourselves to the seven months of 1912 in Table LXXI, the final percentages are altered only from 58 and 154 to 60 and 152 respectively. The difference between day and night magnetic disturbance in the Antarctic *may* of course be much reduced in a highly disturbed year near sunspot maximum, but so far as 1912 and 1913 were concerned the difference was least in the quietest months.

The results we have reached may seem at first sight paradoxical. Bright aurora is intimately associated with magnetic disturbance, and yet the hours during which aurora is seen are the quietest of the 24.

In considering the phenomena, the first question that presents itself is whether there is any essential difference between magnetic disturbance associated with visible aurora and magnetic disturbance not so associated. As Table LXX shows magnetic disturbance at night is in a good many cases unaccompanied by visible aurora, and it is conceivable that the mechanism of production of these disturbances and of the disturbances experienced in daylight hours is different from that of the disturbances accompanied by aurora. On the other hand, if we take the ordinary magnetic storm, as recorded in Europe, we have the storm simultaneously in progress at stations in the south, where no aurora is or ever could be seen, and at stations in the north where aurora is brilliant. In the case of the vertical force the type of disturbance at a European station does seem to depend to a considerable extent on the time of day, but we cannot from the type of the disturbance in the D and H traces infer what the hour of the day is. It is true that when bright aurora is reported at a British station the magnetic traces at the time are usually exceptionally oscillatory, and such rapid oscillations are usually confined to the night hours. But then in Britain the daylight hours are the normally quiet ones.

In the Antarctic, on the other hand, it is the daylight hours that are normally the disturbed ones, and while some of the most brilliant aurora were unquestionably accompanied by magnetic disturbance of an extremely oscillatory character, highly oscillatory conditions were also experienced in several hours near local noon.

If we regarded disturbances accompanied by aurora at Cape Denison as of a special type, then the other type of disturbance including all unaccompanied by aurora would have an extraordinarily pronounced diurnal variation, with a very low minimum at night.

Everything considered, it seems most reasonable to suppose that the presence or absence of aurora makes no fundamental difference to magnetic disturbance, and that the presence of daylight alone prevented aurora from being visible during many of the daylight hours when active magnetic disturbance prevailed. Possibly the existence of a distinctive spectrum may lead to some method of ascertaining the presence of aurora during daylight, and in that event we hope to reach more definite conclusions.

§ 30. While there is a marked tendency, as Table LXX shows, and as will appear more clearly presently, for brilliant aurora to be associated with active magnetic disturbance, there is no *close* relation between the apparent intensity of the two phenomena.

The question is, however, a very complicated one for various reasons. In the first place the apparent brightness of the aurora is largely dependent on the meteorological condition, on the age of the moon, and on the hour of the day. An aurora may be bright over the greater part of the sky, or over only a small part. The brightness may be altering slowly or rapidly with time. The aurora may appear stationary, or in rapid motion. Its distance may be less than 100 km. or more than 1,000 km. There are often visible at the same time auroras of different forms, in different directions. In the ordinary slow-run magnetogram it is hardly possible to associate any individual magnetic change with any individual auroral phenomenon. The magnetic changes which are clearly recorded are of comparatively slow development. When, as sometimes happened during aurora, there were rapid oscillations, the traces were apt to be faint and to intercross, and the means did not exist of fixing the times of turning points with any high precision. Hour lines had been drawn in pencil, obviously with much care, but it could not safely be assumed that the traces of the three elements were absolutely devoid of parallax. Again, there being no auroragram, the exact nature of the changes taking place in the aurora near the specified times of observation was in general unknown. Times of maximum brightness were usually problematical. Thus it was quite impossible to say whether magnetic disturbance and auroral intensity were waxing and waning together.

As a preliminary, the best course seemed to be to take out from the auroral log the hours in which aurora was most prominent, and to make a detailed examination of the magnetic curves during these hours. Table LXXII contains the results of this examination. It includes all Greenwich hours, for which magnetic traces existed, during which one or more auroral observations had been adjudged to merit character 2·0 or 1·5. Sometimes, as it happened, more than one observation within the hour had been deemed of character 1·5 or 2·0, but in such cases only one auroral occurrence is chronicled in the table. Speaking generally, preference was given to that occurrence which seemed to constitute the most intense aurora, but sometimes the selection was determined by the greater explicitness of the information conveyed. The local times employed in the auroral volume are reproduced as printed. The corresponding Greenwich times are also given, and it should be noticed that the local and Greenwich days often differ. Also auroras occurring on what following local time is the first day of a month, may when Greenwich time is used belong to the previous month.

The letters g, l, p, r, y in the column headed colour stand respectively for green, lilac, pink, red and yellow. In the column headed type the letters A, B, C, G, P, S stand respectively for arc, band, curtain, glow, patch, and streamer. More than one type was often present, and not infrequently several specimens of the same type were simultaneously visible. Streamers and glows when seemingly of trifling importance are sometimes omitted from the table. The entry under Alt(itude) usually gives the greatest height above the horizon attained by any species of aurora at the time of observation. But sometimes when the highest aurora was clearly of minor intensity, the entry refers to the brightest aurora present. Preference was also given to the more stable and substantial forms, such as arcs and curtains, as compared with patches and streamers. Aurora usually extended over a considerable area of the heavens. The entry under dir(ection) is intended to give roughly the azimuth of the centre of the auroral area. For example, N. appears if the aurora is given as extending from N.W. to N.E. or from W.N.W. to E.N.E. In many cases no doubt the observer, if fixing on the centre or greatest concentration of aurora at the time, would have judged somewhat differently. No direction is specified when aurora was in the zenith, though of course in such cases there may be much more aurora in one sector of the heavens than another. The general results as to direction in Table LV are in full accordance with Sir Douglas Mawson's conclusions.* "A very small proportion of the demonstrations

* Records of the Aurora Polaris, p. 167.

ever appeared in the southern sky. The most frequent sector is between N.W. and N.E. and more abundantly between N. and N.E. than between N. and N.W."

Of the five columns devoted to the times of turning points the first two give the (Greenwich) day and hour, the last three the minutes as applying to D, H and V respectively. There were always several turning points, often quite a large number, within the hour, but as a rule only the most prominent one for the element concerned is recorded. Sometimes, however, two turning points are given when both were of special prominence. For example, on June 9th, 1912, turning points for H are entered at 12 h. 15m. and at 12h. 20m. These represented the absolute minimum and maximum of the day, the range 311γ for the day arising from a change which occupied only five minutes. Sometimes a turning point is entered when the magnetic conditions are described as quiet. In such a case it represents what was a maximum or minimum for a period usually of an hour or more. When no entry is made in any of the three "minute" columns, it means that none of the visible turning points seemed of special prominence or significance. The letter E attached to the time of a turning point in D implies that it was a maximum of easterly (or minimum of westerly) declination; the letter W implies the opposite. The sign + attached to a turning point in H or V signifies that the element at this time went through a maximum value. The sign — similarly signifies a minimum value. For example, on May 16, 1912, between 8h. and 9h. Greenwich time D attained an easterly maximum at 8h. 30m., while H and V each passed through a minimum value at 8h. 40m.

The entry in the column headed h in Table LXXII it should be noticed is the hour at which the 60 minutes to which the ranges apply *begin*. For example, on May 16, 1912, the ranges3 1γ (or 34′·2) in D, 22γ in H and 22γ in V belong to the hour commencing at 8h. G.M.T. Ranges are given to 1γ, but this degree of accuracy can hardly be claimed, especially in the case of V, where the trace was not infrequently somewhat indifferent. Any uncertainty attaching to the scale values given in Vol. I, Part I, pp. 66, 71, 72 and 74, applies of course to the ranges in Table LXXII, but uncertainties of base values do not come in, as the ranges were all calculated from differences of ordinates.

The description of the curve characteristics is necessarily very slight. The entry "Bay EW" means that during the hour in question the most prominent change in D was a movement to the east, followed by a returning movement to the west. "Bay + —" in the case of either H or V means that the most prominent phenomenon was a rise followed by a fall. "Bay WE" and "Bay — +" signify the exact opposite, the westerly movement in D and the fall in H or V now coming first. During these *bay* movements shorter period oscillations nearly always occurred, but their existence is not mentioned explicitly, unless they were more prominent than usual. So-called *oscillations* lasted only a few minutes, while the to and fro movements described as bays usually took at least half an hour, sometimes a couple of hours. To and fro movements intermediate in length between oscillations and bays are sometimes described as *undulations*, more especially when successive members of the series are of similar length and amplitude. In many cases during aurora the magnetic curves presented no unusual features, exhibiting the usual succession of minor irregular oscillations. The term applied in such cases is "*irregular*." But sometimes along with the short period oscillations there was a conspicuous general drift in one direction. In such cases the direction of the change is indicated, whether an easterly or a westerly movement in D, or a rise or fall in the force. In many cases the propriety of the description bay E–W or bay + — is beyond any question. We have, for instance, following a quiet time a movement setting in simultaneously or nearly so in the three elements, and persisting in one general direction for a considerable time. The rate of change gradually reduces to zero, a recovery sets in, the element returns to nearly its original value and becomes nearly stationary. In other cases, however, the accuracy of the description is more open to doubt. What one man takes as the E movement in an E–W bay another might accept as the E movement in and earlier W–E bay. A good many cases of this kind have been described a "irregular." A more detailed account of one or two of the earlier occurrences in Table LXXII may help to make things clearer.

On March 24, 1912, there was a D turning point (westerly extreme) about 10h. 55m. G.M.T. Between 10h. 55m. and the easterly extreme at 11h. 10m. mentioned in the table there was a movement of about 14′ (13γ) to the east. This was interrupted by some six small short period oscillations. Between 11h. 10m. and 11h. 46m. there was an aggregate movement of 13′ (12 γ) to the west, interrupted by some 15 small short period oscillations. The portion of curve between 10h. 55m. and 11h. 46m. comprises the bay E–W assigned in Table LXXII to the hour 11h. to 12h. Between 11h. 46m. and 12h. 5m. (the E turning point mentioned in the table) there was a smart movement of 30′ (27 γ) to the east, interrupted by some nine minor oscillations. The return movement to the west, including some nineteen small oscillations, was mostly concluded by 12h. 46m., and the second bay E–W which is assigned in Table LXXII to the hour 12h. to 13h. may be regarded as extending from 11h. 46m. to 12h. 46m. But the general movement to the west was resumed at a slower rate after 12h. 46m., and the position existing at 11h. 46m. was not recovered until 13h. 30m. Thus opinions might differ as to when the second bay ended. During the two hours in question the H trace shows a number of tiny oscillations and there is even a slight general concavity (maximum of force) centering about 12h. 0m., but this seems too indefinite to be described as a bay + —. Between 13h. and 14h. on March 24, more than 30 small oscillations varying in character can be detected in the D curve. These were superposed on a general drift to the west, which continued until nearly 15h. The turning point assigned at 13h. 45m. in the table was the result of a larger than usual swing to the west, immediately reversed, which supplied the most westerly reading between 12h. and 14h. 25m.

Take again March 29, 1912. Here there was an exceedingly prominent bay W–E in D, the turning point (W) at 15h. 55m. G.M.T. being the westerly extreme for the day. There were synchronously prominent bays, each + —, in H and V The turning points at 15h. 55m. in H and 16h. 10m. in V—which represent the maxima for the day—differed a little in time, but the curves are rounded, and small oscillations determined the exact times of the maxima. Opinions might differ as to exactly when the bay movement began or ended in any one of the elements, but the existence of a bay movement, of an outstanding character as compared with the movements in adjacent hours, is patent to the eye. In this case the one bay movement was common to the two successive hours 15h. to 16h. and 16h. to 17h. Also while there were as usual numerous short period oscillations, these were of trifling amplitude in the case of H and V, and even in the case of D. doubt was felt as to whether special mention of their existence was called for.

There are eleven hours in Table LXXII for which there is no auroral entry, for example 11h. to 12h. on April 27, 1912. The auroral observation leading to the inclusion of 10h. to 11h. in the table occurred at 10h. 59m., and there was every reason to suppose that the aurora continued bright during the earlier part of the subsequent hour. In this and all the other similar cases, the magnetic character of the curves showed that the hour was clearly associated with an immediately preceding or succeeding hour to which auroral character 1·5 or 2·0 had been assigned.

During some of the principal auroras the most outstanding magnetic phenomenon is undoubtedly the size and number of the short period oscillations, especially in D and H. Examples are afforded by June 8, June 9 and July 6, 1912. Usually a bay movement is also recognisable on these occasions, especially in the V curve. When bay movements occurred simultaneously in the three elements the most usual type was EW in D, and + — in H and V. Some of the best marked and most regular bay movements were of comparative small amplitude, and on such occasions two bay movements sometimes occurred in close or immediate sequence. One of the two bays might be of very small amplitude, and visible only because the subsequent or preceding portion of curve was exceptionally quiet.

§ 31. In all, 250 hours are included in Table LXXII. The earliest ended at 7h., the latest at 23h. G.M.T., and the number of occurrences in the successive Greenwich hours were as follows:—1, 6, 10, 11, 19, 25, 38, 37, 19, 19, 7, 7, 10, 12, 20, 7, 2. The two hours ending respectively at 13h. and at 14h. G.M.T. supplied practically equal numbers, 38 and 37, of occurrences. Thus the time of the greatest frequency may be put at 13h. G.M.T., *i.e.*, 22½h. L.M.T., and another maximum appears during the hour ending at 21h., say 20½h. G.M.T., or 6h. L.M.T. This seems in general agreement with the results obtained by Sir Douglas Mawson* from all his auroral observations. It is true that he makes the morning maximum of frequency at 6h. or 7h. L.M.T. the principal one, but that is when allowance is made for the impossibility of seeing aurora at these hours except near mid-winter. Sir Douglas' remarks "Our experience at

* Records of the Aurora Polaris, p. 166.

Cape Denison very conclusively indicated that the daily period of apparently most intense auroræ was between 9 p.m. and 11·30 p.m. (*i.e*, between $11\frac{1}{2}$h. and 14h. G.M.T.)" fits in exactly with the results embodied in Table LXXII. These results also throw an interesting light on the data arrived at in Tables XLVII and XLIX for the diurnal variation of magnetic disturbance at Cape Denison. Taking the whole fifteen months available, it was found that whether the mean magnetic character or the frequency of occurrence of character 2 was accepted as the criterion of magnetic disturbance, there was a principal maximum in the hour ending at 2h. G.M.T., and a secondary maximum in the hour ending at 14h. G.M.T. It would appear that this secondary maximum of magnetic disturbance is intimately associated with the maximum in the frequency of bright aurora which occurs at practically the same hour.

The fact that Sir Douglas found, when allowance was made for the influence of twilight, that the frequency of aurora went on increasing from a minimum at 2h. L.M.T. ($16\frac{1}{2}$h. G.M.T.) right up to the time when daylight intervened, is also very suggestive in view of the fact that the all month results in Tables XLVII and XLIX give minima of magnetic disturbance in the hour ending at 17h. G.M.T., and a continual increase thereafter up to the maximum in the hour ending at 2h. G.M.T. (or $11\frac{1}{2}$h. L.M.T.). This is at least in harmony with the view that the phenomena which appear as aurora when the absence of other light permits, continue (whether visible or invisible) throughout the twenty-four hours, and attain at Cape Denison a maximum near local noon.

