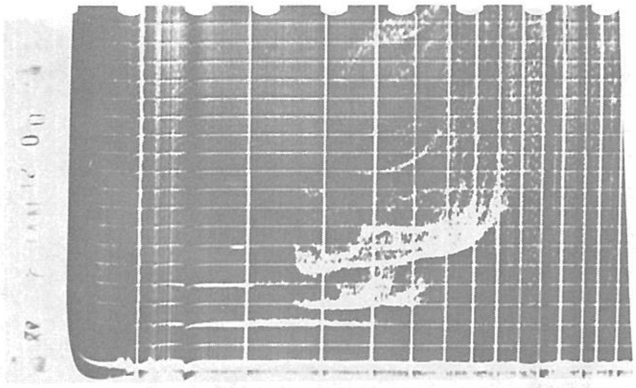
Es TYPE LOW AND RETARDATION

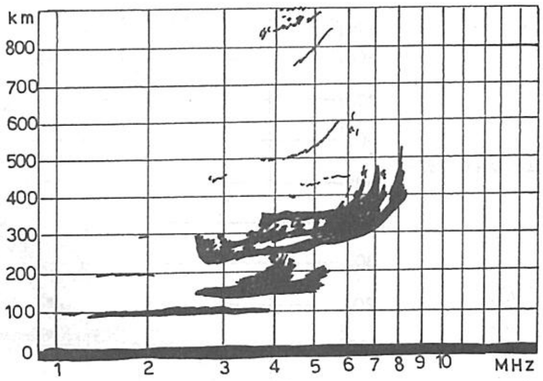


CASEY

6TH JANUARY 1972

1200 U.T.
2000 L.T.

Fig. 5.7



fmin	h'E	foE	h'Es	foEs	fbEs	typeEs
12	A	U250A	95/135	33/45	25	l3/r
h'F	foF1	M3000F1	h'F2	foF2	M3000F2	fxI
220	L			61F		84

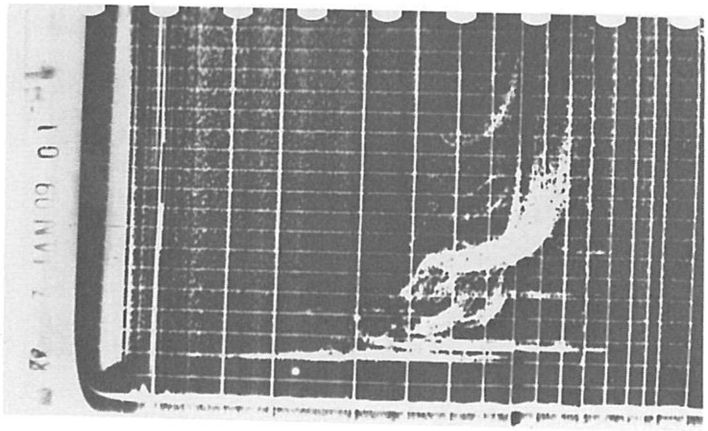
Observations: Two values of h'Es and foEs shown, although only one, that which is considered the most important, would normally be scaled. Obliques indicate presence of tilts, also (h3-3h1) is not equal to (h2-2h1); h3 = 850 km, h2 = 500 km, h1 = 250 km.

foF1 scaled as L. It appears that the trace with h'F at 220 km is the true overhead reflection, as a second reflection is observed with h'F at 500 km (at 4MHz). The primary trace shows little or no foF1 cusp. The cusp at 3.8 MHz is an oblique. Should foF1 be scaled as H (small tilt condition)?

foF2 was scaled as 62F because it appears to be a discrete trace matching with the second reflection.

Editor's Note: The r type Es is clearly at oblique incidence about 100 km away and can be rejected for tabulation under the oblique incidence trace rule. The first entries therefore represent the ionosphere most nearly overhead and would be adopted internationally.

Es TYPES LOW, HIGH, RETARDATION

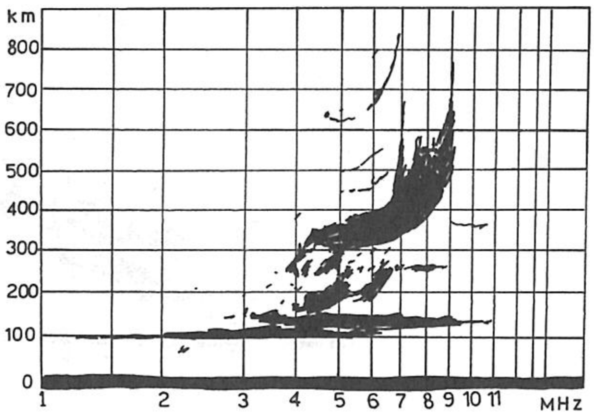


CASEY

7TH JANUARY 1972

0901 U.T.
1701 L.T.

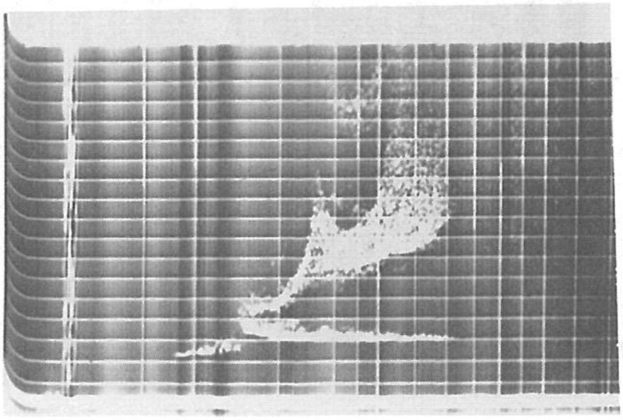
Fig. 5.8



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
13	A	A	100/125/160	61/102/55	38	ℓ/h/r
h'F	**foF1**	**M3000F1**	**h'F2**	**foF2**	**M3000F2**	**fxI**
A	U 43L		310	U 70F		90

Editor's Note: Similar to 6 January 1972. The high Es shows multiple traces which appear overhead. Best analysis is foEs = 102JA, h'Es = 125, type h2, ℓ,r. As second order confirms foF2 value, U not needed. M(3000) could be obtained by identifying main trace from height of second order but needs UF.

ES TYPE HIGH

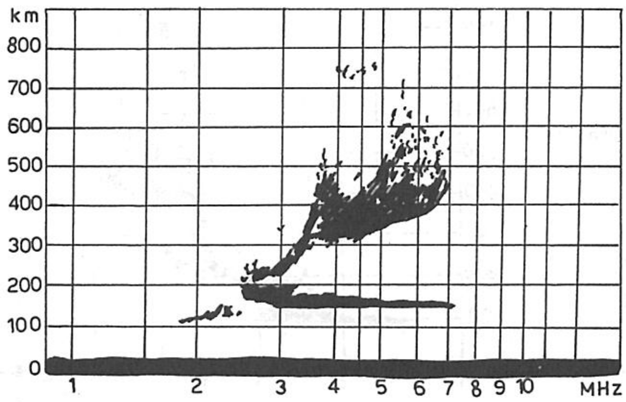


CASEY

5TH OCTOBER 1973

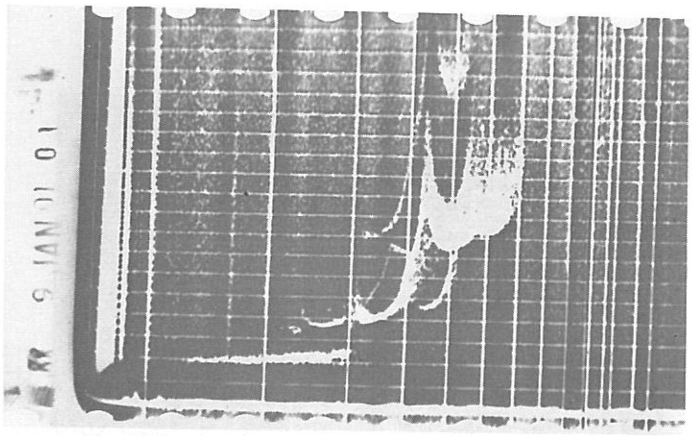
0815 U.T.
1615 L.T.

