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1911-14

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

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SERIES B.
VOL. II.

TERRESTRIAL MAGNETISM AND RELATED OBSERVATIONS.

PART IV.

THE TRANSMISSION OF WIRELESS SIGNALS

IN RELATION TO

MAGNETIC AND AURORAL DISTURBANCES

BY

CHARLES SEYMOUR WRIGHT, C.B., O.B.E., M.C., M.A.

WITH FIFTY-EIGHT TABLES AND SEVENTEEN TEXT FIGURES.

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CONTENTS.

THE TRANSMISSION OF WIRELESS SIGNALS IN RELATION TO MAGNETIC AND AURORAL DISTURBANCES.

BY

C. S. WRIGHT.

WITH 58 TABLES AND 17 TEXT FIGURES.

I.—INTRODUCTION.

THIS Report includes the records of the wireless observations at two stations manned by the Australasian Antarctic Expedition, 1911–1914, under Sir Douglas Mawson, together with the comments of the wireless operators* and data relating to magnetic and auroral phenomena with which the wireless records might be related.

The wireless stations were situated at

1. Cape Denison, Adelie Land (67° 00′ S., 142° 40′ E.)—the Main Antarctic Base.†

2. Macquarie Island (54° 30′ S., 158° 57′ E.)—the Subantarctic Base.

The following wireless records were available for this Report:—

(1) The wireless log of the Adelie Land station for 1913, from the journals of S. N. Jeffryes, F. H. Bickerton and R. Bage, who acted as operators from time to time. This log covers the period March 6th to November 13th, but there are gaps in the record, particularly between April 26th and May 21st, and between June 9th and August 4th. The latter gap was due to the breakage of the wireless mast just below the topgallant cap. This log is reproduced* in Appendix I.

(2) The wireless log of the Macquarie Island station from February 13th, 1912, to August 19th, 1913. A. J. Sawyer acted as operator during that period and contributed a summary statement covering the operation of the station in this interval. The log and Mr. Sawyer's statement are given* in Appendix II.

(3) The wireless log of the Macquarie Island station from September 1st, 1913, to November 28th, 1913, with notes by Mr. C. F. Sandell, who acted as operator during this period. These are also reproduced* in Appendix II.

(4) The analysis of the work of the Macquarie Island station for 1914–1915 by the operator, Mr. F. J. Henderson. This analysis is reproduced in *Australian Monthly Weather Report*, vol. 4, No. 9.

(5) The logs of the wireless station at Wellington up to 1913, of *S.Y.* "Aurora" in February, 1914, and notes on tests between Macquarie Island and Awarua (N.Z.) wireless station were also available, but are not reproduced.

* The original intention of reproducing the "Wireless" logs as appendices to this Report has been abandoned, in order to reduce the cost of this publication—[Ed.].

† Recently, International agreement reached regarding the limits of Adelie Land places the observing station at Cape Denison within the territory of King George Land—[ED.].

It will be observed that simultaneous records for the Adelie Land and Macquarie Island stations are available only for the periods March 6th to June 8th, and August 5th to November 13th, 1913. This is due partly to the high winds experienced at Adelie Land, since the aerial could not be erected to its full height until some time early in 1913, and was again out of action for the same reason between June 9th and August 4th. The scattered nature of the records has made it difficult to deal with these and it would have been most helpful if the wireless log at Adelie Land had been kept in greater detail. It is easy, however, to be wise after the event, and there can be little doubt that some of the difficulties in compiling this Report are due to the great lapse of time since the observations were made. This results partly from the regretted death of Dr. Charles Chree, Sc.D., F.R.S., to whom the discussion of the observations was first entrusted and who had made some progress with the work before the data was handed to the writer. Considerable delay has also occurred since then, and the Report has had to be compiled at intervals as the demands of other work have permitted. Some of the observations only became available at a late date, which has necessitated the revision of the tabulated data.

The wireless logs consist largely of the record of times, messages sent and received, stations heard (with some indication of the strength of signals on an arbitrary scale), amount of interference by other stations or by " statics " (usually denoted by the letter " x "). In the case of the Adelie Land records, there is frequent reference to St. Elmo's Fire. This was caused at low temperatures by drifting snow which resulted in the development of such high potentials that pointed objects, including the wireless masts, could be seen to glow. The effect of these conditions was often to render wireless reception impossible on account of the local discharges of electricity.

The inability to hear another wireless station may be due to the power of the transmitter being insufficient to drown the noise of the various types of interference heard by the receiving station. An apparent lack of response from station B to a call by station A may thus be due to the fact that the background of noise at station B is too great, or that the noise at station A is so great that operator A cannot hear B's reply. B might also be unable to reply because he was otherwise engaged. These circumstances render the interpretation of the logs so difficult that it is necessary to exercise some judgment in deciding what is, and what is not, relevant. It must also be borne in mind that the records refer to the era of crystal reception with all the attendant uncertainty whether the crystal was adjusted to be as sensitive as possible.

In dealing with observations of this type it is necessary to place full reliance on the opinions and impressions of the station operators. This cannot (and should not) be avoided. Confirmation of these opinions must be sought by examination of all the available data, since the difficulties of taking the observations should not obscure any real correlations which exist. If, for example, the wireless operators, on the watch for some association between strength of wireless signals and visible auroral activity, assert that such an association exists, this can be tested with all the available data and, if

confirmed, may give sufficient confidence in the operator's judgment so that other statements, not capable of confirmation, may be accepted even if the evidence (for example the exact times when the phenomena waxed and waned) is not precisely stated in the log.

One of the chief objects in erecting the wireless stations at Adelie Land and Macquarie Island was to ensure the transmission of weather reports to Australia and New Zealand—a service which was surprisingly well maintained during part of the time. One function of the Macquarie Island station was thus that of a relay station, since the distances from the Antarctic continent to Australia and New Zealand were too great for reliable direct communication. The data assume a special importance from the circumstance that the wavelength used (600 metres) is very unlikely to prove the best for long range communication in high latitudes in the light of modern experience.

The wireless equipment at the two stations comprised the standard 1½ KW. Telefunken equipment for ships, driven by a 9 h.p. De Dion petrol engine. The aerial at Macquarie Island, four wires 200 feet in length, was suspended 80 feet above the ground between two masts and was probably led in to the transmitter from one end, the aerial system being thus of the inverted " L " type. Complete details of the gear are not available. From references in the operators' logs, it appears that the normal current in the aerial was about 13 amperes. The station at Macquarie Island was erected on the summit of a hill about 350 feet high at the northern extremity of the island.

Neither station was manned continuously and communication between them was possible only during the hours of darkness. The period of observation, indeed, varied with circumstances, but the Adelie Land station was, generally speaking, in operation at least until 11 p.m. local time, unless conditions were so unfavourable as to preclude the possibility of communication. The maximum range of communication was surprisingly great. The Adelie Land station was occasionally heard in New Zealand while Macquarie Island frequently reported strong signals from stations nearly 3,000 miles away. Reception of Macquarie Island at Adelie Land was often interfered with by " jamming " due to ships in the Australian Bight and by the land stations at Melbourne and Hobart.

A cursory glance at the wireless logs and the operators' statements in the Appendices* will show that communication between the two stations was rarely sustained, in the sense that the strength of signals usually varied, during the observation period, from strong signals to very weak or inaudible signals, which represents a very big range in absolute intensity of sound. The best conditions for communication are obviously associated with a constant signal strength of adequate intensity. However, when only a short message has to be transmitted and interference is serious, the receiving station may prefer short intervals of great signal strength than signals of constant strength, but of such small intensity that the message would be difficult to read.

* The cost of printing the " wireless logs " has been found so great that their reproduction as appendices to this Report has been abandoned—[Ed.].

Generally speaking, the operators' logs did not include many comments on the general excellence of communication or the reverse, but referred to the signals received at any moment as "not heard," "very faint," "faint," "moderate," "strong," "variable," "very faint to strong," or simply "heard." In attempting to correlate the strength of signals in any hour with some other phenomenon such as magnetic activity, it is permissible to allocate arbitrary numbers such as—Not heard = 0, very faint = 1, faint = 2, moderate = 3, strong = 4 and very strong = 5. It is, of course, true that the operator's estimate (for example) of faint may vary somewhat from month to month and that the sound intensity corresponding to "very strong" = 5 may be some hundred times the intensity corresponding to "very weak" = 1. This scale of arbitrary numbers is the one which has been employed in this Report and seems to be adequate to show up any pronounced correlations when the number of observations is sufficiently great. Special difficulties, however, arise when the signal strength is very variable during the hour, as it is clearly not correct to assume that the value during the hour is equivalent to a constant signal strength of the mean value; that is, to assume that a signal strength varying from inaudible to strong is equivalent to a constant faint signal throughout the hour. In the absence of interference and with modern receiving apparatus, the constant faint signal would represent conditions satisfactory for communication, while the signal judged inaudible might still be inaudible with the best and most modern receiving apparatus. For reasons which are given later, the maximum strength of signal recorded in the hour is used to characterise the signal strength of the hour throughout this Report.

Except when otherwise stated, the times used in this Report are the times stated in the wireless logs. At Adelie Land, Local Time was used for the wireless log, which was thus about 9½ hours fast on Greenwich Time. Macquarie Island is stated to have usually employed time 10 hours ahead of Greenwich Time. There is, however, evidence that Sydney Time (about 36 mins. behind Macquarie Island Local Time) was sometimes used. For the purpose of this Report, the times stated in the wireless logs are treated as 9½ hours for Adelie Land, and 10 hours for Macquarie Island, ahead of Greenwich Time when we use data tabulated in Greenwich hours such as the hourly values of magnetic activity at Adelie Land.

Before attempting to examine in detail the observed signal strength for communication between the Antarctic and Subantarctic stations, it is useful to review the present state of our knowledge gleaned from wireless observations in other latitudes and using modern methods and apparatus. It must be admitted at the outset that there is a distinct lack of data relating to communication on the 600-metre wave, which was that employed. It is known that the waves travelling along the earth (the "direct" waves) are so greatly absorbed that they are ineffective at the ranges with which we are concerned and that daytime communication is not to be expected. The gradual bending or reflection of the "indirect" waves, which is responsible for communication at night time, depends on the intensity and distribution of ionisation in the atmosphere, on the wavelength and on the angles of incidence of the waves at the "reflecting" layer. In

lower latitudes this " Kennelly-Heaviside (or E) layer " is seldom, or never, penetrated by the 600-metre or longer waves. The layer develops a relatively sharp lower boundary during the night by recombination of the particles ionised by the sun during the preceding day. The height of this boundary increases during the night from about 80 to about 120 km. The absence of signals during the day is considered to be due to an insufficiently sharp lower boundary and to absorption of the waves by ionisation at lesser heights. During the night, the indirect waves will sometimes result in signals of constant strength, but signal strength may vary and result in " fading," due either to variation in strength of individual downcoming waves or to variations of phase between downcoming waves which have travelled different paths. Such variations in phase may result in a practically complete disappearance of signals, due to interference between waves travelling different paths.

The effect of magnetic disturbance on signal strength is not known with certainty for this wave-length. As magnetic disturbance is associated with visible aurora and as the latter is due to particles or waves emanating from the sun, which ionise the atmosphere when they are absorbed, it is reasonable to expect some correlation between signal strength, auroral activity and magnetic disturbance. The height of the aurora has been measured in high northern latitudes and the lower boundary shows a maximum frequency of occurrence at a height of about 100 km. There is thus a strong probability that the *Aurora Australis* is associated with ionisation both above and below the Kennelly-Heaviside layer. If this layer is the only one with which our 600-metre waves are concerned, we might expect an increase of absorption and reduction of signal strength if and when the aurora penetrated below this layer*, unless the conditions were such as to form a new (auroral) reflecting layer which might turn back the waves before they reached the Kennelly-Heaviside layer. The necessary conditions for this would be an adequate density of " auroral " ionisation and a sufficiently extended ionised layer with a sharp lower boundary at an appropriate place between the transmitting and receiving wireless stations. If these conditions are sometimes fulfilled either an increase or a decrease in signal strength is possible. Since, however, a brilliant aurora is generally one which changes quickly in visible intensity, in position and in shape, it seems likely that wireless signals at such times will be characterised by considerable variations in strength.

Another layer is known to exist in mean latitudes. During the night somewhat shorter waves than 600 metres sometimes penetrate the Kennelly-Heaviside layer and reach another one, the F-layer, which is more intensely ionised and which appears at heights between 220 and 300 km. This layer is most pronounced towards the morning and during the winter months. As the duration of sunlight in midwinter at Adelie Land is relatively short, the possibility has to be considered that the ionisation in the E-layer at night may be insufficient to reflect even waves of 600 metres length. If communication depends upon return of the waves from the F-layer, decrease of signal

* The injection of energy from the sun may also destroy the regularity of the reflecting layer in other ways

strength and variable signals are likely to be associated with auroral displays which are suitably positioned, the chief result being increased absorption due to sporadic ionisation below the F-layer.

On the whole, reduction in signal strength may be expected, possibly also increased variability of signals, on occasions when magnetic disturbance and auroral activity are pronounced. Since the maximum signals in any interval should occur when the reflecting layer is of adequate extent and has a sharp lower boundary, auroral activity and magnetic disturbance might be expected to show quite a close association with reduction of *maximum* signal strength.

Note added March 20th*, 1933.

Since the above was written, a paper by Morris and Brown has appeared in the January, 1933, number of the *Proceedings of the Institute of Radio Engineers* (p. 63 *et seq.*). This paper deals with the transmission characteristics of 14 to 50 metre waves over distances from 3,000 to 5,000 miles and especially their correlation with magnetic disturbance measured at observatories near the receiving stations. For these wavelengths, conditions during a prolonged magnetic storm often led first to improved reception followed by increased fading and then attenuation of signals, which sometimes then disappeared completely for hours or even days. This sequence affected the shorter waves first. The criterion for magnetic disturbance was the " summation range " based on the daily total of the hourly ranges of the horizontal magnetic field or of the horizontal and vertical magnetic fields combined. The authors claim that a method of prediction of future wireless conditions for these wavelengths has been evolved, based on the prediction of " summation ranges " and the high correlation of these with W/T transmission characteristics. The improved operating conditions of transmission paths which do not approach the auroral zone is suggested in this paper.

* Dr. Wright completed the manuscript for this paper about the year 1929, but publication has been delayed. The above note was forwarded subsequently for inclusion.—Ed.

II.—THE FREQUENCY OF OCCURRENCE OF SIGNALS OF DIFFERENT STRENGTH.

In estimating the frequency of occurrence of signals of different intensities, two special difficulties arise. One difficulty is the impossibility of assuring, in any period such as an hour, that the maximum signal strength which we use to characterise the hour is in fact characteristic of that hour. Continuous transmission from one and continuous reception at the other station would be necessary in order to obtain reliable data, whereas in point of fact the character of the hour has to be determined by very few and often by a single observation. In the nature of things the hour has to be characterised by a number whose magnitude depends to a considerable extent on the number of attempts which have been made to determine it, so that chance plays a considerable part in deciding the magnitude of that number when signal strength is variable. The other difficulty is associated with the estimation of signal strength which depends, amongst other things, on the state of the wireless receiver and is a personal estimate on a scale which may vary unconsciously with time. Also the operator's estimate is not always stated, but frequently is logged as "heard." In the tables of this Report, "heard" has been allotted the same number, 3, as "moderate strength" on the score that the signal would probably have been characterised by its faintness or its strength if it had been other than of mean strength.

Tables CXXV and CXXVI give the values of the maximum received signal strength which have been used to characterise each hour (and day) of reception at Adelie Land and Macquarie Island. It will be seen there a e many hours for which no data are available. The chief reason for using the maximum signal strength of the hour as the basis of calculation is that this maximum is considered to be the figure upon which the operators will have concentrated their attention. One might argue that emphasis should be laid upon the occurrences of inaudible and very faint signals on the score that continuous two-way communication is of chief importance and interest. Such a course has the serious objection that the absence of a recorded signal may be due to interference by statics or by other stations or to mal-adjustment of the receiver. By concentrating on the maximum signal in each hour (or day) we are doing what is possible to minimise such uncertainties. It is of course impossible to take account of all uncertainties. For example, if station A calls station B towards the end of an hourly period, B may be unable to reply until the beginning of the next hour and A will log "no reply" during the first of these periods.*

* A reply could not be sept until the petrol-engine for generating current had been started up.

TABLE CXXV.

ADELIE LAND.

Wireless Character of Received Signals.

Date, 1913.	Days.	Hours (Local Mean Time) centred at						Sum of hours.
		8 p.m.	9 p.m.	10 p.m.	11 p.m.	mid-night.	1 a.m. *	
March.								
6	1						...	1
7	3						3	3
8								
9								
10								
11	4			4				4
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23	3				3	3	3	9
24								
25	4				4	4	4	12
26	4				4	4		8
27	3				0	3	0	3
28	0			0	0	0		0
29	4			4	4	4	4	16
30	3							3
31	4		4	4	0	0		8
April.								
1	4	...	4	2	4	2	...	12
2	3	...	3	1	1	1	...	6
3	3		0	3	3	...	...	6
4	4	...	4	4	4	...	...	12
5	4	...	4	...	...	...	...	4
6	3	3	3	3	3	3	3	18
7	4		4	4	4	4	4	20
8	3		3	3	3	3	...	12
9	3		0	3	...	2	...	5
10	3		0	0	0	3	...	3
11	0		0	0	0	0	...	0
12	2		...	...	...	...	...	2
13	3		3	0	0	0		3
14	3		0	3	0	0	...	3
15	3		...	...	3	...	...	3
16	2	2	0	0	0	2	...	4
17	2	...	0	0	2	0	...	2
18	3	3	3	0	0	0	...	6
19	4	...	0	0	4	4	...	8
20	1	...	...	...	1	...	...	1
21	4	4	4	4	4	4	4	24
22	5	...	5	4	4	4	0	17
23	4	4	4	4	4	4	4	24
24	4	4	4	4	4	4	...	20
25	3	3	0	0	0	0	0	3
26	"Aurora appears to be causing much trouble. I get through to M.Q.I. only very rarely and then only for about an hour or less at one time. Signals seldom strong."							
27								
28								
29								
30								
May.								
1	"Aurora appears to be causing much trouble. I get through to M.Q.I. only very rarely and then only for about an hour or less at one time. Signals seldom strong."							
to								
20								
21								

Date, 1913.	Days.	Hours (Local Mean Time) centred at						Sum of hours.
		8 p.m.	9 p.m.	10 p.m.	11 p.m.	mid-nignt.	1 a.m. *	
May.								
22	2	...	...	...	...	2	...	2
23	3	...	3	3	3	3	...	12
24	2	...	...	2	0	0		2
25	3	...	...	...	...	...		3
26	3	...	2	0	0	3		5
27	1	...	1	0	0	0		1
28								
29	2	0	2	0	2	0		4
30	4	...	4	4	0	...		8
31		...	...	...	...	...		...
June.								
1	2		2	0	0	0		2
2	2		0	2	0	0	0	2
3	2		2	0	2	0	0	4
4	3	2	0	0	3	2	...	7
5	3		3	3	3	0	...	9
6	2		2	0	...	...	...	2
7	3	3	3	3	...	...		9
8								
9	"Wireless mast broke off just below top gallant cap. Operations will be suspended until a jury mast is erected."							
Aug.								
5	3	3	2	0	1	0		6
6	4	2	0	0	4	0		6
7	3	0	3	2	2	...		7
8	0		0	0	0	0		0
9	1	1	1	1	1	1		5
10	3	...	0	0	3			3
11	3	0	3	1	0			4
12	4	3	4	1	0	2		10
13	4	0	3	4	3	0		10
14	2	2	1	0	1	0		4
15	5	4	5	0	0	0		9
16	4	0	3	4	1	0		8
17	4	4	0	1	0	4		9
18	4	3	1	3	4	4		15
19	3	3	1	0	2	0		6
20	5	3	5	5	5	0		18
21	5	5	5	3	3	0		16
22	3	2	1	0	3	3		9
23	2	0	0	0	2	0		2
24	4	0	4	4	4	4		16
25	5	5	4	5	3	5		22
26	5	0	5	5	3	3		16
27	4	3	4	4	4	3		18
28	5	3	3	5	3	2		16
29	4	3	4	3	0	3		13
30	4	3	3	3	4	0		13
31	3	0	3	3	0	0		6
Sept.								
1	3	0	0	3	0	2	...	5
2	3	0	0	1	3	0		4
3	1	0	0	0	1	0		1
4	3	3	0	3	0	0		6
5	3	0	3	2	3	0		8
6	3	2	2	3	2	0		9
7	3	0	3	3		0		6
8	3	0	0		3	0		3
9	2	0	2	0	2	1		5
10	0		0	0	0	0		0
11	4	0	2	0	4	2		8
12	1	0	1		0	0		1
13	3	0	0	3	3	3		9

* 60 minutes ending 16 hrs. G.M.A.T.

TABLE CXXV—*continued.*

ADELIE LAND.

Wireless Character of Received Signals.

Date, 1913.	Days.	Hours (Local Mean Time) centred at						Sum of hours.	Date, 1913.	Days.	Hours (Local Mean Time) centred at						Sum of hours.
		8 p.m.	9 p.m.	10 p.m.	11 p.m.	mid-night.	1 a.m. *				8 p.m.	9 p.m.	10 p.m.	11 p.m.	mid-night.	1 a.m. *	
Sept.									Oct.								
14	1		1	0	0	0		1	15	2				2	2		4
15	3	0	1	3	0	0		4	16	3			3	3	3		9
16	3		3	3		0		6	17	3			2	3	2	1	8
17	2	2	0	0	0			2	18	4		2	4	3	3		12
18	4	0		4	3			7	19	3		3	3	0	0		6
19	3	0	3	2	3	0		8	20	2		2	2	0	0		4
20	3	0	0	2	3	0		5	21	3			0	1	3	2	6
21	1		0	0	1	0		1	22	2		1	2	0	2		5
22	4		2	1	4	1		8	23	1		1	1	0	0		2
23	2		0	2	0	0		2	24	3		2	3	3	3	1	12
24	3		0	3	0	0		3	25	3		2	3	3	0		8
25	4		0	4				4	26	3			2	3	1		6
26	3		3	0	0	3		6	27	2			1	2	2		5
27	2		1	0	2	0		3	28	3			0	3	2		5
28	3		0	3	3	0		6	29	3			0	0	3		3
29	3		3	3	0	0		6	30	1			0	1	1		2
30	4		0	3	4	3		10	31	3			3	3	0		6
Oct.									Nov.								
1	2		0	2	2	2	0	6	1	3			3	1	0		4
2	3		0	0	3	3	0	6	2	3		1	3	0	0		4
3	3		0	3	2	0	0	5	3	0			0	0	0		0
4	3		0	0	3	0	0	3	4	2			2	2	0		4
5	0			0	0	0	0	0	5	1			1	1	0		2
6	0			0	0	0	0	0	6	2			2	2	0		4
7	0			0	0	0	0	0	7	2			1	1	2		4
8	4			4	2	0	0	6	8	0			0	0	0		0
9	Aerial carried away.								9	3			3	2	0		5
10	3			0	3	2		5	10	0			0	0	0		0
11	3			0	3	...		3	11	1			0	1	0		1
12	0			0	0	0	0	0	12	2			2	2	2		6
13	3			0	3	0	0	3	13	0			0	0	0		0
14	0			0	0	0		0									

* 60 minutes ending 16 hrs. G.M.A.T.

TABLE CXXVI.

MACQUARIE ISLAND.

Wireless Character of Received Signals.

Date, 1912.	Days.	Hours (Local Mean Time) beginning						Sum of hours.
		8 p.m.	9 p.m.	10 p.m.	11 p.m.	mid-night.	1 a.m. *	
Sept.								
25	1		1			1		2
26	3						3	3
27	1							1
28	3		3	3	3	3	3	15
29	2					0		2
30	0			0	0	0		0
Oct.								
1	0		0	0	0	0		0
2	0		0	0	0	0		0
3	4							4
4	1						0	1
5	3							3
6	3						3	3
7	0							0
8	0						0	0
9	0						0	0
10	0							0
11	...	Aerial at M.Q.I. carried away.						
12	0							0
13	0							0
1913.								
Feb.								
3	3				3			3
4	3			3				3
5	0							0
6	2							2
7	0							0
8	1					1	1	2
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20	2				2	0		2
21	1				1			1
22	2				2	2	2	6
23	2						0	0
24	3					3	3	6
25	0						0	0
26	3						0	3
27	2							2
28	2			2				2
March.								
1	3						3	3
2								...
3	1					1	0	1
4	3				3		3	6
5	0							0
6	1					1		1
7	3		1				3	4
8	3					0	3	3
9	3						3	3
10	3					3	0	3
11	3					3	0	3
12	1							1
13	...							...
14	0							0
15	0							0

Date, 1913.	Days.	Hours (Local Mean Time) beginning						Sum of hours.
		8 p.m.	9 p.m.	10 p.m.	11 p.m.	mid-nignt.	1 a.m. *	
March.								
16	3		3	3	3	0		9
17	2					2		2
18	2							2
19	3			3	3	0		6
20								...
21	3	3						3
22	3	0						3
23	3					3	3	6
24	3							3
25	3							3
26	3							3
27	2						2	2
28	0							0
29	3							3
30	3							3
31	3							3
April.								
1	3							3
2	3					3	0	3
3	3							3
4	3							3
5	3							3
6	3							3
7	3					3	0	3
8	3							3
9	4					0	4	0	4
10	3						3		3
11	1		0			0	1		1
12	3		3	3			0		6
13	3		3	0			0	0	3
14	4		0		4	0			4
15	4		3	0	0	4			7
16	3	0	0		0	3			3
17	3		0		3	0			3
18	5	5	5		0				10
19	3		0	2	3	3			8
20	1		0	1	1	0			2
21	4		1	4	2	0	3		10
22	2		0	0	2	...	...		2
23	2		2	0	...	0	0		2
24	4	3	4	0	0	0	0		7
25	1	0		0	0	1	0		1
26	...								...
27	3	3	0	0	3	0	...		6
28	0		0	0	0	0	...		0
29	3		2	3	3	0	0		8
30	3	1	0	2	3	...	...		6
May.									
1	2	2	2	2	2	2	2		12
2	3	3	3	0	0	0			6
3	4	0		0	4	0			4
4	4	0		4	0	0			4
5	0			0		0			0
6	0			0	0				0
7	0		0	0	0	0			0
8	0			0					0
9	0		0						0
10	0				0				0
11	0		3	3	3				9
12	4	0			4	3	4		11
13	3			3	3	0			6
14	4		0	4	3	0			7
15	2		2		2	0			4

* 60 minutes ending 16 hrs. G.M.A.T.