Of the 250 hours included in Table LXXII, there were only 227 for which the record was complete for all three magnetic elements. The distribution of these 227 hours throughout the (Greenwich) day, and the corresponding mean values calculated for the hourly ranges appear in the earlier columns of Table LXXIII. Mean results are given for the two years separately, as well as for the two combined. Excluding the first and last hours, for which the number of occurrences was insufficient, the ranges obtained for D show little dependence on the hour of the day. In the case of H and V the ranges tend to be larger in the five hours ending at 16h. G.M.T. than at other times. The mean V. range is the largest in both years, but its excess over the mean D and H ranges is not large. For the two years combined, the mean D range is a shade less than the mean H range. In the case of the absolute daily range—as appears from Tables XLV and XLVI of Vol. I, Series B, p. 266–V supplied as here the largest mean value, and relatively considered the excess of the V daily range over the D daily range was fairly similar to that seen in Table LXXIII. But the mean absolute daily range in D exceeded that in H. There was, however, a tendency in the absolute H range to increase in relative importance as disturbance increased.

A remarkable feature in the results from hours of bright aurora in Table LXXIII is the relatively small size of the mean hourly ranges for 1913 as compared with those for 1912. The reduction is relatively much greater than in the case of the all day daily ranges. It is due partly to the absence during the auroral displays of 1913 of any magnetic disturbance approaching several associated with auroral displays during June and July, 1912, and partly to the large number of cases during 1913 when magnetic conditions at times of aurora were quiet rather than disturbed.

The last eight columns of Table LXXIII deal specially with June and September, 1912, the only two months for which measurements had been made of hourly ranges on all days. Of the 140 hours of bright aurora during 1912, June contributed 39 and September 19. The columns headed "aurora" give the mean ranges derived from these thirty-nine or nineteen hours. The numbers of occasions for which the respective hourly means were obtained are given enclosed in brackets. For example, the value for the mean range of H for the hour 12—13h. in June was a mean derived from seven days. The columns headed "all" give for comparison the mean ranges derived from all days of the month.

The values given at the foot of the columns headed "aurora" are obtained from the aggregate of the ranges on all the hours of bright aurora divided by the number, 39 or 19, of these hours. The values at the foot of the columns headed "all" are analogous quantities derived from the all day ranges. For example, the mean value 26γ for H in June is derived from $(18 \times 1 + 30 \times 4 + 33 \times 7 + \ldots\ldots) \div 39$.

It will be seen that while the range during an hour of bright aurora was not invariably in excess of the average from all days of the month, the exceptions to the rule were few, and on the average occasion of bright aurora the range was more than the mean from all days.

The mean hourly ranges derived from the 58 hours composed of the 39 June and 19 September hours of bright aurora are respectively 50 γ for H and 67 γ for V. The former is almost identical with and the latter not very largely in excess of the means derived from all the hours of bright aurora during 1912. It thus seems reasonable to suppose that the conclusions derived from June and September are fairly applicable to 1912 as a whole.

§ 32. As already mentioned, the assignment of auroral characters, and so the choice of hours included in Table LXXIII, was made before the publication of the volume "Records of the Aurora Polaris." When it appeared it contained on p. 149 a list drawn up by Sir Douglas Mawson of the cases when "special colour was noted." The great majority of the hours thus indicated had been included in Table LXXIII, but in view of their special selection by Sir Douglas Mawson it appeared desirable to discuss them individually in more detail, and that accordingly has been done. The magnetic curves had been gone through anterior to any of my work on the aurora, and a list had been made of short period disturbances for comparison with corresponding disturbances at Cape Evans or Eskdalemuir. The list so formed included a considerable number of the occasions on Sir Douglas' list. In cases where a detailed comparison is intended with Cape Evans and Eskdalemuir, the data now given are less exhaustive than would otherwise have been the case. It is hoped to reproduce some of the portions of magnetic trace concerned in a subsequent volume.

May 5, 1912, 21·30 (11*h*. 59*m*. *G.M.T.*).—The last previous observation recorded at which aurora was observed, occurred 3½ hours earlier, so it is uncertain how suddenly the aurora developed. The note at 21·30 is "Clear sky. Bright moonlight . . . A bright aurora in progress. A contorted curtain about 45° up . . ." The colours observed were green, yellow and pink. The subsequent notes were "21·35. The curtain has now risen to 60° up . . ." "21·40 It has now faded . . ." 22·45 and 24·00 "No aurora visible." The auroral characters awarded were 2·0 for the hours 12h. and 13h., and 0·0 for 14h. and 15h. G.M.T.

We have here to do apparently with a very intense aurora, which did not, however, reach the zenith, and which was of comparatively short duration.

In this instance what the magnetic curves show is a fairly isolated disturbance commencing sharply in both D and V at about 11h. 15m. The H magnet was sticking at the time. The initial movements, to the east in D and increase in V, were very large and rapid. They were followed by rapid oscillations of considerable size, especially in D, the oscillations being most noteworthy between 11h. 30m. and 12h. 10m. The oscillations about 11h. 50m. brought back D beyond its original position, and what the D trace shows is a sort of double bay with the magnet finally pointing a good deal to the west of its original position. The V trace shows a single deep bay, the recovery not being quite complete. This was one of the short storms common to Cape Denison and Cape Evans. The storm was one of those dealt with in the volume devoted to the Cape Evans observations. The Cape Evans curves are reproduced in Plate XXXVIIIA of that volume, which includes the five hours ending at 13h. on May 5.

Magnetic character 2 was assigned to only two hours 12h. and 13h., the same as got auroral character 2, but character 1 was assigned from 8h. to 11h. and from 14h. to 19h. Thus it was not a case of a highly disturbed time occurring in an otherwise absolutely quiet time, but of a period much more highly disturbed than adjacent periods, and exhibiting disturbance of a special type. The conclusion of the special disturbance is not so clearly marked as its commencement, but there was no striking movement after 12h. 30m. and the bay in V ended about 13h.

Our positive information as to the presence of aurora is limited to the ten minutes 11h. 59m. to 12h. 9m. G.M.T., which includes only the end of the period during which magnetic oscillations were prominent. We also knew that aurora had ceased to be visible by 13h. 14m.

May 12, 1912, 17·00 (7*h.* 29*m.* *G.M.T.*).—The earliest auroral note on this evening is "16·45. The sky is now dark enough to discern several of the brighter stars. An auroral glow is just visible in the N.E. and is rapidly spreading." The note at 17·00 is "A fine display is in progress, extending . . . to a height of about 20°," and a reference is made to red colour in the lower border of the principal curtain. The only further auroral note for several hours is "18·00 (8h. 29m. G.M.T.) The nebulous arch still continues, but is gradually fading."

The auroral characters awarded were 2·0 for 8h., and 1·0 for 9h.

Aurora was noted again at 21·45 (12h. 14m. G.M.T.), but we have here to do apparently with an isolated display, which was brilliant for an hour or so.

May 12th was a day of considerable and prolonged magnetic disturbance. In all, fifteen hours including 1h. to 9h. were awarded character 2. The day was also highly disturbed at Cape Evans, and the Cape Evans' curves for the first fourteen and the last three hours of the day are reproduced in Plate XLI of the volume devoted to that station. Two intervals, 7h. to 9h. and 11h. to 12h., contain comparatively isolated disturbances, and are included amongst those for which comparative Cape Denison and Cape Evans data will be given. The first of the two intervals includes amongst those for which comparative Cape Denison and Cape Evans data will be given. The first of the two intervals includes the time of the brilliant aurora. The aurora was first seen during twilight, and but for the twilight it might possibly have been seen earlier than 7h. 14m. G.M.T. The D trace was the most disturbed. It shows a deep bay, the turning point in which at 7h. 35m. supplied the extreme easterly reading of the day. The commencement of the bay might be put at 7h. or earlier, but the most striking part of it was a sharp easterly movement commencing about 7h. 25m. and including the time when the most brilliant aurora was recorded. After the easterly extreme, there was a large nearby continuous movement to the west, the most rapid portion of which ended before 8h. 15m. During the time covered by the bay in the D curve there was also a bay in the V curve, commencing at about 7h. 15m. and going on until about 9h., though the end is rather indefinite. There was also disturbance in H., but it was of a less regular kind, and was no larger than during adjacent hours. The disturbance was not one which made any great appeal to the eye, and was in no way remarkable for short period oscillations.

May 15, 1912, 20·45 (11*h.* 14*m*, *G.M.T.*).—The latest previous auroral note stated that the sky was obscured until 20h. The note at 20·45 runs: "A bright nebulous band 30° up . . . at the E, extremity was a strongly coloured green, yellow and red streamer." Aurora of various intensities mostly faint is noted at intervals up to 23·00 (13h. 29m. G.M.T.), after which no aurora was seen for some hours. In this case we have an aurora lasting for more than two hours, but after the first hour it does not seem to have been at all bright. The auroral characters awarded were 1·5 for 12h, and 13h., and 0·5 for 14h. The magnetic characters were 0 for 10h.

2 for 11h. and 12h., and 1 for 13h. and 14h. The D trace has rather a well marked bay (easterly deflection) commencing about 10h. and the interval 10h. to 12h. was one of those selected for comparison of Cape Denison and Cape Evans. The disturbance in H and V seemed rather to lag after that in D; and resembled rather two short bays than one long one. All the traces showed active oscillations, though of no great size about 11h. and a little before 11h. 30m. The times when the brightest aurora was noted were 11h. 14m. and 11h. 31m. Though decidedly reduced after 12h., magnetic disturbance remained fairly active until 13h.

The magnetic disturbance on this occasion, though not very large, is fairly distinctive, and its most active time, if not identical with the time of the brightest aurora, made at least a close approach to it.

June 3, 1912, 21·40 (*12h. 9m. G.M.T.*).—It is noted that at 18·00 the sky was clear, but no aurora was visible. The next note at 21·30 is to the effect that an arch was visible in bright moonlight. The note at 21·40 states, "The arch has slowly extended to the W., and is very bright and shows a red lower border and a greenish tint above." The note at 22·00 is to the effect that the display had faded very much, and no aurora was visible at 22·10 or 22·30. A slight revival occurred at 22·45 (13h. 14m. G.M.T.) and 23·30 (13h. 59m. G.M.T.). The auroral characters awarded were 1·5 for 12h., 2·0 for 13h. and 1·0 for 14h. Every hour subsequent to 8h. was awarded magnetic character 1, but the disturbance was of a very third-rate character, and there was nothing exceptional between 12h. and 13h.

June 8, 1912, 22·55 (*13h. 24m. G.M.T.*) *et seq.*—Aurora of minor brightness was noted at 20h. 35m. (11h. 4m.) and 22h. 40m. (13h. 9m. G.M.T.). The note at 22·55 runs, "A very brilliant aurora . . . . Two strongly defined curtains overhead . . . These wax and wane rapidly . . . The luminescence ripples along the curtains." The display seems to have been at its maximum from 22·55 to 23·10 (13h. 39m. G.M.T.). "The brightest colour effects happened between 23h. and 23h. 5m., when bright rose-pink and red appeared below the usual greenish-yellow of the curtain, and emerald to peacock green above." The curtain reached the zenith during this time. Aurora of considerable though smaller brightness is noted as appearing in or near the zenith at 23·12, 23·25 and 23·40 (14h. 9m. G.M.T.), and at lower altitudes at various times up to 00·40 (15h. 9m. G.M.T.). No aurora was seen at 00·50. There was a faint revival of it at 1·00 and 1·15 (15h. 44m. G.M.T.), but that was its last appearance. The auroral characters awarded were 1·0 for 12h., 2·0 for 14h., and 1·5 for 15h. and 16h. Magnetic character 1 was awarded to 12h., but with that exception every hour up to 16h. got a 2. The day was thus generally disturbed, but the disturbance between 12h. 30m. and 14h. 30m. G.M.T. was quite outstanding. This was one of the intervals selected for the comparison of Cape Denison and Cape Evans. The D, H, and V traces were all in the highest degree oscillatory from about 13h. 20m. to 14h. G.M.T. This includes the time when the most striking colour effects were seen.

This auroral display is particularised by Sir Douglas Mawson as one of the most outstanding displays observed. At its climax it "was a remarkable exhibition of intense auroral activity and of colour." On the magnetic side we have one of the most outstanding exhibitions of large rapid oscillations, and the range in H and still more in V, was very large.

The Cape Evans curves for the whole of June 8th, and the first five hours of June 9th, are reproduced in Plate LIII of the volume dealing with that station.

June 9, 1912, 22·48 (13*h.* 17*m.* *G.M.T.*).—Aurora was observed at the earliest observation of the evening 17·00 (7h. 29m. G.M.T.) and at every subsequent observation with one exception. At 22·25 (12h. 54m. G.M.T.) it was very bright. It was fainter at 22·40, but was brighter again at 22·44. The note at 22·48 is, "A small amount of colour appears . . . and the aurora has brightened generally." A band reached the zenith at 23·00 (13h. 29m. G.M.T.). Aurora of varying brightness was recorded at intervals until 02·35 (17h. 4m.). After an hour or more's absence, it was again visible, but very faint. The auroral characters awarded were 1·0 from 8h. to 11h., 2·0 for 13h. and 14h., 1·5 for 15h., 1·0 for 16h. and 0·5 for 17h. and 18h.

With the exception of 7h., 9h., 11h. and 17h., which got 1, all the hours were of magnetic character 2. There was active disturbance ar Cape Denison the whole day subsequent to 11h. 40m., with comparatively quiet intervals from 14h. 0m. to 14h. 30m. and from 16h. to 17h. There were specially oscillatory times from 12h. 0m. to 12h. 45m., and from 14h. 50m. to 15h. 40m. The only auroral observation during the first of the intervals was at 21·45 (12h. 14m. G.M.T.). The remark made is merely "Ditto," implying that the conditions were similar to those observed 1¾ hours earlier, when there was a nebulous band only 5° up. At the time of the next observation 22·25 (12h. 54m.), when aurora was described as very bright, magnetic disturbance though active was much less active than it had been shortly before. As regards the second interval, 14h. 50m. to 15h. 40m., when rapid magnetic oscillations were particularly in evidence, there are notes of aurora at 00·20 (14h. 49m.), 00·40 (15h. 9m.), 00·55 (15h. 24m.) and 01·10 (15h. 49m. G.M.T.). On the first of these four occasions the note runs, "The aurora has increased in brilliancy. An arch 15° up . . ." On the last three of the occasions it was less bright. The fact that magnetic disturbance was much more prominent during these two times of moderate aurora than during the time of its greatest brilliancy is evidenced by the fact that the times which had been selected for the comparison of Cape Evans included only the two intervals 11h., 30m. to 13h. 0m., and 14h. 30m. to 16h. 0m. On this occasion, as a matter of fact, the disturbance at Cape Evans was comparatively trifling.

Whilst the magnetic disturbance synchronises with the brightest aurora was considerably smaller than during either of the two intervals mentioned above, it would not have failed to attract special attention if it had occurred on an otherwise quiet day. In V there was a pretty regular bay + — (or increase followed by decrease) lasting from about 13h. 10m. to 14h. 0m., which may be regarded as including the whole period of the brightest aurora. The V trace during this time was in no way specially oscillatory. In H there was a sharp bay — + from about 13h. 17m. to 14h. 14m., and short period oscillations were more in evidence than in V. The movements in D included an extreme westerly turning point about 13h. 25m. and an extreme easterly turning point at about 13h. 36m. The ranges included in the movements between 13h. 10m. and 14h. 0m. were 68 γ in D, 128 γ in H, and 136 γ in V.