Fig. 5.9



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
18	110	245	150	64	E 25G	h
h'F	foF1	M3000F1	h'F2	foF2	M3000F2	fxI
210	36		315F	U 52F		72

Z TRACES

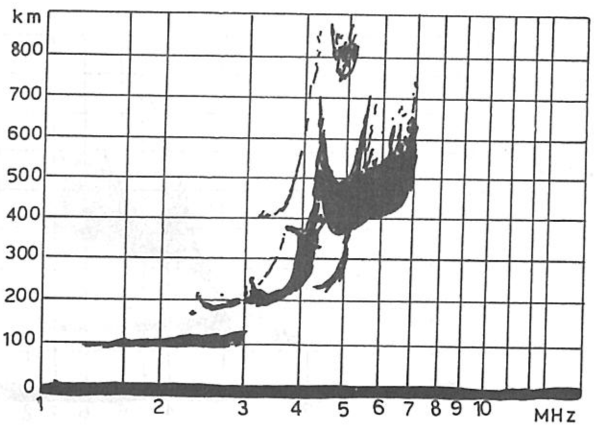


CASEY

9TH JANUARY 1972

0101 U.T.
0901 L.T.

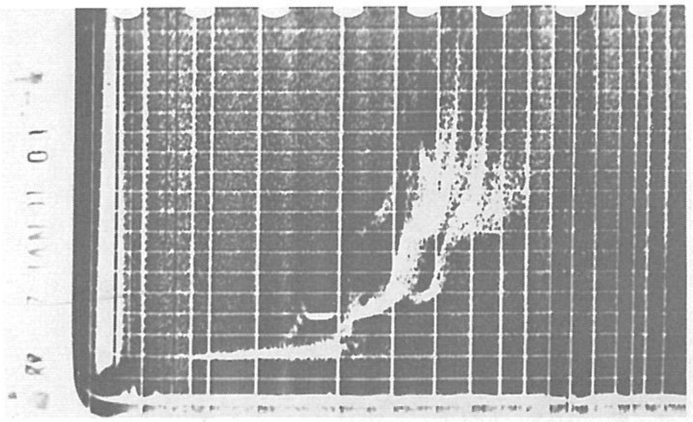
Fig. 5.10



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
12	95Z	310	G	E 31G	E 31G	
h'F	**foF1**	**M3000 F1**	**h'F2**	**foF2**	**M3000 F2**	**fxI**
190	42		365	U54F		70

Observations: A z component is visible, with fzE = 240-Z, fzF1 = 037. fzF2 is obscured by spread, and the foF2 frequency is determined using the inside edge of the F2 trace.

fzE

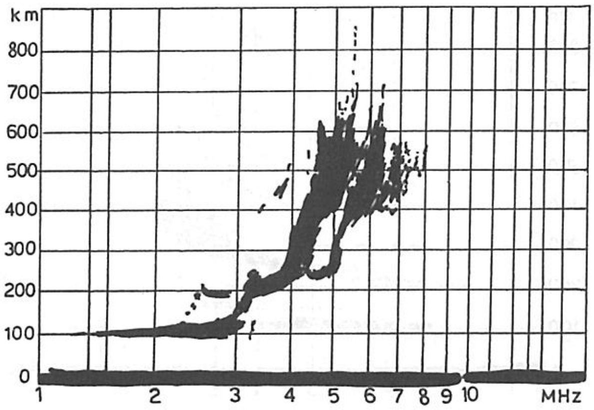


CASEY

7TH JANUARY 1972

0101 U.T.
0901 L.T.

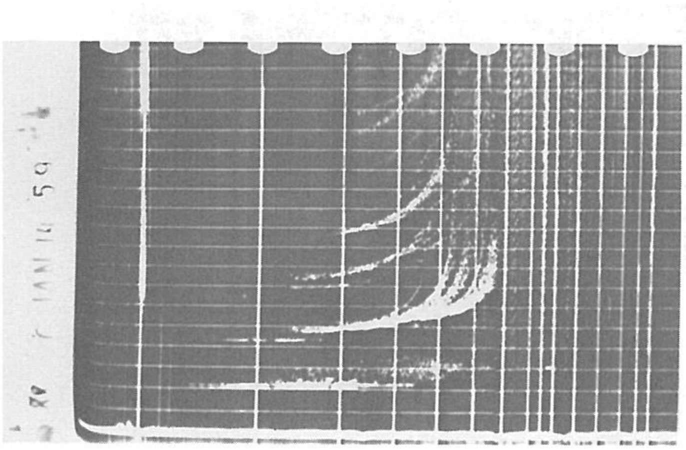
Fig. 5.11



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
12	95Z	320	G	E 32G	E 32G	
h'F	foF1	M3000 F1	h'F2	foF2	M3000 F2	fxI
190	U 46F		385	55F		80

Observations: fzE at 2.5 MHz. foF2 is measured from a discrete trace at 5.5 MHz.

Fz TRACE



CASEY

6TH JANUARY 1972

1459 U.T.
2259 L.T.

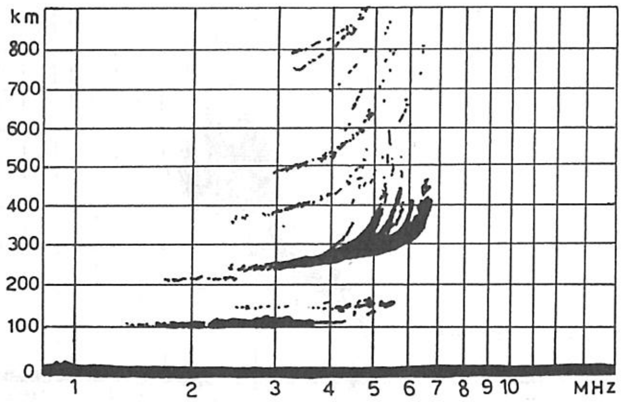
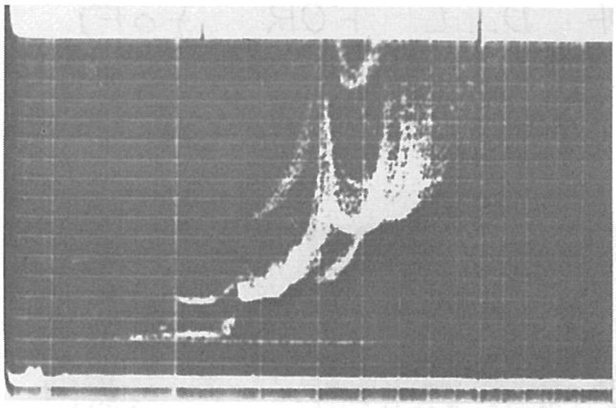


Fig. 5.12

fmin	h'E	foE	h'Es	foEs	fbEs	type Es
14	A	A	100	36	24	ℓ
h'F	**foF1**	**M3000 F1**	**h'F2**	**foF2**	**M3000 F2**	**fxI**
235 Z				Z 53F		68

Observations: Notice the z component trace at 4.6 MHz, clean, no spread, no second reflection. The value of foF2 was derived from the z component, although the second reflection trace would also give a good value for foF2.

Editor's Note: Where several different criteria confirm, the numerical value lies within accuracy rules limit for unqualified data, no qualification is needed. Prefer 053 or 053F.