TABLE CXXVI—*continued.*

MACQUARIE ISLAND.

Wireless Character of Received Signals.

Date, 1913.	Days.	Hours (Local Mean Time) beginning						Sum of hours.	Date, 1913.	Days.	Hours (Local Mean Time) beginning						Sum of hours.
		8 p.m.	9 p.m.	10 p.m.	11 p.m.	mid-night.	1 a.m.				8 p.m.	9 p.m.	10 p.m.	11 p.m.	mid-nignt.	1 a.m.	
May.									Sept.								
17	0	0		0	0	0		0	25	4			0	4	4		8
18	3		1	3	3	3		10	26	3						3	3
19	2	0		2	2	2		6	27	1			0	1	0		1
20	4			2	4	3		9	28	1			0	1			1
21	3	0	3					3	29	1		1	0	0			1
22	3	0		0	2	3		5	30	5		1	5	1	4		11
23	3	0	0	3	3	0		6	Oct.								
24	0	0	0	0	0			0	1	0			0	0			0
25	3	0		3	0			3	2	4			0	4	1		5
26	3	0			0	3	3	6	3	3		3	0	2			5
27	0				0	0		0	4	1			0	1			1
28	0			0	0			0	5	0							0
29	...	not in action.							6	0			0	0			0
30	3		2	3	2	0		7	7	0			0	0			0
31	0				0	0		0	8	4			4	0			4
June.									9	...	M.A.L.'s aerial carried away.†						...
1	3		3		0	0		3	10	0			0	0			0
2	3		3	0	3	0		6	11	0			0	0			0
3	1			1	0			1	12	0			0	0			0
4	3	2	0		3	3		8	13	1			0	1			1
5	4		4	2		0		6	14	0			0	0			0
6	0		0	0	0	0		0	15	1			0	1	1	1	3
7	3		3	0				3	16	1			1	1	0		2
8	0				0	0		0	17	3			3	3	3		9
Aug.									18	3			3	3	3		9
5	3	3	3	0				6	19	3			3	0			3
6	3	0	0	3	3	0		6	20	1			1	0			1
7	3	0	3	3	0			6	21	0			0	0			0
8	...	...							22	0			0	0			0
9	0				0	0		0	23	0			0	0			0
10	1				1	0		1	24	3			3	3	3		9
11	3	2	3		0	0		5	25	3			0	3			3
12	3	3	3		3	0		9	26	1			1	0	1		2
13	3		3	3	3			9	27	1			0	0	1		1
14	0			0	0	0		0	28	1			0	1			1
15	3	3	0	0	0			3	29	2			0	1	2		3
16	1	0	1	1	0			2	30	0			0	0			0
17	3	3	3			3		9	31	2			2	2			4
18	3			1	3			4	Nov.								
Sept.									1	0				0			0
1	3			3	0			3	2	0				0			0
2	3			3	0			3	3	0							0
3	1			1	1			2	4	0							0
4	0							...	5	0				0			0
5	0							...	6	1				1	1		2
6	0			0	0			0	7	3				3	1		4
7	0			0	0			0	8	0				0			0
8	4			0	4			4	9	3				3	0		3
9	0			0	0			0	10	0				0			0
10	0			0	0			0	11	0				0			0
11	4			0	4			4	12	2				1	2		3
12	5	5	0	5	3			13	13	2				2	0		2
13	0							...	14	0				0			0
14	0							...	15	1				1	1	1	3
15	3			3	0			3	16	5				5	5		10
16	3			3				3	17	3				3	3		6
17	2	2			0			2	18	4				4	3		7
18	3		2	3	3			8	19	4				4	4		8
19	3			3	3			6	20	2				2	2		4
20	5			5	5			10	21	0							0
21	0		0	0	0			0	22	0							0
22	5			0	5			5	23	0							0
23	1			1	0			1	24	0							0
24	0		0	0	0			0	25	0							0

60 minutes ending 16 hours G.M.A.T.

† The call signal for the Main Box at Cape Denison, was M.A.L.

In these two tables, the times noted at the head of each column are as stated on page 462. Adelie Land and Macquarie Island times differed by approximately half an hour and the data are so arranged that the 1st, 2nd, etc., columns of each table refer to the same interval, if we neglect (as is done in this Report) the fact that the difference in times kept at the two stations is not exactly 30 minutes. Table CXXVII shows the percentage frequency of occurrence of hours which were characterised by maximum recorded signal strengths having the estimated values 0, 1, 2, . . . 5. As stated previously, " very strong " = 5 and " inaudible " = 0.

In view of the statements already made, it is not surprising to find a maximum on the frequency curve at about moderate strength, for signals received both at Adelie Land and at Macquarie Island. This maximum is, however, surpassed by the percentage number of hours in which signals were inaudible. This number varies from 37% to 52% and therefore comprises nearly half the hours of record. In this table, line (*a*) refers to observations up to June 8th, 1913, and (*b*) to the remainder, i.e., subsequent to August 4th of the same year.

The maximum numbers occur for signal values 0 and 3 (or 4) and, though the inherent deficiencies of the data will favour the occurrence of high values at these places, the deficiencies of the material are not wholly responsible for these results. It will be seen later that the frequency distribution differs according to the amount of magnetic disturbance, the maximum at signal value 0 being higher and at signal value 3 lower on disturbed days. Some part at least of the maximum for signal strength 0 is therefore associated with magnetic disturbance and some part of the maximum for strength 3 with quiet magnetic conditions. Both quiet or magnetically disturbed periods show a minimum frequency for very faint or faint signals. The curve of frequency distribution is in fact very similar to the curve of frequency distribution of wind strength at a station such as Cape Evans, on the border of the Ross Barrier. The normal glacial anticyclone distribution gives a high percentage of calms, but the occurrence of blizzard winds causes a hump in the curve corresponding to days when the normal anticyclonic circulation is interrupted.

TABLE CXXVII.

Reception at—	Percentage Number of Hours during which the Wireless Signals Received had the following Maximum Strength.						Reception at—	Percentage Number of Hours during which the Wireless Signals Received had the following Maximum Strength.					
	0	1	2	3	4	5		0	1	2	3	4	5
Adelie Land (*a*) ...	37%	3%	10%	22%	27%	1%	Macquarie Id. (*a*)	52%	6%	11%	26%	4%	1%
(*b*) ...	45%	10%	14%	22%	6%	3%	(*b*)	47%	16%	5%	22%	5%	4%

TABLE CXXVIII.

Reception at—	Percentage Number of Days during which the Wireless Signals had the following Maximum Strength.						Reception at—	Percentage Number of Days during which the Wireless Signals had the following Maximum Strength.					
	0	1	2	3	4	5		0	1	2	3	4	5
Adelie Land (*a*) ...	4%	6%	20%	41%	27%	2%	Macquarie Id. (*a*)	24%	9%	12%	45%	9%	1%
(*b*) ...	11%	9%	15%	42%	17%	6%	(*b*)	35%	18%	6%	27%	8%	5%

The general similarity of the frequency distribution for the two stations is to be expected if, as seems reasonable, reception at both stations is on the average simultaneously good, bad or indifferent. This point is examined in the next part of this section of the Report.

A similar table (CXXVIII) has been compiled to show the frequency distribution of maximum signal strength for days. The maximum strength for the day is the absolute maximum signal strength observed in any hour of the evening observation period. Clearly, the maximum signal strength of the day will be higher than the mean of the hours unless all hours have the same maximum value. As it is unlikely that all hours of the day will be allotted identical signal strengths, the maximum at inaudible signals is lower for days than for hours; how much lower naturally depends on the strength of the tendency for an hour of inaudible signals to be preceded and followed by similar hours.

As before, (*a*) and (*b*) in Table CXXVIII refer to the two periods before June 9th and after August 4th, 1913. The maxima at signal strengths 0 and 3 with an intervening minimum for faint or very faint signals are clear at Macquarie Island. At Adelie Land, however, the maximum at signal strength 0 has disappeared, from which it is possible to deduce that hours of received signal strength 0 while quite frequent at this station do not tend so strongly to be preceded and followed by hours of similar wireless character as is the case at Macquarie Island.

III.—SIGNAL STRENGTH AT ADELIE LAND AND MACQUARIE ISLAND IN CORRESPONDING PERIODS.

Partly in order to test the value of the arbitrary allocation of numbers 0, 1, 2, 3, 4, 5, to the audibility scale inaudible, very faint, faint, moderate, strong and very strong, the method has been applied to the hours of simultaneous observation at the two wireless stations, to see if the assumption is correct that hours in which signals are, for example, logged " good " at one station, are hours of signals above average strength at the other station. We would expect this assumption to be correct if, on the average, the same paths are travelled by the incoming as by the outgoing waves between one station and the other. The two periods for which data are simultaneously available are March 6th to June 8th and August 5th to November 13th, during 1913.

TABLE CXXIX.

Mean Value of the Maximum Signal Strength Received at Macquarie Id. during Hours when Reception at Adelie Land was allotted the following Values—					
0	1	2	3	4	5
0·5	0·6	1·4	2·1	2·2	0*
(0·25)	(0·7)	(1·6)	(2·3)	(3·2)	(2·5)*

* Two cases only.

TABLE CXXX.

Maximum Strength of Signals in the Hour at Adelie Land.	Percentage Number of Hours during which the Maximum Signal Strength had the following Values at Macquarie Id.						Maximum Strength of Signals in the Hour at Adelie Land.	Percentage Number of Hours during which the Maximum Signal Strength had the following Values at Macquarie Id.					
	0	1	2	3	4	5		0	1	2	3	4	5
0 class	79%	6%	5%	6%	1%	1%	3 class	23%	16%	6%	43%	6%	6%
1 class	71%	14%	...	14%	...	...	4 class	24%	8%	11%	41%	13%	2%
2 class	37%	24%	7%	27%	2%	2%	5 class	100%*	...	...	...	...	...

* Two cases only.

Table CXXIX gives the average values of the maximum signals recorded during hours at Macquarie Island, these hours being arranged in classes according as the maximum signal strength at Adelie Land in the same hour was 0, 1, 2, 3, 4, or 5. Due allowance was, of course, made for the difference of about ½ hour between the times kept at the two stations.

The numbers shown in brackets are the average values of the maximum recorded signal strength in days corresponding to reception at Adelie Land on the same days. Of the 12 days when Adelie Land was unable to hear Macquarie Island, Adelie Land signals were not heard at Macquarie Island on 10 occasions.

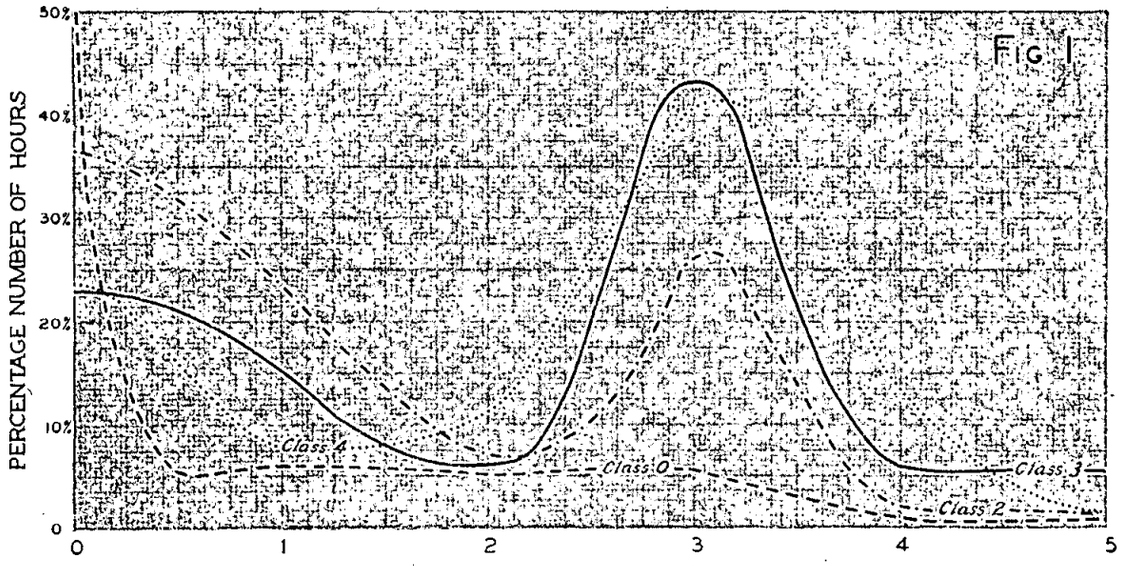


FIG 1
PERCENTAGE NUMBER OF HOURS
50%
40%
30%
20%
10%
0
Class 4
Class 0
Class 3
Class 2
0
1
2
3
4
5
STRENGTH OF SIGNALS IN HOURS AT MACQUARIE ID.

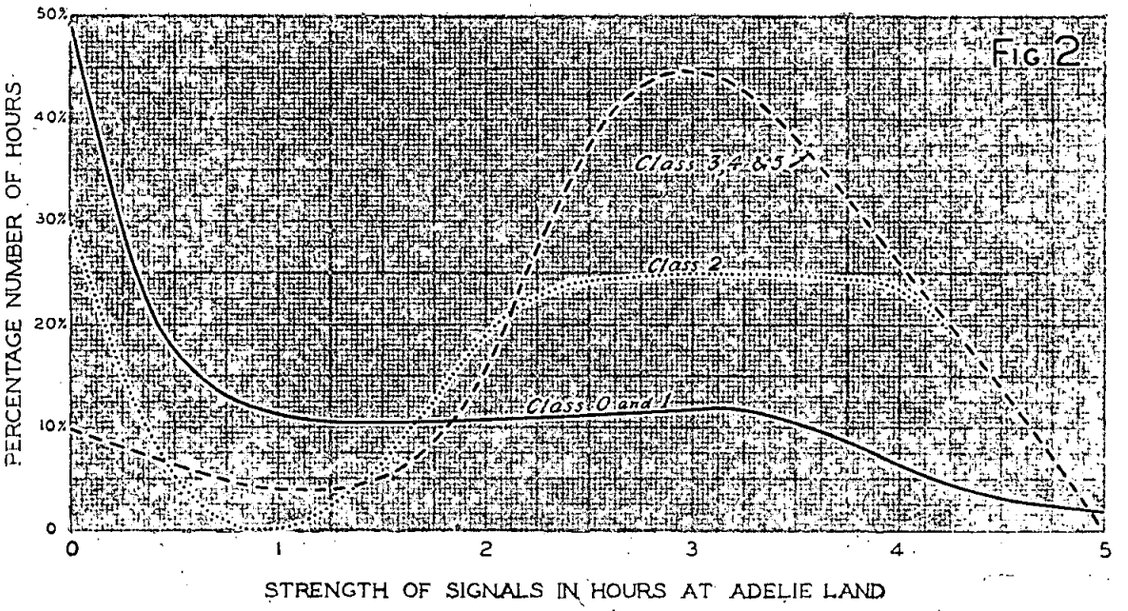


FIG 2
PERCENTAGE NUMBER OF HOURS
50%
40%
30%
20%
10%
0
Class 3, 4 & 5
Class 2
Class 0 and 1
0
1
2
3
4
5
STRENGTH OF SIGNALS IN HOURS AT ADELIE LAND

The tendency for the two sets of hourly numbers to increase together is quite striking. For corresponding hours in which signals were inaudible at Macquarie Island, no signals were heard at Adelie Land during more than half the number of hours. The tendency was especially pronounced in October, when there were 26 hours of very faint or inaudible signals at Adelie Land corresponding to 24 cases of inaudible signals at Macquarie Island, one case of " very faint " and one case of " moderate " signal strength.

These results seemed to be sufficiently interesting to warrant examination of the frequency with which hours of maximum signal intensity 0, 1, 2, 3, 4, 5, occurred at one station when the hours were divided in classes according to the strength of signal received at the other station. Tables CXXX and CXXXI and Figs. 1 and 2 are drawn up on this basis. The tables are arranged on a percentage basis and, in actual numbers, there were rather more hours below signal strength 2 at Adelie Land than above it, and the disproportionality was greater at Macquarie Island.

TABLE CXXXI.

Maximum Strength of Signals in the Hour at Macquarie Id.	Percentage Number of Hours during which the Maximum Signal Strength had the following Values at Adelie Land.						Maximum Strength of Signals in the Hour at Macquarie Land.	Percentage Number of Hours during which the Maximum Signal Strength had the following Values at Adelie Land.					
	0	1	2	3	4	5		0	1	2	3	4	5
0 class	56%	11%	11%	12%	7%	2%	3 class	9%	5%	17%	45%	23%	...
1 class	18%	9%	30%	33%	9%	...	4 class	9%	...	9%	36%	45%	...
2 class	31%	...	19%	25%	25%	...	5 class	14%	...	14%	57%	14%	...

The figures for percentage frequency distribution at Macquarie Island (Table CXXX exhibit a gradual reduction in the number of hours of inaudible signals as the received signals at Adelie Land become stronger. The numbers for classes 4 and 5 are very similar and show very well a maximum frequency of moderate signal strength—a maximum which is hardly apparent in the hours (class 0) when signals were inaudible at Adelie Land. In general, the effect upon (maximum) hourly signal strength at Macquarie Island of unfavourable causes (if such causes can be measured by the signal strength at Adelie Land) is greatly to increase the relative number of hours of inaudibility. The effect of favourable causes, or the absence of unfavourable causes, is to reduce the relative number of hours of inaudibility and to enhance the number of hours of signal strength above 2.

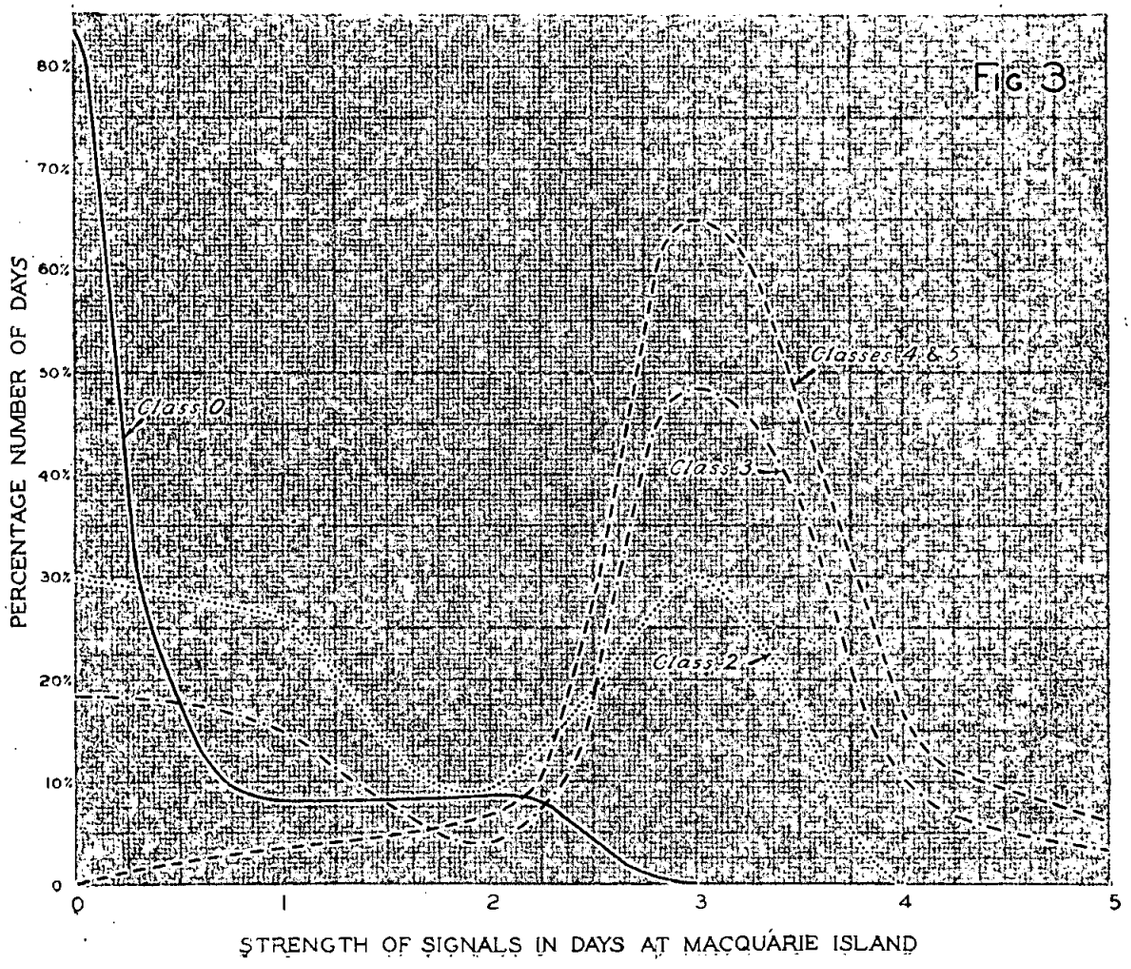
TABLE CXXXII.

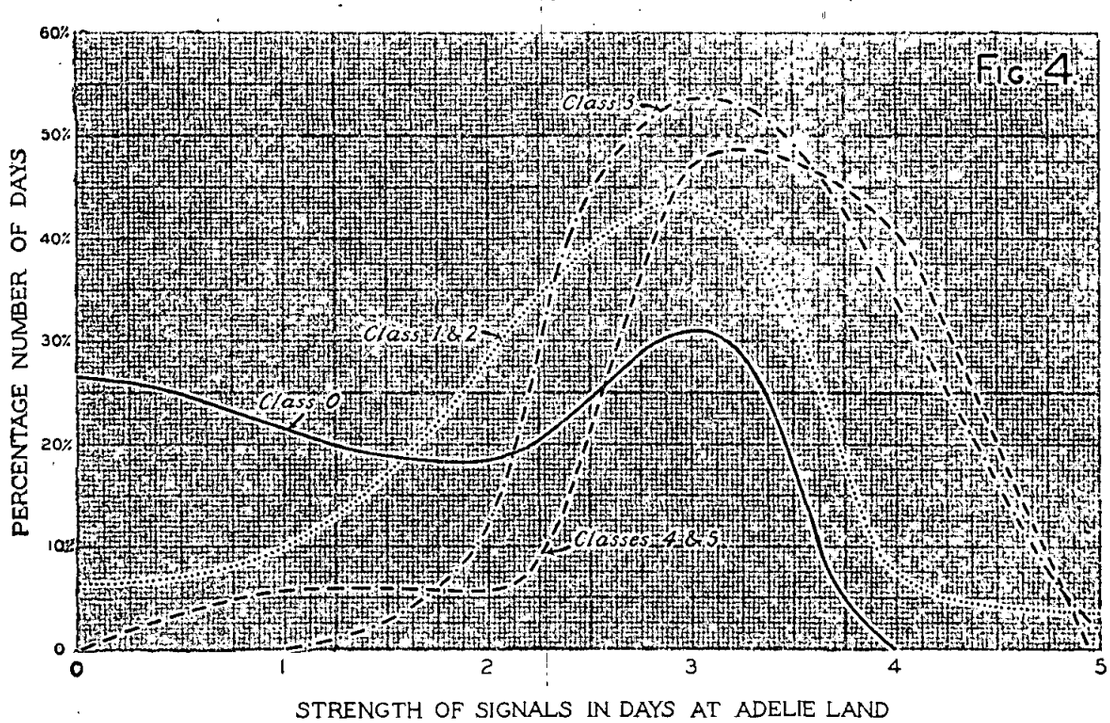
Maximum Strength of Signals in the Day at Adelie Land.	Percentage Number of Days during which the Maximum Signal Strength had the following Values at Macquarie Id.						Maximum Strength of Signals in the Day at Adelie Land.	Percentage Number of Days during which the Maximum Signal Strength had the following Values at Macquarie Id.					
	0	1	2	3	4	5		0	1	2	3	4	5
0 class	83%	8%	8%	...	...	...	3 class	18%	15%	5%	48%	10%	3%
1 class	67%	25%	...	...	...	8%	4 class	...	4%	4%	67%	18%	7%
2 class	30%	26%	9%	30%	...	4%	5 class	...	...	50%	50%	...	...

TABLE CXXXIII.

Maximum Strength of Signals in the day at Macquarie Is.	Percentage Number of Days during which the Maximum Signal Strength had the following Values at Adelie Land.						Maximum Strength of Signals in the day at Macquarie Is.	Percentage Number of Days during which the Maximum Signal Strength had the following Values at Adelie Land.					
	0	1	2	3	4	5		0	1	2	3	4	5
0 class	28%	22%	19%	31%	...	...	3 class	...	...	13%	53%	33%	2%
1 class	5%	15%	30%	45%	5%	...	4 class	...	...	....	54%	45%	....
2 class	12%	...	25%	38%	12%	12%	5 class	...	17%	17%	33%	33%	...