June 10, 1912, 23·05 (13*h.* 34*m. G.M.T.*) *et seq.*—No aurora was visible at 21·15 or 21·45 (12h. 14m. G.M.T.), but the lower sky was then obscured by snow drift. Low arches were observed at 22·07 (12h. 36m. G.M.T.), 22·15 and 22·30. The first intimation of prominent aurora is "23·04 (13h. 33m. G.M.T.). A bright arch 35° up." The following note is attached to the interval 23·05 to 23·20 (13h. 34m. to 13h. 49m. G.M.T.) :—"At 23h. 5½m. the aurora burst out forming a great broad mass 40° up. . . The colouration on the upper portion was bright green, shading off below into rose pink and red. The colour effect is the greatest yet noted at Cape Denison . . . Color effects repeatedly appeared until 23h. 10m. . . . The phenomenon gradually waned." Brightening of the display was noted at 23·30 (13h. 59m. G.M.T.), 23·32 and 23·35. Aurora apparently of considerable strength was noted at 23·43 (14h. 12m. G.M.T.) and 24·00 (14h. 29m. G.M.T.). It then became fainter, and was even invisible at 01·25 (15h. 54m. G.M.T.). Later it revived, was bright in the zenith at 04·10 (18h. 39m. G.M.T.), and continued to be visible until 07·30 (21h. 59m. G.M.T.). Aurora was thus present almost continuously during nearly the whole night. The auroral characters awarded were 2·0 for 14h. and 15h., 1·5 for 13h., 18h, 19h, and 21h., 1·0 for 16h., 20h. and 22h.

Magnetic character 2 was assigned to every hour from 13h. to 24h., with the exception of 17h., which got a 1. The latter was an hour in which no aurora was seen.

The earliest disturbance that makes an appeal to the eye is a bay, E.W. in D, + — in H and V, lasting from about 12h. 15m. to 13h. 20m. This is remarkable chiefly for the resemblance between the traces from the three elements, which remained closely in phase.

As will appear later, resemblance between the H and V traces was often close, but on this occasion the resemblance extends to the D trace. During the time of the bay the ranges were D 30γ, h. 47γ, V 83γ. Rapid oscillations, though of no great size, were present from 12h. 30m. to 12h. 50m. This includes a time, 12h. 44m., when a bright, though low, auroral arch was observed.

The next movement which appeals to the eye is a sharp bay, — +, in the H trace, lasting from about 13h. 35m. to 13h. 55m. The movement which produced practically the total fall in H, 86γ, took only two or three minutes, and occurred during the time when the aurora was at its brightest. During the time of this bay in H, short period oscillations, though not of any great amplitude, were prominent in the traces of all three elements, but the H trace was the only one showing any marked individuality.

Disturbance remained active but of a somewhat nondescript character. An idea of its activity can be derived from two hourly ranges which were as follows, the auroral characters being added for purposes of comparison :—

Hour ending at—	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	24h.
	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
Hourly range D	25	50	39	76	35	120	117	94	47	41	102	38
Hourly range H	46	101	47	40	29	42	44	54	46	47	83	51
Hourly range V	83	109	51	83	47	74	160	85	102	29	120	31
Auroral character ...	1·5	2·0	2·0	1·0	...	1·5	1·5	1·0	1·5	1·0	0·0	...

It will be observed that the ranges within the hours bear little relation to the auroral character figures. No aurora was observed within the hour ending at 23h., but the ranges it supplied are amongst the largest.

June 30, 1912, 20·52 (11*h.* 21*m.* *G.M.T.*).—Bright moonlight prevailed on this occasion, which probably explains the restrained nature of the language descriptive of the aurora. The earliest note of aurora was at 20·08 (10h. 37m. G.M.T.) when a faint nebulous arch was 5° up. This was observed to be brighter at 20·47 and at 20·50. The note at 20·52 is "Arch much brighter and more active. The lower border is of a reddish tint." Aurora, which one would suppose from the language employed to have been only moderately bright, was observed up to altitude of 14° or 15° at 21·05 (11h. 34m. G.M.T.) and 21·20 (11h. 49m. G.M.T.). Faint aurora was observed at 21·35 (12h. 4m. G.M.T.) and a "medium bright" arc up to 9° at 22·03 (12h. 32m.) and 22·20 (12h. 49m. G.M.T.). No aurora was seen after this, but there was bright moonlight. The auroral characters assigned were 1·0 for 11h., and 1·5 for 12h. and 13h. The magnetic characters were 1 for 11h. and 13h., and 2 for 12h.

There was a fair amount of magnetic disturbance from 9h. 30m. to 12h. 0m., but it was of rather a nondescript character, no two elements being at all in phase. In D. there were three distinct but not deep bays all E.W. with westerly extremes at about 9h. 40m., 10h. 18m., 11h. 12m. and 12h. 3m., and easterly extremes at about 9h. 55m., 10h. 38m. and 11h. 28m. H fell from 9h. 45m. to 10h. 10m., rose from 10h. 10m. to 10h. 22m., fell from 10h. 22m. to 10h. 40m., and rose from 10h. 40m. to 11h. 25m. The last was the largest movement. Towards the end of it, and subsequently until 11h. 50m., short period oscillations were somewhat more prominent. V showed no special disturbance until 10h. 30m. Two bays then presented themselves, both + —. The first extended from 10h. 30m. to 11h. 5m., the second lasted about an hour and was much the deeper. There were short period oscillations during both the bays in V, but of trifling amplitude. The aurora was brightest towards the end of what were the largest movements in D, H and V. But the short period oscillations were of quite a trifling character, as compared for example with those recorded between 13h. and 14h. on June 8th. An idea of the comparatively minor character of the disturbance may be derived from the following particulars of the hourly ranges. The auroral characters are attached—

Hour ending at—	10h.	11h.	12h.	13h.
	γ	γ	γ	γ
Hourly range D	29	45	56	14
Hourly range H	19	26	24	24
Hourly range V	7	27	67	28
Auroral character	...	1·0	1·5	1·5

July 1, 1912, 23·17 (13h. 46*m. G.M.T.*):—At the time of the earliest observation of the evening 19·50 (10h. 19m.) no aurora was observed. The note at 23·17, when it was first recorded runs, "A powerful aurora is in operation. Curtain . . ., 30° up. Faint colour phenomenon . . . The display waned rapidly at 23·29 (13h. 48m. G.M.T.). Bright moonlight reduced the brilliance, and only strong effects visible." At 23·23 (13h. 52m. G.M.T.) the aurora was "no longer visible in the moonlight." It was, however, seen at 23·33, 23·50 and 24·00 (14h. 29m. G.M.T.), but not later. The auroral characters awarded were 2·0 for 14h., 1·0 for 15h., and 0·0 for the subsequent hours. Magnetic character 2 was awarded to 14h. and 15h. All the other hours of the day from 8h. to 24h. obtained character 1. The interval 13h. 20m. to 14h. 30m. was one of those selected for the comparison of Cape Denison and Cape Evans. During this time there was a well-marked bay E.W. in D of a very ordinary type, the beginning of which at about 13h. 20m. was more definite than the conclusion. The turning point at 13h. 40m. supplied the most easterly reading of the day. Movements in H and V, force increasing, commenced practically simultaneously with the commencing movement in D. The turning points, at 13h. 35m. in H and 13h. 40m. in V, supplied the maxima of the day. Short period oscillations, but of small amplitude, were present in all three curves during the time when the brightest aurora was noted. After attaining a maximum, H and V both fell pretty rapidly at first. The fall in H, however, was soon interrupted, and the subsequent movements were for a time rather irregular. The fall in V progressed rapidly until 14h. 0m., and it continued at a slower rate with some interruptions until nearly 14h. 25m. V was then still a good deal higher than at 13h. 20m. A second rise then set in and continued until about 14h. 36m. A decided tendency to fall then set in and continued until 16h. 0m. when V had nearly the same value as at 13h. 20m. During the second rise in V, and subsequently up to 14h. 50m., there were some fair movements in H.

It will be observed that the brightest aurora was observed a few minutes subsequent to the principal turning points which occurred in all three elements. From the appearance of the curves we can hardly avoid the conclusion that the movements following the turning points represented the second stage of a disturbance which commenced about 13h. 20m. The inference we should naturally draw is that the aurora had been in existence for some little time before it was seen. The aurora seen from 14h. 22m. to 14h. 29m. was presumably associated with the second rise in V.

July 5, 1912, 19·50 (10*h.* 19*m.* *G.M.T.*) *et seq.*—Earlier notices from 17·00 (7h. 29m. G.M.T.) onwards mention aurora. It was very bright at 18·00 (8h. 29m. G.M.T.) and 18·15 (8h. 44m. G.M.T.). At 19·00 (9h. 29m.) there was a bright curtain 10° up. The note at 19·50 runs, "An exceptionally brilliant display. A curtain about 10° up . . . the lower edge of a definite reddish tinge." Records of aurora go on at short intervals until after local midnight 14h. 29m. G.M.T., when the sky had become largely overcast. Notes as to colour include the following:—20·05½ and 20·07 (10h. 38m. G.M.T.) "pink lower border," 20·10 (10h. 41m. G.M.T.) "sheets of lilac colour," 20·13 (10h. 44m. G.M.T.) "lilac streamers," 20·39 (11h. 8m. G.M.T. "pink below shading into green tints above," 21·30 (11h. 59m. G.M.T.) "pink lower border," 23·10 (13h. 39m. G.M.T.) "very strong curtains . . . colour showing," 23·15 (13h. 44m. G.M.T.) "an intense curtain showing brick-red, rose-pink, lilac and green tints." Pink colour was also observed at 23·34 and at 23·41 (14h. 10m. G.M.T.). Auroral characters were awarded as follows:—8h. 1·5, 9h. 2·0, 10h. 1·5, 11h. 2·0, 12h. 2·0, 13h. 1·0, 14h. 2·0, 15h. 1·5. This and the subsequent day, July 6, were two of the five days which Sir Douglas Mawson mentions as supplying the most remarkable colour effects. This aurora occurred during a time of most persistent magnetic disturbance. From 17h. on July 3rd to 6h. on July 6th every single hour was awarded magnetic character 2, with the exception of 7h. on the 5th, which got a 1. July 5th was also persistently disturbed at Cape Evans, but during the hours when aurora was observed at Cape Denison no interval presented itself which seemed fitted for the intercomparison of the two stations. The movements at Cape Denison were in general of a very irregular character, and the different elements were not in phase. There was little in the general appearance of the curves to suggest one interval of time as more appropriate for measurements than another. Hourly ranges were accordingly measured with the following results, the auroral characters being added for comparative purposes.

Hour ending at—	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.
	γ	γ	γ	γ	γ	γ	γ	γ
Hourly range D	48	34	38	86	136	102	63	54
Hourly range H	27	47	55	169	140	144	88	99
Hourly range V	37	39	47	174	59	94	191	151
Auroral character	1·5	2·0	1·5	2·0	2·0	1·0	2·0	1·5

July 6, 1912, 06·55 (*July 5th, 21h. 24m. G.M.T.*).—It would appear that prior to this frequent observations had been taken without detecting aurora. Conditions, however, were unfavourable, as there was bright moonlight, while much of the sky was overcast. The note at 06·55 runs, "A curtain 7° up . . . pinkish and greenish colours visible." Aurora was also seen though apparently faint at 07·00, 07·04, 07·07 and 07·14 (21h. 43m. G.M.T.), but it was invisible at 07·21. It was again seen at 07·30 (21h. 59m. G.M.T.), 07·35 and 07·45 (22h. 14m. G.M.T.). On the two last occasions it was in or near the zenith. It was invisible at 07·49, but at 07·58 (22h. 27m. G.M.T.) a faint curtain reached to the zenith. No further observation was made in view presumably of twilight. The auroral characters assigned were 1·5 for 22h. and 1·0 for 23h. As already explained, a long sequence of hours including 22h. and 23h. were of magnetic character 2. As compared with the immediately preceding hours, disturbance was enhanced between 21h. and 22h. at least in D and V. The hour was one of those selected for the comparison of Cape Denison and Cape Evans. A sharp movement started almost if not quite simultaneously in the three elements, a minute or two after 21h. It was to the west in D, and was a fall in both H and V. The turning point (minimum) in H was reached about 21h. 22m. near the time when aurora was brightest. It was reached a few minutes later in V and D. What happened close to the turning point in D is doubtful. The appearance of the curve suggests that some obstacle held up the magnet for some minutes. The return movements, to the east in D, and representing increase of force in H and V, were larger in D and V than the commencing movements. The resulting bays are, in the case of H and V sharply terminated at about 21h. 45m. But the D movement continued up to 22h., though at a slower rate. The appearance of the curve suggests that the entire bay forms a disturbance of definite source. If so, it would appear that the conditions first detected as aurora at 21h. 24m. must have then been in existence for fully twenty minutes. Short period oscillations were not at all prominent between 21h. and 22h. Though aurora was seen at 22h. 14m. and 22h. 27m., magnetic conditions were a good deal quieter between 22h. 0m. and 22h. 30m. than they had been for a good many hours. A rapid westerly movement in D began at 22h. 30m., a change of 2° 25′ (132 γ) taking place in about fourteen minutes. This was followed by a larger but somewhat slower easterly movement terminating about 23h. 25m. The resulting bay in D closely resembles that experienced between 21h. and 22h. The aurora seen at 22h. 27m. may possibly have continued during this second bay, though invisible on account of twilight.

July 6, 1912, 18·40 (*9h. 9m. G.M.T.*) *et seq.*—This was one of the five occasions of specially brilliant colour effects particularised by Sir Douglas Mawson. Aurora of varying intensity had been observed at intervals since 16·05 (6h 34m G.M.T.). Every observation taken since 16·19 (6h. 48m. G.M.T). had shown it, though it was "almost gone" at 17·26 (7h. 55m. G.M.T.). The note at 18·40 runs, "An arch 10° up . . . of a faint reddish colour" While this was apparently the earliest observation of colour, later occurrences would seem to have been a good deal brighter, judging by the following notes :—20·43 (11h. 12m. G.M.T.) "A brilliant arch . . . reddish lower border," 20·46 and 20·48 "lilac colour," 20·50 (11h. 19m. G.M.T.) "colour rose to lilac," 21·06 (11h.35 m. G.M.T.). "Brilliant lilac coloured curtains," 21·26 (11h. 55m. G.M.T.). "A vortex of colour and motion crossed the zenith." Aurora continued to be recorded at every observation until local midnight (14h. 29m. G.M.T.). At several observations times in the early morning it was invisible, but it then revived and was recorded at every observation time from 04·15 (18h. 44m. G.M.T.) to 07·40 (22h. 9m.), when it was overpowered by twilight. Red or pink colour was noticed at 04·36 (19h. 5m. G.M.T.), 04·43½ and 05·15 (19h. 44m. G.M.T.). The auroral characters awarded were 2·0 for 12h. and 20h., 1·5 for 13h., 19h. and 2h., 1·0 for 7h. to 10h., 14h., 15h., 22h. and 23h., 0·5 for 11h. and 16h., and finally 0·0 for 17h. and 18h. Magnetic character was 1 from 7h. to 11h., 2 from 12h. to 15h., 1 for 16h., and 2 for 17h. to 23h.