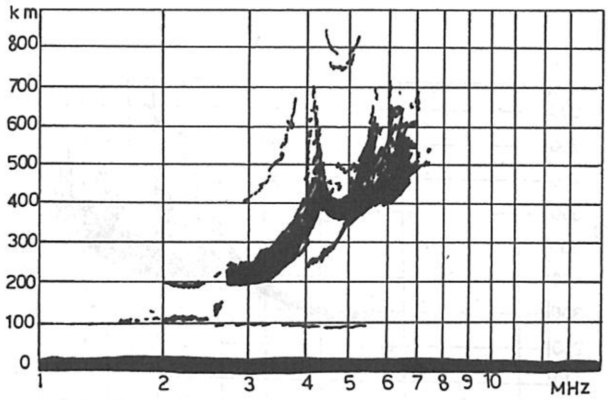


CASEY

3RD DECEMBER 1973

0401 U.T.
1201 L.T.

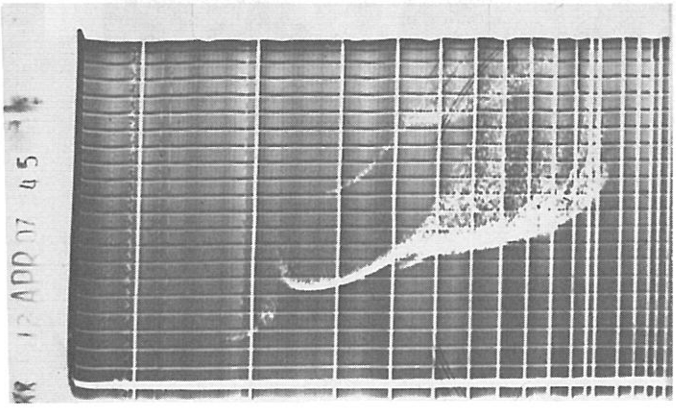
Fig. 5.13



fmin	h'E	foE	h'Es	foEs	fbEs	typeEs
15	110Z	280	100	45	E 28G	ℓ
h'F	foF1	M3000F1	h'F2	foF2	M3000F2	fxI
190	41		360	U55F		76

Observations: fzE at 2.0 MHz. fxF1 just visible at 5.0 MHz. foF2 was identified from the second reflection trace.

USE OF D..L FOR foF1



CASEY

12 TH APRIL 1970

0745 U.T.
1545 L.T.

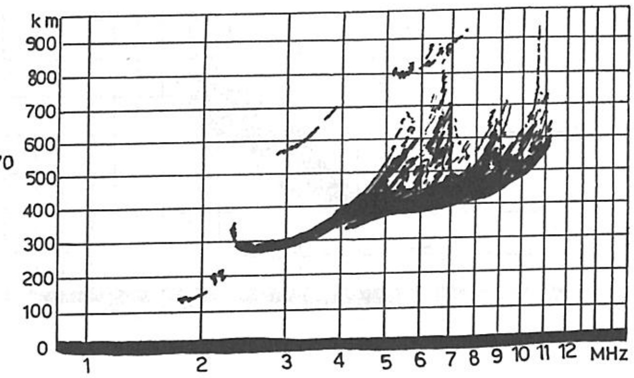
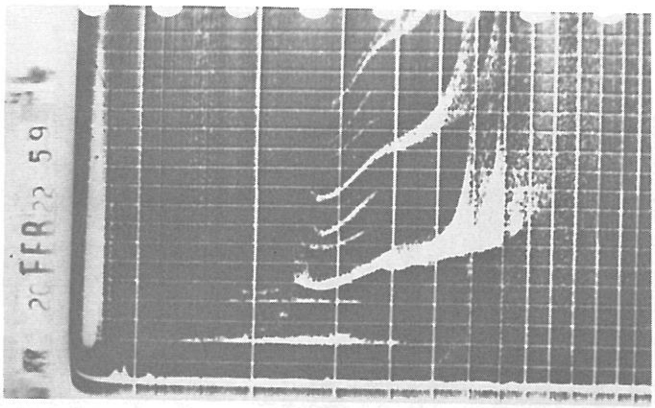


Fig. 5.14

fmin	h'E	foE	h'Es	foEs	fbEs	typeEs
18	120	220	G	E 22G	E 22G	
h'F	foF1	M3000F1	h'F2	foF2	M3000F2	fxI
260	D 45L		H	106F		114

LARGE SCALE TILTS



CASEY

20 TH FEBRUARY 1972

2259 U.T.
21/ 0659 L.T.

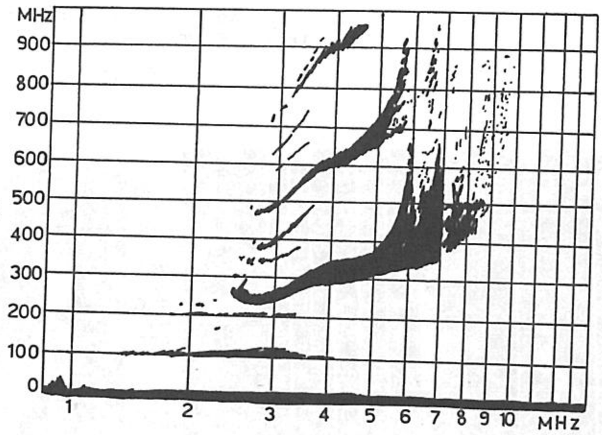


Fig. 5.15

fmin	h'E	foE	h'Es	foEs	fbEs	typeEs
13	A	U220A	100	34	24	l
h'F	foF1	M3000F1	h'F2	foF2	M3000F2	fxI
230	D42L		L	U60F		98

Observations: The height intervals of the multiple F2 echo traces are dissimilar, indicating large scale tilt. This would not be shown on our normal scaling sheets, as letter F would take preference. An inside edge measurement was used for foF2, as the second order value is inconsistent.

Editor's Note: The doubt in the possible value of foF2, as shown by second order and trace width, does not exceed accuracy rule limit, so qualifying letter U not necessary.