It is not possible from this table to deduce anything about the probable result if complete data had been available, i.e., if observations could have been freed from the effects of statics, jamming, discontinuous operation, etc. One might be tempted, from the fact that the figures in Column 0 are so similar for classes 3 and 4, to assume, quite unjustifiably, that these figures are a measure of the incompleteness of the operating data. In reality all we can assert is that the more unfavourable the conditions appear





to be, the greater is the probability that a signal of normal strength (3) will be reduced to faintness or inaudibility. Indeed, the " unfavourable " causes which are operative may be such that they *sometimes* combine so as not to reduce, or even so as to enhance, signal strength in conditions judged by inadequate criteria to be unfavourable.

There is little in Table CXXXI which calls for separate comment. The figures under classes 1 and/or 2 seem to be irregular, and this may be due to an insufficient number of observations. The smallness of the figure in the last three classes for inaudible signals at Adelie Land contrasts with the corresponding data in Table CXXX.

Similar tables (CXXXII and CXXXIII) and Figs. 3 and 4 have been formed on the basis of the maximum signal strength of the day for different classes of reception on the same day at the other station. These tables are given below and show clearly how the maximum of moderate signal strength at Macquarie Island disappears when no signals are received at Adelie Land. The reverse is not true, indications of the maximum appearing at Adelie Land even on days when reception at Macquarie Island was impossible. This may be due to the fact that days of inaudibility at Adelie Land occurred less frequently than they did at Macquarie Island.

IV.—VARIATION OF SIGNAL STRENGTH DURING THE DAY.

Scrutiny of the operators' logs at the two stations permits us to say that there is a tendency for hours of weak, strong, or variable signals to be followed and preceded by hours of similar character. In this respect the strength of received signals is analogous to magnetic and auroral activity in the sense that a very active day is likely to include a number of hours of great activity and to be preceded and followed by similarly active days.

As stated previously, the hours chosen for observation were those immediately preceding and following local midnight at Adelie Land, since the distance from Macquarie Island was so great that the direct wave was completely absorbed. It was thus necessary to rely entirely upon "reflection" of the wireless waves from ionised layers in the atmosphere which are only effective at night. As a result, communication between Adelie Land and Macquarie Island was impossible for a time in the summer when the duration of sunlight at Adelie Land approached 24 hours daily. It is possible to observe a gradual restriction of the hour when either station first heard the other during the southern spring and early summer in 1913. At Macquarie Island, the signals of Adelie Land were heard between 8 and 9 p.m. (Local Time) during September; during October, the first mention of signals is between 9 and 10 p.m.; in November, the first reference to signals is still later. No signals were heard after Nov. 20th. At Adelie Land signals were frequently heard between 8 and 9 p.m. (Local Time) until September 20th; after this date, the first reference to signals appears between 9 and 10 p.m.; no signals were heard after November 13th.

TABLE CXXXIV.

Reception at—	Mean Values of the Maximum Signal Strength, in Hours Centred at—						Reception at—	In Hours commencing—					
	8 p.m.	9 p.m.	10 p.m.	11 p.m.	mid-night.	1 a.m.		8 p.m.	9 p.m.	10 p.m.	11 p.m.	mid-night.	1 a.m.
Adelie Land ...	1·7	1·8	1·7	1·7	1·2	1·3	Macquarie Id....	1·3	1·5	1·2	1·4	1·2	1·4
	(1·8)	(1·6)	(1·7)	(1·7)	(0·9)	(0·3)		(1·3)	(1·6)	(1·1)	(1·3)	(1·6)	(1·7)

Table CXXXIV above shows the mean values of the estimated signal strength during the observation hours in the period February, 1912, to November 20th, 1913, for Macquarie Island, and March 6th to Nov. 13th, for Adelie Land. As usual, the operators' remarks have been converted into the scale 0, 1, 2, 3, 4, 5, using only the maximum intensity mentioned during each hour. When no record appears for any hour, the hour is not given the signal strength 0, but is excluded from the list.

The fact that the estimated signal strength at Adelie Land is generally greater than at Macquarie Island must, of course, be considered to be without significance, since they represent personal estimates by different sets of operators.

The figures for Macquarie Island show that, on the average, signals were of the same strength throughout the day's observation period. Naturally, individual months showed considerable variations, especially as the number of observations in the first two and the last columns were relatively few. The figures for Adelie Land, however, show a tendency for signals to fall off after midnight, a tendency which is substantiated by the fact that the numbers in the next to last column are less than those in the column preceding it in every monthly period except March, during which reception at this station was infrequently noted in the operator's log. The reduction is pronounced during the second half of the year (August 5th to November 13th), the figures for which are shown in brackets.

It is not easy to find a plausible explanation for the reduced signal strength at Adelie Land during the last two hours. In the second half of the year, a large proportion of the entries in the penultimate column are in October; many of the entries are of inaudible signals and, for reasons already stated, such entries are less satisfactory to deal with than the more positive records of signal strengths which are audible. Also there may have been a natural tendency on the part of the operator to relax his vigilance towards the end of the day's observation period, since all the necessary traffic would normally have been dealt with by midnight. Such an explanation might have been acceptable had a similar reduction of signal strength been observed at Macquarie Island. On the other hand the two last hours are the only ones during which, on the whole, reception at Adelie Land was nominally worse than at Macquarie Island, and a closer analysis of the data shows that the relative deterioration of signals at Adelie Land is practically confined to the last three months, September to November 13th, 1913.

It is natural to attempt to relate the deterioration in signals with magnetic disturbance at Adelie Land, but data are not available after early August. For the period March 6th to June 8th, hourly magnetic characters are known and the maximum of disturbance appears in the hour centred 11·30 p.m. Local Time, the disturbance in this hour and in the hours which immediately precede and follow it being almost the same. There is also no obvious connection with auroral activity. On the whole, it is considered that the evidence for the reality of a difference between northward and southward bound wireless waves at this time of night is hardly sufficient to enable any deductions to be drawn.

V.—SEASONAL VARIATION OF SIGNAL STRENGTH.

The mean values of the maximum signal strength received in each hour and each day of individual months have been formed with the object of examining whether the data are sufficiently precise to show a seasonal variation in signal strength. The mean values are shown in Table CXXXV below for both stations.

On the whole, the signal strength at Macquarie Island was the more regular and was generally below that received at Adelie Land. At the latter station there was a progressive decrease in strength from March until June and, after the re-erection of the aerial, from August until November. These progressive decreases may owe something to a gradual deterioration of the apparatus (deterioration of insulation, for example). This does not seem adequate, however, to account for the low values at Adelie Land relative to Macquarie Island for September and November. The value in the former month is probably associated with the change of operators at this time, while the low value of November is considered to be real and due to the increase in the number of hours of daylight and restriction of the possible hours of observation to those very close to midnight.

TABLE CXXXV.

Receiving Station and Period of Observation.	Mean Value of the Maximum Received Signal Strength during—		Receiving Station and Period of Observation.	Mean Value of the Maximum Received Signal Strength during—	
	Days.	Hours.		Days.	Hours.
Adelie Land, 1913.			Macquarie Id., 1912.		
March 6th–31st	3·0	2·6	September 25th–October 13th	1·2	1·0
April 1st–25th	3·1	2·2	February 3rd–28th	1·7	1·6
May 21st–June 8th	2·5	1·3	March	2·3	2·0
August 5th–31st	3·6	2·1	April	2·9	1·2
September	2·7	1·1	May	1·9	1·2
October	2·3	1·3	June 1st–8th	2·1	1·1
November 1st–13th	1·5	0·8	August 5th–18th	2·2	1·4
			September	2·0	1·5
			October	1·3	1·0
			November 1st–20th	1·5	1·7

It will be remembered that signal strength at Adelie Land was low in the last two hours of the observation period between September and November. Even when we exclude these two hours, however, we find that signal strength was below that at Macquarie Island in September and November. On the whole, this suggests a gradual reduction of signal strength at Adelie Land due to approaching continuous daylight at this station, followed by a sharp reduction in signals at the end of the observing season.

This sharp reduction of signals shows very clearly at Macquarie Island, where signal strength was well maintained until reception became impossible at a time of year when this station was still in darkness, though the paths of the wireless waves were partly illuminated by sunlight.

Indeed, one of the chief features of this table is the relatively high intensity of signals received at Macquarie Island in February, March and November. There seems little doubt that the records from Adelie Land would have made mention of the fact if the received signals had been of equivalent strength in February and we seem to be forced to the conclusion that there is a real difference between reception at the two stations in the early autumn as well as in the late spring. This difference may be such as to enhance the strength of signals received at Macquarie Island as well as to reduce their strength at Adelie Land.

In order to examine further the influence of approaching daylight on signal strength, an attempt has been made to relate the dates when each station first heard and last heard one another on either side of midsummer. In 1912 the Adelie Land station operated only with a jury mast and did not hear Macquarie Island at all; it was last heard by Macquarie Island on October 6th. In 1913, Macquarie Island first heard Adelie Land on February 3rd, while the Adelie Land records refer for the first time to Macquarie Island on March 6th, though there is evidence in the log of the other station that reciprocal communication was established on February 20th. Adelie Land last heard Macquarie Island on November 12th and Macquarie Island last heard Adelie Land on November 20th. It is possibly significant that reception at Macquarie Island commenced earlier and continued later.

In lower latitudes the rule is that night conditions are established about an hour after sunset and last until about an hour before sunrise, corresponding approximately to illumination of the Kennelly-Heaviside layer by the sun. The time of occurrence of this illumination can be calculated roughly by the formula—

$$\text{Cos } 100^\circ = \text{Sin } \delta \sin \phi + \cos \delta \cos \phi \cos \text{H.A.}$$

where H.A. is the hour angle for which the sun is 10° below the horizon, δ is the sun's declination and ϕ the latitude of the place in question. The appropriate hour angles may, less accurately but more conveniently, be read by the use of a protractor from a stereographic projection upon a plane tangent to the earth at the South Pole.* In what follows, it is convenient to refer to the limiting hour angles when the sun is just 10° below the horizon as the hour angle of "dusk." Fig. 5 gives a rough plot showing as abscissae the limiting hour angle of "dusk" (measured from local midnight) for three positions in the latitudes of Adelie Land, Macquarie Island and the mean latitude of these stations. The ordinates are the dates of the year 1913.

* I am indebted to Instr. Capt. Baker, R.N., for this convenient method, which has the advantage of dealing with different latitudes on a single diagram.

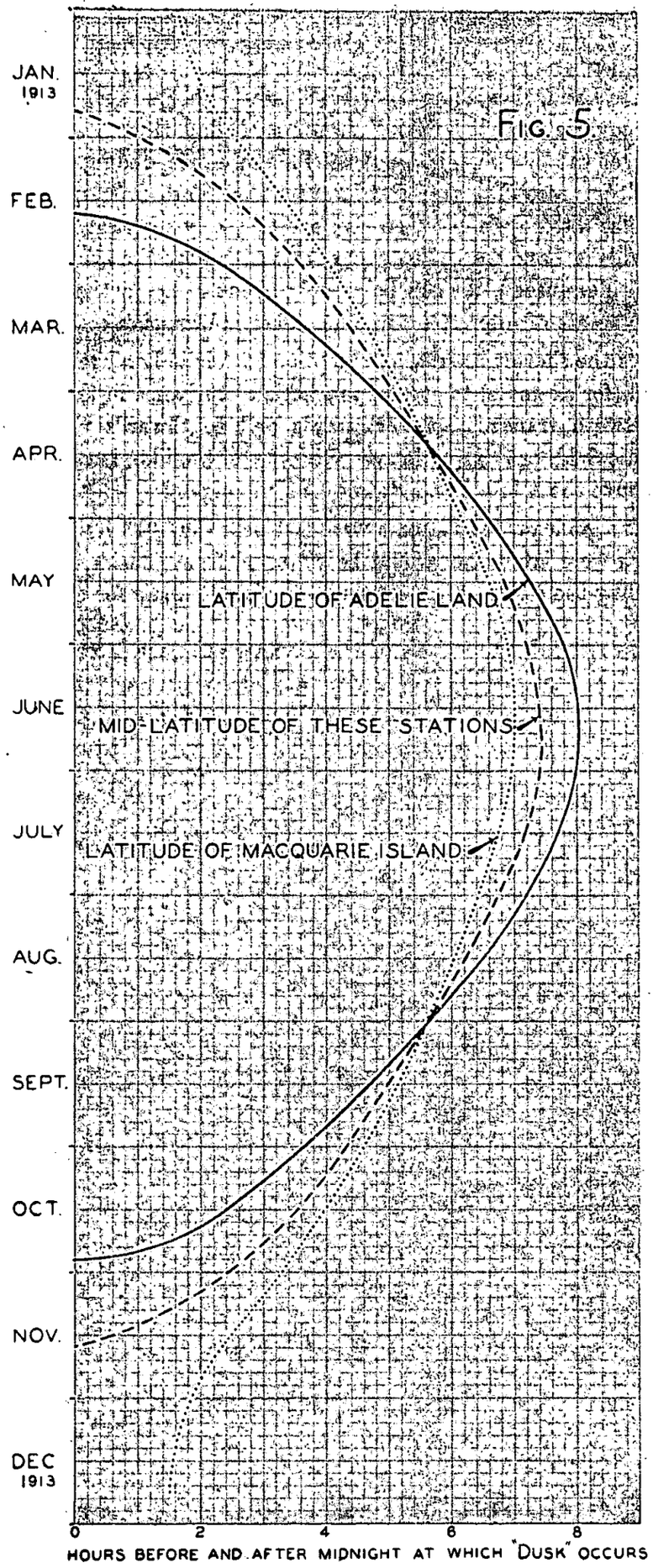

JAN.
1913
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC
1913
LATITUDE OF ADELIE LAND.
MID-LATITUDE OF THESE STATIONS.
LATITUDE OF MACQUARIE ISLAND.
0
2
4
6
8
HOURS BEFORE AND AFTER MIDNIGHT AT WHICH "DUSK" OCCURS

FIG. 5

At Adelie Land, there is no " dusk " before February 14th, 1913, or after October 28th. At Macquarie Island, " dusk " occurs each day throughout the year. At the mean latitude of the two stations, 60° 45′ S., the corresponding dates when the hour angle of " dusk " is zero (i.e., occurs at local midnight) are January 24th and November 18th, 1913. The latter date corresponds almost exactly with the date when Macquarie Island heard Adelie Land for the last time, on which date the atmosphere above Adelie Land was well illuminated, the sun being only about 4° below the horizon at midnight. There are two points of interest on which further information could be desired.

(*a*) Does the shorter interval of reception at Adelie Land represent a real circumstance, related (for example) to greater magnetic disturbance in the Antarctic, or to the differences between transmission northwards and southwards nearly parallel to the earth's magnetic field, or to the relative proximity of the illumination by sunlight in the atmosphere above the Adelie Land station near midnight ?

(*b*) Is it significant that signals were last heard in 1913 by both wireless stations on dates which were later than would be expected from considerations of illumination by the sun, using the dates of first hearing signals as a basis for calculation ?

Since, in succeeding sections of the Report, evidence is presented to show that there is a definite decrease of signal strength at times when magnetic disturbance occurs, it is necessary to examine the " monthly " mean values of signal strength in Table CXXXV in relation to the available measures of magnetic disturbance.

The best of these measures is likely to be the mean hourly magnetic character number at Adelie Land for the hours which comprise the daily observation period.† The mean values for each month for the four hours commencing 8·30 p.m. Local Time of Adelie Land are given in Table CXXXVI below. These values are not available beyond July, 1913, and the mean values of Christchurch daily magnetic character number are therefore also shown. It will be seen that the two sets of numbers do not run by any means closely parallel to one another.

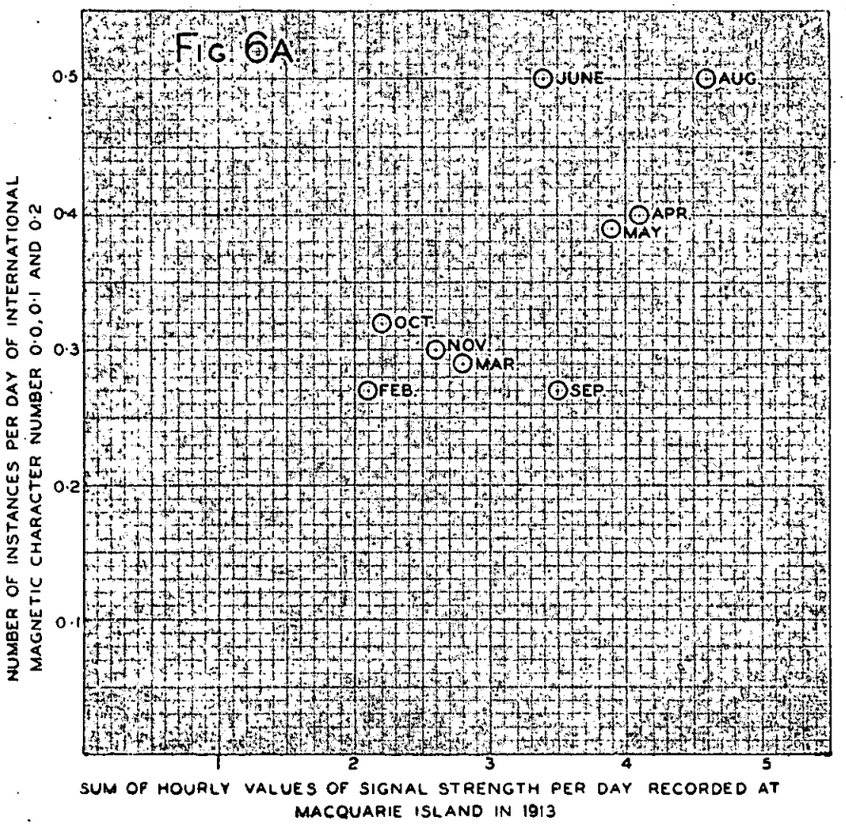
TABLE CXXXVI.

Year and Month.	Mean Hourly Magnetic Character Number at Adelie Land for the Four Hours commencing 8·30 p.m.	Mean Daily Magnetic Character Number at Christchurch.	Year and Month.	Mean Hourly Magnetic Character Number at Adelie Land for the Four Hours commencing 8·30 p.m.	Mean Daily Magnetic Character Number at Christchurch.
1912.			1913		
September ...	·46	·60	April	·72	·50
October	·74	·84	May	·50	·52
November ...	·76	·70	June	·46	·30
December.....	...	·58	July	·47	·35
1913.			August	...	·29
January	·95	·74	September ...	...	·60
February	·74	(·42)†	October ...	...	·68
March	·67	(·56)†	November ...	...	·60

* Part of month only.

† See footnote to page 485.

Comparison of this table with Table CXXXV discloses no obvious connection between the mean values of the (maximum) wireless signals at either station and the measures of magnetic disturbance. Many attempts have been made to relate the two sets of figures in some simple way, but the only moderately satisfactory relation found is between the mean value of signal strength at Macquarie Island, measured by the sum of all the maximum hourly values recorded, and the number of days in the interval possessing International magnetic character number* 0·0, 0·1 or 0·2, i.e., the number of days little disturbed magnetically. This relation is exhibited in Fig. 6A.



Certainly there is nothing in Table CXXXVI to suggest that we ought to modify the tentative conclusion already reached that the progressive deterioration in signal strength at Adelie Land between March and June is probably due to deterioration of the wireless apparatus and not to something associated with magnetic disturbance. There is also nothing to account for the low value of signal strength at the same station in September, 1913, or for the low value of November relative to October. Of these, the former was thought to be associated with the change of operators at that time and the latter to be due to approaching daylight at Adelie Land.

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* See footnote to page 485.

At Macquarie Island also, reception is not at its best in the months of low mean magnetic activity and it seems clear that the mean signal strength of individual periods of about a month is not related in any obvious fashion with the mean magnetic disturbance.

The following sections of the report are devoted to discussion of the relations between received signal strength, magnetic disturbance and auroral activity. No attempt is made to relate the wireless data with meteorological changes from day to day; this point has been examined for the wireless log of Macquarie Island in 1914–1915*. It is desirable, however, to draw special attention to certain entries by the operators at Macquarie Island. As Mr. Sawyer says in his summary statement reproduced in Appendix II: "Sometimes for several consecutive nights, but usually for only an hour or so, all signals received from practically anywhere west of our meridian would be at a minimum; simultaneously stations in this direction would report minimum signals from Macquarie Island. On the other hand, at the same time signals received from positions east of the meridian were either in the ascendant or at a maximum. . . ." The entries in the logs are too few to permit any attempt to examine the causes of this well-marked phenomenon at Macquarie Island. One is, however, tempted to suggest that future Expeditions with more modern equipment should study the angular arcs of good and bad communication and their changes from day to day in the hope that they may be related to important meteorological phenomena.

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* *Australian Monthly Weather Report*, vol. 4, No. 9.

VI.—DISCUSSION OF WIRELESS COMMUNICATION AND TERRESTRIAL MAGNETIC ACTIVITY, MONTH BY MONTH.

As pointed out previously, a considerable amount of information regarding the relationships between the terrestrial magnetic elements and wireless communication has been gathered since 1912–1913, when the observations of the Mawson Expedition were made. Generally speaking, the correlations are between signal strength and magnetic disturbance. The " magnetic character number " is one arbitrary measure of the variability of the magnetic elements during a chosen interval, derived by inspection of magnetograph records.* Other measures of activity have been proposed and are in use, but as the magnetic data at Adelie Land and the other nearest observatory (Christchurch, N.Z.) are available expressed in magnetic character number, this measure of terrestrial magnetic disturbance is used throughout this Report. Since the magnetic activity of the earth is associated with certain phenomena visible on the sun, it is clear that correlations between wireless communication and sunspot numbers (for example) may be expected. Such relationships are not discussed in this Report.

The years of observation, 1912–1913, were fortunately, it is believed, for the wireless operations, years of low magnetic activity, 1913 being the " minimum " year of the 11-year cycle of solar activity and terrestrial magnetic activity. This point must be continually borne in mind since the possibility exists that quite other results might have been obtained if the observations had been made in a year of maximum activity.

The magnetic data which are used in the analysis are complete so far as the International magnetic character numbers are concerned and almost complete for the Christchurch daily magnetic character numbers which are reproduced in Table CXXXVII. These were specially supplied by Mr. H. F. Skey, to whom the writer is greatly indebted. The only gap in these numbers is for a period from February 25th to March 4th, 1913, inclusive.

* The International Magnetic Character Number is derived from the values for daily magnetic character number supplied by a large number of magnetic observatories, most of which are situated in the Northern Hemisphere. Where International Character numbers have been used in this Report, they have been taken from the tables published annually in " Terrestrial Magnetism and Atmospheric Electricity."

TABLE CXXXVII.

September, 1912—*December*, 1915.

1912.

CHRISTCHURCH.

MAGNETIC CHARACTER FIGURES.

Day of Month.	Sept.	Oct.	Nov.	Dec.
1	0 +	2	1	0
2	0	1	1	1
3	0	0 +	0	1
4	1	0 +	1	0
5	1 —	0	2	0
6	1	1 —	1	1
7	0	1	0	2 —
8	0 +	1	0 +	1
9	1	1	1	1
10	1 —	0 +	2	0
11	0 +	2 —	2 —	0 +
12	1	1	0 +	0
13	0 +	1	0	1
14	0 +	2	1 +	1 —
15	0	1 +	1	0
16	0	1 +	1	0
17	2	1	1 —	0
18	2 —	0	1 —	1
19	1 —	1 —	0 +	0
20	1	1 —	1	0 +
21	1	1 —	0	0
22	1	1	1 +	2
23	1	1	1	2
24	2	0 +	0 +	1
25	0	1	0	1 —
26	0 +	0	2 —	1
27	1	1 —	0 +	0
28	0	1 +	0	0
29	0	0	0	0 +
30	0	1	0 +	0
31		1 —		1 —
Sums	18	26	21	18

TABLE CXXXVII—*continued.*

September, 1912—*December*, 1915.

1913.

CHRISTCHURCH.

MAGNETIC CHARACTER FIGURES.

Day of Month.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0 +	0		1	1 —	2 —	0 +	0	0 +	0	1 +	0 +
2	1	0 +		0 +	1 —	1	0	0	0	0	2	1
3	2 —	0		0 +	1	1 +	1	0	0	0	2 —	1 —
4	1 —	0		1 —	2	1 —	0	0	0	0	0 +	1 +
5	1 —	0	0	0	2	0 +	0 +	0	0	1 +	0 +	1 +
6	0	0	0 +	0	2	0 +	0	0	2	2	1	1 +
7	0	1	1 —	0	2 —	0	0 +	1	1 +	2	1 +	1 —
8	1 —	1	0 +	0	1 —	0	0 +	0 +	2	2	2 —	0 +
9	1	1	0 +	2	1 —	0	0	1	2	1	1	0 +
10	1	0 +	0	1	0 +	0	0 +	1	1 +	2 —	0 +	0
11	1	0 +	0 +	1	0	1 —	0	1	1	1 —	0	0
12	0	2 —	0 +	1 +	0	0	1 +	1 —	1	1 —	0 +	0
13	0 +	1	0	1 —	0 +	0	1	1 —	0	0 +	1 —	0
14	1	2	2	0 +	0	0 +	1	0 +	0	0 +	0	0 +
15	1	1	2 —	1	0 +	1 —	1	1 —	1	1	1	0 +
16	0	0	1	1	0	0 +	0 +	1	1	0 +	0	0 +
17	0	0	1	1 +	0 +	0 +	0 +	0 +	0 +	0	0 +	0 +
18	2 —	1 —	0 +	0	0 +	0	0 +	0 +	0	1	0 +	1 —
19	1	1 —	1 —	0	0 +	0 +	0	0	0 +	2 —	0 +	1 —
20	0 +	0 +	0 +	0	0	0	2 —	0	0	2 —	0 +	0
21	1	0 +	1 +	0	0 +	0	1 —	0	0 +	1	0 +	0 +
22	1 —	0	0 +	0	0	0	1 —	0	2 —	1	1	0 +
23	1 —	0 +	1	1	0	0 +	0	1	2 —	0	0 +	0 +
24	0 +	0	1	0 +	0	0 +	0 +	0 +	0 +	0	0 +	0 +
25	1		0 +	1 —	1	0	2 —	0	0	0 +	0 +	2 —
26	0 +		0	0	0 +	0 +	0	0 +	0 +	0	1	2
27	1		1 —	1 —	1	0 +	0	0	0	0 +	1	0 +
28	1		1	1	0 +	0 +	0	0	1 —	0 +	2 —	0
29	0		0 +	0 +	0	1	0	0	0	0	1	0
30	2		1	0	1 —	1	0	0	1 —	0 +	0	0 +
31	1 —		1		0 +		0	0	1			0
Sums	23			15	16	9	11	9	18	21	18	12

TABLE CXXXVII—*continued.*

September, 1912—*December*, 1915.