If preceded by a quiet time, hours 7h. to 11h. might have been assigned 2's, but the disturbance during them was active rather than large. Subsequently, except from 15h. to 16h., the movements were larger, but if we except 11h. 0m. to 13h. 0m. disturbance was active rather than great. The movements between 11h. and 13h. were very large, and between 11h. 30m. and 12h. 30m. they were very highly oscillatory. The H and V instruments at this time were more than usually sensitive, and both traces got off the sheet. The two D traces also got off the sheet, and for a time near 12h. it is doubtful whether either of them was on the sheet. Owing to the rapidity of the movements, the traces were very faint, and there are apparently discontinuous portions of curve which might represent either D trace or V trace, or partly both. If these were V trace, the daily range in V was greater than that given in Vol. I*, while if they were D trace it was the daily range in that element which was underestimated. The measurement given below assume them to be D trace. It is thus possible that the ranges assigned to that element for 12h. and 13h. may be overestimates; the ranges for the other two elements for these two hours are in any case underestimates. The results are as follows, the auroral characters being added for comparative purposes.

Hour ending at...	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.
	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
Hourly range D	25	14	9	15	24	289	149	19	28	26	73	41	61	63	50	63	46
Hourly range H	28	14	18	18	13	498	500	23	21	18	24	30	67	48	31	58	47
Hourly range V	27	7	11	16	15	295	117	117	39	17	34	28	59	91	31	64	67
Auroral character	1·0	1·0	1·0	1·0	0·5	2·0	1·5	1·0	1·0	0·5	0·0	0·0	1·5	2·0	1·5	1·0	1·0

July 7, 1912, 04·36 (*July* 6, 19*h.* 5*m.* *G.M.T.*) *et seq.*—As this fell in the same Greenwich day as the previous occurrence, the two have been discussed together above They were presumably parts of the same exhibition.

* Vol I of this Series.

August 6, 1912, 17·00 (*7h. 29m. G.M.T.*).—The earliest note of the evening at 16·30 (6h. 59m. G.M.T.) recorded "a bright curtain seen in daylight 4° up . . ." The note at 17·00 was, "Ditto, but more intense. The colour appears yellowish to pinkish green, probably apparent colour affected by the daylight." This seems the only reference to colour. There are numerous observations of aurora throughout the night up to 06·28 (20h. 57m. G.M.T.). At three of the times of observation aurora was invisible, but there is no (Greenwich) hour from 7h. to 21h. in which it was not seen. The auroral characters awarded were 2·0 for 7h., 8h., 10h., and 11h., 1·5 for 9h., 12h., 13h., 14h. and 16h., 1·0 for 15h. and for 17h. to 21h. The magnetic character was 2 from 4h. to 9h. inclusive, and 1 from 10h. to 17h. inclusive. It was 0 for 18h. and 21h., but 1 for 19h. and 20h.

There were some considerable movements, but none of any great rapidity, and short period oscillations were in no way conspicuous. Of the larger movements the one which makes most appeal to the eye is a bay E.W. in D, and − + in H and V, lasting in D from about 6h. 30m. to 8h. 0m. It commenced some ten minutes later in H and V, and its conclusion in these two elements is indefinite. The ranges in the course of the 1½ hours were 223 γ in D, 180 γ in H and 72 γ in V. The corresponding Cape Evans trace was, unfortunately, missing, so that a comparison was impossible. Subsequently there was what might be regarded as a very prolonged bay E.W. in D, lasting from about 8½h to 15h. The H and V movements during this time do not make much appeal to the eye, but the value of H increased fairly steadily up to 14h., the mean value for that hour exceeding the 8h. mean by 77 γ. Much the most conspicuous movement during the remainder of the time when aurora prevailed was a bay W.E. in D from about 17½h. to 19½h. The ranges during the interval were 99 γ in D, 32 γ in H and 77 γ in V. There was a fair bay + − in V, but it commenced half an hour later than the bay in D.

The coloured aurora occurred during the progress of the first and largest bay movement, but no special oscillations accompanied it. The auroral display during the time of the later bay was seemingly faint rather than bright. Hourly ranges were measured with the following results, the auroral characters being added for comparative purposes.

Hour ending at	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.
	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
Hourly range D	186	211	30	71	47	21	45	39	69	20	20	69	84	13	17
Hourly range H	118	104	91	17	36	32	40	43	17	28	16	12	20	28	7
Hourly range V	70	69	21	32	31	38	20	52	76	45	35	25	80	33	10
Auroral character	2·0	2·0	1·5	2·0	2·0	1·5	1·5	1·5	1·0	1·5	1·0	1·0	1·0	1·0	1·0

August 21, 1912, 20·20 (10*h.* 49*m.* *G.M.T.*).—The only earlier observation of the night taken at 18·00 (8h. 31m. G.M.T.) reported merely the existence of bright moonshine. The note at 20·20 was "A bright nebulous arch 5° up . . . Colour bright yellow with a pink lower edge." A curtain 8° up was noted at 20·48 (11h. 17m. G.M.T.). No aurora was visible at 21·11 (11h. 40m. G.M.T.) or at several later hours, but the sky had become misty. The auroral characters awarded were 1·5 for 11h. and 1·0 for 12h. Magnetic character 1 was allotted to these two hours, and to several other hours immediately before and after them. But in assigning these character figures attention had been mainly directed as was usual to the H and V traces. The D trace contained a fairly prominent bay of long duration extending from about 9h. to 15h. The turning point of this at 11h. 2m. supplied the extreme easterly reading of the day. The portion of D trace from 10h. 30m. to 12h. 0m. formed as it were a bay within a bay, which included both the times when aurora was observed. The ranges during this period of 1½ hours were D. 56 γ, H. 24 γ, V. 39 γ. The amplitude was thus very moderate, and short period oscillations were not prominent.

September 12, 1912, 20·26 (10*h.* 55*m.* *G.M.T.*).—The two earliest observations of the evening at 18·00 and 19·55 (10h. 24m. G.M.T.) disclosed no aurora, which was first observed at 20·05 (10h. 34m. G.M.T.). The note at 20·26 runs, "Two bright arches with streamers 5° up . . . faint reddish tint below." Aurora was noted at all the subsequent observations up to 00·45 (14h. 14m. G.M.T.), but all at low altitudes and mostly faint. No aurora was seen at 01·30 (15h. 59m. G.M.T.) or 02·15 (16h. 44m. G.M.T.), though the sky was clear, but a faint glow was seen 03·00 (17h. 29m. G.M.T.). The auroral characters awarded were 1·5 for 11h. and 12h., 0·5 for 13h., and 1·0 for 14h. to 16h. The magnetic characters awarded were 2 for 11h., 1 for 12h. to 15h., and 0 for 16h. Previous to the aurora, from 5h. to 10h., the magnetic character had been 1. The only prominent feature in the curves is a bay EW in D, + — in H and V, which supplied the extreme easterly reading of the day in D at 10h. 50m., and the maxima for the day in H and V at 10h. 50m. and 10h. 58m. respectively. The bay may be regarded as extending from 10h. 30m. to 12h. 0m., an interval selected for the comparison of Cape Denison and Cape Evans. The principal part of the change in all the elements occurred, however, in about 27 minutes, from about 10h. 47m. to 11h. 14m., the movements during that interval constituting a bay within a bay. Their range was 71 γ in D, 37 γ in H, and 48 γ in V. This secondary bay includes the time of the brightest aurora. It contains some rapid oscillations, but of a very minor character. There is nothing in the appearance of the H. and V. curves after 12h. which suggests the existence of any special source of disturbance. The movement in the declination magnet to the west between 12h. and 15h., as derived from the mean hourly values, was fully twice as great as in the average day of the month, but it presented no special features.

September 18, 1912, 21·20 (11*h.* 49*m.* *G.M.T.*) *et seq.*—At the earliest observation hour 20·00 (10h. 29m. G.M.T.) no aurora was seen. It was first observed at 21·09

(11h. 34m. G.M.T.) when a bright curtain waxing and waning attained an altitude of 15°. The note at 21·20 runs, "The display is now very bright and active and shows colour . . . In eight minutes the curtain rose from 15° to . . . . 50°." At 21·25½ (11h. 54·5m. G.M.T.) "A coronal vortex in the zenith" is reported. At 21·30 (11h. 59m. G.M.T.) "The curtain now reached a maximum southerly position about 10° south of the zenith." The aurora seems to have remained bright until 21·50 (12h. 19m. G.M.T.). But at 21·57 there was only a small curtain and at 22·03 (12h. 32m. G.M.T.) only a nebulous glow 10° up. No aurora was seen later than this, but there was moonlight, which might have obscured faint effects, and later the sky became overcast. The auroral characters awarded were 11h. 0·0, 12h. 2·0, 13h. 2·0, 14h. 0·0. The magnetic characters were 1 for the hours preceding the aurora, 2 for 12h. and 13h., and 1 for the four subsequent hours.

This is one of the five occasions specified by Sir Douglas Mawson as presenting the most remarkable colour effects. According to the note on his p. 66, "The display was . . . almost next to the great one of early July. The corona effect at the zenith as the curtain passed over was well illustrated. The colour was chiefly rose-pink and emerald green . . . At times the general outline of the curtain was . . . repeatedly traversed by waves of excitation kindling it successively from west to east with a brilliant light."

This would seem to have been a sharply defined isolated occurrence of aurora, and it was accompanied by magnetic disturbance, whose commencement a little before 11h. 30m. is sharply defined in all the elements. The interval 11h. 20m. to 12h. 50m. which includes all the notable movements was one of those selected for the comparison of Cape Denison and Cape Evans. The traces at Cape Evans from 0h. to 14h. appear in Plate LVIII of the volume devoted to that station. At Cape Denison the commencement may be put at 11h. 27m., the commencement movement being to the east in D, and a rise in H and V. It brought D to the extreme easterly position of the day at 11h. 40m., and H simultaneously attained its maximum value for the day. From 11h. 40m. to 12h. 10m. the traces were all considerable oscillatory. One of the oscillations brought D at 11h. 50m. to a position more *westerly* by 40° than the position existing at the beginning of the disturbance, and another brought H at 11h. 58m. to the *minimum* value for the day. After these extreme positions were attained further oscillations brought D to the east of its undisturbed position, and enhanced H temporarily above its original value. Thus the disturbance in D and H were not simple bays, though initially of the bay type. The V trace also experienced rapid oscillations between 11h. 40m. and 12h. 10m., but the principal movement was an *increase* of force which brought V to its maximum for the day at about 11h. 55m. The oscillations left V considerably enhanced above its initial value, and the fairly rapid fall which went on until 12h. 30m. completed a disturbance which may fairly be regarded as of the ordinary bay type. It will be noticed that the most oscillatory time in the magnetic elements included the time when the most outstanding auroral effects were observed. But the oscillations, though decidedly exceptional, were poor compared with those observed on July 6 between 11½h. and 12h., and on June 8 between 13½h. and 14h., and on May 5 between 11½h. and 12h.

October 15, 1912, 22·02 (12*h.* 31*m.* *G.M.T.*).—The earliest observation of the evening at 21·58 reports a curtain 10° up. The note at 22·02 runs, "The curtain extends and brightens, rising to 15° . . . A reddish colouration appears on the lower border." A "faint reddish colour" was also observed at 22.10, and a "flash of red and green" at 22·15. Fainter aurora was observed at 22·18 and at 22·36 (13h. 5m. G.M.T.), but none was visible later. It is explained, however, that "during this display medium moonlight and considerable twilight prevailed."

The auroral characters awarded were 1·5 for 13h., and 1·0 for 14h. Hours 12h. to 15h. got magnetic character 2, and the three following hours magnetic character 1.

This would seem to have been a short isolated appearance of aurora. There was considerable magnetic disturbance, some of it decidedly oscillatory, both earlier and later in the day, but the aurora was presumably associated with a somewhat prominent disturbance, which in the case of H and V took the shape of a simple bay + —, commencing shortly after 12h. and finishing about 13h. 30m. During the same time there were three prominent movements in D, to west, to east, and to west again. The interval 12h. 0m. to 13h. 30m. was one of those selected for the comparison of Cape Denison and Cape Evans. Plate LX of the volume devoted to Cape Evans reproduces a portion of the traces of October 15, but refers to hours prior to the appearance of aurora at Cape Denison. The D, H and V curves at Cape Denison all show short period oscillations about the time when the aurora was observed, but they are of a trifling character.

October 17, 1912, 21·45 (12*h.* 14*m.* *G.M.T.*).—Aurora was reported at the earliest observation hour of the evening 21·40 (12h. 10m. G.M.T.) when there was a nebulous arch 14° up. The note at 21·45 runs, "The arch has risen to 20° . . . A faint reddish tinge on the lower border; considerable twilight." The presence of aurora was noted at intervals up to 22·30 (12h. 59m. G.M.T.). None was seen at 22·45 (13h. 14m. G.M.T.), or at the later hours of observation. Auroral character 1·5 was assigned to 13h., the adjacent hours receiving character 0·0. The magnetic characters assigned were 2 for 11h., 1 for 12h. and 13h., 0 for 14h. to 17h. During the time when aurora was seen a fairly active westerly movement was in progress in D, but the character of the H and V curves was rather 0 than 1. The appearance of the curves between 12h. and 13h. is not at all suggestive of the presence of any special cause of disturbance, while the appearance of the curves between 10h. 30m. and 12h. decidedly is so.

May 1, 1913, 21·15 (11*h.* 44*m.* *G.M.T.*).—The magnetic traces for this day are missing.

May 5, 1913, 20·15 (11*h.* 44*m.* *G.M.T.*).—Aurora had been seen earlier in the evening at 18·00 (8h. 29m. G.M.T.), but none was visible at 19·34 (10h. 3m.). The note at 20·15 mentions "A broad, bright . . . nebulous arch with a reddish lower border . . . reaching 6° in elevation." At 20·20 the arch had risen, and a streamer curtain reached to 40° above the horizon. Aurora was reported at each subsequent observation time until local midnight (14h. 29m. G.M.T.), when the sky became obscured. The auroral characters awarded were 1·0 for 9h., 0·0 for 10h., 1·5 for 11h., 1·0 for 12h., 13h. and 14h., 0·5 for 15h. Every hour from 9h. to 15h. got magnetic character 1 except 11h., which got a 2.

The most noteworthy disturbance during the hours when aurora was seen was a bay, E.W. in D, which commenced a few minutes before 10h. and ended about 11h. Neither this nor the corresponding H and V traces was at all remarkable for short period oscillations. Hourly ranges were measured with the following results, the auroral character being added for comparative purposes.

Hour ending at—	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.
	γ	γ	γ	γ	γ	γ	γ	γ
Hourly range D	91	35	21	56	15	19	19	31
Hourly range H	58	40	24	24	11	21	16	32
Hourly range V	45	21	11	22	14	22	22	43
Auroral character	0·0	1·0	0·0	1·5	1·0	1·0	1·0	0·5

The hour ending at 8h., which represents the largest ranges included only one observation taken at 7h. 59m., at which no aurora was seen. It may be remarked as a coincidence that specially bright aurora was also observed on the same date of the previous year.

June 11, 1913, 22·54 (13*h.* 23*m.* *G.M.T.*).—The earliest observation of aurora was at 20·12 (10h. 41m. G.M.T.). It was also seen at 21·05 (11h. 34m.) and 22·07 (12h. 36m.), but was invisible at 20·52 (11h. 21m.) and 21·45 (12h. 14m. G.M.T.). It continued to be seen at each subsequent observation until 00·30 (14h. 59m.), after which it was invisible for several hours. The note at 22·54 runs, "A bright curtain with a tinge of red below . . ." The auroral characters awarded were 0·5 for 11h., 1·0 for 12h. and 13h., 1·5 for 14h., 1·0 for 15h. and 0·0 for the next three hours. Magnetic character 1 was awarded to 13h. and 14h. All the other hours of the day subsequent to 6h. were of character 0.