REPLACEMENT LAYER SEQUENCE

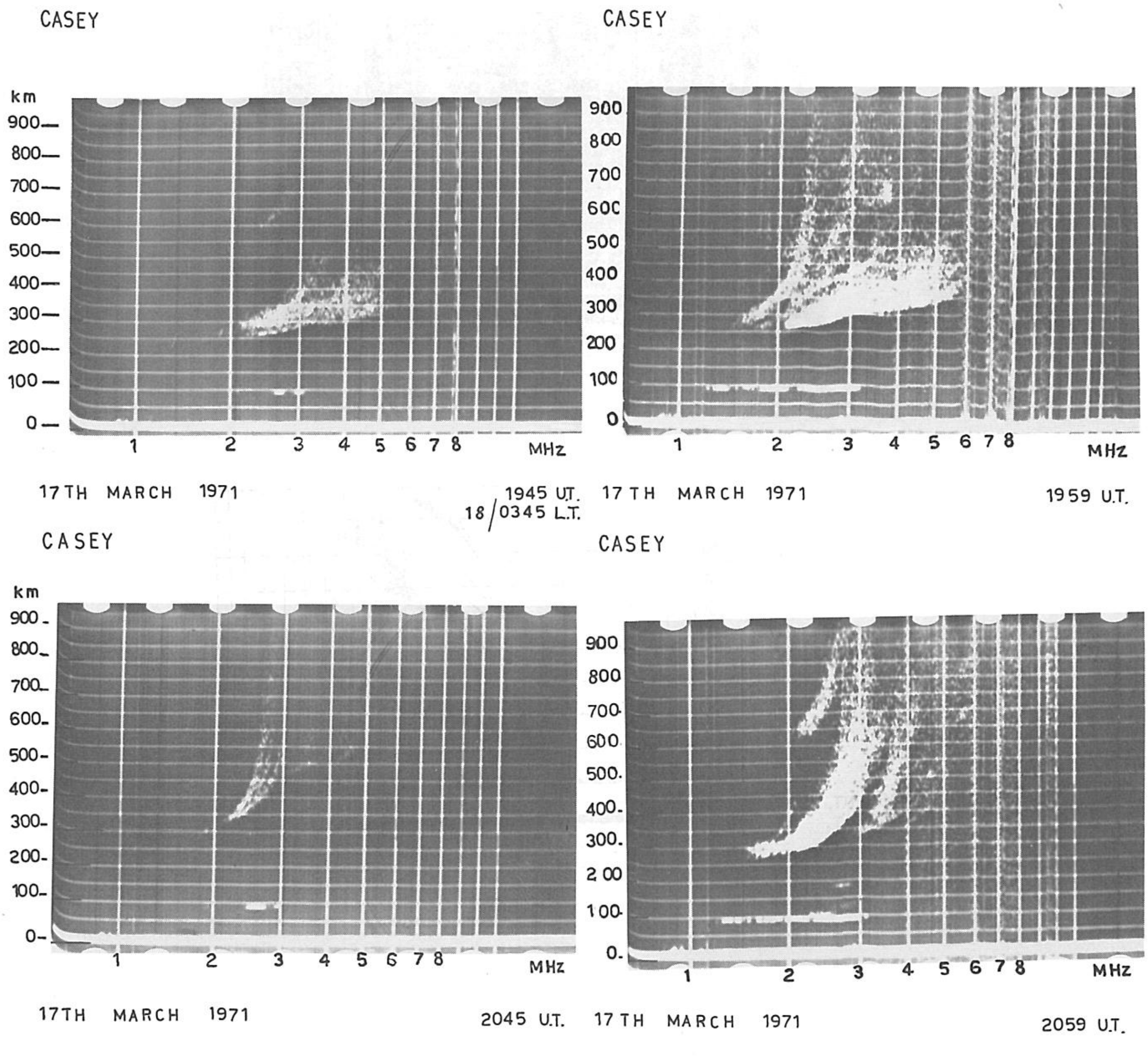


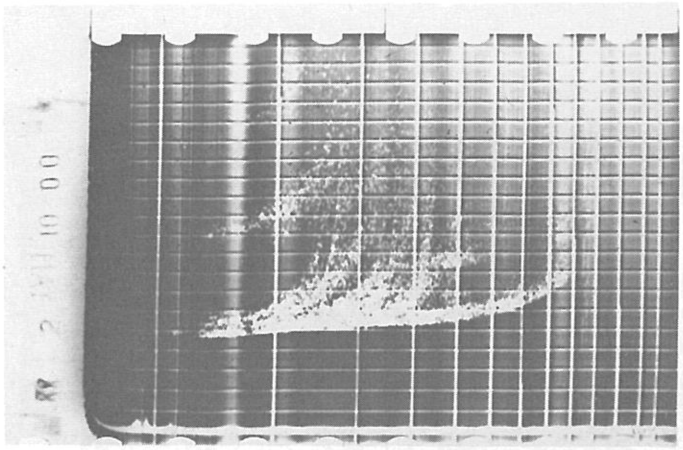
Fig. 5.16

17TH MARCH 1971 CASEY 1959 U.T.

fmin	h'E	foE	h'Es	foEs	fbEs	type Es
12	B	E120B	90	21	15	f
h'F	foF1	M3000 F1	h'F2	foF2	M3000 F2	fxI
E255A				U22F		60

Observations: In this sequence the F layer with h'F at 250 km at 1945 UT is gradually replaced by another F layer, visible on the 1959 UT ionogram (foF2 at 2.4 MHz). The high gain ionogram taken at 2059 UT shows the first F layer completely replaced.

POLAR SPUR



CASEY

2ND MAY 1972

1000 U.T.
1800 L.T.

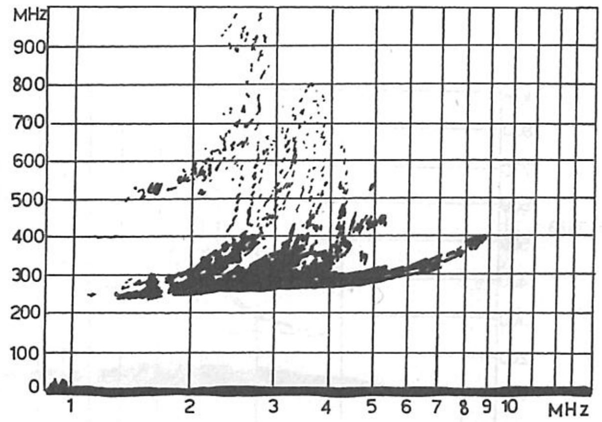
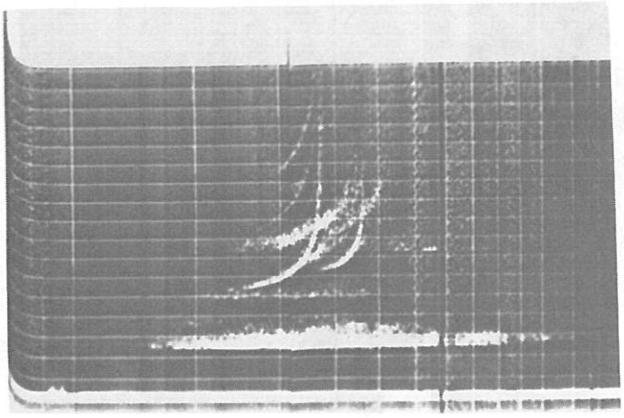


Fig. 5.17

fmin	h'E	foE	h'Es	foEs	fbEs	typeEs
13	B	E130B	B	E 13B	E 13 B	
h'F	foF1	M3000F1	h'F2	foF2	M3000F2	fxI
230				27F		89

Observations: foF2 was measured using a discrete trace at 2.7 MHz, hence the unqualified value. fxI is measured as the highest observed frequency, i.e. the top frequency of the polar spur, 8.9 MHz.

SUMMER - NO SPREAD

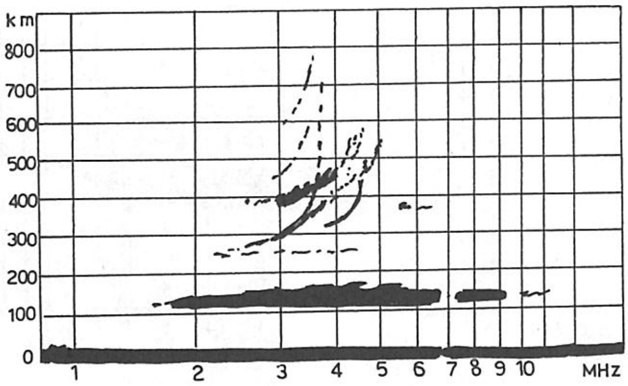


CASEY

5TH DECEMBER 1973

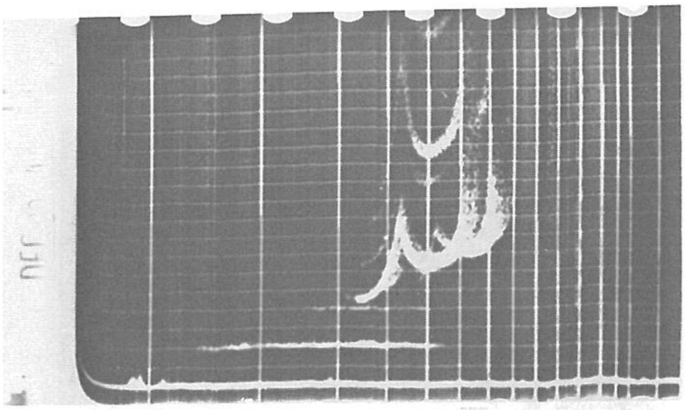
1445 U.T.
2245 L.T.

Fig. 5.18



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
15	B	E 150B	120	104	23	f
h'F	foF1	M3000 F1	h'F2	foF2	M3000 F2	fxI
E260A				37		46X

Editor's Note: The foE entry shows normal E is expected to be present; h'Es is consistent with Es type c at this time of day. The range spread is considerably greater than normally expected so there is a possibility of some Es type a also present. Non-vertical traces at F heights also suggest this. Preferred typing c2,a, or c2.