1914.

CHRISTCHURCH.

MAGNETIC CHARACTER FIGURES.

Day of Month.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1	0	2 —	2	0 +	2	0 +	2	1	2 —	2	0 +
2	1	1 —	1 +	1 —	1	1	0	2 —	0 +	1	1	0
3	1 —	1	2 —	1 —	0 +	2 —	0	2 —	1	1	2	1 —
4	0 +	1	2 —	0 +	0	0 +	0 +	2 —	1 +	1	2	1
5	2 —	0 +	0 +	1 —	0 +	1 —	2	1	2 —	1 —	1 +	1
6	1	2 —	2	2 +	1	1 —	1 +	2	1 +	1 +	0 +	1 —
7	1	1 —	1 +	1 +	1	1 —	1	1 +	0 +	1 +	2 —	2
8	1	0 +	1	2	1	1	0 +	1	0 +	1	1 —	2 —
9	0	0 +	1	1	0 +	0 +	1	0 +	2	2 —	0 +	1
10	0 +	0	1	1	0	0	1 +	1 —	1 +	1 +	0 +	1
11	0 +	0 +	1	1	1 —	0 +	0 +	1	1 —	1	2	1 —
12	1	0 +	1	1	0	0	0 +	0 +	1	1	1	0 +
13	2 —	0 +	0 +	1	1 —	0	1 —	1	1 —	2 —	0 +	0
14	0 +	0 +	1 —	0 +	0 +	1 —	1 —	1 —	0 +	0 +	1	0
15	1 —	1 +	1 +	0 +	1	0 +	0	1	1 —	1 —	2 —	0 +
16	1	0 +	0 +	2 —	1 +	0	0 +	0 +	1	1	1 +	2 —
17	1	1	1	1 —	2	0	0 +	1 —	1 —	2 —	1 +	2 —
18	1 —	1	1	0 +	0 +	0	0 +	1	1	2 —	1	0 +
19	0 +	0	1	1	0	1	1 —	1	0 +	1	1	1
20	0 +	0 +	1	1 —	0	1	1	2 —	1	1 +	0	0
21	1 —	0	0 +	1 +	1 —	1 —	1	1	0 +	2	1 —	0
22	2 —	1	0 +	0 +	1 —	1 —	1	0	0 +	1	0	1 —
23	1 —	1 —	0 +	1 —	0	0	1	2	2	1 —	0	0 +
24	0	1	0	1 —	1 —	0	1	0 +	2 —	1 —	0	1
25	0 +	0 +	1	0 +	1 —	1	2	1	1	0	0 +	0 +
26	0	0 +	1	1 —	2 —	1	2	1	0 +	0	1	0 +
27	0	0 +	1 —	1	0	2 —	1	1	2	1	2	1
28	1 —	1	0 +	1 —	1	2 —	2 —	1	1	2	1	2
29	0 +		0	0	0	1	2	2	2—	2	1	0 +
30	0 +		1 —	0 +	0	1	2 —	2 —	1	1	1 —	0
31	1 —		0 +		1		2	2 —		0 +		1
Sums	21	13	25	26	18	22	27	36	28	35	28	22

TABLE CXXXVII—*continued.*

September, 1912—*December*, 1915.

1915.

CHRISTCHURCH.

MAGNETIC CHARACTER FIGURES.

Day of Month.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2	0 +	0	1	1 +	0 +	0	1	0	1 +	2	0
2	1 —	2	0	2	2 —	1 —	2 —	2	1 —	0	1	0 +
3	0	0 +	0	2 —	1 +	0	1	1 +	0 +	0 +	1	1
4	2 —	0 +	0 +	1 —	1	0	0	1	0	0 +	0 +	0 +
5	2	1 +	0 +	1	1	0 +	0+	0 +	2 —	0	2 —	0
6	1	1	1 —	0 +	1	0	2 —	1	0	1 —	2 +	2
7	1 +	0 +	1 +	1	0	0 +	0	1	0 +	1	1 +	1 +
8	1	2 —	2 —	2	0	1 +	1 —	1 +	0 +	0	1 +	1
9	1 —	2	2 —	1 —	0	1 —	2	0 +	0	0	1	0
10	0 +	1	1	0	0 +	0	2 —	1	1	1	1 +	0 +
11	0 +	0	1	0 +	0 +	0	2	1 —	1 —	1	2 —	1 —
12	1 —	1	0 +	0 +	1 +	2	2	1 —	0 +	0	2	1 —
13	1	1 —	0 +	0	1	2	0 +	0	1 —	0 +	1 —	0 +
14	1	0 +	0 +	1 —	0 +	1	0 +	0 +	1 —	2 —	0 +	1
15	1	0 +	0	1	1 —	0	0	0	0 +	2	1 +	2
16	0 +	0	0	2	2 —	1 —	0	0	1 —	1 +	2	2 —
17	0 +	0	1	0 +	2	2 +	0	1 +	2	1 —	1 +	0 +
18	0	0	1	2	1	2	0 +	1 —	0	1 —	2 —	0 +
19	0	2 —	1 +	2	1 —	1 —	0 +	1 +	0 +	2	2 —	1 —
20	0 +	2 —	2 —	2	2	1 —	0	1 —	0	2	2 —	1
21	0	2 —	2	1 +	2 —	1	0	1 —	1 —	2 —	2 —	0 +
22	1 —	1 +	1	2	1 +	2	1 —	0 +	2	1 +	2 —	0
23	0 +	2 —	0	2 —	1 —	1	0 +	1	2 +	2	0	1
24	1	2 —	1	1 —	1	0 +	0 +	1 —	2	2	0	0 +
25	2	2 —	2	1	1	2	1	0 +	2	2	1	1
26	1	1	1	2	0 +	0 +	1	2	2 —	1 +	2 —	2
27	2 —	0 +	1	0 +	2	0 +	2	2	2 —	1 —	1	1
28	1 —	0 +	1 —	0	0	1 —	0 +	2	2	0 +	2 —	0
29	1 —		0 +	0 +	0 +	1 +	1	2	2	1	0 +	0 +
30	1		1	1 —	0 +	1 —	1	2	2	1	0	1
31	0 +		0 +		0 +		0	1		1		1
Sums	25	25	23	31	26	24	21	29	29	30	37	21

Adelie Land magnetic character numbers had already been allotted by Dr. Chree both for days and hours (Table CXXXVIII)*, but the magnetograph instruments were not in action during the period August to November, 1913, which comprised a good portion of the period for which wireless data were available for the Adelie Land station. The magnetic records are therefore only useful before June 9th, 1913, on which date the wireless mast at Adelie Land was blown down so that wireless data are not available for the period June 9th to August 4th inclusive, which comprised the period of least sunlight and the months of least magnetic activity in the whole 11-year cycle.

In dealing with the relationship between wireless communication and magnetic activity, it is proposed first to discuss the data, month by month, in this section and to postpone the general review of the data, considered for each wireless station separately, to the succeeding sections of the Report.

In what follows, the signal strength as before is expressed in the arbitrary scale: inaudible = 0, very faint = 1, and so on up to very strong = 5, and the figure stated refers to the maximum strength heard during the day (or hour). The magnetic character is expressed in the scale 0, 1, 2; two corresponding to very great magnetic activity and 0 to very slight activity. The scale of magnetic activity is by no means the same at stations such as Adelie Land and Christchurch. The former station, being close to the South Magnetic Pole and the auroral zone, is practically always more disturbed than Christchurch. Thus a " 1 " at the latter station represents less disturbance than a " 1 " at Adelie Land, and the figures for magnetic character are of chief value in separating the days in any interval into three categories—very slightly, moderately and very greatly disturbed. As pointed out, the character numbers are derived by inspection of the magnetograph curves and represent a very large range of disturbance. Portions of the Adelie Land magnetograph curves are reproduced in Figs. 6 to 9, and show the range of variation in disturbance covered by the hourly values of character number (0, 1 and 2) which were allotted by Dr. Chree.

TABLE CXXXVIII.

Date	Days.	Magnetic Character Numbers (Adelie Land) of hours (Local Mean Time) centred at—							Date	Days.	Magnetic Character Numbers (Adelie Land) of hours (Local Mean Time) centred at—						
		8 p.m.	9 p.m.	10 p.m.	11 p.m.	Mid-night.	1 a.m. *	Sum of hours.			8 p.m.	9 p.m.	10 p.m.	11 p.m.	Mid-night.	1 a.m. *	Sum of hours.
Oct., 1912									Oct., 1912								
1	2	1	1	1	1	1	1	6	11	2	2	2	1	1	1	2	9
2	1	0	0	0	0	0	1	1	12	1	1	2	1	1	1	0	6
3	1	0	0	0	1	0	0	1	13	1	2	2	1	1	1	0	7
4	1	1	1	2	2	1	0	7	14	2	2	2	2	2	2	2	12
5	0	0	0	0	1	0	0	1	15	2	1	2	2	2	2	1	10
6	1	0	0	2	2	1	0	5	16	2	2	2	1	1	1	1	8
7	1	1	1	1	1	2	2	8	17	2	2	1	1	0	0	0	4
8	2	1	1	2	1	1	0	6	18	1	1	0	0	0	0	0	1
9	1	1	2	1	0	0	0	4	19	0	0	0	1	1	1	1	4
10	2	1	1	0	1	0	1	4	20	2	0	0	0	0	0	0	0

* 60 minutes ending 16 hours G.M.A.T.

* A day of magnetic character 2 may include hours of magnetic character 1, or even of character 0.

TABLE CXXXVIII—*continued.*

Date.	Days.	Magnetic Character Numbers (Adelie Land) of hours (Local Mean Time) centred at—							Date.	Days.	Magnetic Character Numbers (Adelie Land) of hours (Local Mean Time) centred at—						
		8 p.m.	9 p.m.	10 p.m.	11 p.m.	Mid-night.	1 a.m.	Sum of hours.			8 p.m.	9 p.m.	10 p.m.	11 p.m.	Mid-night.	1 a.m.	Sum of hours.
1913									1913								
Feb. 1	1	0	0	0	1	1	0	2	April 6	0	0	0	0	0	1	0	1
2	1	1	0	0	1	0	0	2	7	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	8	1	0	0	0	0	1	0	1
4	0	0	0	0	0	1	1	2	9	2	1	2	2	2	2	2	11
5	1	0	0	1	1	0	1	3	10	2	2	1	1	1	1	1	7
6	1	0	0	0	0	0	0	0	11	2	2	2	1	1	1	1	8
7	1	0	0	1	1	1	1	4	12	1	1	1	1	1	2	2	8
8	1	1	1	1	1	1	1	6	13	1	0	1	1	1	0	0	3
9	2	1	1	1	1	0	1	5	14	1	0	1	1	0	1	1	4
10	1	0	0	0	0	0	1	1	15	1	1	0	0	0	1	1	3
11	0	0	0	1	1	1	1	4	16	1	0	0	2	2	1	1	6
12	2	1	1	0	2	1	1	6	17	1	1	1	1	2	2	1	8
13	2	1	1	1	1	1	1	6	18	0	0	0	0	1	1	0	2
14	2	2	2	2	2	2	2	12	19	1	0	0	0	1	1	0	2
15	2	1	1	1	2	2	1	8	20	1	0	0	1	1	0	0	2
16	1	1	1	1	2	2	2	9	21	0	0	0	0	0	0	0	0
17	1	1	1	1	1	1	1	6	22	1	0	0	1	1	1	0	3
18	2	1	1	1	0	1	1	4	23	1	0	0	1	1	1	1	4
19	1	1	1	2	2	1	1	8	24	0	0	0	0	1	0	1	2
20	1	1	1	0	0	1	1	4	25	0	0	0	1	1	0	0	2
21	1	1	0	0	1	0	0	2	26	0	1	1	1	1	1	0	5
22	1	0	0	0	0	1	0	1	27	1	1	1	1	2	2	1	8
23	1	0	0	1	0	1	1	3	28	1	1	1	1	1	0	1	5
24	0	0	1	1	0	1	0	3	29	0	1	0	0	1	1	1	4
25	2	1	2	2	1	1	1	8	30	0	0	0	0	1	1	0	2
26	2	2	1	1	1	2	2	9									
27	1	1	1	0	0	0	0	2									
28	0	0	0	1	1	1	0	3	May 1	...	...	...	...	...	...	...	...
									2	1	0	2	1	0	1	0	4
									3	1	2	2	1	0	0	0	5
Mar. 1	0	0	0	0	0	0	0	0	4	2	1	1	2	2	1	1	8
2	0	1	0	1	0	1	0	3	5	2	2	1	1	1	1	2	8
3	0	0	0	1	0	0	0	1	6	2	1	1	2	2	1	2	9
4	1	1	1	1	0	0	0	3	7	2	2	1	2	2	2	1	10
5	1	0	0	1	1	0	0	2	8	1	0	0	1	1	1	1	4
6	1	0	0	2	1	0	0	3	9	1	1	1	1	1	1	1	6
7	1	0	0	1	1	1	0	3	10	1	0	0	0	1	0	0	1
8	1	0	1	1	1	1	1	5	11	0	0	0	0	0	0	0	0
9	1	1	0	0	0	1	1	3	12	0	0	0	0	0	0	0	0
10	0	0	1	0	0	0	0	1	13	0	0	0	0	0	0	0	0
11	1	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0
12	1	0	0	0	0	0	0	0	15	0	1	0	0	0	0	0	1
13	0	0	0	1	0	0	0	1	16	0	0	0	0	0	0	0	0
14	2	2	1	1	2	2	2	10	17	1	0	0	0	1	0	0	1
15	2	2	2	1	1	1	1	8	18	0	0	1	0	0	0	0	1
16	2	1	0	1	1	1	1	5	19	1	1	1	0	0	0	0	2
17	2	1	1	1	2	1	1	7	20	0	0	0	0	1	1	0	2
18	1	0	0	1	2	1	1	5	21	0	1	0	1	1	0	0	3
19	1	1	1	0	1	1	0	4	22	0	1	0	0	0	0	0	1
20	1	1	1	1	1	1	1	6	23	0	0	0	0	0	0	0	0
21	1	1	1	1	2	1	1	7	24	0	0	0	0	1	1	0	2
22	1	1	0	0	1	0	0	2	25	1	0	0	1	1	0	0	2
23	2	0	1	1	1	1	2	6	26	0	1	0	1	0	0	0	2
24	1	1	1	1	0	1	1	5	27	1	0	0	1	2	1	0	4
25	0	1	1	0	1	0	1	4	28	1	0	1	1	0	0	0	2
26	1	0	1	0	1	1	1	4	29	1	0	0	0	1	2	1	4
27	1	1	1	1	1	0	0	4	30	0	0	0	1	0	0	0	1
28	1	0	1	1	1	0	0	3	31	0	0	0	0	0	0	0	0
29	1	0	0	0	0	1	1	2									
30	2	1	1	1	1	1	1	6									
31	2	0	0	0	1	2	2	5	June 1	1	1	1	1	1	1	1	6
									2	2	1	1	1	1	2	1	7
									3	1	1	1	1	1	1	1	6
April 1	2	0	1	1	0	2	1	5	4	1	1	2	2	1	0	0	6
2	1	1	0	1	1	1	0	4	5	0	0	0	0	1	1	0	2
3	1	0	0	1	1	1	0	3	6	1	1	0	0	0	0	0	1
4	1	0	0	0	1	1	1	3	7	0	0	0	0	0	1	0	1
5	1	0	0	0	0	1	0	1	8	0	0	0	0	0	0	0	0

1.—*September 25th to October 13th*, 1912.

This period comprises all the days of 1912 on which the Adelie Land wireless station was heard at Macquarie Island.

The erection of the masts and aerial at Adelie Land proceeded slowly during 1912 as opportunity and weather permitted. By August 31st, two of the three sections of both northern and southern masts were completed and a temporary aerial erected. During the first half of September, improvements were made in the earth system and repairs effected whenever the lead-in wires broke away as the result of high winds. For several days before September 25th, short messages were sent to Macquarie Island periodically, but these were not heard until the 25th. On October 7th the aerial system was further improved by raising a topgallant section on the northern mast, bringing it up to 90 feet in height, and an optimistic note appears in the record for October 12th, stating that the wireless masts had held remarkably well up to date and pointing out that one fine day with wind less than 30 miles per hour was all that was required to complete the aerial system. Unfortunately, a hurricane arose on October 12th–13th, and the northern mast collapsed. The gusts of wind were estimated by Mawson to have reached something like 250 miles an hour.

Signals might therefore reasonably have been heard by Macquarie Island between mid-September and October 13th, but were not, in fact, picked up until September 25th.

During this year, no signals were received by the Adelie Land station. The reason for this is fairly obvious, as the whole of the wireless equipment was installed during this year in the outer hut, where the temperature was usually below freezing point. As a result the instruments were covered with rime which thawed periodically when the temperature rose slightly. In the following year, only the power plant was installed in the outer hut, the remainder of the gear being transferred to the inner hut, where it was almost always free from ice and water.

While September 15th was quiet magnetically during the hours of observation and also the 19th up to midnight, the interval between the 15th and the 25th was not distinguished otherwise by magnetically quiet conditions. The 25th, 26th, 27th, 28th and 29th were, however, quiet as were the 2nd, 3rd and 5th October, judged by the Adelie Land magnetograph records. By the same standard, September 30th, October 1st and 4th and October 6th to 13th were all disturbed magnetically to a greater or less extent.

Correspondingly, signals were heard by Macquarie Island between September 25th and 29th and between October 3rd and 6th, inclusive, but not on other days. The Macquarie Island station was out of action on October 11th.

While there were many magnetically quiet hours during this period when no signals were heard, all hours during which signals were heard were hours allotted hourly character number 0 at Adelie Land. It will be seen there is a strong tendency for a succession of days, good (or bad) for communication, to follow one another and for the days of good communication to occur on magnetically undisturbed days, and *vice versa.* Exceptions to the latter are the absence of recorded communication on September 30th and October 2nd. Also the record of signals on October 4th and 6th, when conditions were somewhat disturbed at Adelie Land. It may also be noted that the days of communication were generally days to which daily magnetic character 0 was allotted at Christchurch; conversely, days of no communication were allotted magnetic character 1 or over at Christchurch.

Table CXXXIX shows the average magnetic character numbers for days of audible and inaudible signals.

TABLE CXXXIX.

Reception at Macquarie Island, September 25th to October 13th, 1912.	Average magnetic character numbers.			
	International. (Days.)	Adelie Land. (Days.)	Christchurch. (Days.)	Adelie Land.* (Sum of Hours.)
Days of communication	0·23	0·8	0·2	1·7
Days of no communication	0·48	1·3	0·9	5·0
Mean values of above days	0·36	1·1	0·56	3·3

* Sum of hourly magnetic character numbers during the 6-hourly observation periods.

For this period, *all* communication took place during hours with hourly magnetic character 0, the mean character number of hours of no reception being 0·40.

The magnetograph records of September 28th and October 6th are shown in Figs. 6 and 7. The former is characteristic of very quiet conditions, while the latter includes two hours in the observation period allotted magnetic character 2.

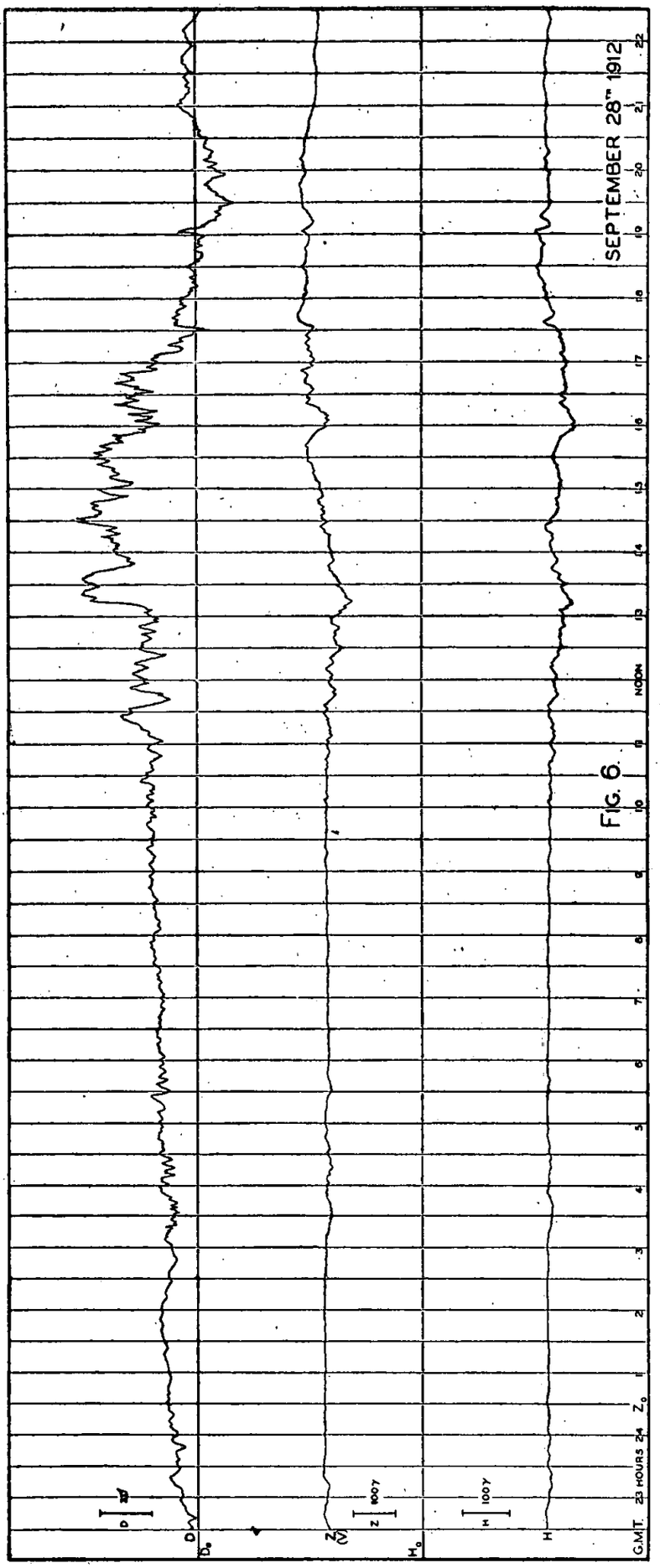

FIG. 6.

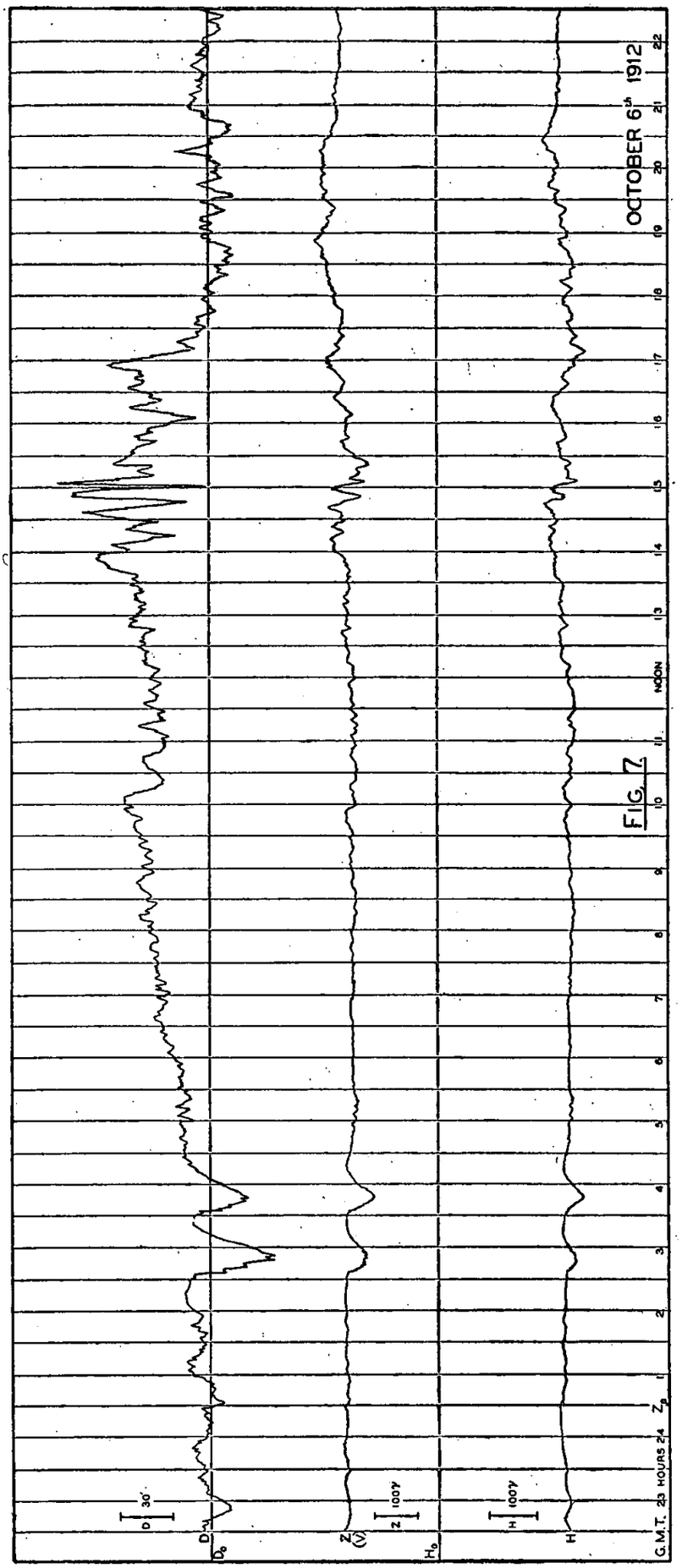
OCTOBER 6th 1912
NOON
G.M.T. 23 HOURS 24
D
30'
Z (V)
100γ
H
100γ
D0
H0
Z0
H0

FIG. 7.