The day as a whole was an exceptionally quiet one, twenty hours out of the twenty-four being of character 0, and none of character 2. But during the time of the aurora, the H and V traces showed two very regular bays, in immediate succession to one another, the two elements appearing to be almost exactly in phase. A trace of a third very shallow bay following immediately on the other two can also be made out. The bays are all + —, *i.e.*, the rise of force comes first. Turning points which were (temporary) maxima and minima being distinguished as +, —, the following are appropriate times :—

Turning points—
H .... 12h. 29m. (—), 12h. 52m. (+), 13h. 12m. (—), 13h. 30m. (+), 14h. 5m. (—), 14h. 40m. (+).
V .... 12h. 27m. (—), 12h. 52m. (+), 13h. 12m. (—), 13h. 30m. (+), 14h. 15m. (—), 14h. 40m. (+).

The recovery (fall) constituting the second part of the third bay was indefinite. That bay appeals to the eye more as a check than as a reversal of the regular change in progress at the time. The turning points at 12h. 52m. in V and at 13h. 30m. in H supplied the maxima of the day.

From the start up to 13h. 12m. the D trace was closely in phase with the other two. The commencement may be put at 12h. 25m., or at 12h. 31m., representing a westerly (W.) turning point. The next turning point at 12h. 48m. represented the easterly extreme of the day. Instead, however, of a turning point at 13h. 12m., we have the westerly movement continuing until 13h. 30m. A comparatively small movement to the east then followed, leading to a turning point (E.) at about 13h. 38m. The westerly movement which followed went on until nearly 14h. 30m. At 13h. 30m. D was still a good deal to the east of its original position. Thus the D trace from 12h. 30m. to 14h. 30m. may be regarded as supplying two successive bays, the one ending and the other beginning at 13h. 30m., or as a single irregular bay. After 14h. 30m. there was a temporary reversal or check of the westerly movement in D, corresponding apparently to the third bay suggested by the H and V traces. The fairest idea of the amplitude of the movements accompanying the aurora seems obtainable from a subdivision of the whole time of the disturbance into three parts, as follows :—

Time.	Ranges.		
	D	H	V
12h. 27m. to 13h. 12m.	37γ	24γ	52γ
13h. 12m. to 14h. 12m.	20γ	22γ	33γ
14h 12m. to 15h. 12m.	10γ	10γ	11γ

The brightest aurora occurred during the second period, which answers to the second bay in H and V. At the times of the two earliest observations of aurora 10h. 41m. and 11h. 34m. G.M.T. only the most trifling magnetic movements were in progress.

June 19, 1913, 23·16 (13*h.* 45*m*, *G.M.T.*) *et seq.*—Observations up to 22·00 (12h. 29m. G.M.T.) reported no aurora, but bright moonlight. At 22·30 (12h. 59m. G.M.T.), however, a nebulous band 8° up is reported, and at 23·04 (13h. 33m. G.M.T.) "a very brilliant curtain reaching as high as the zenith." The note at 23·16 runs, "A very great exhibition near the zenith. The main band 70° up showing colours and a swirling motion along it." At 23·22 (13h. 51m. G.M.T.) the aurora was "rapidly waning," and at 23·25 and 23·38 (14h. 7m. G.M.T.) it was faint at a low altitude. It was invisible at 24·00 (14h. 29m. G.M.T.). At 00·33 (15h. 2m. G.M.T.), however, a bright arch up to 12° with a reddish tint was reported. At the next observation time 01·00 (15h. 29m. G.M.T.) the arch was much fainter, and observations from 01·30 (15h. 59m. G.M.T.) onwards reported no aurora visible. The auroral characters awarded were 1·0 for 13h., 2·0 for 14h., 1·0 for 15h. and 1·5 for 16h. The magnetic characters were 0 for 12h. and 13h., 2 for 14h, 1 for 15h. and 16h., and 0 for 17h. and 18h.

The aurora would seem to have been a comparatively short isolated one, confined to the time 12½h. to 16h., and the time of exceptional brilliancy is not known to have exceded twenty minutes, ending before 13h. 51m. A note explains that the maximum might have preceded 13h. 33m., as an interval of 34m. had elapsed since the last previous observation.

What the magnetic curves show is a quiet time extending from 11h. to 13h., then a disturbance which began at about 13h. 3m. in H and V with a sharp rise of force, and went on to about 14h. 30m. There were considerable oscillations between 13h. 20m. and 13h. 55m. After 13h. 55m. the H and V traces were very smooth, though a considerable change took place in V. The disturbance was simplest in the V trace, which shows a single bay + —, the turning point at 13h. 35m. supplying the maximum for the day. Short period oscillations appear on the V trace from 13h. 20m. to 13h. 40m., but they are comparatively small. Initially there was a smart rise in H, as in V, and it led to the maximum for the day at 13h. 12m. After being nearly stationary for some minutes, H began to fall, but oscillations then set in and continued until about 13h. 55m. At that time, H was higher than it was originally at 13h. But the oscillations after 13h. 30m., which were much larger in H than in V, were mainly in the negative side, and supplied at 13h. 48m. the minimum for the day. After 13h. 55m., H began to fall smoothly, but the fall was slower than in V and stopped earlier. The disturbance in D is in its general features a bay E.W., which supplied at about 13h. 40m. the extreme easterly reading of the day. But superposed on the bay movement were rapid oscillations, which though not large absolutely were considerable as compared with the amplitude of the bay. One of these oscillations brought D at about 13h. 33m. a considerable distance to the west of its initial position. The return movement to the east produced in five minutes a change of 55′ in D. These rapid changes in D were synchronous with the brightest time of the aurora.

The ranges from 13h. 0m. to 14h. 30m., which covers the time during which the aurora was continuously visible, and also the time of active magnetic disturbance, were D 49γ, H. 94γ and V 101γ.

Subsequently there were what might be regarded as trifling bays + — in H and V, from say 15h. 0m. to 15h. 30m., which includes the two last auroral observations. The ranges during this half-hour were D 16γ, H 11γ and V 13γ.

July 7, 1913, 23·08 (13*h.* 37*m.* *G.M.T.*) *et seq.*—First seen at 17·24 (7h. 53m. G.M.T.) aurora was reported at every subsequent time observation, with one exception up to 02·00 (16h. 29m. G.M.T.), after which time it was invisible for several hours. The exceptional intermediate occasion when aurora was invisible was 20·54 (11h. 23m. G.M.T.). It became visible again only five minutes later, thus it would seem to have been practically continuous during 8½ hours. The earlier observations up to 20·39 (11h. 8m. G.M.T.) describe the aurora as faint or very faint, but in general it attained considerable altitudes, being in the zenith at 20·19 (10h. 48m. G.M.T.). From 21·54 (12h. 23m. G.M.T.) to 22·43 (13h. 12m. G.M.T.) it is described as moderately bright, but its altitude was then only 12° or less. At 22·53 (13h. 22m. G.M.T.) it is described as bright, but the altitude was only 4°. The note at 23·08 runs, "A long bright curtain . . . . maximum elevation 25°, much motion at the E end where it is red below." At 23·12 (13h. 41m. G.M.T.) it was "very bright again; red below . . . maximum elevation 35°. At 23·15 it was "again very brilliant and much colour" and had "risen somewhat higher." 23·18 (13h. 47m. G.M.T.) was "another bright period . . . colour effects pinkish . . . greenish . . ." Other times of special brilliancy were 23·20½ and 23·26½ (13h. 55½m. G.M.T.). It had become much fainter by 23·29 (13h. 58m. G.M.T.), and subsequently was faint or very faint. On one occasion 01·30 (15h. 59m.), though very faint, it was in the zenith.

The auroral characters awarded were 1·0 from 9h. to 12h., 1·5 for 13h., 2·0 for 14h., 1·0 for 15h. and 16h., 0·5 for 17h. and 0·0 for 18h. and 19h.

The magnetic characters were 1 for 9h., 0 for 10h., 11h. and 12h., 1 for 13h., 2 for 14h., 1 for 15h., and 0 for 16h. to 19h.

There was minor disturbance from midnight to 4h., before aurora was seen, and again from 20h. to 24h., but during the intermediate part of the day it was generally very quiet, except from 12h. to 15h., when the disturbance was very moderate. The ranges for the day as a whole were only 56′ (50γ) in D, 47γ in H and 90γ in V. The V range is slightly above the mean for the month, but the D and H ranges are well below. The magnetic character assigned to the day as a whole was 0, and the international character 0·4.

The disturbance between 12h. and 15h. was of the simplest type in V, where i consisted of two bays, the first extending from about 12h. 15m. to 13h. 15m., the second and deeper from 13h. 30m. to 14h. 20m. The bays were both + —. The + turning point on the second at 13h. 58m. supplied the maximum for the day. It coincided practically with the termination of the brightest auroral period.

During the earlier bay in V there was the suggestion of a very shallow + — bay in H and there was a fair E.W. bay in D, the turning point in which at 12h. 43m. supplied the extreme easterly reading for the day.

During the time of the second bay in V there was first a small rise in H to the maximum for the day at 13h. 37m., then a fall, with trifling short period oscillations superposed, to the minimum for the day at 13h. 55m. This was followed by a rise and some irregular movements, the movement immediately preceding 14h. 20m. being a slight fall. The corresponding D disturbance was similarly irregular. The motion was on the whole easterly to 13h. 42m., westerly to 13h. 55m., easterly to 14h. 2m. and finally westerly. The most conspicuous movement was that to the east between 13h. 55m. and 14h. 2m. The disturbance in D and H between 13h. 30m. and 14h. 20m. might be regarded as composed of two bays, the first ending and the second beginning at 13h. 55m.; the first was the more oscillatory period, but absolutely considered were small. The ranges during the times covered by the two bays in V were as follows :—

Interval.	Ranges.		
	D	H	V
12 15m. to 13h. 15m.	25γ	9γ	16γ
13h. 30m. to 14h. 20m.	26γ	47γ	52γ

While the magnetic disturbance accompanying the brightest aurora had sufficient individuality to catch the eye, the fact that it did so was largely due to the general quietness of the curves during adjacent hours. No one, I think, who regarded brilliant aurora and large magnetic disturbance as invariably associated would have suspected from the appearance of the curves that anything very exceptional in the way of aurora had been going on.

July 10, 1913, 22·53 (*13h. 22m G.M.T.*).—Faint aurora was reported at 16·43 (7h. 12m. G.M.T.), but it was not seen again until 21·35 (12h. 4m. G.M.T.), when there was a "faint nebulous band 2° up . . ." At 22·00 (12h. 29m. G.M.T.) there was "a bright nebulous arch" 16° up. At the next two observation times, 22·15 and 22·25, its altitude was greater, but it was apparently less bright. The note at 22·53 runs, "A bright nebulous band 35° up . . . shows a tinge of red below in places." Aurora was subsequently reported at intervals until 03·23 (17h. 52m. G.M.T.), being apparently bright or moderately bright up to 02·03 (16h. 32m. G.M.T.), and subsequent to that faint or very faint. It was invisible at 04·17 (18h. 46m. G.M.T.)

The auroral characters awarded were 0·0 from 9h. to 12h., 1·5 for 13h. to 17h., 0.5 for 18h. and 0·0 for 19h. The magnetic character was 1 for 10h., 13h., 14h., 15h., 17h., 18h. and 19h., and 0 for 9h., 11h. 12h. and 16h.

Throughout the time of this aurora the V trace was faint and almost invisible in places. No bays or oscillations of any size were visible. Neither the D nor the H trace shows any single large movement throughout the whole day, and it was awarded a daily character 0; but it was definitely unquiet during most of the time when aurora was seen. The V trace appeared unsuitable for the measurement of hourly ranges, but the D and H traces were measured with the following results, the auroral character being added for comparative purposes.

Hour ending at—	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.
	γ	γ	γ	γ	γ	γ	γ	γ
Hourly range D	13	27	15	15	17	14	10	12
Hourly range H	11	13	15	15	8	12	15	12
Auroral character	0·0	1·5	1·5	1·5	1·5	1·5	0·5	0·0

When short period oscillations are small, as they were in the present case, their presence may not add much to the hourly ranges. It has also to be remembered that in July the regular diurnal variation is near its minimum. Thus the comparison of the above with similar previous data may suggest the influence of the aurora was less than it actually was. Still, making every allowance, it must be conceded that the magnetic disturbance was of a very trifling nature.

The most regular part of the disturbance in H was a succession of three bays + — between 17h. and 18½h., each lasting about half an hour. Aurora was certainly present during the two first bays, but whether it was present during the third bay it is impossible to say, as no observation was taken until after it was over.

Sir Douglas Mawson's list of specially bright auroras contains three more examples, but they refer to dates subsequent to the stoppage of the magnetograph. All included, Sir Douglas' list contains only nine occasions of bright coloured aurora in 1913, as compared with 19 in 1912, and the five displays which he considered the most notable all occurred in 1912. As our discussion will have shown, some of the occasions of bright coloured aurora in 1913 exhibited little trace of magnetic disturbance, and none of them were accompanied by magnetic disturbance which at all rivalled in intensity that displayed on several occasions during 1912. This is quite in keeping with the results of the more exhaustive investigation summarised in Table LXXIII.

1913 was the year of sunspot minimum, Wolfer's frequency for the year being 1·4 as compared with 3·6 for 1912, and 9·6 for 1914; but the decline in sunspot frequency from 1912 to 1913 appears trifling as compared with the decline in auroral or magnetic activity at Cape Denison.

TABLE LXX.—Auroral and Magnetic Hourly Characters.

Auroral Character.	0·0			0·5			1·0			1·5			2·0		
Magnetic Character.	0.	1.	2.	0.	1.	2.	0.	1.	2.	0.	1.	2.	0.	1.	2.
1912.															
April ...	3	7	1	3	7	3	8	13	6	0	3	0	0	1	1
May ...	13	11	6	3	3	2	9	17	2	1	10	4	0	0	3
June ...	20	16	8	10	7	4	15	49	22	1	16	10	0	2	9
July ...	34	25	6	24	8	3	49	47	17	11	5	10	0	0	7
August ...	53	21	2	13	8	0	43	20	1	8	10	1	0	3	2
September	48	16	0	12	4	0	31	16	4	6	7	3	0	0	2
October ...	5	10	4	0	0	0	1	2	3	0	2	3	0	0	0
1913.															
March ...	6	0	0	2	1	0	3	4	0	0	1	0	0	0	0
April ...	10	20	2	3	9	1	4	20	3	1	2	2	0	0	0
May ...	26	3	1	8	3	0	4	22	0	1	4	2	0	0	0
June ...	41	9	1	18	10	0	36	36	1	5	17	0	0	2	1
July ...	34	19	0	24	5	0	49	21	0	22	21	2	1	0	1
Totals ...	293	157	31	120	65	13	252	267	59	56	98	37	1	8	26
Percentages	61	33	6	61	33	6	44	46	10	29	51	20	3	23	74

TABLE LXXI.—Expectation of Magnetic Disturbance during Hours when Aurora Visible and Invisible.

	Hours of Day when Aurora		Number of 2's during Hours of Day when Aurora		Expectation of Aurora as percentage of expectation for average hour of the day on hours of day when aurora	
	Seen.	Not seen.	Seen.	Not seen.	Seen.	Not seen.
1912.						
April	13	11	58	117	61	148
May	15	9	59	93	62	162
June	17	7	111	74	85	136
July	17	7	82	59	82	143
August	16	8	37	81	47	205
September	12	12	16	98	28	171
October	5	19	24	234	44	115
1913.						
March	5	19	17	141	52	113
April	14	10	27	87	41	183
May	15	9	33	18	103	95
June	17	7	11	6	91	121
July	16	8	19	8	106	89
12 Months	......	......	494	1,016	58	154

TABLE LXXII.—Occasions of Brighter Aurora.