CASEY

13TH DECEMBER 1972

0045 U.T.
0845 L.T.

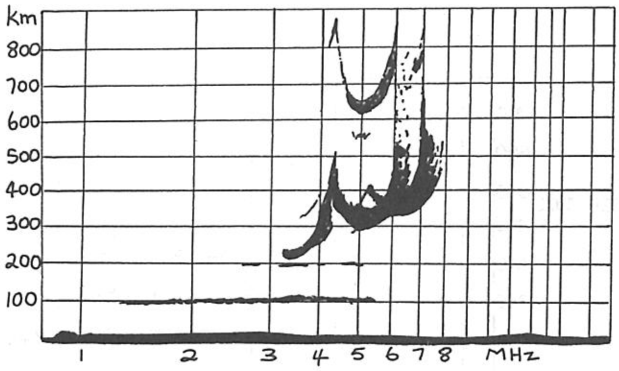
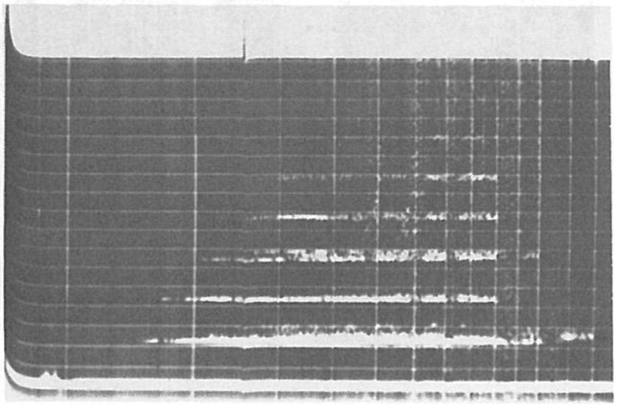


Fig. 5.19

fmin	h'E	foE	h'Es	foEs	fbEs	type Es
14	A	A	100	48	32	l2
h'F	foF1	M3000 F1	h'F2	foF2	M3000 F2	fxI
210	43		300	60F		79

REPLACEMENT LETTER "A"

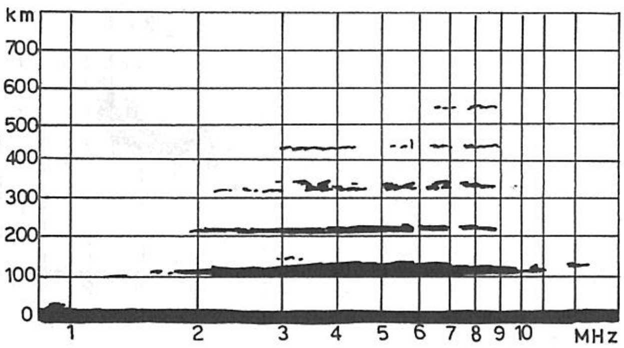


CASEY

6TH DECEMBER 1973

1400 U.T.
2200 L.T.

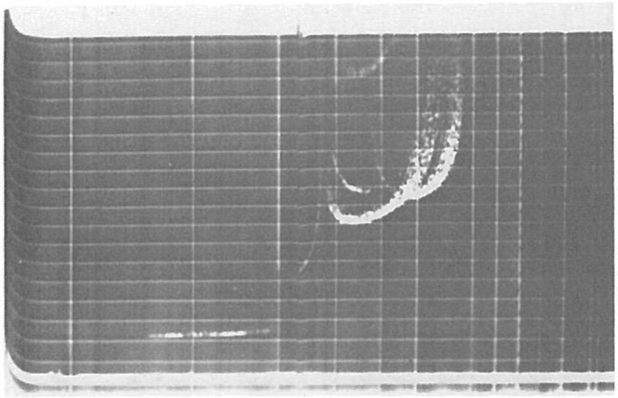
Fig. 5.20



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
15	B	E 150 B	100	J 143 A	A 110 A	f 5
h'F	foF1	M3000 F1	h'F2	foF2	M3000 F2	fxI
A	A		A	A	A	A

Observations: fbEs deduced from multiples (3rd order).

SMALL TILTS, USE OF DESCRIPTIVE LETTER H

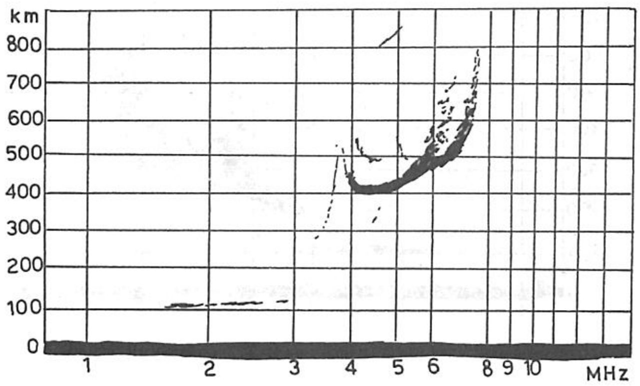


CASEY

2ND OCTOBER 1973

0615 U.T.
1415 L.T.

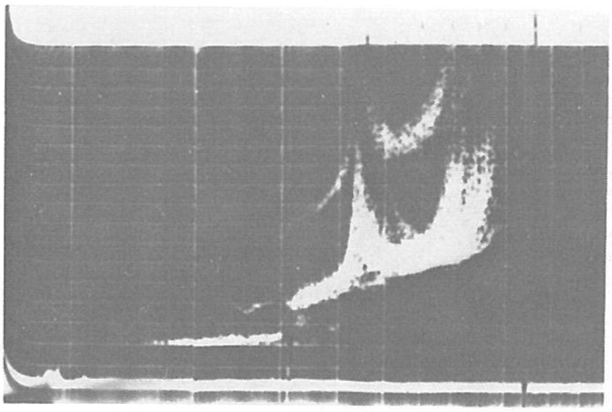
Fig. 5.21



fmin	h'E	foE	h'Es	foEs	fbEs	typeEs
16	110	U310Y	G	E 31G	E 31G	
h'F	**foF1**	**M3000F1**	**h'F2**	**foF2**	**M3000F2**	**fxI**
Y	U 38H		400	U 62F		75

Observations: Satellite trace near foF1 indicates small tilts. Note gap in region of foE, possibly due to Lacuna, as there is no retardation cusp at fmin F.

DAYTIME SUMMER IONOGRAM, WITH SPREAD

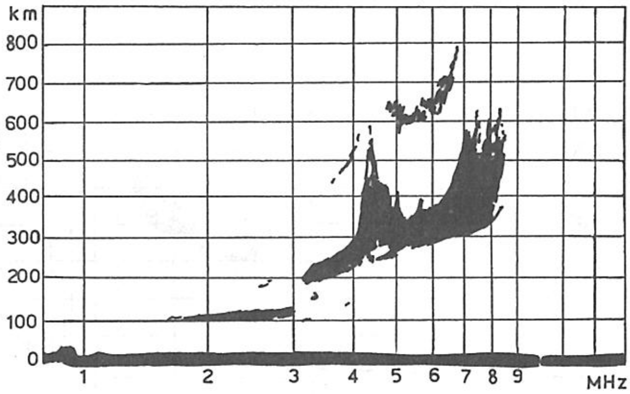


CASEY

3RD DECEMBER 1973

0901 U.T.
1701 L.T.

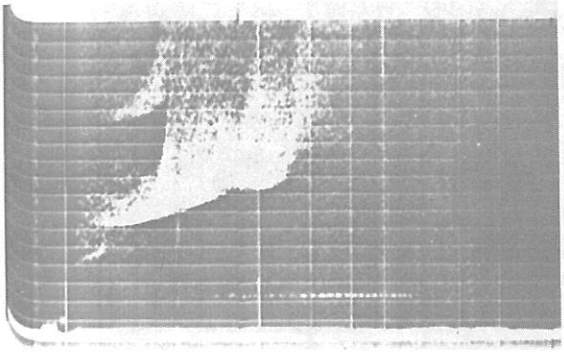
Fig. 5.22



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
16	100	305	G	E 31G	E 31G	
h'F	**foF1**	**M3000 F1**	**h'F2**	**foF2**	**M3000 F2**	**fxI**
180	43		270	U 70F		86

<u>Observations:</u> Good foF1 cusp. fxF1 is at 5.2 MHz.