2.—*February 3rd to 28th*, 1913.

The destruction of the aerial on October 13th, 1912, put an end to communication for that year. When Capt. Davis arrived at C. Denison (Adelie Land) with the ship in the summer 1912–1913, and it was decided to carry on the land station for a second year, assistance was given to the shore party by members of the ship's crew in the erection of a single mast 115 feet high built from the wreckage of the two masts, together with a short staymast, about 20 feet high, erected to windward of the main mast. Transmissions commenced early in February, but the exact date is not recorded; they were first picked up by Macquarie Island on February 3rd. Though there is no record of reception of the Macquarie Island signals at Adelie Land during February, it is clear from the log of the former station that two-way communication was established on February 20th and possibly earlier. In the absence of records from Adelie Land, it is necessary to rely solely on the Macquarie Island log. It is possible that the absence of records from Adelie Land is due partly to the efforts of the operator having been concentrated on getting messages through to the "Aurora," which had a wireless receiver but no transmitting apparatus. There is also a considerable gap between February 9th and 19th in the Macquarie Island records, which seems to be due to unfavourable magnetic conditions in this interval combined with interference from atmospherics (statics).

Magnetically, the month was relatively undisturbed until February 12th and after the 19th with the exception of the 25th and 26th. Magnetic records from Christchurch are missing after February 24th.

Wireless signals were heard at Macquarie Island on the 3rd, 4th, 6th and 8th and from February 20th to the end of the month, excluding the 25th, which was relatively disturbed, magnetically, as already stated.

It will be seen that there is again a strong tendency for days of communication (and of no communication) to run in sequence, February 5th, 7th and 25th being exceptions to this rule. There is again a tendency for days of good (or bad) communication to be associated with quiet (or disturbed) magnetic conditions. Judged by these standards, however, we should expect signals to have been heard on the 5th, 7th, 10th and 11th, but not on the 8th or 26th. Possibly the lack of recorded signals on the 5th, 7th and 11th can be put down to slight magnetic disturbance during the particular hours of transmission, late in the evening. Except for the 8th, all days on which signals were recorded were allotted Christchurch magnetic character 0, so far as the records from this observatory are available.

Table CXL which follows gives the average magnetic character numbers for days of communication and of no communication during February.

TABLE CXL.

Reception at Macquarie Island, February 3rd to 28th, 1913.	Average magnetic character numbers.			
	International. days.	Adelie Land. days.	Christchurch. days.	Adelie Land. Sum of hours.*
Days of communication	·32	·75	·1	2·9
Days of no communication	·76	1·4	·8	6·0
Mean values of above days	·55	1·1	·5	4·6

* Sum of hourly magnetic character numbers (Adelie Land) during the 6-hourly observation periods.

It is interesting to note that hours of no communication are all allotted magnetic character number 1 or 2 at Adelie Land while hours of recorded signals are all allotted character number 0 and 1. The average hourly magnetic character number for different classes of reception at Macquarie Island was as follows :—

Hours of no reception	1·25
,, very faint signals ...	1·0
,, faint signals	0·4
,, moderate signals ...	0·2

3.—*March*, 1913.

At Adelie Land, the first record of signals heard appears in the log on March 6th, but from other sources it appears that "poor communication was recorded on the 1st, 2nd, 3rd and 4th March, but the 5th and 6th were bad occasions." From this time on, the results of the evening's work were recorded by the operator in increasing detail. No record appears, however, for many of the days about the middle of the month, but it is clear from subsequent correspondence with Sir Douglas Mawson that the absence of record is to be interpreted as "no signals heard." At Macquarie Island signals were received on most days at some time during the evening period and it is notable that signals were never strong, but at the same time were not often below average strength.

Magnetically, the month commences quietly and remains undisturbed until the 14th. Then follows a disturbed period of four days. From the 18th to the end of the month the disturbance is on the whole greater than in the first half of the month, but varies a good deal from day to day. No records are available from the Christchurch Observatory for the period March 1st to 4th, inclusive.

At Macquarie Island atmospherics interfered considerably with reception but there were only four days (5th, 14th, 15th and 28th) when signals might otherwise have been heard, but were not. Of these four days, the 5th and 28th were not magnetically disturbed days. Reception was below the average on the 6th, 12th, 17th, 18th and 27th.

The Adelie Land records are too scrappy for reliable results, except from the 23rd to the end of the month. Statics interfered on the 24th and the 27th and 28th were the worst of the remaining days, both of which were relatively undisturbed.

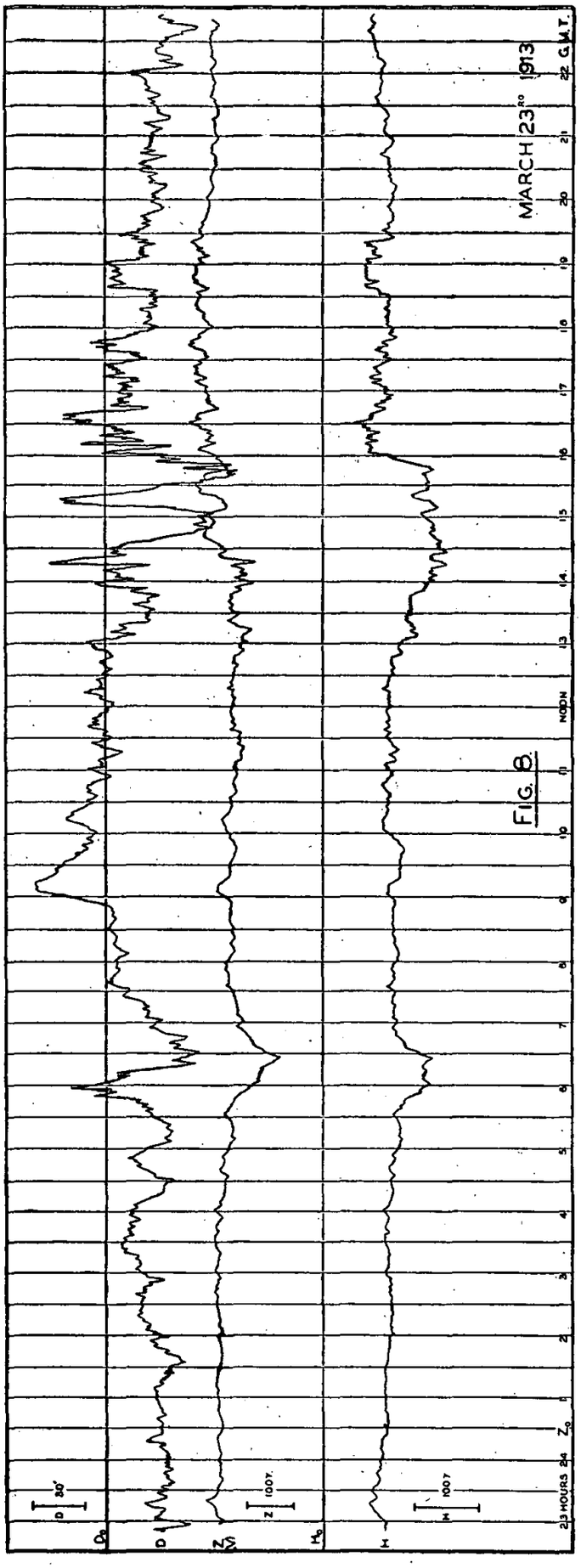

FIG. 8.

At first sight, it seems as if the association between magnetic disturbance and bad wireless communication may have broken down. Also for the first time moderate signal strength is recorded at Macquarie Island during an hour which is allotted magnetic character 2 at Adelie Land. This hour is the last one of the observation period on March 23rd–24th (hour ending 16 G.M.A.T.) and the magnetograph record is reproduced in Fig. 8. Moderate signal strength was also recorded at Adelie Land in this hour and good reception in several hours allotted magnetic character 1.

TABLE CXLI.

March, 1913.	Average magnetic character numbers.			
	International. days.	Adelie Land. days.	Christchurch. days.	Adelie Land. Sum of hours.*
Reception at *Macquarie Island*.—				
Days of moderate reception	·51	1·0	·5	3·8
„ faint reception	·60	1·3	·7	5·3
„ very faint reception	·2	1·0	0·0	1·5
„ no reception	·8	1·5	1·2	5·8
Average of last three classes	·60	1·3	·8	4·7
„ all classes	·54	1·1	·6	4·1
Reception at *Adelie Land* (from March 6th)—				
Days of good reception	·58	1·0	·2	3·2
„ moderate reception	·68	1·5	1·0	4·8
„ very faint reception	·1	1·0	0·0	3·0
„ no reception	·63	1·1	·6	4·5
Average of first three classes	·57	1·2	·5	3·8
„ all classes	·61	1·2	·56	4·2

* Mean value of sum of hourly magnetic character numbers (Adelie Land) during the 6-hourly observations periods.

Table CXLI has been formed to exhibit the mean magnetic character of days of different class of wireless reception. Since, however, the number of days of inaudible signals received at Macquarie Island is so small, the data have been grouped in a variety of classes. The fifth line in each half of the table is added in the attempt to obtain a class containing an adequate number of days to compare with the relatively large class of moderate signal strength at Macquarie Island and of inaudible signals at Adelie Land. It will be seen that the differences between the mean character numbers for moderate reception at Macquarie Island and reception below moderate is small, as also is the difference between inaudible and audible signals at Adelie Land. The differences, though small, are in the direction we should expect from the analysis of the earlier periods.

It seems as if a new regime may have become established in March, communication being no longer possible only in quiet magnetic conditions, but possible in spite of moderate, and sometimes great, disturbance. In the following months, days of no communication become rare.

During this period, the average magnetic character of hours of different classes of received signals was as follows :—

March, 1913.

	Reception at Macquarie Island.	Reception at Adelie Land.
Inaudible signals	0·5	0·9
Very faint signals	0·0	.....
Faint signals	0·5	.....
Moderate signals	0·5	0·8
Good signals	.....	0·5

4.—*April*, 1913.

At Macquarie Island, signals failed to be received only on the 28th and some days were logged for the first time as good and very good. Interference from atmospherics was also rare. Signals were received at Adelie Land every day, some days being marked good and very good, but the record ceases after the 25th with the omnibus note attached that " 'Aurora' appears to be causing much trouble. I get through to M.Q.I. only very rarely and then only for about an hour or less at one time. Signals seldom strong." Sir Douglas Mawson reports, however, that during the period (April 26th to May 20th) covered by this note, half a dozen long messages were transmitted and that there was a definite improvement in the wireless conditions after May 14th, though the good periods did not last more than an hour at a time. On April 20th, St. Elmo's Fire is noted as a cause of interference, but atmospherics did not seem to be troublesome during the month.

Magnetically, the month started well and was undisturbed generally until the 9th, the disturbed period then lasting from the 9th to the 17th, inclusive, the 14th and 15th being, however, quiet. From the 18th to the end of the month conditions were quiet, except for the 26th to 28th, inclusive, which were moderately disturbed.

Reception at Macquarie Island was generally moderate to good at some period of the night, the worst days being the 11th, 20th, 22nd, 23rd, 25th and 28th, most of which were magnetically undisturbed. The best days were the 9th, 14th, 15th, 18th, 21st and 24th. The first of these days was the most disturbed day of the month and the remainder were relatively undisturbed.

Reception at Adelie Land became much more consistent during this month up to the 20th and there were many days when strong signals were heard in all, or most, of the hours in the observation period, possibly due to the gradual extension of darkness. The worst days were the 11th, 12th, 16th, 17th and 20th, if we exclude the final days of the month for which records are not available. If instead of taking account of the best signals of the day, we count the sum of the best signal strengths in each hour, we find the best periods for reception up to the 19th are from the 1st to the 8th April and after the 18th. Within limits, these periods were the least disturbed in the interval and it seems likely therefore that reception at Adelie Land will show a reasonably close correspondence with magnetic disturbance. While the remainder of the month (after the 25th) is generally more disturbed there seems to be nothing in the magnetic data which is sufficient to account for the operator's remark covering the whole of this period and the greater part of May. Scrutiny of the magnetograph records confirms this opinion.

The following table (No. CXLII) exhibits the difference in magnetic character of days of wireless reception of different classes.

TABLE CXLII.

April, 1913.	Average magnetic character numbers.			
	International. days.	Adelie Land. days.	Christchurch. days.	Adelie Land. Sum of hours.*
Reception at Macquare Island—				
Days of good and very good reception	·63	·7	·5	3·7
Days of moderate reception	·59	·9	·5	3·9
Days of faint, very faint and no reception ...	·37	1·0	·7	4·0
Mean Value	·55	·9	·5	3·9
Reception at Adelie Land.—				
Days of very good and good reception ...	·33	·8	·3	2·2
Days of moderate reception	·64	·9	·5	3·7
Days of faint, very faint and no reception ...	·80	1·2	·8	6·4
Mean value	·54	·8	·5	3·9
Mean of days after 25th	·42	·4	·4	4·8

* Mean value of sum of hourly magnetic character numbers (Adelie Land) during the 6-hourly periods.

The great indifference of reception at Macquarie Island to magnetic disturbance is striking in distinction to the strong association with reception at Adelie Land which appears notwithstanding the inclusion of the disturbed days April 9th and 10th in the list of days of moderate reception and the appearance of April 20th, a quiet day, as a day of very faint reception at Adelie Land.

The 9th appears also in the list of days of good reception at Macquarie Island on the strength of a single hour when signals rose to the level of "good." The magnetograph record of the 9th is reproduced in Fig. 9.

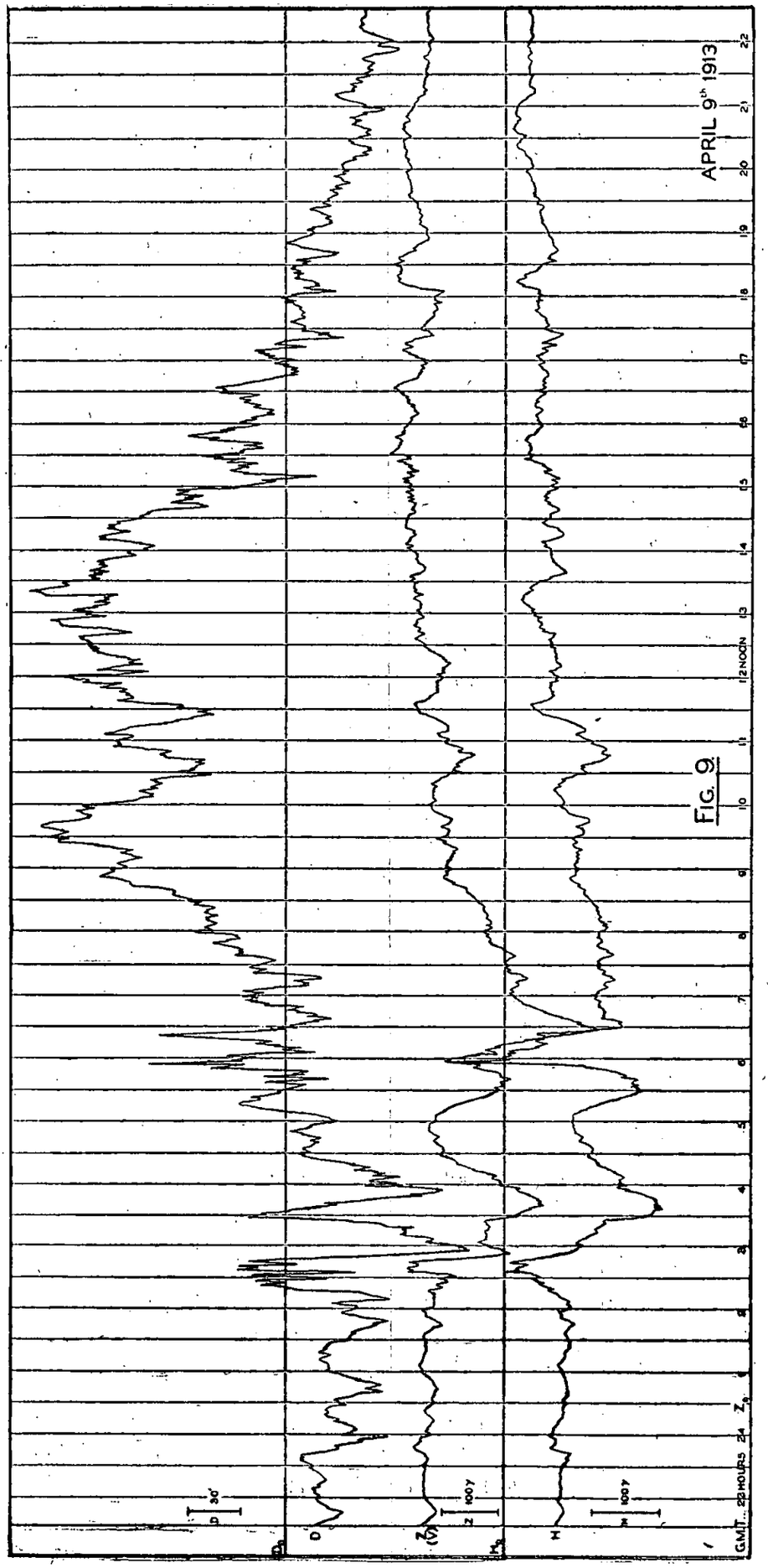

FIG. 9

During this period the average magnetic character of hours of reception was as follows :—

April, 1913.

—	Reception at Macquarie Island.	Reception at Adelie Land.
No signals heard	·74	·81
Very faint signals	·5	1·0
Faint signals	·2	1·3
Moderate signals	·83	·43
Good signals	·6	·36
Very good signals	0·0	0·0

These numbers are at least suggestive of a state of affairs in which increased magnetic disturbance may have either a favourable or an unfavourable association with wireless reception at Macquarie Island, the unfavourable effect predominating at Adelie Land, but less strongly at Macquarie Island. As usual, disturbed hours are not confined to hours of no reception. For Macquarie Island, three hours of fair or good reception were awarded magnetic character 2, while many hours of magnetic character 0 occurred when no signals were heard. The same is generally true at Adelie Land; three 2's appear in hours of faint signals and one in an hour of moderate reception, but many 0's appear in hours when no signals were heard.

In Table CXLII the class of the day is decided by the strongest recorded signal of the day. A different classification of the days of the month would have been obtained if some other criterion had been used, for example, the sum of the maximum signal strengths recorded in each hour of the day. The mean magnetic character numbers for the nine most favourable days for reception at each station according to this criterion are shown in Table CXLIII below.

TABLE CXLIII.

April, 1913.	Mean magnetic character numbers.			
	International. days.	Adelie Land. days.	Christchurch. days.	Adelie Land. Sum of hours.*
Most favourable days at Macquarie Island	·46	·4	·3	3·4
Mean values	·55	·9	·5	3·9
Most favourable days at Adelie Land	·40	·7	·3	2·1
Mean values	·54	·8	·5	3·9

* Sum of hourly magnetic character numbers during the 6-hourly observation period.

Comparison with Table CXLIII suggests that this method of choosing days of good reception gives a slightly better correspondence with low magnetic character at Macquarie Island. Only two days are in the most favourable list for both stations. From the scanty evidence of these tables we should be inclined to judge that constant and good reception at Macquarie Island shows a closer association with low magnetic character than does a high peak value of reception during some hour of the day.

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5.—*May 1st to 31st, and June 1st to 8th*, 1913.

This period includes all the days up to June 9th, on which day the aerial at Adelie Land was again blown down so that records do not recommence until August when the magnetic data at Adelie Land come to an end.

The Macquarie Island station was only out of action on May 29th, but there were many days during which no signals were heard from Adelie Land. No pronounced reduction in the strength of signals, when heard, seems to have taken place.

Adelie Land, however, seems to have suffered a reduction in strength of received signals as well as the loss of record due to interference from St. Elmo's Fire on May 21st, 28th, 31st and June 8th. In addition no records appear until May 21st, the previous part of the month being covered by the note already referred to—" 'Aurora' appears to be causing much trouble. I get through to M.Q.I. only very rarely and then only for about an hour or less at one time. Signals seldom strong." Sir Douglas Mawson in a private communication makes it clear that the whole of the period was not equally bad, but that there was an improvement after the 14th May. Such an improvement from May 12th is quite evident in the wireless log of Macquarie Island.

Magnetically, there seems to be little to distinguish the period before May 21st from that which follows except that the first part of the month was relatively disturbed up to about May 9th while, in compensation, the next ten days or so were very quiet. While therefore the operator's note cannot be questioned, we have every reason to suspect that the comment is not equally applicable to all days in the early part of May. The days from May 10th to 24th, inclusive, were all allotted Christchurch magnetic character 0, and this was indeed the longest sequence of 0's in the whole of 1913. From the 25th to the end of the month was less quiet magnetically, and the first four days of June were somewhat disturbed and followed by a period of inactivity. Data for the magnetic disturbance at Adelie Land on May 1st are not available.

At Macquarie Island wireless reception of signals from Adelie Land was lacking from May 5th to 11th, inclusive. It will be seen from this that signals did not fail immediately with the commencement of magnetic disturbance, nor did they recover immediately the disturbance was over. No signals also were received on the 17th, 24th, 27th, 28th and 31st May, or on June 6th and 8th. Some of these days were exceptionally quiet, notably May 31st and June 8th.

At Adelie Land, wireless reception was also poor on the 27th May. There was interference, of greater or less extent, from St. Elmo's Fire on May 21st, 22nd, 28th, 31st and June 8th, and, it is probable that this interference accounts for the lack of reception at Macquarie Island on some of the days noted, since there would be no incentive to continue calling Macquarie Island if the reply could not be heard in any case.

The mean magnetic character of days for different classes of wireless reception is shown in Table CXLIV below.

The relative indifference of reception at Macquarie Island to magnetic disturbance, on the average, is again a feature, coupled with a slight increase of magnetic character on days of best reception. Indeed, magnetic disturbance is by no means confined to days when wireless reception is bad—a feature we have already seen in other months.

The closer relationship which appears for signals received at Adelie Land may of course be due to the fact that the period May 1st to 20th is not included, but examination shows that worse reception at Macquarie Island during this period was, if anything, associated with magnetic activity below the average.

If, instead of using the maximum signal strength of the day, we use the sum of the maximum signals in each hour as a criterion of the goodness of reception we might expect to find a closer relationship with magnetic disturbance. Using this criterion for deciding the fifteen days of best reception at Macquarie Island, we find these days have mean magnetic characters of ·36, ·4, ·3, and 2·0. For the headings in the last four columns of Table CXLIV, compared with ·46, ·65, ·55, and 2·9 which represent the mean values for all days. This criterion is of value in that it introduces the factor of continuity of signal strength in successive hours.

TABLE CXLIV.

May and June 1st to 8th, 1913.	Average magnetic character numbers.			
	International. days.	Adelie Land. days.	Christchurch. days.	Adelie Land. Sum of hours.*
Reception at Macquarie Island.—				
Days of good reception	·52	·5	·5	3·0
,, moderate reception	·38	·4	·5	2·4
,, faint, very faint, and no reception ...	·52	·9	·6	3·3
Mean value	·46	·65	·55	2·9
Reception at Adelie Land (May 21st to June 8th).—				
Days of good and moderate reception	·27	·3	·4	2·0
,, faint and very faint reception	·59	·9	·6	3·9
Mean value	·5	·7	·6	3·2
Mean value for May 1st to 20th	·55	·8	·65	3·3

* Mean value of sum of hourly magnetic character numbers (Adelie Land) during the 6-hourly observation periods.

The improvement in the figures for Adelie Land by a similar choice of the best days in the period is hardly appreciable.

A closer relationship with magnetic character appears between wireless reception in individual hours and hourly magnetic character in the same hours. This is shown in Table CXLV below.

TABLE CXLV.

May and June 1st–8th, 1913.

Class of Reception.	Mean magnetic character of hours (Adelie Land) for reception at	
	Macquarie Island.	Adelie Land.
Not heard	·67	1·0
Very faint signals	1·0	0·0
Faint signals	·1 } mean	·5 } mean
Moderate signals	·35 } ·53	·2 } ·33
Good signals	·50	·5

As the number of hours is so few mean values have been added for all hours when signals were heard at all. The relatively high character numbers both for very bad and good signals at Macquarie Island is still noticeable and suggests that magnetic disturbance sometimes is associated temporarily with enhanced received signals, at least at Macquarie Island.

In this period there was one instance of an hour of good reception and one of fair reception at Macquarie Island being awarded magnetic character 2. At Adelie Land there were only four hours of magnetic character 2 on days for which records are available between May 21st and June 8th; no signals were received in any of these four hours.

6.—*August 5th to 31st*, 1913.