Auroral Data.										Magnetic Data.										
Time of Occurrence.						Colour.	Type.	Alt.	Di.	Times of Turning Points.					Range in Hour.			Characteristics of Magnetic Curves.		
Local.			Greenwich.									D.	H.	V.	D.	H.	V.	D.	H.	V.
d	h	m	d	h	m			°		d	h	m	m	m	γ	γ	γ			
March, 1912.																				
24	21	15	24	11	44	...	A.S.	8	N.	24	11	10 E.	...	...	25	11	...	Bay E.W.	Rather smooth	....
...	22	00	...	12	29	...	A.	8+	N.	...	12	5 E.	...	...	22	11	...	Bay E.W.	Small oscillations	....
...	23	15	...	13	44	...	A.	8+	N.	...	13	45 W.	...	...	14	8	...	Irregular to west	Irregular	....
25	24	00	25	14	29	...	B.S.	12	N.	25	14	27 W.	30+	...	17	26	...	Bay W.E.	Bay + —	....
29	22	30	29	12	59	...	C.	60	N.	29	12	20 E.	...	25+	63	30	27	Bay E.W. Oscillations ...	Irregular oscillations ...	Irregular.
30	01	05	...	15	34	...	C.	15	N.	...	15	50 W.	55+	...	157	127	59	Bay W.E. Oscillations ...	Bay + —	Bay + —.
...	01	40	...	16	9	...	C.	50	N.N.E.	...	16	...	...	10+	119	133	71	Bay W.E. Oscillations ...	Bay + —	Bay + —.
April, 1912.																				
20	19	00	20	9	29	...	G.S.	18	N.E.	20	9	25 E.	30—	...	25	21	21	Irregular	Irregular	Irregular.
...	19	50	...	10	19	...	A.	12	N.E.	...	10	...	...	25+	17	19	17	Irregular	Irregular	Irregular.
...	23	15	...	13	44	...	...	....	N.	...	13	25 E.	18+	24+	17	44	61	Bay E.W. Oscillations ...	Bay + —	Bay + —.
22	24	00	22	14	29	...	C.	10	N.	22	14	...	25+	30+	22	20	17	Undulations, oscillations ...	Undulations, oscillations ...	Undulations, oscillations.
27	20	30	27	10	59	g.p.	C.	5	N.	27	10	...	45+	45+	...	23	36	Magnet stuck	Bay + —	Double bay + —.
...	...	...	...	...	...	...	...	...	...	...	11	...	17—	5+	...	32	17	Magnet stuck	Irregular, oscillations ...	Double bay + —.
May, 1912.																				
4	22	00	4	12	29	...	C.	15	N.N.E.	4	12	12 E.	...	2+	42	26	15	Bay E.W.	Bay + —	Bay + —.
5	21	30	5	11	59	g.y.p.	C.	45	N.N.E.	5	11	30 E.	...	46+	158	...	306	Double bay E.W.	Magnet stuck	Bay + —.
...	21	35	...	12	4	...	C.	60	N.N.E.	...	12	0 E.	...	...	165	...	229	Double bay E.W.	Magnet stuck	Bay + —.
12	06	10	11	20	39	...	C.	90	...	11	20	45 W.	28+	...	51	34	41	Irregular	Irregular	Irregular.
...	06	50	...	21	19	...	A.	60+	N.N.E.	...	21	...	5—	15+	33	39	22	Irregular	Irregular	Irregular.
...	17	00	12	7	29	r.	C.	20	N.N.E.	12	7	35 E.	...	...	101	51	31	Bay E.W.	S form + — + ...	Double bay + —.
15	20	45	15	11	14	g.y.r.	B.S.	30	N.N.E.	15	11	4 E.	0—	3+	61	113	73	Bay E.W.	Double bay — +, oscillations.	Double bay + —.

TABLE LXXII.—*Continued.*

Auroral Data.										Magnetic Data.											
Time of Occurrence.						Colour.	Type.	Alt.	Dir.	Times of Turning Points.					Range in Hour.			Characteristics of Magnetic Curves.			
Local.			Greenwich.									D.	H.	V.	D.	H.	V.	D.	H.	V.
d	h	m	d	h	m			°		d	h	m	m	m	γ	γ	γ			
May, 1912.																				
...	21	39	...	12	8	...	B.S.	50	N.E.	...	12	9 W.	12—	...	40	43	53	Irregular, oscillations ...	Bay— + ...	Irregular.
16	05	05	...	19	34	...	B.C.P.	90	...	...	19	20 W.	...	...	16	19	24	Bay W. E.	Irregular	Irregular.
...	06	00	...	20	29	...	A.B.P.S.	90	...	...	20	...	45+	45+	32	23	20	Irregular	Irregular	Irregular.
...	18	00	16	8	29	...	B.	20	N.	16	8	30 E.	40—	40—	31	22	22	Undulations	Irregular	Irregular.
...	19	55	...	10	24	...	B.	8	N.	...	10	35 W.	...	...	17	17	12	Irregular	Irregular	Irregular.
...	23	30	...	13	59	...	C.	20	N.E.	...	13	...	57+	...	24	47	60	Bay E.W.	Bay + —	Bay + —.
...	...	...	...	...	...	...	...	...	...	...	14	12 E.	...	5+	45	47	70	Bay E.W.	Bay + —	Bay + —.
25	24	00	25	14	29	...	A.C.	35	N.E.	25	14	...	59+	30+	12	15	17	Small oscillations	Small oscillations	Small oscillations.
27	03	30	26	17	59	...	C.	90	...	26	17	...	8+	...	14	13	10	Irregular	Irregular	Irregular.
...	03	50	...	18	19	...	C.	90	...	...	18	35 E.	1—	...	11	11	10	Irregular	Irregular	Irregular.
...	04	50	...	19	19	...	C.B.	90	...	...	19	...	14+	...	8	9	8	Irregular	Irregular	Irregular.
...	06	00	...	20	29	...	C.B.	90	...	...	20	...	...	...	6	5	5	Irregular	Rather quiet	Rather quiet.
June, 1912.																				
5	21	30	3	11	59	...	A.	6	N.N.E.	3	11	3 W.	15—	15—	26	20	27	Undulations	Undulations	Undulations.
...	21	40	...	12	9	r.g.	A.S.	...	N.	...	12	27 E.	3+	3+	23	19	22	Double bay E.W.	Undulations	Undulations.
8	22	55	8	13	24	r.p.g.y.	C.	90	...	8	13	....	45+	35+	122	338	358	Highly oscillatory	Highly oscillatory	Bay + —, highly oscillatory.
...	23	45	...	14	14	...	A.	65	N.N.E.	...	14	0 E.	...	54—	148	66	303	Highly oscillatory	Highly oscillatory	Bay + —, highly oscillatory.
9	00	40	...	15	9	...	C.	45	N.E.	...	15	50 E.	50+	22+	48	45	115	Bay E.W.	Oscillations	Bay + —.
...	22	25	9	12	54	...	B.	35	N.	9	12	28 E.	{15— 20+}	15+	137	311	315	Bay E.W., highly oscillatory	Highly oscillatory	Bay + —, highly oscillatory
...	23	00	...	13	29	...	B.	90	...	...	13	25 W.	25—	27+	68	128	136	Oscillatory	Bay — +, oscillatory ...	Bay + —, oscillatory.
10	00	20	...	14	49	...	A.	15	N.N.W	...	14	...	58—	16—	79	175	151	Highly oscillatory	Bay — +, highly oscillatory	Double bay + —, oscillatory.
...	...	...	...	...	...	...	...	...	...	...	15	35 E.	{12+ 33—}	10+	89	189	272	Highly oscillatory	Bay — +, highly oscillatory	Double bay + —, oscillatory.
...	22	15	10	12	44	...	A.	7	N.	10	12	22 E.	57+	55+	25	46	83	Bay E.W.	Bay + —	Bay + —.
...	23	05	...	13	34	g.p.r.	...	...	...	...	13	42 W.	42—	50+	50	101	109	Bay E.W. and oscillations ...	Bay + — and bay — + ...	Bay + — and second bay + —.
...	23	35	...	14	4	...	C.	...	N.	...	14	29 E.	12—	...	39	47	51	Oscillatory	Undulations	Undulations.

TABLE LXXII.—*Continued.*

Auroral Data.										Magnetic Data.											
Time of Occurrence.						Colour.	Type.	Alt.	Dir.	Times of Turning Points.					Range in Hour.			Characteristics of Magnetic Curves.			
Local.			Greenwich.									D.	H.	V.	D.	H.	V.	D.	H.	V.
d	h	m	d	h	m			°	...	d	h	m	m	m	γ	γ	γ			
June, 1912.																					
11	03	00	10	17	29	...	C.S.	...	...	10	17	30 E.	42+	...	120	42	74	Bay W.E. ...	Irregular ...	Irregular.
..	04	10	...	18	39	...	A.	90	...	...	18	6 W.	20+	57+	117	44	160	Bay W.E. ...	Irregular ...	Bay + —.
...	05	55	...	20	24	...	A.	90	...	...	20	3 E.	58—	...	47	46	102	Irregular ...	Irregular ...	Irregular.
...	21	30	11	11	59	...	A.S.	...	N.E.	11	11	17 W.	35—	35—	52	26	48	Bay E.W. ...	Irregular ...	Irregular.
...	21	48	...	12	17	...	A.	...	E.N.E.	...	12	0 E.	...	...	54	51	45	Bay E.W. ...	Irregular ...	Irregular.
...	22	44	...	13	13	...	A.	15	N.N.E.	...	13	5 E.	...	40+	24	24	54	Bay E.W. ...	Irregular ...	Irregular.
12	02	00	...	16	29	...	C.A.	90	...	...	16	38 E.	...	...	28	9	20	Irregular ...	Irregular ...	Irregular.
...	06	33	...	21	2	...	A.S.C.	30	N.E.	...	21	3 W	...	...	19	26	27	Irregular ...	Oscillations (small) ...	Oscillations (small).
...	20	15	12	10	44	...	A.S.	12	N.E.	12	10	40 E.	48+	48+	42	26	50	Bay E.W. ...	Double bay + — ...	Double bay + —.
...	21	05	...	11	34	...	A.C.	10	N.	...	11	53 E.	...	...	33	14	40	Irregular ...	Irregular ...	Irregular.
...	21	32·5	...	12	1·5	...	...	...	E.N.E.	...	12	12 W.	15—	19+	43	63	47	Large oscillation ...	Large oscillation ...	Bay + —, large oscillation.
...	23	15		13	44	...	A.	5	N.N.E.	...	13	...	58+	...	23	26	27	Irregular ...	Oscillations (small) ...	Irregular.
...	24	00	...	14	29	...	B.	10	N.	...	14	1 E.	...	1+	36	16	30	Irregular ...	Oscillations (small) ...	Irregular.
13	04	36	...	19	5	...	B.A.	90	...	...	19	40 E.	...	...	29	17	40	Irregular ...	Irregular ...	Irregular.
...	05	37	...	20	6	...	B.	90	...	...	20	...	...	...	19	15	17	Irregular ...	Irregular ...	Irregular.
14	05	33	13	20	2	...	C.P.	90	...	13	20	30 E.	40+	36+	19	28	31	Undulations ...	Double bay + — ...	Double bay + —.
17	01	10	16	15	39	...	B.	4	N.	16	15	...	10+	10+	15	9	11	Irregular ...	Bay + — ...	Bay + —.
...	01	45	...	16	14	...	C.	10	N.	...	16	30 E.	...	...	15	7	12	Irregular ...	Irregular ...	Irregular.
...	03	53	...	18	22	...	A.S.	30	N.E.	...	18	40 W.	...	40—	20	8	14	Irregular ...	Irregular ...	Irregular.
...	06	15	...	20	44	...	A.	75	N.E.	...	20	42 W.	35—	29—	35	13	35	Double Bay W.E.	Bay — + ...	Bay — +.
...	06	40	...	21	9	...	B.A.	90	...	...	21	...	15—	20+	25	24	26	Double Bay W.E.	Bay — +, undulations	Irregular.
...	07	46	...	22	15	...	C.S.	70	N.W.	...	22	...	35+	...	38	18	28	Irregular ...	Irregular ...	Irregular.
19	21	35	19	12	4	...	A.	12	N.E.	19	12	...	...	...	8	6	7	Trifling oscillations	Trifling oscillations ...	Trifling oscillations.
21	06	00	20	20	29	...	C.	90	...	20	20	8 E.	13+	13+	14	18	17	Undulations ...	Undulations ...	Undulations.
23	04	40	22	19	9	...	C.	90	...	22	19	12 E.	...	18+	12	6	17	Short bay E.W. ...	Small oscillations ...	Short bay + —.
30	20	52	30	11	21	r.	A.	...	...	30	11	28 E.	...	30+	55	24	67	Bay E.W. ...	Irregular, oscillations	Bay + —.
...	22	03	...	12	32	...	A.	9	N.	...	12	...	...	17+	14	24	28	Irregular ...	Undulations ...	Undulations.

2032—R

TABLE LXXII.—*Continued.*

Auroral Data.										Magnetic Data.											
Time of Occurrence.						Colour.	Type.	Alt.	Dir.	Times of Turning Points.					Range in Hour.			Characteristics of Magnetic Curves.			
Local.			Greenwich.									D.	H.	V.	D.	H.	V.	D.	H.	V.	
d	h	m	d	h	m			°		d	h	m	m	m	γ	γ	γ				
July, 1912.																					
1	23	17	1	13	46	r.	C.	30	N.	1	13	40 E.	35+	40+	50	54	161	Bay E.W.	Bay + —.	Bay + —.	
5	08	00	4	22	29	...	S.C.	90	...	4	22	44 W.	...	...	119	75	89	Irregular	Irregular	Irregular.	
...	17	30	5	7	59	...	C.A.	9	N.N.E.	5	7	28 E.	43—	43—	48	27	37	Bay E.W.	Irregular	Short bay + —.	
...	18	15	...	8	44	...	C.B.	...	E.	...	8	50 E.	...	...	34	47	39	Double bay E.W.	Irregular, oscillations ...	Irregular, oscillations.	
...	19	00	...	9	29	...	C.A.	10	E.N.E.	...	9	15 W.	27+	27+	38	55	47	Irregular	Irregular, oscillations ...	Irregular, oscillations.	
...	20	10	...	10	39	p.l.	C.S.	35	...	...	10	30 E.	45—	55+	86	169	174	Bays E.W., oscillations ...	Undulations, oscillations ...	Undulations, oscillations.	
...	21	30	...	11	59	p.	C.	...	N.E.	...	11	5 E. / 59 W.	29—	25—	136	140	59	Bays E.W., oscillations ...	Undulations, oscillations ...	Undulations, oscillations.	
...	...	...	...	...	...	...	...	...	...	...	12	32 E.	2—	33+	102	144	94	Narrow bay E.W., oscillations	Oscillations	Oscillations.	
...	23	15	...	13	44	r.p.g.l.	C.	40	...	...	13	46 W.	55+	48+	63	88	191	Bay E.W., oscillations ...	Irregular	Large oscillatory rise.	
...	23	41	...	14	10	p.	C.	...	N.W.	...	14	38 E.	...	...	54	99	151	Irregular	Irregular	Large oscillatory fall.	
6	06	55	...	21	24	p.g.	C.	7	N.	...	21	25 W.	22—	27—	170	62	124	Bay W.E.	Bay — + ...	Bay — +.	
...	21	26	6	11	55	c.	C.	90	...	6	11	22 E.	55—	45+	289	498	295	Double bay E.W., large oscillations.	Bay — +, large oscillations	Bay + —, large oscillations.	
...	21	32	...	12	1	c.	C.	45	N.E.	...	12	...	...	...	149	500	117	Double bay E.W., large oscillations.	Bay — +, large oscillations	Bay + —, large oscillations.	
7	04	29	...	18	58	...	A.	90	...	...	18	42 W.	42—	42—	61	67	59	Bay W.E.	Bay — + ...	Bay — +.	
...	04	36	...	19	5	r.	A.	90	...	...	19	14 W.	...	22+	63	48	91	Bay W.E.	Irregular	Bay + —.	
...	06	00	...	20	29	...	A.	90	...	...	20	38 E.	...	...	50	31	31	Irregular	Irregular	Irregular.	
9	19	35	9	10	4	...	A.	10	N.	9	10	...	...	...	24	10	17	Irregular	Small oscillations	Small oscillations.	
...	21	45	...	12	14	...	C.	12	N.	...	12	...	...	11+	40	34	57	Bay E.W.	Irregular	Bay + —.	
10	22	00	10	12	29	...	A.	8	N.N.E.	10	12	17 E.	...	...	13	10	16	Short bay E.W.	Trifling oscillations ...	Small oscillations.	
...	22	47	...	13	16	...	A.	...	...	...	13	12 E.	...	12+	19	7	17	Bay E.W.	Trifling oscillations ...	Trace of bay + —.	
11	06	20	...	20	49	...	C.	90	...	...	20	...	...	10+	21	15	30	Irregular	Small oscillations	Bay + —.	
12	18	00	12	8	29	...	A.	15	N.	12	8	...	...	...	...	7	10	No trace	Rather quiet	Rather quiet.	
...	20	17	...	10	46	...	A.	10	N.	...	10	...	...	...	...	5	7	No trace	Rather quiet	Rather quiet.	
13	01	05	...	15	34	...	A.	20	N.	...	15	...	10+	...	...	12	11	No trace	Irregular	Irregular.	
...	06	00	...	20	29	...	B.	90	...	...	20	...	...	...	...	6	5	No trace	Rather quiet	Rather quiet.	