WINTER SPREAD F

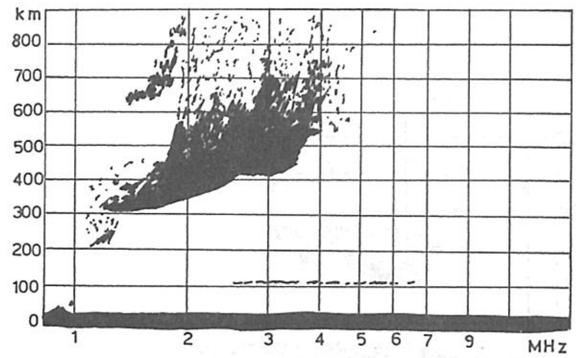


CASEY

19TH JUNE 1973

0201 U.T.
1001 L.T.

Fig. 5.23

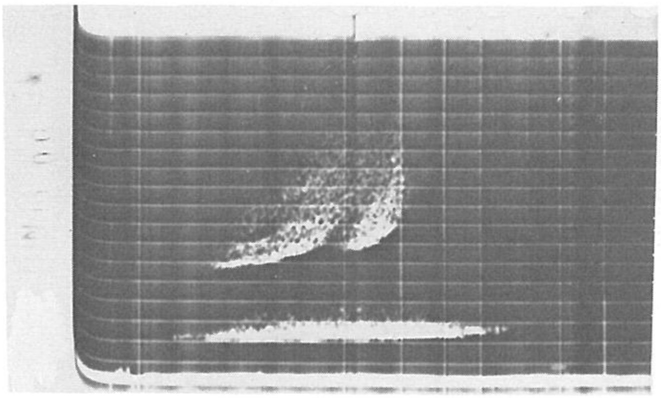


fmin	h'E	foE	h'Es	foEs	fbEs	type Es
11	B	U125K	115	60	E 13G	k,f
h'F	foF1	M3000F1	h'F2	foF2	M3000F2	fxI
310				U 19F		45

Observations: Using second reflection, a good value may be obtained for foF2. Value of foE is uncertain due to layer tilt. This is believed to be a particle E layer, and "k" is used for Es type. However foEs, fbEs and h'Es are scaled for the flat type Es layer observed.

Editor's Note: Meteor Trace. This is a typical example of a large meteor giving an apparent Es flat trace. The regular deep fading is typical. h'Es, foEs, fbEs entries therefore incorrect, foE entry permissible. This is strictly either particle E seen obliquely or an Es type r trace. The virtual height is abnormally large so it could be rejected as an oblique trace. Optimum analysis probably type r,k, foEs = 125, fbEs = (foE)K = 110UK. foE entry 110UK. (K takes precedence over UB).

WINTER SPREAD F

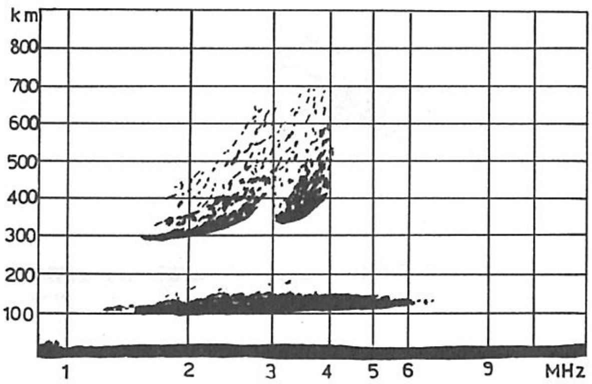


CASEY

18TH JUNE 1973

1000 UT
1800 LT.

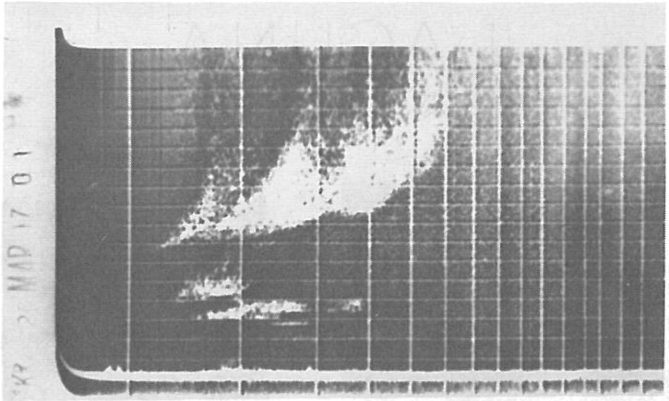
Fig. 5.24



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
12	B	E120B	100	62	15	f
h'F	foF1	M3000 F1	h'F2	foF2	M3000 F2	fxI
285				F		40

Observations: Normal winter spread, with some range spreading present.

Editor's Note: The existence of foE above 1 MHz in winter is unlikely; probably no entry better. If foE is expected at this time, Es trace cannot be flat and type is deduced from h'Es relative to expected h'E. By convention flat is used when foE cannot be recorded.



CASEY

20 TH MARCH 1973

1701 UT
0101 L.T. (21 ST)

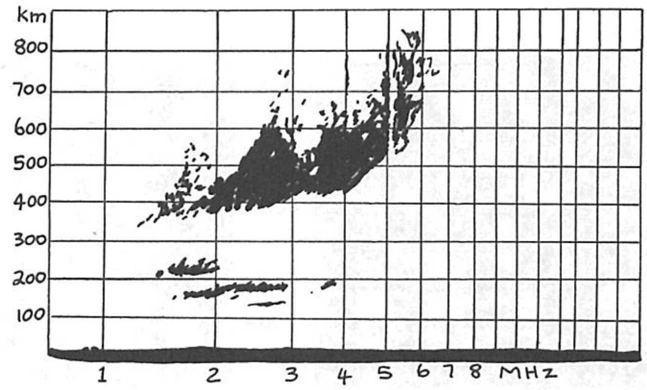
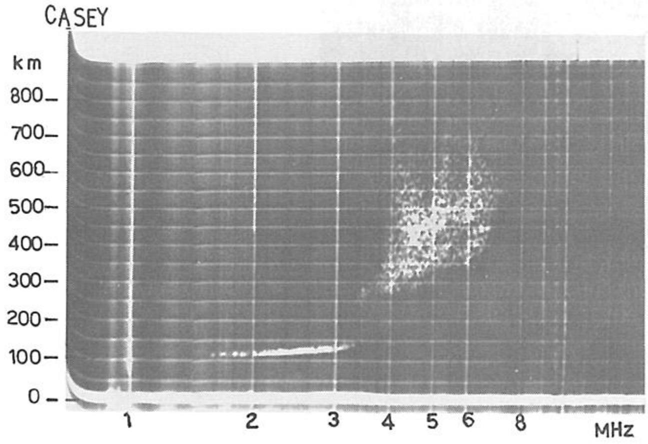