The aerial at Adelie Land, which was blown down on June 9th, was again erected and working on August 5th, on which day signals were again picked up by Macquarie Island. Very satisfactory records of signal strength are available for the former station and signals were on the whole unusually strong. Unfortunately the records from Macquarie Island are somewhat scrappy for this month owing to the illness of the operator and the need for supplementing a shortage of food from the very meagre resources of the island. There is no indication of improved reception at Macquarie Island in the interval August 5th to 18th for which records are available. At Adelie Land some interference is noted from St. Elmo's Fire and from atmospherics and frequent reference is made to variable signal strength.

Magnetically, August was a very quiet month. No days were allotted character 2 at Christchurch and character 1 was allotted to only nine days—the 7th, 9th to 13th, 15th, 16th and 23rd. On the International scale, August 9th to 13th, 15th, 16th and 23rd were the most disturbed days. The magnetic records at Adelie Land ceased early in August and this valuable source of information is lacking for the remainder of the year.

According to the wireless records at Macquarie Island (5th to 18th) the received signals were never strong and signals were poor or inaudible on the 9th, 10th, 14th and 16th. Two of the best days were however the 12th and 13th, both of which were allotted Christchurch magnetic character 1.

At Adelie Land, the 12th and 13th were also days of good reception. The 7th 9th, 10th, 11th and 23rd were below the average in reception, corresponding to magnetic disturbance above the average, but there were other days—5th, 6th and 14th—for which there was no such correspondence. The 8th and 23rd suffered from interference due to St. Elmo's Fire.

As stated above, reception at Adelie Land was above the average in this month, very good signals being noted quite frequently. Constant reference is however made to variability in signal strength, but this may be a characteristic associated with loud signals at Adelie Land and may signify no more than that variation in signal strength is more likely to force itself on the attention when the general level of signal strength is high. Corresponding to this high general level we see that the number of hours in which no signals are heard is relatively low.

The following table shows the mean magnetic character number for days of wireless reception of different classes, the class being determined by the maximum signal of the day.

TABLE CXLVI.

August, 1913.

Class of Reception.	Average magnetic character numbers.	
	International. days.	Christchurch. days.
Reception at Macquarie Island—		
Days of moderate reception	·60	·56
,, very faint or no reception	·75	·75
(Mean values)	(·65)	(·6)
Reception at Adelie Land—		
Days of very good reception	·42	·2
,, good reception	·47	·3
,, moderate reception	·47	·4
,, very faint, faint, or no reception	·60	·5
(Mean values)	(·48)	(·33)

At each station only four days fell in the last class of reception. The number of days noted at Macquarie Island is too small to enable reliable conclusions to be drawn, but there seems to be a progressive increase of magnetic activity as reception at Adelie Land deteriorates, so far as the Christchurch character numbers may be taken as a reliable index of magnetic activity.

The mean magnetic character numbers of the best and worst days of the month, judged by the sum of the maximum signals received in each hour of the day, are shown in the table below.

TABLE CXLVII.

August, 1913.

Class of Reception.	Average magnetic character number of days.	
	International.	Christchurch.
Reception at Macquarie Island—		
Best days (6 in number)	·53	·5
Worst days (6 in number)	·70	·7
Reception at Adelie Land—		
Best days (12 in number)	·41	·2
Worst days (10 in number)	·54	·4

As usual, the association between wireless reception and magnetic activity is only statistical. There were only nine days of moderate magnetic disturbance during the period. One of these days was a day of very good signal strength at Adelie Land, three were days of good signals, three of moderate, one of faint and one of very faint signals. The most interesting feature is that the association between magnetic activity and reduced signal strength at Adelie Land shows itself even in a very quiet month which contained no really disturbed days.

7.—*September*, 1913.

In September there was a definite decrease in the strength of signals received at Adelie Land. On the contrary, signals at Macquarie Island seemed to be better than during August, though the entries in the operator's log are usually confined to the two hours preceding local midnight. At this station also the approach of summer is heralded by considerable interference from atmospherics, especially in the early part of the month. While a possible result of this is a restriction of the opportunities for a record of signal strength at Adelie Land there is no strong evidence for such a restriction. Indeed, there is only a single day (the 10th) when no signals were heard at Adelie Land in September and this is not a day when atmospherics seemed to be causing much trouble at Macquarie Island.

Magnetically, the month was much more disturbed than August, especially between September 5th and 12th, inclusive, and September 22nd and 23rd, five days in all being allotted magnetic character 2 at Christchurch (6th, 8th, 9th, 22nd, 23rd) and eight days magnetic character 1.

At Macquarie Island, no signals were heard on ten days (four of which were disturbed by atmospherics to such an extent that reception was impossible). Of the remaining six days, two (6th and 9th) corresponded with days of magnetic character 2; two (17th and 10th) to character 1; and two (21st and 24th) to character 0.

At Adelie Land, signals were not heard only on the 10th, while the days allotted magnetic character 2 were by no means the least favourable for wireless reception.

The average magnetic character number of days of different classes of reception is set out in Table CXLVIII below.

TABLE CXLVIII.

September, 1913.

Class of Reception.	Average magnetic character number of days.	
	International.	Christchurch.
Reception at Macquarie Island —		
Days of very good and good reception	·83	1·0
,, moderate reception	·44	·3
,, faint and very faint reception	·37	·5
,, no reception	·83	1·0
(Mean values)	(·67)	(·7)
Reception at Adelie Land—		
Days of good reception	·76	·8
,, moderate reception	·49	·5
,, faint reception	·75	1·0
,, very faint and no reception	·56	·8
(Mean values)	(·58)	(·67)

It will be seen that there is at both stations a certain tendency for signals of mean strength to occur on days of low magnetic activity, as if magnetic disturbance was sometimes associated with enhanced and sometimes with diminished signal strength. There is, however, a distinct difference between the magnetic character (Christchurch) of the best and worst days for reception at Macquarie Island when days are classified according to the sum of the maximum signals heard in each recorded hour of the day. This is shown in Table CXLIX below.

TABLE CXLIX.

September, 1913.

Class of Reception.	Average magnetic character number of days.	
	International.	Christchurch.
Reception at Macquarie Island—		
Best days (6 in number)	·55	·33
Worst days (12 in number)	·60	·75
Reception at Adelie Land—		
Best days (7 in number)	·77	·86
Worst days (10 in number)	·62	·60

For Adelie Land, September seems to be anomalous in that there is an association between magnetic disturbance and *improved* reception.

8.—*October*, 1913.

During this month signs are not lacking of restriction at Adelie Land due to the lengthening hours of daylight. At the same station interference from atmospherics becomes more frequent. The signals received are becoming weaker and only rise to the

level of good reception during two hours of the month. At Macquarie Island references to received signals are largely restricted to the two hours preceding midnight and complaints of interference from atmospherics become relatively frequent. The aerial at Adelie Land was out of action on October 9th.

Magnetically, the month was slightly more disturbed than was September. Disturbance was chiefly confined to the periods 5th to 12th, inclusive, and 18th to 22nd. Six days were given magnetic character 2 at Christchurch Observatory—the 6th, 7th, 8th, 10th, 19th and 20th.

Reception at Macquarie Island seems to have been below the average between the 4th and 14th, which includes the first period of magnetic disturbance and also between the 20th and 23rd, inclusive. The 18th was, however, one of the best days of the month, signals being of moderate strength for three consecutive hours on that day.

At Adelie Land, the first half of the month was worse for reception than the second half, especially the 4th to 14th, excluding the 8th and 10th, both of which were highly disturbed magnetically. Interference from atmospherics was a cause of trouble on the 5th, 6th, 7th and 14th. At this station the 18th was also one of the best days of the month for reception, while the 19th, 20th and 21st were not, relatively, bad days.

It looks, therefore, as if any positive relation which may appear in this month between magnetic disturbance and bad reception will be due chiefly to the days of the month between the 4th and 14th. Analysis of the data shows that this is indeed the case and that the relation is somewhat prejudiced at Adelie Land by the interference from atmospherics between the 5th and 7th.

As usual, the days of the month have been grouped (in Table CL) into classes of reception to show the average magnetic character of each class.

TABLE CL.

October, 1913.

Class of Reception.	Average magnetic character number of days.	
	International.	Christchurch.
Reception at Macquarie Island—		
Days of good and moderate reception	·49	·6
,, faint and very faint reception	·45	·4
,, no reception	·66	·9
(Mean values)	(·54)	(·67)
Reception at Adelie Land—		
Days of good and moderate reception	·48	·6
,, faint and very faint reception	·37	·6
,, no reception	1·02	1·2
(Mean values)	(·54)	(·67)

The mean magnetic character number of the worst and best days for reception, judged by the sum of the maximum signal strength recorded in each hour of the day, is shown below.

TABLE CLI.

October, 1913.

Class of Reception.	Average magnetic character of days.	
	International.	Christchurch.
Reception at Macquarie Island—		
Best days (7 in number)	·50	·6
Worst days (12 in number)	·66	·9
Reception at Adelie Land—		
Best days (12 in number)	·45	·6
Worst days (11 in number)	·70	·7

Clearly, any association between wireless reception and magnetic disturbance rests on the data recorded on a few days of great magnetic disturbance, during which wireless reception was unfavourably affected.

9.—*November 1st to 20th*, 1913.

This interval covers the remainder of the period under review, November 20th being the last time signals were heard from Adelie Land at Macquarie Island. No signals from the latter station were, however, noted after the 12th and the record at Adelie Land ceases on November 13th, there being no note of the date on which the station ceased to work. Static interference was noted by Macquarie Island on the 3rd, 4th, 7th, and 17th, and notes of reception are confined to the two darkest hours of the night. At Adelie Land, atmospherics interfered on the 8th and signals were seldom noted except between 9.30 p.m. and 0.30 a.m. (Local Time).

Except for the 4th and 5th, magnetic disturbance is generally evident in the first nine days of the month, though the 13th and 15th were awarded Christchurch magnetic character 1. Only three 2's were given—on the 2nd, 3rd and 8th.

Generally speaking, reception at Macquarie Island was below the average up to the 14th of the month and improved later, being very good in two consecutive hours on the 16th and similarly good on the 19th.

At Adelie Land, signals never rose above the level of moderate and only in three hours up to this level. November 2nd, though awarded character 2 (Christchurch), was not relatively a bad day for reception. On the other hand, no signals were heard on the other two days of great disturbance (3rd and 8th).

Table CLII below gives the average magnetic character of days of different classes of reception.

TABLE CLII.

November, 1913.

Class of Reception.	Average magnetic character of days.	
	International.	Christchurch.
Reception at Macquarie Island—		
Days of very good, good, and moderate reception ...	·38	·3
,, faint and very faint reception	·32	·6
,, no reception	·53	·8
(Mean values)	(·44)	(·6)
Reception at Adelie Land—		
Days of moderate reception	·80	1·3
,, faint and very faint reception	·42	·3
,, no reception	·65	1·2
(Mean values)	(·58)	(·85)

Mean magnetic character numbers are shown below for the best and worst days for reception, judged by the sum of the signal strengths recorded in each hour of the day.

TABLE CLIII.

November, 1913.

Class of Reception.	Average magnetic character of days.	
	International.	Christchurch.
Reception at Macquarie Island—		
Best days (6 in number)	·35	·17
Worst days (8 in number)	·53	·8
Reception at Adelie Land—		
Best days (6 in number)	·52	·8
Worst days (7 in number)	·64	·9

It looks as if, during this month, the association between signal strength and magnetic disturbance is stronger at Macquarie Island than at Adelie Land. The interval for which records are available is not, however, the same for each station.

The occurrence of a high mean character number on days during which signals at Adelie Land rose above the average of the month at some time of the day, though it rests on the evidence of only three days, is believed to be of some significance and only confirms what has happened in other months, viz., the occasional occurrence of signals of unusual strength on days which are highly disturbed magnetically.

TABLE CLIV.

Class of Reception.	Average Christchurch magnetic character number for signals of the following maximum strength in the day.					
	Very good.	Good.	Moderate	Faint.	Very faint.	No signals heard.
Reception at Macquarie Island—						
Sept. 25th, 1912, to June 8th, 1913	0·0	0·5	0·44	0·31	0·45	0·80
Aug. 5th to Nov. 20th, 1913 ...	0·8	0·7	0·48	0·33	0·59	0·76
All observations	0·67	0·58	0·46	0·32	0·54	0·78
Reception at Adelie Land—						
March 6th to June 8th, 1913 ...	0·0	0·36	0·57	0·70	0·33	1·00
Aug. 5th to Nov. 13th, 1913 ...	0·17	0·59	0·52	0·73	0·22	1·11
All observations	0·14	0·48	0·54	0·72	0·25	1·08

In order to obtain a general picture of the data presented in this section of the report, Table CLIV has been formed. In this table the average Christchurch magnetic character numbers are shown for signals of the maximum intensities in the day shown at the top of the columns, the data being arranged so as to separate the period prior to June 9th from that which follows August 4th.

For each period and at each station, days when no signals were heard were allotted, on the average, appreciably higher magnetic character numbers than other days. At Macquarie Island days of good and very good signals were also on the average somewhat disturbed days magnetically, but this tendency seems to be confined to the second period (August 5th to November 20th) and is due mainly to a few days in September, 1913.

At both stations, there is a definite minimum of magnetic character. This is for faint signals at Macquarie Island and for very faint signals at Adelie Land. Reference to Figs. 15 and 10 suggest that these minima are due to the fact that no days of magnetic character 2 coincided with days of faint signals at Macquarie Island or with days of very faint signals at Adelie Land. The maximum for faint signals at Adelie Land seems to be due to the relatively infrequent occurrence of these signals on days of magnetic character 0.

It is of course possible to criticise a procedure which lumps together all strong signals without consideration whether these are heard in a period when communication is easy or difficult, for example, owing to the nearness of summer and restriction in the number of possible hours of communication in the day. The table which follows is intended to meet this objection by placing the days in each month in three classes only, the two highest signal values which appear in the month, inaudible signals, and the mean of all days recorded.

TABLE CLV.

Class of Reception.	Mean magnetic character numbers (Christchurch) for days of the following classes.		
	Above the average strength.	Inaudible signals.	All days.
(Max. of day.)			
Reception at Macquarie Island—			
Sept., 1912–June 8th	·42	·80	·52
Aug. 5th–Nov. 20th	·63	·76	·63
(Sept., 1912–Nov. 20th)	(·49)	(·78)	(·57)
Reception at Adelie Land—			
Mar. 6th–June 8th	·4	1·0	·52
Aug. 5th–Nov. 13th	·5	1·1	·58
(March to Nov. 13th)	(·49)	(1·1)	(·55)

As hourly magnetic character numbers are available for Adelie Land until August, a table has been formed for the period March to June 8th to see how the mean magnetic character of the hour of reception varies with the maximum strength of signal heard in the hour. The most interesting feature of this table is the stronger association between magnetic character and signal strength below average in the same hours for Adelie Land than for Macquarie Island. There seems to be no obvious reason why there should be a difference of this nature.

TABLE CLVI.

March–June 8th, 1913.	Average magnetic character number (Adelie Land) of hours of reception in the following classes.						
	Very good.	Good.	Moderate.	Faint.	Very faint.	Inaudible signals.	Mean.
Reception at—							
Macquarie Island	0	·5	·5	·2	·4	·8	·58
Adelie Land	0	·4	·4	·8	·8	·9	·63

A review of these results makes it clear that there is a definite tendency at both stations for periods when signals were inaudible to be periods of magnetic disturbance above the average. This tendency is, however, stronger in some months than in others. Clearly, however, magnetic disturbance is not a sufficient and adequate criterion by which one may separate periods of good from periods of bad reception and, indeed, there is one month (reception at Adelie Land in September, 1913) when the average magnetic character of the days judged unfavourable for wireless was less than that of days considered most favourable.

Also there is no evidence from either station to suggest that there was a progressive change in the mechanism of wireless transmission during the seasons. There is, however, some indication that reception at Macquarie Island was possibly more sensitive to magnetic disturbance in the months when the hours of communication were restricted by daylight. Section V deals with reception at Macquarie Island of signals from Tasmania and New Zealand in later years and the relatively large number of days in the interval September to November, 1915, which were days both of bad reception and of great magnetic disturbance is possibly consistent with this view.

VII.—STRENGTH OF SIGNALS RECEIVED AT ADELIE LAND.

In this section of the Report, the whole of the data for Adelie Land is considered with the object of ascertaining more closely what relationships exist between the recorded wireless signals and the magnetic character of the corresponding days and hours.

TABLE CLVII.

Magnetic character number of day (Christchurch), Mar. 6th to Nov. 13th, 1913.	Adelie Land. % number of days with the (maximum) received signal strength.					
	0	1	2	3	4	5
0	4%	11%	13%	43%	22%	7%
1	11%	6	19	41	21	2
2	25%	0	25	37	12	0

TABLE CLVIII.

Magnetic character number of day (Christchurch), Mar. 6th to Nov. 13th, 1913.	Adelie Land. % number of hours with the (maximum) received signal strength.					
	0	1	2	3	4	5
0	36%	8%	11%	26%	15%	4%
1	48%	8	14	18	11	1
2	58%	6	21	11	3	0

TABLE CLIX.

Magnetic character number of days (Adelie Land), Mar. 6th to June 8th.	Adelie Land. % number of hours with the (maximum) received signal strength.					
	0	1	2	3	4	5
0	24%	0%	5%	34%	36%	0%
1	40%	7	13	15	24	1
2	50%	0	15	19	15	0

TABLE CLX.

Magnetic character number of hours (Adelie Land), Mar. 6th to June 8th, 1913.	Adelie Land. % number of hours with the (maximum) received signal strength.					
	0	1	2	3	4	5
0	22%	1%	9%	31%	35%	1%
1	45%	5	10	14	25	0
2	69%	0	19	12	0	0

The most useful method of exhibiting the data is in the form of tables and curves in which the days and hours are classified according to their magnetic character and the relative frequency of occurrence noted in each class of days (or hours) specified by the maximum signal strength 0, 1, 2, 3, 4 and 5. Tables CLVII and CLVIII for example, divide the data into three classes according to the magnetic character (Christchurch) allotted to the day. Tables CLIX and CLX classify the data in terms of the magnetic character (Adelie Land) of the day and the hour, and are therefore restricted to the period March 6th to June 8th for which corresponding magnetic and wireless data are available.

There are four tables of this type, the curves of frequency distribution being shown in Figs. 10, 11, 12 and 13. It is clear from the tables that, on the whole, the chance of an hour, or a day, of fair to very good reception decreases as the magnetic activity of the hour, or day, increases, with a correspondingly increased chance of poor or no reception. This tendency is least pronounced in Table CLVII where we are concerned with the maximum signal of the day and the magnetic character of the day measured at Christchurch. It is most pronounced in Table CLX which refers to the maximum signal of the hour and the magnetic character of the same hour, both measured at Adelie Land.

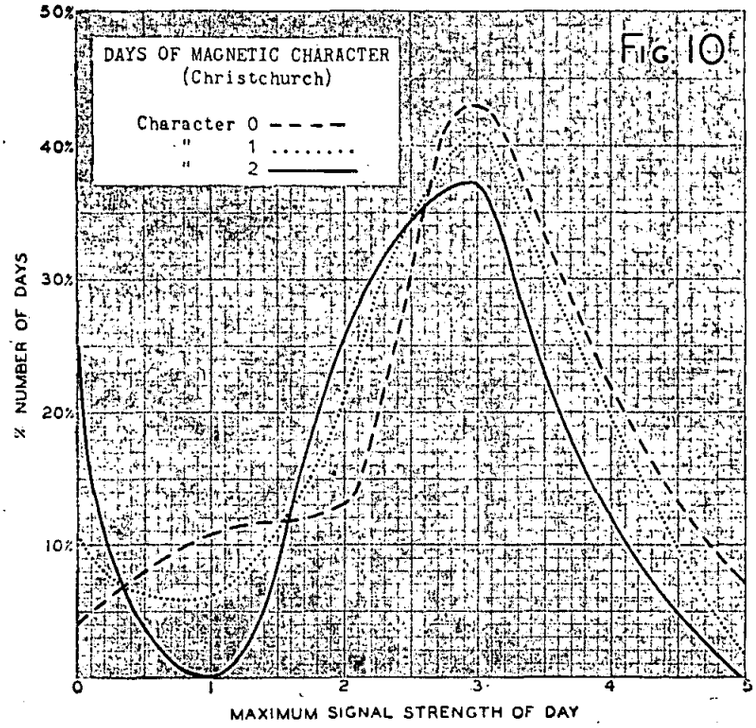

Fig. 10.—RECEPTION AT ADELIE LAND.

Frequency distribution of signal strength on days of different magnetic character (Christchurch).

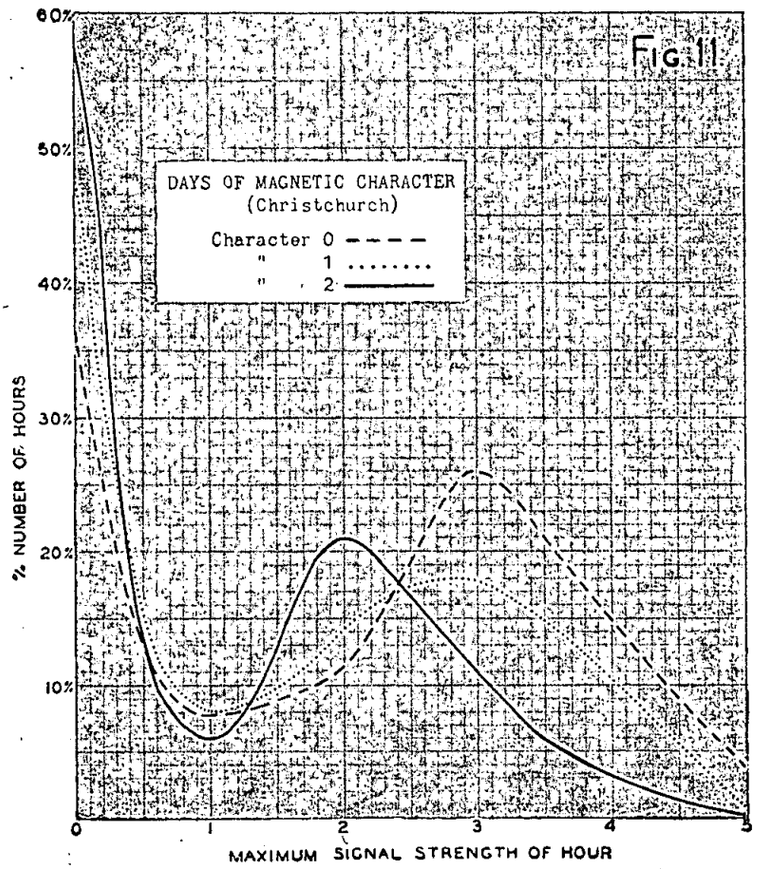

Fig. 11.—RECEPTION AT ADELIE LAND

Frequency distribution of signal strength of hours on days of different magnetic character (Christchurch).

Even in Fig. 10 there are indications that the maximum of the curve which occurs for signals of moderate strength or over may be displaced towards lower signal values during magnetically disturbed periods. This tendency is clear in the other figures, but especially in Fig. 13 which shows the maximum of the distribution curve displaced from signal strength 4 to signal strength 2 in hours of strong magnetic disturbance measured at Adelie Land. This is a fairly convincing demonstration of the association between magnetic disturbance and poor wireless reception at Adelie Land in the same hours, signals being inaudible during no less than 69 per cent. of the total number of disturbed hours. The demonstration would have been much more convincing if the number of magnetically disturbed hours had been greater.

A feature of these curves which is difficult of explanation is the general occurrence of a minimum at signal strength 1 which is maintained even when the maximum is strongly displaced towards reduced signal strength during periods of great magnetic disturbance. It seems clear that we have not to do with a frequency distribution of normal " probability " type, in which all signals below the background of disturbance are classified as inaudible. The number of instances of inaudible signals seems too great or the number of instances of very faint signals too few.

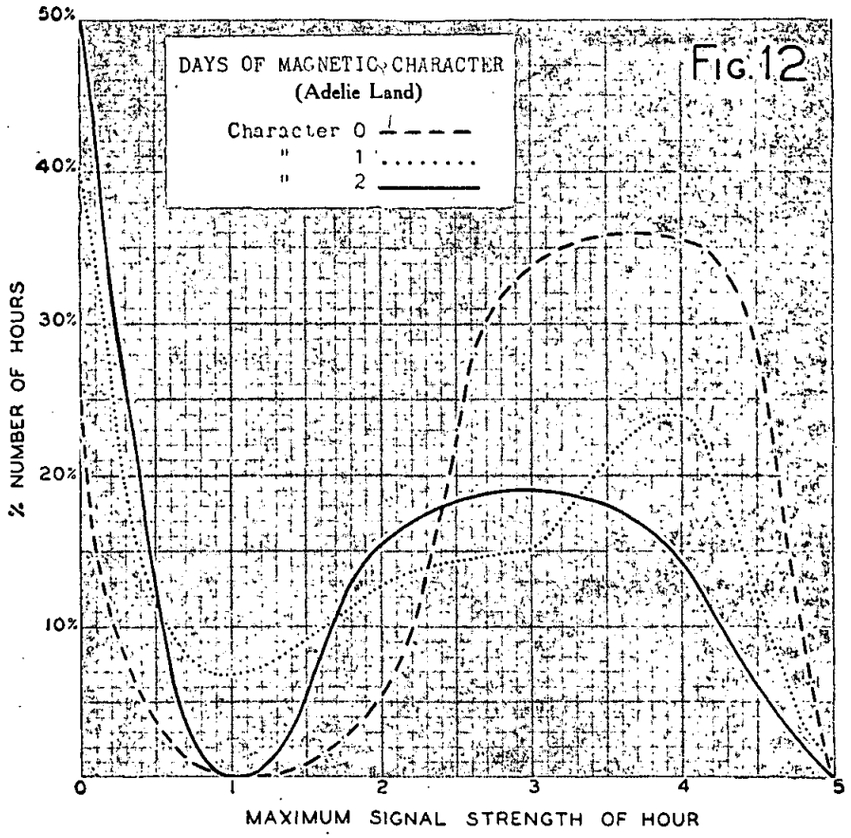

Fig. 12.—RECEPTION AT ADELIE LAND.