TABLE LXXII.—*Continued.*

Auroral Data.										Magnetic Data.											
Time of Occurrence.						Colour.	Type.	Alt.	Dir.	Times of Turning Points.					Range in Hour.			Characteristics of Magnetic Curves.			
Local.			Greenwich.									D.	H.	V.	D.	H.	V.	D.	H.	V.
d	h	m	d	h	m			°		d	h	m	m	m	γ	γ	γ			
July 1912.																				
14	17	57	14	8	26	...	C.	80	N.E.	14	8	...	...	...	5	7	...	Rather quiet	Rather quiet	No trace.
...	22	35	...	13	4	...	B.S.	...	N.E.	...	13	3 E.	...	...	14	9	...	Undulations	Small undulations	No trace.
15	04	15	...	18	44	...	B	...	N.W.	...	18	...	...	...	7	8	...	Rather quiet	Rather quiet	No trace.
...	06	45	...	21	14	...	C.	90	...	...	21	...	5—	...	13	20	...	Undulations	Undulations	No trace.
...	18	00	15	8	29	...	A.	5	N.E.	15	8	45 E.	59—	59—	14	22	11	Bay E. W.	Bay — + ...	Bay — +.
18	06	00	17	20	29	...	C.	30	N.N.E.	17	20	26 W.	...	44+	26	20	25	Irregular	Irregular	Irregular.
20	00	39	19	15	8	...	C.P.	40	N.E.	19	15	26 E.	...	...	14	11	12	Irregular	Small oscillations	Irregular.
...	22	15	20	12	44	...	A.S.	30	N.	20	12	...	33+	...	32	19	29	Oscillatory change to east ...	Irregular	Irregular rise.
21	06	00	...	20	29	...	C.A.	90	...	...	20	15 E.	...	...	9	7	10	Irregular	Small oscillations	Small oscillations.
Aug., 1912.																				
3	22	50	3	13	19	...	C.S.	40	N.	3	13	...	20—	...	28	30	52	Oscillatory change to west ...	Irregular	Oscillatory fall.
4	06	05	...	20	34	...	C.	90	...	...	20	31 W.	50+	48+	22	36	29	Irregular	Irregular	Irregular.
6	16	30	6	6	59	...	C.	4	E.N.E.	6	6	...	40+	40+	186	118	70	Bay E.W.	Bay — + after rise ...	Bay — + after rise.
...	17	00	...	7	29	y.p.g.	C.	...	...	...	7	12 E.	20—	1—	211	104	69	Bay E.W.	Bay — + after rise ...	Bay — + after rise.
...	17	36	...	8	5	...	A.	3	E.	...	8	...	...	...	30	91	21	Irregular	Nearly steady rise	Fairly regular rise.
...	19	26	...	9	55	...	A.	8	N.E.	...	9	54 E.	54+	54+	71	17	32	Bay E.W.	Irregular	Bay + — after fall.
...	19	36	...	10	5	...	A.	...	...	...	10	33 W.	59—	59—	47	36	31	Bay E.W.	Irregular	Bay + — after fall.
...	21	00	...	11	29	...	B.	6	N.E.	...	11	0 E.	48—	48—	21	32	38	Bay E.W.	Bay + —	Bay + —.
...	21	32	...	12	1	...	C.	12	N.N.E.	...	12	45 W.	...	...	45	40	20	Bay E.W.	Rise, small oscillations ...	Irregular, oscillations.
...	22	56	...	13	25	...	C.	8	N.E.	...	13	8 E.	...	27+	39	43	52	Oscillatory change to west ...	Irregular	Bay + —.
7	01	22	...	15	51	...	C.	15	N.	...	15	0 W.	...	15—	20	28	45	Irregular	Irregular	Irregular.
10	05	20	9	19	49	...	C.	...	...	9	19	55 E.	...	50—	31	20	17	Oscillatory change to east ...	Irregular	Irregular.
...	22	30	10	12	59	...	C.A.	90	...	10	12	59 E.	...	27—	14	11	13	Small oscillations	Small oscillations	Small oscillations.
11	19	30	11	9	59	...	B.	15	N.E.	11	9	...	15—	15—	8	17	20	Small oscillations	Small oscillations	Small oscillations.
...	23	50	...	14	19	...	C.	5	N.	...	14	9, 53 E.	7, 42 +	8, 42 +	10	15	16	Two bays, each E.W. ...	Two bays each + — ...	Two bays each + —.
12	21	00	12	11	29	...	A.	5	N.	12	11	55 W.	...	...	9	5	4	Small oscillations	Rather quiet	Rather quiet.

TABLE LXXII.—*Continued.*

Auroral Data.										Magnetic Data.												
Time of Occurrence.						Colour.	Type.	Alt.	Dir.	Times of Turning Points.					Range in Hour.			Characteristics of Magnetic Curves.				
Local.			Greenwich.									D.	H.	V.	D.	H.	V.	D.	H.	V.		
d	h	m	d	h	m			°		d	h	m	m	m	γ	γ	γ					
Aug., 1912.																						
...	22	50	...	13	19	...	A.	4	N.N.E.	...	13	40 E.	...	...	7	4	5	Small oscillations	Rather quiet	Rather quiet.		
...	24	00	...	14	29	...	A.	6	N.E.	...	14	...	...	...	3	3	6	Rather quiet	Rather quiet	Small undulations.		
13	05	25	...	19	54	...	C.	90	...	...	19	...	35–	...	20	17	11	Oscillatory change to east	Undulations	Undulations.		
...	05	40	...	20	9	...	C.	90	...	...	20	1 E.	50+	...	20	19	13	Irregular	Irregular	Undulations.		
16	18	00	16	8	29	...	C.	10	E.	16	8	31 W.	...	...	19	8	13	Irregular	Rather quiet	Undulations.		
...	22	25	...	12	54	...	C.S.	10	N.	...	12	45 E.	41+	41+	37	16	37	Bay E.W.	Bay + —	Bay + —.		
...	22	35	...	13	4	...	A.	10	N.	...	13	...	...	...	32	13	40	Bay E.W.	Bay + —	Bay + —.		
21	20	20	21	10	49	v.p.	A.	5	N.N.E.	21	10	...	56+	56+	63	15	45	Bay E. W.	Irregular	Irregular.		
...	...	...	...	...	...	...	...	...	...	...	11	2 E.	...	...	54	19	19	Bay E.W.	Irregular	Irregular.		
Sept., 1912.																						
4	20	45	4	11	14	...	C.S.	30	N.	4	11	20 E.	33—	20+	71	20	41	Bay E.W.	Irregular	Bay + —.		
...	21	50	...	12	19	...	C.	5	N.	...	12	...	42+	...	35	30	24	Irregular	Irregular	Irregular.		
12	20	26	12	10	55	r.	A.S.	5	N.	12	10	50 E.	50+	58+	87	47	74	Bay E.W.	Bay + —	Bay + —		
...	20	37	...	11	6	...	A.	...	...	...	11	...	...	...	54	31	59	Bay E.W.	Bay + —	Bay + —.		
13	21	00	13	11	29	...	A.	2·5	N.	13	11	18 E.	...	25+	17	3	9	Shallow bay E.W.	Nearly level	Shallow bay + —.		
...	22	36	...	13	5	...	A.	5	N.	...	13	27 E.	18+	18+	19	25	24	Bay E.W.	Bay + —	Bay + —.		
14	01	00	...	15	29	...	A.	5	N.	...	15	34 W.	...	...	10	7	7	Irregular	Irregular	Irregular.		
...	24	00	14	14	29	...	A.	4	N.N.E.	14	14	40 E.	42+	42+	9	9	15	Bay E.W.	Small undulation	Small undulation.		
15	03	20		17	49	...	A.	90	...	...	17	...	...	...	8	6	5	Rather quiet	Rather quiet	Rather quiet.		
16	21	00	16	11	29	...	A.	5	N.	16	11	2 E.	2+	2+	17	34	37	Double bay E.W.	Bay + —	Bay + —.		
17	03	04	...	17	33	...	C.A.	90	...	...	17	33 W.	...	...	12	11	10	Irregular	Irregular	Irregular.		
...	04	15	...	18	44	...	C.	90	...	...	18	...	...	...	7	5	7	Irregular	Small oscillations	Small oscillations.		
18	21	25	18	11	54·5	r.p.g.	C.	90	...	18	11	40 E.	{40+ 58—}	55+	117	269	226	Bay E.W., oscillations	Oscillations	Bay + —, oscillations.		
...	21	45	...	12	14	...	C.	30	N.	...	12	...	...	...	62	95	118	Bay E.W., oscillations	Oscillations	Bay + —, oscillations.		
20	01	28	19	15	57	...	C.	9	N.	19	15	...	...	...	17	30	34	Undulations	Undulations	Irregular.		
...	01	50	...	16	19	...	C.	12	N.W.	...	16	42 W.	48+	...	29	20	45	Undulations	Undulations	Undulations.		
...	23	50	20	14	19	...	C.	14	N.	20	14	15 W.	20+	28+	26	30	37	Irregular	Bay + —	Bay + —.		
...	...	...	...	...	...	...	...	...	...	24	9	52 E.	...	54+	97	50	73	Double bay E.W.	Irregular rise	Irregular.		
24	20	03	24	10	32	...	A.	8	N.	...	10	7 E.	...	...	120	71	37	Double bay E.W.	Irregular rise	Irregular.		

TABLE LXXII.—*Continued.*

Auroral Data.											Magnetic Data.									
Time of Occurrence.						Colour.	Type.	Alt.	Dir.	Times of Turning Points.					Range in Hour.			Characteristics of Magnetic Curves.		
Local.			Greenwich.									D.	H.	V.	D.	H.	V.	D.	H.	V.
d	h	m	d	h	m			°		d	h	m	m	m	γ	γ	γ			
Oct., 1912.																				
10	23	26	10	13	55	...	C.	2	N.	10	13	52 E.	50+	50+	11	20	28	Irregular	Bay +—	Bay +—.
14	20	50	14	11	19	...	A.	14	N.N.E.	14	11	38 E.	44+	42+	30	50	57	Bay E.W.	Bay +—	Bay +—.
...	22	29	...	12	58	...	S.	...	...	...	12	...	53+	...	36	40	57	Bay E.W.	Bay +—	Bay +—.
...	...	...	...	...	...	...	...	...	...	...	13	8 E.	...	10+	99	34	73	Bay E.W.	Bay +—	Bay +—.
15	22	15	15	12	44	r.g.	C.	18	N.W.	15	12	...	54+	54+	83	113	170	Bay E.W.	Bay +—	Bay +—.
...	...	...	...	...	...	...	...	...	...	...	13	2 E.	...	...	73	73	133	Bay E.W.	Bay +—	Bay +—.
17	21	45	17	12	14	r.	A.	20	N.E.	17	12	48 W.	...	...	28	13	24	Irregular	Irregular	Irregular.
Mar., 1913.																				
16	02	30	15	16	59	...	C.	70	N.W.	15	16	25 E.	...	...	34	22	16	Bay E.W.	Irregular	Irregular.
April, 1913.																				
4	03	30	3	17	59	...	C.	90	...	3	17	48 E.	50+	...	17	10	10	Bay E.W.	Bay +—	Irregular.
10	05	00	9	19	29	...	C.	6	N.N.W.	9	19	10 W.	45—	30—	90	54	57	Irregular	Irregular	Irregular.
14	21	06	14	11	35	...	C.	10	N.	14	11	38 W.	50+	50+	25	12	16	Irregular	Irregular	Irregular.
15	23	15	15	13	44	...	A.S.	6	N.E.	15	13	...	...	...	8	6	8	Rather quiet	Rather quiet	Rather quiet.
16	22	25	16	12	54	...	C.S.	40	E.N.E.	16	12	...	47+	58+	59	60	120	Bay E.W. oscillations ...	Bay +— oscillations ...	Bay +— oscillations.
...	...	...	...	...	...	...	...	...	...	...	13	O.E.	...	...	60	27	71	Bay E.W. oscillations ...	Bay +— oscillations ...	Bay +— oscillations.
May, 1913.																				
5	20	15	5	10	44	r.	A.	6	N.	5	10	15 E.	17—	20+	58	25	25	Bay E.W.	Irregular	Double bay +—.
9	21	50	9	12	19	...	C.	50	N.E.	9	12	6 E.	...	25+	26	29	44	Bay E.W.	Irregular	Bay +—.
...	23	04	...	13	33	...	C.	45	N.N.E.	...	13	54 W.	54—	58+	41	48	63	Irregular	Bay —+	Bay +—.
29	23	41	29	14	10	...	B.C.	90	...	29	14	18 W.	40—	27+	69	92	55	Bay W.E., oscillations ...	Bay —+, oscillations ...	Bay +—, oscillations.
30	21	50	30	12	19	...	G.	...	N.E.	30	12	19 E.	15+	21+	41	23	43	Bay E.W.	Bay +—	Bay +—.
...	22	47	...	13	16	...	B.	14	N.N.E.	...	13	...	...	...	10	6	8	Irregular	Rather quiet	Irregular.
31	06	00	...	20	29	...	C.	90	...	...	20	...	...	...	18	24	16	Undulations	Undulations	Undulations.