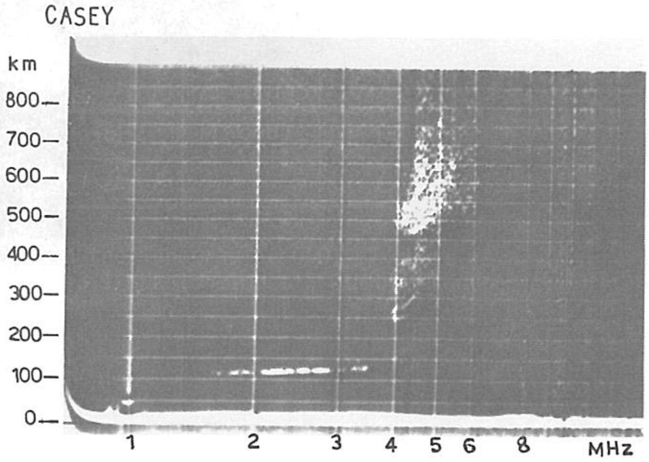
Fig. 5.25

fmin	h'E	foE	h'Es	foEs	fbEs	type Es
13	B	E130B	150	29	E 13B	a
h'F	foF1	M3000 F1	h'F2	foF2	M3000 F2	fxI
E330B				F		60

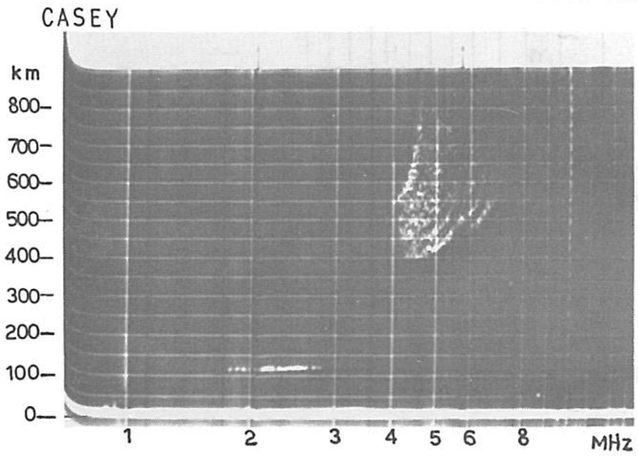
LACUNA



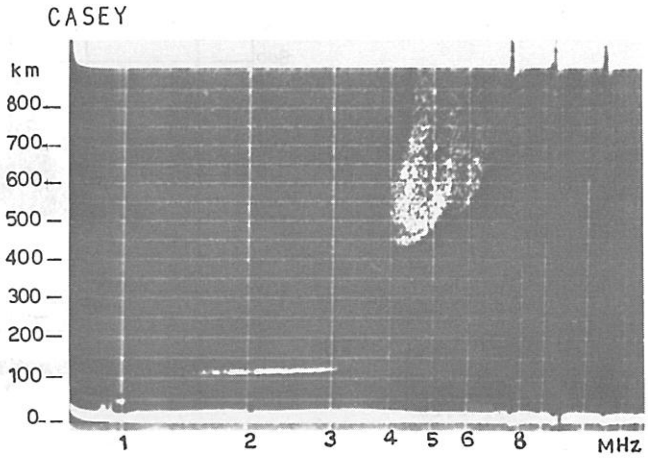
2ND OCTOBER 1973 — 0345 U.T. 1145 L.T.



2ND OCTOBER 1973 — 0401 U.T.



2ND OCTOBER 1973 — 0445 U.T.



2ND OCTOBER 1973 — 0501 U.T.

Fig. 5.26

2ND OCTOBER 1973 CASEY 0445 U.T.

fmin	h'E	foE	h'Es	foEs	fbEs	type Es
18	110	Y		E 18B	E 18B	
h'F	foF1	M3000F1	h'F2	foF2	M3000F2	fxI
Y	Y			U 46F		69

Observations: A typical case of Lacuna. In the ionogram at 0501 UT there is a faint trace of slant type Es extending from 3.1 MHz to almost 5.0 MHz. Lacuna is closely associated with slant type Es.

USE OF LETTER "G" FOR FoF2

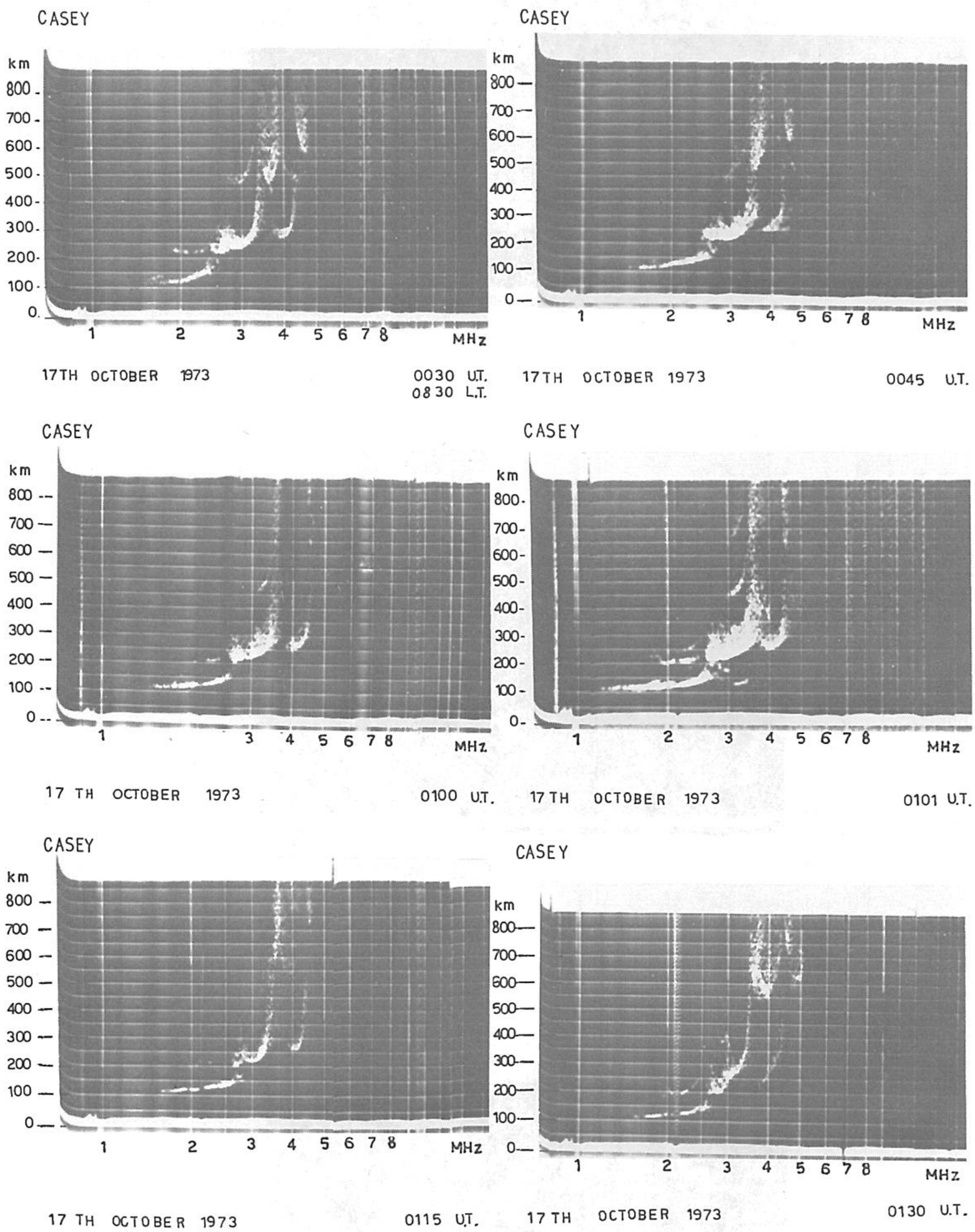


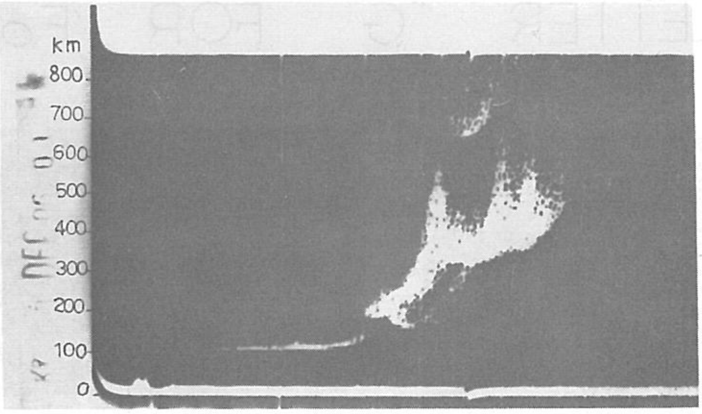
Fig. 5.27

17TH OCTOBER 1973. CASEY 0100 U.T.