Frequency distribution of signal strength of hours on days of different magnetic character (Adelie Land).

The most likely explanation of why there are so many occasions when signals are inaudible even during magnetically quiet periods seems to be the difficulty of maintaining the crystal at its maximum sensitivity when signals are very weak.

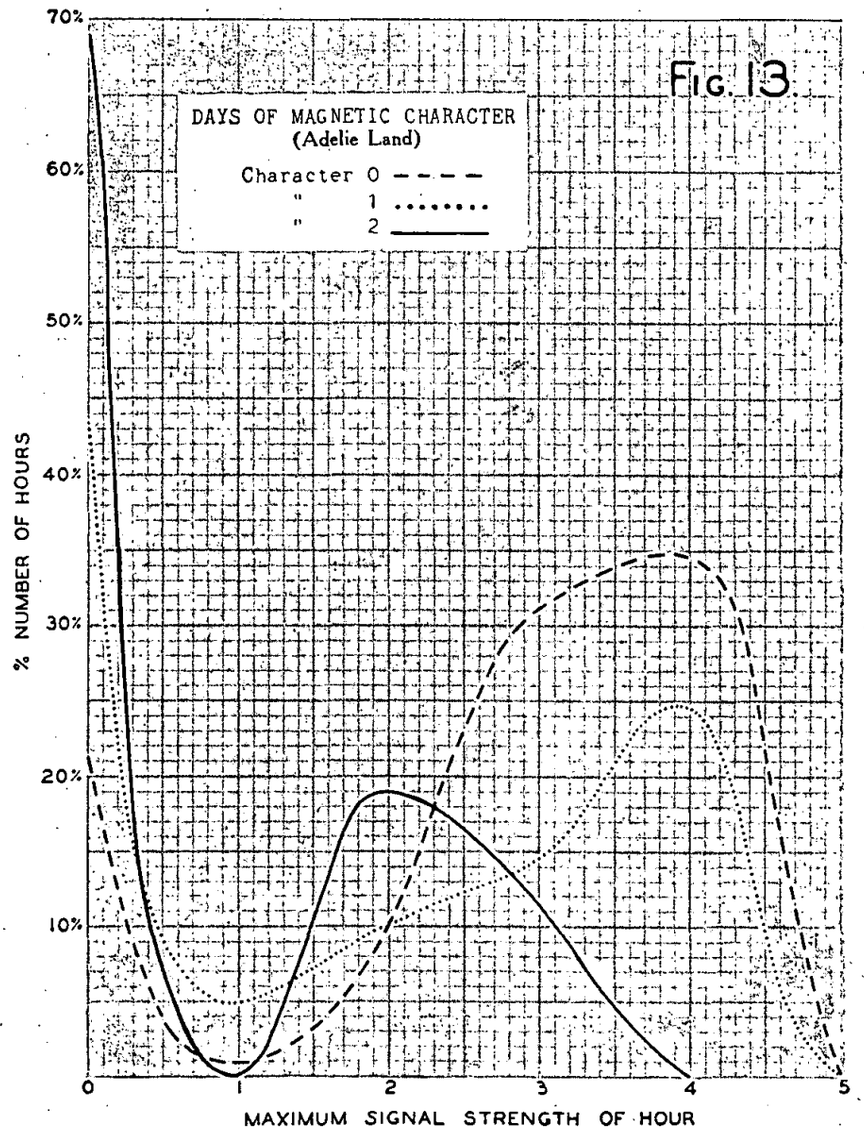

Fig. 13.—RECEPTION AT ADELIE LAND.

Frequency distribution of signal strength of hours in hours of different magnetic character (Adelie Land).

TABLE CLXI.

Reception at Adelie Land.

Magnetic character of day (Christchurch).	Mean values of					
	Maximum signal strength received during the hour.		Maximum recorded signal in the day.		Sum of maximum recorded signal strength in each hour of the day.	
	Up to June 8.	After Aug. 4.	Up to June 8.	After Aug. 4.	Up to June 8.	After Aug. 4.
0	2·6	1·6	3·1	2·8	9·0	6·8
1	1·5	1·3	2·6	2·6	5·1	5·1
2	1·0	0·9	2·5	2·1	3·5	3·7

Table CLXI gives the mean values of the maximum signal strength corresponding to days of different magnetic character (Christchurch). The second and third columns relate to the maximum signal in each hour of the observation period, the fourth and fifth columns to the maximum signal heard in the daily period of observation, while the last two columns give the sums of the individual hourly signals of days during this period. The last two columns do not therefore distinguish between hours of signal strength zero and hours when no record appears in the log. In all columns, a greater or less tendency is shown for days of increasing magnetic disturbance at Christchurch to be associated with hours and days of reduced signal strength and, as would be expected, this relation is less apparent in the fourth and fifth columns which relate to the maximum signal of the day. The ratio of the numbers in the seventh to the numbers in the third column (and the numbers in the sixth to the numbers in the second column) is very constant and independent of the character number of the day.

Days have also been divided according to the sums of the hourly values of signal strength into groups 0–2, 3–5, etc., and the corresponding mean magnetic character number (Christchurch) for each group is shown in Table CLXII below.

TABLE CLXII.

Sum of hourly signal values in the day (Mar. 6th to June 8th and Aug. 5th to Nov. 13th).	Mean magnetic character number (Christchurch) of the day.	Sum of hourly signal values in the day (Mar. 6th to June 8th and Aug. 5th to Nov. 13th).	Mean magnetic character number (Christchurch) of the day.
0—2	·71	9—11	·58
3—5	·72	12—14	·33
6—8	·49	15 upwards	·07

This table shows that days of continuously good reception are most likely to be days when the Christchurch magnetic character is low.

The association between signals received at Adelie Land and the Christchurch magnetic character of the day may be summed up as follows :—There is a slight tendency for the maximum signal strength of the day to be related to a low Christchurch magnetic character number and a stronger tendency for days of low (Christchurch) character number to include a number of hours of high (maximum) signal strength.

One might expect that similar, but more pronounced, results would be obtained by comparing the figures for wireless reception at Adelie Land with the magnetic character of the day and hour measured at the same station. It must be remembered, however, that magnetic character numbers allotted at Adelie Land are not on the same scale as those allotted at Christchurch. The magnetic disturbance at the former station is generally greater in view of its closeness to the south magnetic pole. The following tables exhibit the relation between magnetic character of days and hours at Adelie Land and the quality of wireless reception there. The period in question is March 6th to June 8th, inclusive.

TABLE CLXIII.

Reception at Adelie Land.

Daily magnetic character number (Adelie Land), Mar. 6th to June 8th, inclusive.	Mean value of (maximum) signal strength.	
	days.	hours.
0	3·2	2·6 (10·7)
1	2·8	1·8 (5·7)
2	2·8	1·5 (5·2)

TABLE CLXIV.

Reception at Adelie Land.

Hourly magnetic character number (Adelie Land).	Mean value of (maximum) signal strength of hours.
0	2·6
1	1·7
2	0·8

The numbers shown in brackets are the sums of the (maximum) hourly values recorded during the day and seem to emphasize the importance of days of character number 0 for continuous reception at Adelie Land during the day. The numbers in the second column of Table CLXIV, as would be expected, show a closer relationship with the magnetic character of the hour than with the magnetic character of the day. Comparison of Tables CLXIV and CLXI (column 2) is instructive: in the former table the numbers for character 2 are appreciably lower than for character 1 while the difference is less significant in the latter table.

In the table below, the days have been divided according to the sum of the hourly magnetic character numbers at Adelie Land during the day; this sum is shown in the first column. The second column contains the average value of the sum of the signal values recorded in each hour of the day.

TABLE CLXV.

Sum of hourly magnetic character numbers (Adelie Land) in the 6-hour period of observation (Mar. 6th–June 8th).	Sum of (maximum) hourly signal strengths during the observation period.	Sum of hourly magnetic character numbers (Adelie Land) in the 6-hour period of observation (Mar. 6th–June 8th).	Sum of (maximum) hourly signal strengths during the observation period.
0—2	8·7	6—8	3·5
3—5	7·2	9—11	5·0

Only one day had a magnetic character so bad as to fall in Class 9–11 so that the evidence for the last figure in column two rests on a very slender basis. So far as it goes, the evidence suggests that signal strength does not fall off greatly until hourly character number 2 begins to appear.

As a companion to the above table, days have been divided in classes according to the sum of the (maximum) hourly values of signal strength recorded in the 6-hour period of observation (in the first column), the second column showing the mean values of the sum of the hourly magnetic character numbers.

TABLE CLXVI.

Sum of (maximum) hourly signal strengths (Mar. 6th to June 8th).	Mean value of sum of hourly magnetic character numbers (Adelie Land).	Sum of (maximum) hourly signal strengths (Mar. 6th to June 8th).	Mean value of sum of hourly magnetic character numbers (Adelie Land).
0—2	4·4	9—11	3·0
3—5	4·0	12—14	2·6
6—8	3·4	15 upwards	1·7

The data in this table is plotted in Fig. 14 and furnishes convincing evidence that, on the average, the signal strength decreases more or less regularly as the magnetic disturbance increases.

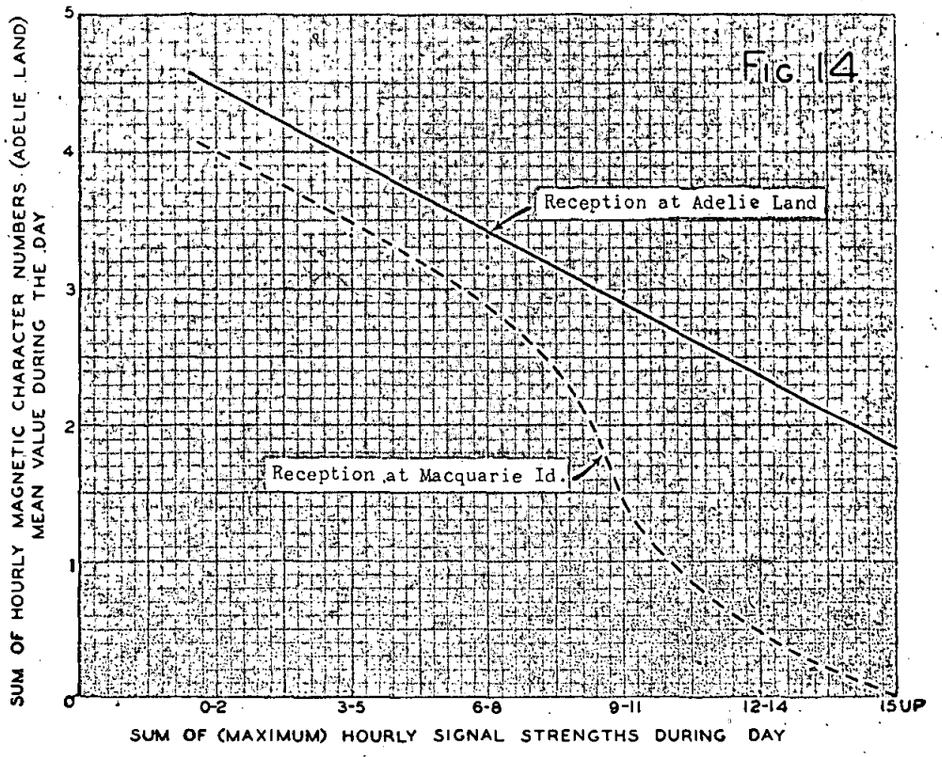

Fig. 14.—RECEPTION AT ADELIE LAND.

March 6th to June 8th, 1913.

This section of the report has, so far, dealt only with the maximum signal strength recorded in the observation period and its component hours. There is some rather indefinite evidence that hours of high (maximum) signal values tend to be preceded and followed by other hours similarly characterised, but the question of variability of signal strength within the hour has not been discussed. Indeed, this question is not an easy

one and no satisfactory method of dealing with the matter has been discovered other than to accept the operator's references to variability of signals and the "fading" and to compare the character number for periods so characterised with the mean value of all days. In the first instance, all days on which the operators at Adelie Land made mention of variable signal strength have been grouped together and the mean value of the Christchurch magnetic character formed for these days. The mean character numbers are 0·69 and 0·53 for the two periods March 6th to June 8th and August 5th to November 13th. The mean values for *all* days in these periods are 0·53 and 0·59. There seems to be little evidence here for any systematic association between fading and magnetic disturbance and this is emphasized by the fact that the period April 26th to May 21st was not especially characterised by magnetic disturbance though the omnibus note in the operator's log was very suggestive of a period of great difficulty in communication due to fading of signals. On the other hand, the corresponding magnetic character numbers (Adelie Land) for variable signals in the period March 6th to June 8th are for days 1·0 (0·9) and for sum of hours 4·5 (3·5). The numbers in brackets are the mean values for the whole period. The difference in these numbers is suggestive but is an inadequate basis from which to draw reliable conclusions. The indefiniteness of the results is quite possibly due to the fact that only a proportion of the total number of hours of variable signal strength were so characterised by the operators.

VIII.—STRENGTH OF SIGNALS RECEIVED AT MACQUARIE ISLAND.

The wireless data available covers the periods September 25th to October 13th, 1912, and February 3rd to November 20th, 1913, except for the interval June 9th to August 4th when the Adelie Land wireless station was out of action. Some record is also missing in August.

The relationships between wireless reception at Macquarie Island and magnetic character are discussed here as in the preceding Section, which deals with the Adelie Land wireless data.

TABLE CLXVII.

Magnetic character number of day (Christchurch), Sept., 1912, to Nov. 20th, 1913.	Macquarie Island. % number of days with the (maximum) received signal strength.					
	0	1	2	3	4	5
0	24%	13%	11%	39%	10%	3%
1	29%	14	8	42	4	3
2	61%	9	0	9	17	4

TABLE CLXVIII.

Magnetic character number of day (Christchurch), Sept., 1912, to Nov. 20th, 1913.	Macquarie Island. % number of hours with the (maximum) received signal strength.					
	0	1	2	3	4	5
0	42%	10%	10%	29%	6%	2%
1	49%	12	8	27	2	2
2	82%	4	0	4	8	2

TABLE CLXIX.

Magnetic character number of hour (Adelie Land), Mar. 6th, 1913, to June 8th, 1912.	% numbers of hours with the (maximum) received signal strength.					
	0	1	2	3	4	5
0	46%	5%	14%	27%	7%	2%
1	60%	6	3	29	2	0
2	73%	0	0	18	9	0

Tables CLXVII, CLXVIII and CLXIX and Figs. 15, 16 and 17 show the percentage number of days and hours allotted the maximum signal strengths 0, 1, 2, 3, 4 and 5, the data being classified according to the magnetic character of the day at Christchurch Observatory and of the hour at Adelie Land. Magnetic character numbers at Adelie Land are available only up to the end of July, and Table CLXIX and Fig. 17 deal only with the period March 6th to June 8th, 1913, as was the case in Table CLX of the preceding section.

From the tables it is clear that, on the whole, the chance of an hour or a day of poor or no reception increases as the magnetic character of the hour or day increases. In this respect days of magnetic character 2 (Christchurch) are strongly differentiated from other days, possibly because they occur so infrequently. As usual, there is a pronounced minimum for very faint or faint signals which separates the maximum at signals of about moderate strength from the maximum which occurs for no signals heard, and it may be significant that the minimum is especially pronounced for the days and hours which are highly disturbed magnetically. It is interesting to note that this minimum tends to occur for faint signals received at Macquarie Island while it appeared for very faint signals received at Adelie Land. The per cent. number of occasions when no signals were heard tends to be higher for reception at Macquarie Island than at Adelie Land; especially is this true of the maximum signal of the day shown in Table CLXVII.

Comparing Figs. 15 and 16 with the corresponding figures of the last section (10, 11 and 12), it is clear that the curves of frequency distribution differ considerably. At Macquarie Island there is a considerable reduction of the maximum of the curve at moderate signal strength on days of great magnetic disturbance with a shift of this maximum towards greater signal strength instead of towards lesser signal strength as is the case for reception at Adelie Land. This suggests an occasional increase of signals at Macquarie Island during magnetically disturbed periods; the number of occasions is however too few to enable definite deductions to be drawn and the possibility of quiet intervals in a magnetically disturbed day must be borne in mind.

Comparison of Fig. 17 with Fig. 13 of the preceding section is also instructive. These are the only curves which refer to the magnetic character of the hour. The maximum of the curves again appear at about moderate signal strength and the values at the maximum are roughly the same for reception at the two stations, but the displacement of the maximum (towards lower signal values) in disturbed hours is confined

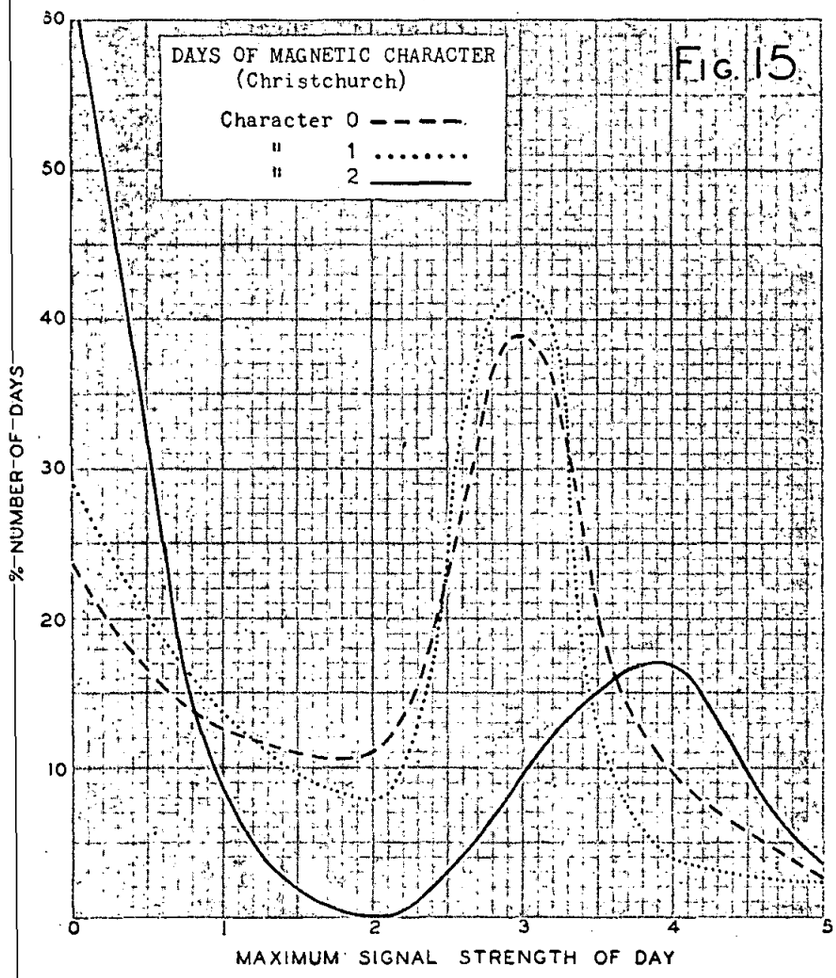

Fig. 15.—RECEPTION AT MACQUARIE ISLAND.

Frequency distribution of signal strength on days of different magnetic character (Christchurch).

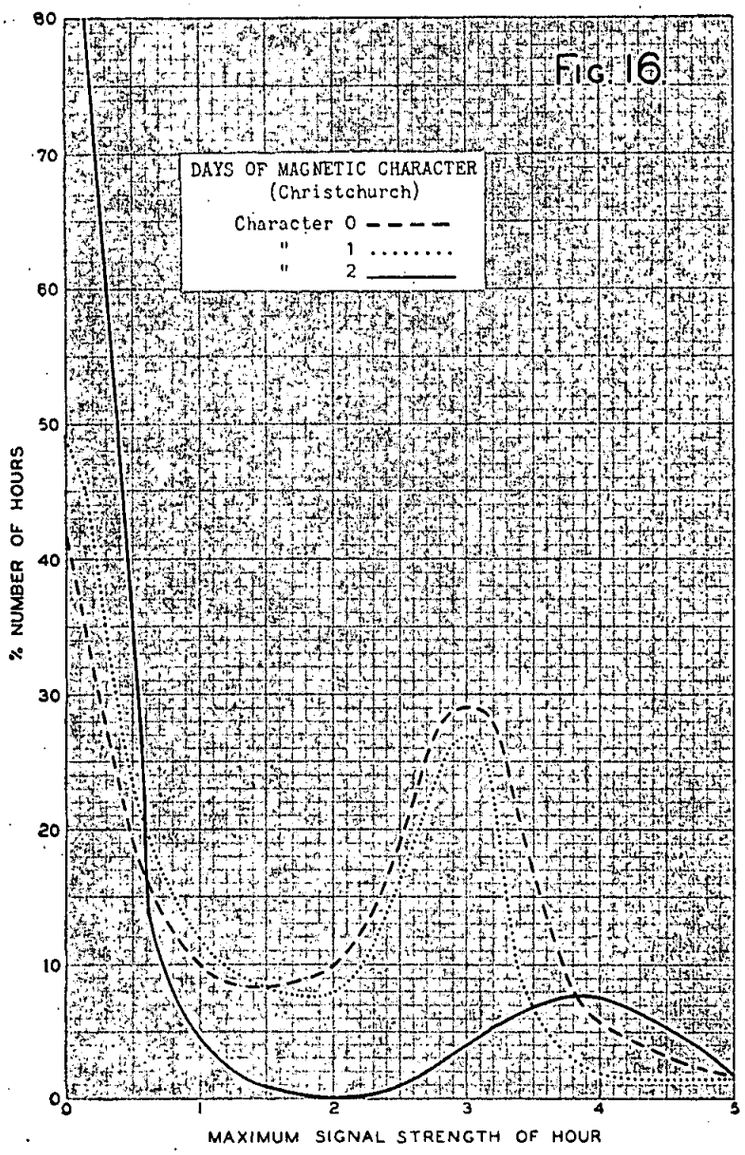

Fig. 16.—RECEPTION AT MACQUARIE ISLAND.

Frequency distribution of signal strength of hours during days of different magnetic character (Christchurch).

to reception at Adelie Land. The maximum at signal strength 0 is, however, much more pronounced at Macquarie Island than at Adelie Land for hours of lower magnetic character than 2, which is in line with the fact, already noted in Table CXXVII of Section I, that signals were heard less frequently at Macquarie Island.

On the whole, the most striking difference between the frequency distribution curves at the two stations is the fact that there is a shift of the maximum towards lower signal values at Adelie Land and at Macquarie Island a less definite shift of the maximum towards higher signal values. Average signal strength at Macquarie Island is, however,

reduced during magnetically disturbed periods, partly by the large number of hours of no reception and partly by the small number of occasions on which the received signals are above moderate strength.

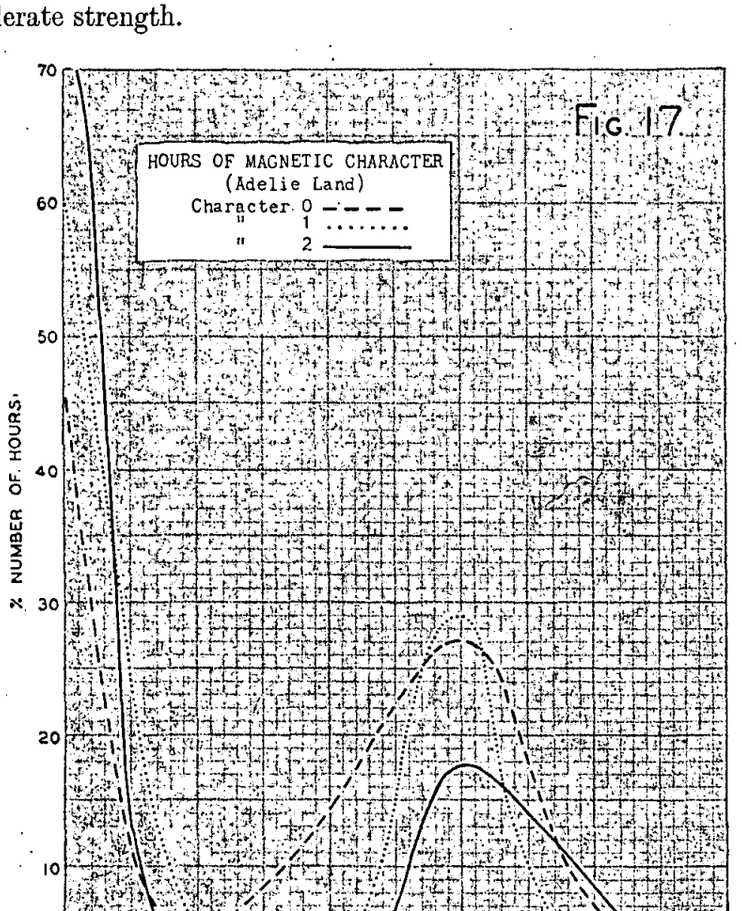

Fig. 17. RECEPTION AT MACQUARIE ISLAND.

Frequency distribution of signal strength of hours in hours of different magnetic character (Adelie Land).