TABLE LXXII.—*Continued.*

Auroral Data.										Magnetic Data.										
Time of Occurrence.						Colour.	Type.	Alt.	Dir.	Times of Turning Points.					Range in Hour.			Characteristics of Magnetic Curves.		
Local.			Greenwich.									D.	H.	V.	D.	H.	V.	D.	H.	V.
d	h	m	d	h	m			°		d	h	m	m	m	γ	γ	γ			
June, 1913.																				
2	01	00	1	15	29	...	C.B.	45	N.N.W.	1	15	30 W.	32—	32—	26	20	18	Irregular	Irregular	Irregular.
...	18	14	2	8	43	...	B.	5	N.	2	8	55 E.	...	...	29	18	16	Bay E.W.	Bay — + ...	Bay — +.
...	...	...	...	...	...	...	...	...	...	...	9	...	2—	2—	21	18	24	Bay E.W.	Bay — + ...	Bay — +.
...	22	25	...	12	54	...	A.	5	N.	...	12	...	...	...	12	17	16	Undulations	Undulations	Undulations.
4	00	50	3	15	19	...	B.	15	N.	3	15	10 W.	...	...	19	23	22	Undulations	Irregular	Irregular.
5	19	38	5	10	7	...	C.	35	N.N.E.	5	10	12 E.	...	30—	15	14	11	Bay E.W.	Irregular	Rather quiet.
...	23	20	...	13	49	...	B.S.	15	N.N.W.	...	13	46 W.	50 +	50 +	7	15	21	Small oscillations	Irregular	Irregular.
6	16	43	6	7	12	...	B.	25	N.	6	7	11 E.	12 +	14 +	21	11	16	Bay E.W.	Irregular	Bay + —.
...	19	30	...	9	59	...	A.	8	N.E.	...	9	48 W.	...	...	16	14	10	Irregular	Irregular	Irregular.
...	20	24	...	10	53	...	A.	12	N.	...	10	36 E.	...	...	21	15	14	Irregular	Irregular	Irregular.
...	21	00	...	11	29	...	A.	12	N.	...	11	10 W.	...	...	18	10	10	Irregular	Irregular	Irregular.
...	22	42	...	13	11	...	S.	45	N.	...	13	...	...	5 +	18	10	22	Irregular	Irregular	Irregular, fall.
11	22	54	11	13	23	r.	C.	...	N.	11	13	38 E.	30 +	30 +	26	22	27	Bay E.W.	Bay + —	Bay + —.
19	23	04	19	13	33	...	C.	90	...	19	13	{33 W. {40 E.	{12 + {48—	35 +	49	94	111	Bay E.W., oscillations ...	Oscillations	Bay + —, oscillations.
20	00	33	...	15	2	r.	A.	12	N.N.W.	...	15	...	...	...	19	18	22	Irregular	Small bay + —	Bay + —.
23	22	13	23	12	42	...	A.	35	N.	23	12	30 E.	...	36 +	18	15	37	Bay E.W.	Irregular	Bay + —.
25	21	35	25	12	4	...	B.	5	N.N.E.	25	12	...	...	25—	5	5	6	Rather quiet	Rather quiet	Small undulations.
...	24	00	...	14	29	...	A.	45	N.N.E.	...	14	...	...	55 +	7	10	12	Irregular	Small oscillations	Small oscillations.
30	03	50	29	18	19	...	C.	> 30	N.E.	29	18	35 E.	36 +	36 +	20	12	17	Bay E.W.	Irregular	Undulations.
...	06	30	...	20	59	...	C.	< 90	...	...	20	59 E.	52 +	54 +	40	24	28	Undulations	Undulations	Undulations.
...	19	14	30	9	43	...	B.S.	10	N.E.	30	9	15 E.	24—	...	30	28	21	Bay E.W.	Bay — + ...	Irregular.
...	20	50	...	11	19	...	B.	30	N.N.E.	...	11	...	40—	57 +	23	27	24	Undulations	Irregular	Irregular.
...	22	00	...	12	29	...	B.S.	35	N.	...	12	...	...	55—	18	13	26	Undulations	Irregular rise	Irregular fall.
July, 1913.																				
1	01	20	...	15	49	...	B.	20	N.E.	...	15	...	3 +	...	22	23	23	Irregular	Irregular fall	Irregular fall.
...	05	10	...	19	39	...	C.	90	...	...	19	15 E.	...	...	20	12	15	Irregular	Irregular	Irregular.
...	07	12	...	21	41	...	C.	90	...	...	21	29 W.	33—	...	46	20	23	Bay W.E.	Undulations	Undulations.

Table LXXII.—*Continued.*

Auroral Data.										Magnetic Data.											
Time of Occurrence						Colour.	Type.	Alt.	Dir.	Times of Turning Points.					Range in Hour.			Characteristics of Magnetic Curves.		
Local.			Greenwich.									D.	H.	V.	D.	H.	V.	D.	H.	V.
d	h	m	d	h	m			°		d	h	m	m	m	γ	γ	γ			
July, 1913.																					
...	...	...	...	...	...	...	...	...	...	3	9	57 E.	52+	57+	55	15	23	Bay E.W.	Mainly — +	Bay + —.
3	19	39	3	10	8	...	C.	2	N.N.E.	...	10	...	6—	10—	43	29	25	Bay E.W.	Mainly — +	Bay + —.
...	22	37	...	13	6	...	B.S.	35	N.	...	13	24 W.	...	...	11	5	6	Irregular	Rather quiet	Rather quiet.
...	23	40	...	14	9	...	B.	15	E.N.E.	...	14	54 E.	...	...	7	6	6	Rather quiet	Rather quiet	Rather quiet.
4	23	00	4	13	29	...	B.	25	N.	4	13	...	38+	38+	5	8	9	Rather quiet	Shallow bay + —	Shallow bay + —.
...	24	00	...	14	29	...	B.	12	N.N.W.	...	14	...	20+	20+	5	8	7	Rather quiet	Shallow bay + —	Shallow bay + —.
6	16	35	6	7	4	...	C.	30	N.E.	6	7	...	...	...	4	4	5	Rather quiet	Rather quiet	Rather quiet.
...	22	56	...	13	25	...	C.	>70	S.S.W.	...	13	...	...	...	4	2	6	Rather quiet	Quiet	Rather quiet.
7	22	09	7	12	38	...	B.S.	10	N.E.	7	12	43 E.	...	57+	25	5	16	Bay E. W.	Irregular	Bay + —.
...	23	12	...	13	41	r.	C.	35	N.	...	13	55 W.	{37+ 55—	58+	26	47	56	Irregular, oscillations	Mainly + — +	Bay + —.
8	05	00	...	19	29	...	A.	90	...	...	19	30 W.	50+	...	13	16	24	Irregular	Undulations	Irregular.
...	07	00	...	21	29	...	A.	90	...	...	21	27 W.	18+	18+	15	13	11	Irregular	Undulations	Undulations.
...	22	32	8	13	1	...	C.	25	N.E.	3	13	4 E.	15+	23+	18	12	16	Bay E.W.	Bay + —	Bay + —.
10	22	15	10	12	44	...	B.	30	N.	10	12	40 E.	...	...	27	13	...	Irregular	Irregular	Trace too faint.
...	22	53	...	13	22	r.	B.	35	N.N.E.	...	13	...	...	...	15	15	...	Irregular to west	Irregular rise	Trace too faint.
11	00	20	...	14	49	...	C.	15	N.	...	14	...	55+	50+	15	17	...	Irregular	Irregular rise	Trace too faint.
...	01	04	...	15	33	...	B.	15	N.	...	15	...	...	...	18	8	...	Irregular to west	Irregular	Trace too faint.
...	02	03	...	16	32	...	C.	20	N.N.W.	...	16	42 W.	...	...	14	11	...	Irregular	Irregular	Trace too faint.
22	23	22	22	13	51	...	B.	30	N.N.E.	22	13	...	...	...	13	24	31	Irregular	Irregular rise	Irregular.
23	00	35	...	15	4	...	B.	20	N.	...	15	...	9+	24+	10	20	26	Irregular	Irregular fall	Irregular.
26	04	00	25	18	29	...	C.	90	...	25	18	29 E.	29+	26+	42	33	42	Bay E.W.	Bay + —	Bay + —.
...	21	06	26	11	35	...	A.	12	N.	26	11	...	...	...	9	4	5	Undulations	Rather quiet	Rather quiet.
...	22	07	...	12	36	...	A.	...	N.	...	12	32 E.	...	35+	12	5	7	Bay E. W.	Irregular	Short bay + —.
27	00	43	...	15	12	...	C.B.P.	15	...	...	15	...	...	...	7	4	4	Rather quiet	Rather quiet	Rather quiet.
...	01	38	...	16	7	...	B.S.	6	N.E.	...	16	42 W.	...	35+	21	5	8	Bay W.E.	Irregular	Irregular.
...	03	00	...	17	29	...	C.	...	N.W.	...	17	7 W.	12+	35+	31	13	24	Bay W.E.	Irregular	Bay + —.
...	05	00	...	19	29	...	C.	90	...	...	19	18 W.	...	15+	14	18	22	Irregular	Irregular	Irregular.
...	06	00	...	20	29	...	C.	90	...	...	20	...	35+	...	11	10	12	Irregular	Irregular	Undulations.
...	17	18	27	7	47	...	A.	15	N.N.E.	27	7	...	...	...	7	13	6	Irregular	Irregular fall	Irregular.

Table LXXII.—*Continued.*

Auroral Data.										Magnetic Data.									
Time of Occurrence.						Colour.	Type.	Alt.	Dir.	Times of Turning Points.					Range in Hour.			Characteristics of Magnetic Curves.		
Local.			Greenwich.									D.	H.	V.	D.	H.	V.	D.	H.	V.
d	h	m	d	h	m			°		d	h	m	m	m	γ	γ	γ			
July, 1913.																				
...	18	00	...	8	29	...	B.	10	N.N.E.	...	8	...	50—	...	6	9	15	Undulations	Irregular	Irregular.
...	18	32	...	9	1	...	A.	15	N.	...	9	10 W.	...	...	7	9	10	Irregular	Undulations	Undulations.
...	20	00	...	10	29	...	C.S.	...	...	...	10	20 E.	...	25—	12	5	9	Irregular	Irregular	Irregular.
...	21	00	...	11	29	...	A.	...	N.	...	11	...	...	...	6	4	5	Irregular	Irregular	Irregular.
...	22	30	...	12	59	...	A.	7	N.	...	12	...	...	...	10	8	7	Irregular to west	Irregular	Irregular.
28	00	35	27	15	4	...	C.	90	...	27	15	25 W.	45—	45—	13	9	11	Undulations	Irregular	Irregular.
...	21	23	28	11	52	...	A.S.	15	E.N.E.	28	11	...	...	...	13	2	3	Bay E.W.	Rather quiet	Bay + —.
...	21	35	...	12	4	...	A.	12	E.N.E.	...	12	6 E.	...	8+	10	4	8	Bay E.W.	Undulations	Bay + —.
...	23	18	...	13	47	...	A.	15	N.	...	13	50 E.	42+	42+	10	9	12	Bay E.W.	Bay + —	Bay + —.
29	00	45	...	15	14	...	C.G.	15	N.	...	15	...	1+	...	9	13	8	Irregular	Undulations	Irregular.
...	20	00	29	10	29	...	C.	45	N.N.E.	...	10	31 E.	33—	...	8	6	5	Irregular	Undulations	Rather quiet.
30	00	36	...	15	5	...	A.	3	N.	...	15	...	...	...	8	7	9	Small short period oscillations	Short period oscillations	Short period oscillations.
...	05	50	...	20	19	...	C.	90	...	...	20	...	...	...	12	7	20	Irregular to west	Irregular	Irregular fall.
...	20	03	30	10	32	...	...	18	E.N.E.	30	10	31 E.	37—	...	13	9	10	Bay E.W.	Irregular	Irregular.
31	19	20	31	9	49	...	A.	12	N.N.W.	31	9	...	...	...	8	7	5	Irregular	Irregular	Irregular.
Aug., 1913.																				
1	03	00	*	17	29	...	C.	10	N.	*	17	3 W.	15+	16+	21	16	20	Bay W.E.	Bay + —	Bay + —.
...	03	46	*	18	15	...	C.	30	N.E.	*	18	57 W.	...	...	14	5	13	Irregular	Irregular	Irregular.
...	05	30	*	19	59	...	C.	90	...	*	19	35 E.	...	...	12	8	10	Irregular	Irregular	Irregular.
...	06	30	*	20	59	...	C.	90	...	*	20	10 40 E.	16 48 +	16 48 +	19	16	15	Double bay E.W.	Double bay + —	Double bay + —.
5	23	21	5	13	50	...	C.	5	N.E.	5	13	...	...	...	15	5	...	Irregular	Rather quiet	No trace.
6	00	15	5	14	44	...	A.	20	N.	5	14	...	...	...	7	4	...	Irregular	Rather quiet	No trace.
...	18	30	6	8	59	...	B.P.	10	N.E.	6	8	31 W.	40+	...	15	21	20	Irregular	Bay + —	Irregular.
...	20	00	...	10	29	...	A.	12	N.N.W.	...	10	...	...	...	13	6	5	Irregular	Irregular	Rather quiet.
...	21	36	...	12	5	...	A.	12	N.N.W.	...	12	...	...	...	7	4	3	Irregular	Rather quiet	Rather quiet.
8	04	00	7	18	29	...	C.	90	...	7	18	...	...	...	4	4	5	Rather quiet	Rather quiet	Rather quiet.

* July 31st.

TABLE LXXIII.—Hourly Ranges on Occasions of Bright Aurora.

Hour (G.M.T.) ending at—	Occurrences.	Mean hourly range.			June, 1912.				September, 1912.			
					H hourly range.		V hourly range.		H hourly range.		V hourly range.	
		D	H	V	Aurora	All	Aurora	All	Aurora	All	Aurora	All
h.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
7	1	186	118	70	...	...	...	...	...	...	...	...
8	6	65	35	29	...	...	...	...	...	...	...	...
9	8	22	30	20	...	...	...	...	...	...	...	...
10	11	34	23	26	...	...	...	...	50 (1)	15	73 (1)	17
11	17	40	31	33	26 (1)	18	50 (1)	20	59 (2)	18	55 (2)	20
12	22	52	62	53	21 (4)	30	45 (4)	33	71 (5)	25	74 (5)	31
13	35	39	53	50	74 (7)	33	78 (7)	41	62 (2)	17	71 (2)	22
14	33	33	43	61	123 (5)	33	137 (5)	44	25 (1)	14	24 (1)	19
15	16	36	41	59	76 (4)	29	134 (4)	41	19 (2)	12	26 (2)	16
16	17	30	35	42	81 (3)	28	133 (3)	39	18 (2)	14	20 (2)	16
17	6	41	33	29	8 (2)	12	16 (2)	17	20 (1)	11	45 (1)	15
18	7	32	16	22	42 (1)	14	74 (1)	19	8 (2)	14	8 (2)	20
19	9	34	22	36	26 (2)	14	87 (2)	23	5 (1)	17	7 (1)	21
20	12	27	20	28	12 (2)	16	28 (2)	23	...	...	...	...
21	19	25	21	26	24 (5)	22	40 (5)	25	...	...	...	...
22	6	51	31	39	25 (2)	26	26 (2)	24	...	...	...	...
23	2	78	47	59	18 (1)	27	28 (1)	31	...	...	...	...
Totals and Means, 1912 and 1913	227	37	38	43	...	...	...	...	...	...	...	...
Totals and Means, 1912 alone...	140	48	52	56	54	26	77	33	42	17	46	22
Totals and Means, 1913 alone...	87	20	17	21								

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LIST OF TABLES.—*Continued.*