The fact that the chance of an hour or a day of no wireless reception at either station increases as the magnetic character of the period increases cannot of course be interpreted as indicating a causal relationship between magnetic disturbance and bad wireless reception. For example, somewhat similar frequency distribution curves are obtained in Section I when the wireless data are divided in classes according to the quality of reception at the other station in the same period. It is obvious in this case that poor quality of wireless reception at one station is not the cause of poor wireless reception at the other, but that both are dependent upon some variable factor or factors which cannot be specified. The relationship between poor wireless reception and magnetic disturbance is no doubt of a similar type in the sense that both are dependent upon circumstances which we are unable to specify.

The mean values of (maximum) signal strength at Macquarie Island for hours of different magnetic disturbance measured at Adelie Land are shown in Table CLXX below:

TABLE CLXX.

Reception at Macquarie Island.

Hourly magnetic character number (Adelie Land), Sept. 25th, 1913, to June 8th, 1913.	Mean value of (maximum) signal strength of hours.	
0	1·5	(1·5)
1	1·0	(1·1)
2	0·9	(0·8)

This table may be compared with Table CLXIV which deals with reception at Adelie Land. The actual values of signal strength are generally smaller than those recorded at Adelie Land and the ratio of signal strength for character 0 to that for character 2 is smaller, a result which may be inherent in the scale of numbers allotted at each station to signals of different strength. Note that the values for character 1 and character 2 are nearly the same. The figures in brackets refer to the period March 6th to June 8th.

TABLE CLXXI.

Reception at Macquarie Island September 25th, 1912, to November 20th, 1913.

Magnetic character of day (Christchurch.)	Maximum signal strength received during hour.		Maximum recorded signal in the day.		Sum of maximum recorded signal strength in each hour of the day.	
	Up to June 8.	After Aug. 4.	Up to June 8.	After Aug. 4.	Up to June 8.	After Aug. 4.
0	1·6	1·5	2·3	1·7	3·6	3·4
1	1·2	1·3	1·9	1·7	3·0	3·3
2	0·5	0·7	1·2	1·3	1·2	1·3

Numbers for the magnetic disturbance of days, estimated at Christchurch, are available for the whole period of observation and the mean values of signal strength at Macquarie Island are shown in Table CLXXI for days of character 0, 1 and 2. The corresponding data for reception at Adelie Land appeared in Table CLXI. It seems clear either that a lower standard of signal strength was adopted at Adelie Land than at Macquarie Island or that signals were actually stronger at the former station, but there is no way of deciding which alternative is the more likely. On the whole, there seems to be less difference between reception on days of character 0 and days of character 1 at Macquarie Island and this is particularly noticeable in the last two columns. While, for reception at Adelie Land, there is a progressive deterioration of signal strength as the magnetic disturbance of the day increases, the deterioration of reception at Macquarie Island takes place chiefly on days of magnetic character 2 (Christchurch). In other words, reception at Macquarie Island is insensitive to slight magnetic disturbance at Christchurch, while reception at Adelie Land deteriorates progressively as this disturbance increases.

A similar table is given below in which, however, the magnetic character of the day estimated at Adelie Land, appears; the period covered is from March 6th to June 8th, 1913.

TABLE CLXXII.

Reception at Macquarie Island March 6th to June 8th, 1913.

Daily magnetic character number (Adelie Land).	Mean value of (maximum) signal strength.	
	Days.	Sum of all hours in the day.
0	2·8	4·9
1	1·9	2·4
2	1·6	2·2

Comparison of the last column of Table CLXXII with the sixth column of Table CLXXI suggests that reception at Macquarie Island is better on days of magnetic character 0 (Adelie Land) than on days of character 0 (Christchurch), due possibly to a relative scarcity of the former, but reception is worse on days of great disturbance estimated at Christchurch than on days of great disturbance at Adelie Land. It is believed this is due to a similar circumstance, viz., that highly disturbed days are less common at Christchurch than at Adelie Land.

The final table in this section classifies days according to the sum of (maximum) signal strength in all hours of the day, the mean value of the sum of the hourly magnetic character numbers (Adelie Land) being shown in the second column for each class.

TABLE CLXXIII.

Reception at Macquarie Island to June 8th, 1913.

Sum of (maximum) hourly signal strengths.	Mean value of sum of hourly magnetic character numbers (Adelie Land).	Sum of (maximum) hourly signal strengths.	Mean value of sum of hourly magnetic character numbers (Adelie Land).
0 to 2	3·9	9 to 11	1·4
3 to 5	3·4	12 to 14	None.
6 to 8	3·2	15	0

From this table, it is seen that, as signal strength improves, the magnetic character of the period decreases at first slowly and then quite rapidly. Really satisfactory reception at Macquarie Island, fairly constant and of reasonable signal strength, is obtained on the average when magnetic disturbance is consistently low at Adelie Land. Reference to Table CLXVI shows that as reception at Adelie Land improves, the corresponding decrease in magnetic activity is much more regular. The data are plotted together in Fig. 14.

These observations, as already pointed out, were obtained during months when magnetic disturbance was unusually slight and it seems certain that communication would have been more difficult if the wireless records had been made, not during the minimum of the 11-year cycle as they were, but at the maximum of magnetic activity.

IX.—WIRELESS RECEPTION AT MACQUARIE ISLAND IN 1914–1915.

All the data so far considered suffer from the disadvantage that the estimates of quality of reception have rested on the maximum recorded signal strength in individual hours or days and this strength may have been, for example, an instantaneous high value in a period which was otherwise a bad one for communication. It would have been most valuable if each operator had listed for each month his estimate of the best and worst hours and days for reception.

Data have already been published regarding reception at Macquarie Island of signals from the wireless stations at Hobart, The Bluff and Wellington between February, 1914, and November, 1915.* These give the operator's own statement of the seventy-five nights of bad or no reception of signals from the three stations mentioned during the interval in question. The magnetic character of the period was becoming progressively worse and this may account for the fact that most of the days of bad or no communication occurred in 1915.

As the data are not analysed in respect of magnetic disturbance in the publication quoted, a short discussion of the relationship between wireless reception and magnetic activity is added here.

The list of nights of bad or no communication comprised seventy-five instances. Hobart, The Bluff and Wellington being not heard on thirty-six, forty-four, and forty-five nights, respectively. On thirteen nights, no signals were heard from any of the three stations. The mean magnetic character numbers for these days are given in Table CLXXIV below.

TABLE CLXXIV.

Reception at Macquarie Island.	Mean magnetic character numbers of days of bad or no reception.	
	International character numbers.	Christchurch character numbers.
36 days of no reception from Hobart	1·1	1·3
44 ,, ,, ,, reception from The Bluff	1·1	1·4
45 ,, ,, ,, reception from Wellington	1·0	1·3
13 ,, ,, ,, reception from none of the above stations	1·2	1·4

The average magnetic character numbers for 1914 and 1915 were, respectively, International 0·54 and 0·62; Christchurch 0·82 and 0·88. The differences between the magnetic character of the average day and days of bad or no communication are considerable, and would be greater but that some of the days of bad reception were days of slight magnetic activity. On the other hand, there were also many days of considerable magnetic disturbance which are not represented in the list of days of bad wireless reception. The mean magnetic character numbers in Table CLXXIV are generally slightly higher than those corresponding to the days of the thirty-three most active auroral displays viewed from Macquarie Island (see Section VI).

* *Australian Monthly Weather Report and Meteorological Abstract*, vol. 4, No. 9.

In the interval February, 1914, to November, 1915, inclusive, there were seventy-five days of bad or no wireless communication and 144 magnetically disturbed days (of character 2 or 2 + at Christchurch). Only thirty-seven days, however, appear in both lists. Of these thirty-seven, no less than twenty-five occur in September, October, and November, 1915, a period which included thirty-two magnetically disturbed days and forty-four days of bad or no reception. The association of bad wireless reception and magnetic disturbance does not seem to be one of direct cause and effect and it appears that other circumstances are also important and that these circumstances may have been especially unfavourable to wireless reception in the interval September to November, 1915. Sudden changes in received signal strength are known to take place for longer wireless waves,* and it is possible that the increased association of bad wireless reception with magnetic disturbance in these three months is due to something of the same nature.

X.—WIRELESS COMMUNICATION AND AURORAL DISPLAYS.

In examining the wireless logs, frequent reference is found to the unfavourable effect of aurora upon communication. Up to midwinter, 1913, there seems also to have been some discussion on the subject between the operators at Adelie Land and Macquarie Island. While it seems that the operator at the latter station in June, 1913, was not convinced that there was a relationship between the Aurora and wireless communication, the Adelie Land operator states " There is now no doubt remaining as to the damping effects of aurora on ether waves. This conclusion arrived at by comparing with magnetograph curves and also by ocular observations of aurora on nights clear from cloud and drift. No signals have been received when aurora has been visible and when curves of magnetograph show any activity to speak of." Sir Douglas Mawson is equally definite regarding the association between poor wireless reception at Adelie Land and auroral activity. This evidence is based on direct observation and is the best possible evidence for the reality of the effect, especially as, on days of great activity, the aurora changes form and intensity so quickly that it would be difficult to describe the changing phenomena simultaneously in the wireless and auroral logs.

C. F. Sandell, in his notes covering three months operation of the Macquarie Island station says " I can positively state that aurora in some of its wonderful phases has a decidedly baneful effect on wireless waves . . . . . as the display increased in its activity, or decreased, so Hobart's signals varied and, when the aurora had attained what seemed to be its greatest activity, I absolutely failed to read Hobart's signals . . . so I have come to the conclusion that the aurora in certain forms affects the wireless waves and that, in other forms, it has little or no effect."

* This phenomenon has been called the Hollingworth anomaly.

It is difficult to obtain numerical confirmation from the logs, and quite impossible to examine the effect of auroral form or position on wireless reception. This is largely due to the fact that aurora was invisible for so much of the time—chiefly owing to clouds, blizzards and moonlight. When, as in these records, the wireless logs are also incomplete the difficulties are multiplied.

The existence of some connection between wireless communication and auroral display is, however, to be expected. We see in the Polar Aurora the effects of particles or waves reaching our atmosphere from the sun; the ionisation arising from absorption of the particles or waves is associated locally with the occurrence of magnetic disturbance and this, we have seen, is related to unfavourable conditions for wireless reception. Numerically the relation between magnetic disturbance and auroral display in polar regions shows most clearly for displays of unusual intensity, unusual colour, etc.* In lower latitudes, the aurora which accompanies great magnetic storms is generally accompanied by conditions unfavourable for wireless communication.

The Polar Aurora, when strong, varies greatly in respect of intensity, shape and position. In the case of the Macquarie Island and Adelie Land stations, a bright aurora occurring mid-way between the two stations should be visible from both, if it occurs at the same height as it appears in high northern latitudes. Operator's reports are to the effect that increase of brightness is generally associated with decreased intensity of received signals. This result might occur if the increased ionisation during strong aurora increased the absorption of the wireless waves returned from the" reflecting layer," or if the effective area of the layer was decreased. Other causes, such as changes of phase and polarisation of the wireless waves might operate in addition.

The impossibility of recording continuously on this expedition the quick changes of form, position and intensity of active aurora has already been mentioned. However, since instants of active auroral display are likely to be followed by other instants of activity and hours of active display by other similar hours*, there is some hope of finding a numerical relationship between strength of wireless reception and auroral activity though we can hardly expect to obtain very definite results. Hours for which wireless and auroral data are both available are indeed relatively uncommon, especially prior to August, 1913.

For the purpose of obtaining numerical confirmation of the statements quoted at the beginning of this section, the entries in the auroral log* have been allotted numbers—0 for no aurora, 1 for very faint, 2 for faint, or aurora seen but not specially designated, 3 for moderately bright, 4 and 5 for bright and very bright, the maximum intensity in the hour being taken in each case. A special difficulty arises from the fact that it has been necessary to exclude hours of " no aurora " whenever the sky was partly overcast for fear that aurora might have been present behind the clouds. The effect is undoubtedly to exclude from the lists a certain number of hours when no aurora was present and thus further to weaken any numerical confirmation of a relationship between aurora and wireless communication.

* C. S. Wright—British (Terra Nova) Antarctic Expedition, 1910–1913. Observations of the Aurora, p. 32, *et seq.*

In Table CLXXV which follows, the maximum signal strength and the maximum auroral activity in corresponding hours are considered. The estimated numerical equivalents for the latter appear in Tables CLXXVI and CLXXVII, the original data appearing in Mawson's Report*.

TABLE CLXXV.

Wireless reception at Adelie Land.	Mean value of the (maximum) auroral activity of hours at Adelie Land.	
	Mar. 6th to June 8th, 1913.	Aug. 5th to Oct. 23rd, 1913.
Hours when no signals were heard	1·93	2·14
Hours when signals were heard...	1·85	1·73
Wireless reception at Macquarie Island.	Sept. 25th, 1912, to June 8th, 1913.	Aug. 5th to Oct. 23rd, 1913.
Hours when no signals were heard	1·84	2·50
Hours when signals were heard...	1·64	1·84

The differences in these numbers for the two classes of hours—signals heard and not heard—is hardly significant except for the period after 5th August, 1913. The reality of the tendency for increased auroral activity at Adelie Land to be associated with inaudible signals is testified by the fact that the tendency appears for each month of the latter interval (except for reception at Macquarie Island in August). The period prior to June 8th is unsatisfactory in respect of the small number of corresponding hours and the results for this period must be viewed with some suspicion.

TABLE CLXXVI.

Date.	Intensity of Aurora seen from Macquarie Island in hours (Local Time) beginning					
	8 p.m.	9 p.m.	10 p.m.	11 p.m.	midnight.	1 a.m.
1913.						
April 9	2	3	2	4		
28		2		0	0	
29	2		2	0		
May 1	2	4	3	2	2	
4						1
5			2	2		
30		5	3	2	2	
June 5			2	2	1	
6	2	4	2	2	2	2
Aug. 5	2	3	3	2	2	
8				1		
22	3				2	2
23	2				2	
31			1	1	0	0
Sept. 2	1		2	2	2	2
4			2	2		
5		4	3	0	0	0
8				2		
9		2	5	2		
21		2	—	—	2	2
22	2	3	2	2	2	2
24		Aurora seen at intervals.				
Oct. 1	2	2	2	3	0	0
8	4	2	2	—		
18			2	2	2	2
25			2	2	2	0
Mean values	2·2	3·0	2·3	1·8	1·4	1·2

* Sir Douglas Mawson—Records of the Aurora Polaris. Scientific Reports, Series B, vol. II, Part I.

TABLE CLXXVII.

Date.	Intensity of Aurora seen from Adelie Land in hours (Local Time) centred at					
	8 p.m.	9 p.m.	10 p.m.	11 p.m.	midnight.	1 a.m.
1912.						
Sept. 27	0	2	1			
28	0	0	2	2		
29	0	0	0	2	3	
Oct. 10	0	0		3	2	2
11		0		2	0	
13			0	0	0	0
1913.	Auroral records recommence Mar. 5th, 1913.					
Mar. 5				2	0	
6				3	4	0
9			2	1	2	2
11			0	0	2	0
15						2
April 1		2	2		2	0
2	2	0	2	2		2
3		2		2	2	
4	0	2	0	1	1	0
10		2	0	0	0	2
11		2	2	4	0	
14		4	3	0	0	2
15	2	2		4	2	0
16			4	2	2	
29	2	2	0	0	0	
May 1	2	4	4	0	0	0
5	4	3	2	2	1	
9	2	2	4	4	2	1
24	0			0	2	0
25	0	0	0	2	2	0
29	0	0	2	3	5	2
30	0	2	4	3	2	2
31				2		
June 1						4
2	2	2	4		0	2
3	2			0	2	5
5	3	3	2	3	2	
6	3	3	3	3	1	1
7	0	2				
Aug. 5				4	3	3
6	3	2	3	2	2	0
7					3	
8	0			2	2	0
25	2	3	3	1	0	1
26	0	0	2	0	2	0
27	2	0	2	4	4	4
29	0	0	0	0	0	0
30	0	0	0	0	0	0
31	1	2	3	4	4	4
Sept. 6					3	1
8					3	0
9	4	3	5	3	2	0
11	2	0	2	0	2	3
15				2		
19	1	2	2	1		
22		2	1	3	3	2
23	2	1	4	4	3	4
24		0	2	2	1	0
28					0	2
29			2	2	0	2
Oct. 2		2	4			
9			3	0	0	0
10			5	2	0	
11			3	0	0	0
12			4	3	0	0
13					0	0
18			0	0	1	0
19		0	4	4	3	2
20				4	2	2
21		0	0	3	0	0
23				0	0	
Mean values	1·3	1·7	2·2	1·9	1·5	1·2

It is possibly significant that the differences shown in Table CLXXV between the mean auroral activity in the two classes of hours become more pronounced in the months nearest to the southern summer. These are the months when communication is in any case less certain and, it will be remembered, are also the months of greater magnetic activity when the intensity of signals at Adelie Land apparently fell below the intensity of signals received at Macquarie Island. The data appear in Table CLXXVIII.

TABLE CLXXVIII.

	Mean value of the (maximum) auroral activity in hours at Adelie Land.	
	No signals heard.	Signals heard.
Reception at Adelie Land—		
Mar. 6th to April 30th, 1913	1·69	1·60
May and June 1st—8th	2·15	2·16
August	2·30	2·05
September	2·20	1·89
October	2·0	0·91
Reception at Macquarie Island—		
Sept. 25th, 1912, to April 30th, 1913	2·1	1·3
May and June 1st to 8th	1·7	2·0
August and September, 1913	2·34	2·11
October, 1913	2·66	1·25

The differences are exceptionally large in October and may owe something to the fact that the estimate of intensity of the aurora is bound to depend upon the amount of light received from other sources and this extraneous light is greatest in the months adjacent to the southern summer.

On the average, days of strong auroral displays at Adelie Land were allotted magnetic character numbers (Christchurch) well above the average and we might therefore expect that the "frequency distribution curves" for wireless reception in hours of low auroral activity would bear some relationship to the distribution curve during periods of low magnetic activity. Table CLXXIX shows the per cent. number of hours in which signals of different strength were heard at Adelie Land and Macquarie Island arranged in two classes according to whether the activity of the aurora visible in that hour was below moderate or above.

TABLE CLXXIX.

Activity of the Aurora at Adelie Land in corresponding hours.	% number of hours in which the (maximum) signal strength had the following values.						
	0	1	2	3	4	5	Mean value of signal strength.
Hours with activity between—	Reception at Adelie Land.						
0 and 2	44%	4%	12%	23%	13%	4%	1·68
3 and 5	53%	6%	15%	15%	9%	2%	1·26
	Reception at Macquarie Island.						
0 and 2	48%	5%	12%	30%	5%	0%	1·38
3 and 5	68%	6%	10%	10%	3%	3%	0·84

These numbers should be compared with those in Tables CLX and CLXIX in which hours are classified according to the magnetic character of the hour. The last column of the table gives the mean received signal strength for hours in the two auroral classes. The lower mean values are seen to be due partly to the enhanced number of hours of inaudibility in hours of auroral activity above the average; there is also some tendency for the maximum at moderate signal strength to be displaced (as for reception at Adelie Land in magnetically active periods) to lower signal values when the aurora is active.

Taking into consideration all the difficulties, it is considered we are justified in placing full reliance upon the statement of those on the spot that auroral activity at Adelie Land did have, on the average, an unfavourable effect upon signal strength.

The corresponding data for auroral activity observed at Macquarie Island (Table CLXXVII) are much less satisfactory in that the number of coincident hours is very small, especially for auroral activity above the average (only twelve such hours for wireless reception at Adelie Land and eleven for reception at Macquarie Island) Table CLXXX below gives the mean auroral activity of hours in two classes—hours during which the wireless signals were inaudible and hours when they could be heard.

TABLE CLXXX.

	Mean value of the (maximum) auroral activity of hours at Macquarie Island.
	1912–1913.
Wireless reception at Adelie Land—	
Hours when no signals were heard	1·8
Hours when signals were heard	2·2
Wireless reception at Macquarie Island—	
Hours when no signals were heard	2·2
Hours when signals were heard	2·3

The results are surprising. Auroral activity at Macquarie Island was greater when signals were heard at Adelie Land than when they were inaudible, while the difference is inappreciable for reception at Macquarie Island. Apart from the small number of occasions referred to in the last paragraph, the results may owe something to the fact that the auroral data from Macquarie Island is very incomplete in the sense that entries in the record are confined to days when the aurora was seen at some time. The number of such hours was very small—five hours of reception at Adelie Land and three of wireless reception at Macquarie Island.

Table CLXXXI gives the per cent. frequency of hours of different wireless signal value at both stations arranged in two classes according to the auroral activity of the hour as observed at Macquarie Island.

Some information is also available from the records of wireless reception and auroral activity at Macquarie Island from December, 1913, to November, 1915, inclusive. These records are reported in the Australian Monthly Weather Report.* The data include lists of days in this interval on which auroral displays were seen—148 days in all. The mean magnetic character number of these days is naturally greater than for the mean of the years. By excluding those auroral manifestations which were not bright and which otherwise appeared to be of usual type, the number of days of unusual displays may be reduced to thirty-three†. These thirty-three days have the very high mean magnetic character of 1·36, estimated at Christchurch Observatory and 0·98 on the International Scale, notwithstanding the fact that a fair proportion of days have a low magnetic character. Only eleven of these thirty-three days are noted in the list of seventy-five days of bad or no wireless reception from the three stations at Hobart, The Bluff and Wellington. Of the 148 days on which aurora was seen only twenty-eight of them were days of bad or no reception. The relative number of days of such reception coinciding with days of auroral display therefore increases as the auroral activity increases. It is interesting to note that seventeen out of the twenty-eight days in the two years, which were common to the list of seventy-five days of bad or no reception and to the list of 148 aurora days, occurred in the last two months of November and December, 1915, which were magnetically active months.

Neither auroral activity nor magnetic activity, nor the two in conjunction, seem to be attended invariably by poor wireless reception, and a great deal of investigation will be necessary before we are in a position to understand fully these complex relationships. This investigation must be carried out with modern scientific tools in and near the auroral zones if it is to be effective and must be continued for a sufficient length of time to ascertain how the phenomena vary in years of great and small solar (and magnetic) activity.

TABLE CLXXXII.

List of thirty-three most active Auroras seen at Macquarie Island in 1914–1915.

	Magnetic Character Number.			Magnetic Character Number.	
	Christchurch.	International.		Christchurch.	International.
1914.					
Feb. 5th	0	0·8	May 17th	2	1·3
20th	0	0·2	18th	1	0·2
26th	0	0·1	June 8th	1	0·9
Mar. 19th	1	0·5	12th	2	1·4
April 1st	2	1·0	17th	2	2·0
6th	2	1·9	20th	1—	0·2
June 27th	2—	1·2	29th	1	0·7
July 30th	2—	1·4	July 6th	2—	1·1
31st	2	1·3	Aug. 2nd	2	1·2
Aug. 16th	0	0·1	Sept. 5th	2—	0·5
Sept. 9th	2	0·8	Oct. 17th	1—	0·9
Oct. 10th	1	0·7	20th	2	1·4
Nov. 5th	1	0·9	Nov. 6th	2	2·0
1915.			10th	1	0·9
Feb. 8th	2—	0·9	16th	2	1·7
Mar. 11th	1	0·6	17th	1	1·5
23rd	0	1·0			
April 23rd	2—	1·0	Means	1·36	0·98

* Loc. Cit. Vol. 4, No. 9, p. 495.

† See Table CLXXXII.

TABLE CLXXXI.

Activity of the Aurora at Macquarie Island in corresponding hours.	% number of hours in which (maximum) signal strength had the following values.						
Hours with activity between—	0	1	2	3	4	5	Mean value of signal strength.
			Reception at Adelie Land.				
0 and 2	42%	9%	9%	33%	7%	0%	1·5
3 and 5	25%	0%	50%	8%	17%	0%	1·9
			Reception at Macquarie Island.				
0 and 2	47%	0%	17%	27%	7%	3%	1·6
3 and 5	55%	0%	27%	18%	0%	0%	1·1

These numbers should be compared with those in Tables CLX and CLXIX in which the data are arranged in classes according to the magnetic activity. For auroral activity below the average the per cent. distribution seems to be of normal type. Also reception at Macquarie Island in hours of auroral activity above the average is normal in the sense that reception is poor, due partly to the increased chance of occurrence of an hour of inaudibility and partly to a shift of the maximum towards lower signal values (in hours of great magnetic activity there was a shift towards higher signal values). The numbers for reception at Adelie Land in hours of active aurora are abnormal in the sense that the very strong tendency towards an increased frequency of inaudible signals in magnetically disturbed hours has no counterpart for hours of auroral activity above the average at Macquarie Island. While this is no justification for casting doubt upon the numerical data, the fact that days of auroral activity at Macquarie Island were days of more than average magnetic activity is sufficient to cause some doubt whether the very small number of hours of auroral activity is at all a representative sample.

On the whole, it is considered very doubtful if the sample of hours provided by the Macquarie Island record of auroral activity is sufficient to enable any conclusions to be drawn. There is certainly insufficient evidence to doubt the expressed views of Mr. Sandell who was in a position to observe both sets of phenomena continuously, to the effect that the aurora viewed from Macquarie Island exercised a "baneful" influence upon wireless reception at that station. Possibly an hour is too long an interval for observation in view of the continuous changes of form and intensity which occur during an active auroral display.

Notwithstanding the unsatisfactory nature of the evidence, there are certainly occasions when auroral displays seem to be clearly related to unfavourable wireless conditions. In October, 1912, for example, the record between October 1st and 13th includes six days on which aurora was seen. On one of these thirteen days, the aerial at Macquarie Island was out of action and of the remaining twelve days, eight were days on which no signals were heard at Macquarie Island. These eight days included all of six days on which the aurora was seen at Macquarie Island. As already pointed out, definite evidence of this nature possibly comes to light only in circumstances when wireless communication is being maintained with difficulty.

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