fmin	h'E	foE	h'Es	foEs	fbEs	type Es
14	110	260	G	E 26G	E 26G	
h'F	**foF1**	**M3000 F1**	**h'F2**	**foF2**	**M3000 F2**	**fxI**
210	U 34F		G	E 34G	G	45X

USE OF LETTER "G" FOR foF2

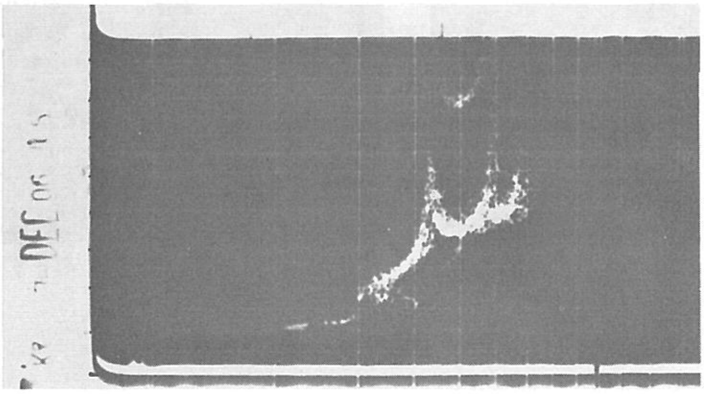
This sequence of ionograms shows the foF2 frequency decreasing to below the foF1 frequency. At 0030 UT foF1 = 3.4 MHz, foF2 = 3.8 MHz. By 0045 UT, foF2 has decreased in value to below foF1, only the spread component of foF2 showing. At 0115 UT, foF2 gradually reappears.



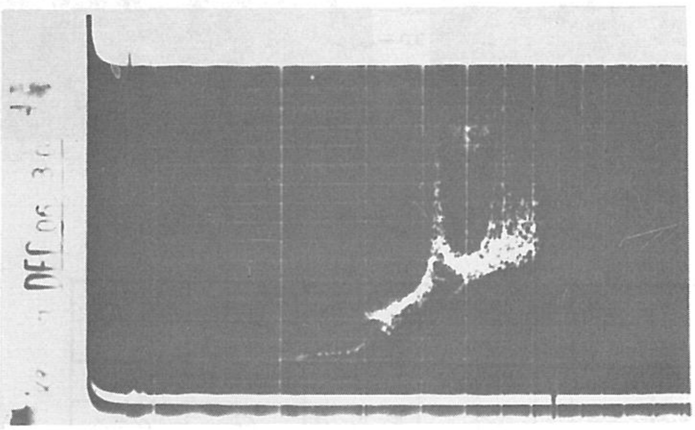
CASEY

3RD DECEMBER 1973

0601 U.T.
1401 L.T.

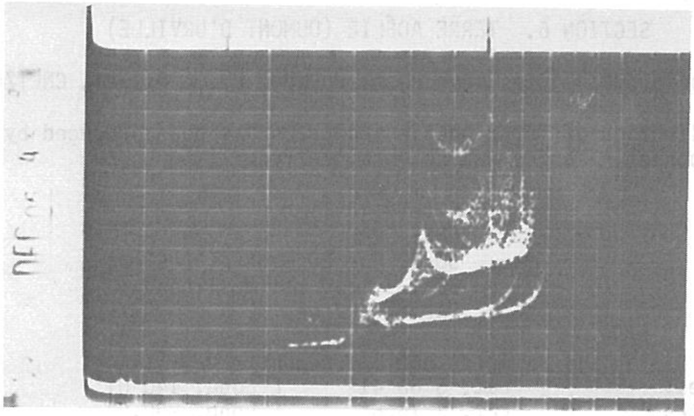


0615 U.T.
1415 L.T.



0630 U.T.
1430 L.T.

Fig. 5.28 (cont'd.)



CASEY

3RD DECEMBER 1973

0645 U.T.
1445 L.T.

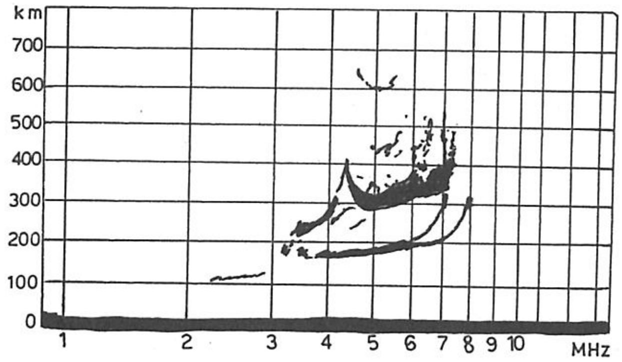


Fig. 5.28

fmin	h'E	foE	h'Es	foEs	fbEs	type Es
22	110	335	?	?	?	?
h'F	foF1	M3000 F1	h'F2	foF2	M3000 F2	fxI
220	42		290	U 61F		74

Observations: The unusual feature, at 175 km, with critical frequency at 7.0 MHz does not appear to be an Es layer. This feature appeared only on one frame, and the sequence on the previous page shows ionograms taken before 0645 UT. There appears to be a high type Es on all the ionograms.

Editor's Note: While very rare, this type of trace has been reported before as a short-lived phenomenon. More cases are needed to find out what is happening. Anyone seeing such a sequence is invited to inform INAG. Some research is needed --- there is no obvious solution at present. It could be a very severe local TID or a particle E seen at oblique incidence. It is more likely to be an F-layer anomaly than E, but if so probably involves electric forces not yet recognized.

SECTION 6. TERRE ADÉLIE (DUMONT D'URVILLE)

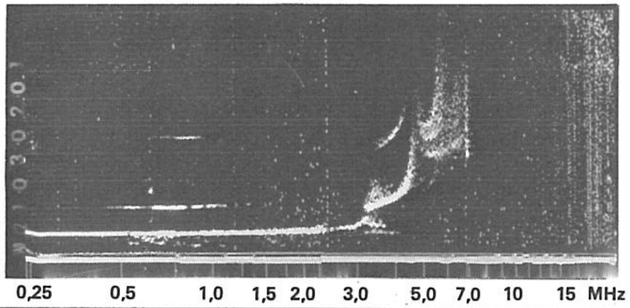
Terre Adélie ionograms and ionogram notes have been provided by G. Pillet, CNET/CRPE, Paris, France.

Editor's Note: A collection of Terre Adélie ionograms has been produced by G. Pillet and published as a booklet. Copies can be obtained from:

Mlle G. Pillet
CNET/CRPE
38-40 Rue du General LeClerc
92 131 Issy Les Moulineaux
Paris, France.

Station name:	Terre Adélie (Dumont d'Urville)	
Geographic coordinates:	Lat. S 66°41'	E Long. 140°01'
Geomagnetic coordinates:	Lat. S 75.5°	E Long. 230.9°
Invariant latitude:	80.52°	
Magnetic dip:	89.62°S	
Time used:	135°E (UT + 9 hours)	

DUMONT D'URVILLE
3.1.1972
02.01 UT
11.01 LT



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
E	100	315	135-G	037	032 EG	H
h'F	**foF1**	**M3 000 F1**	**h'F2**	**foF2**	**M3 000 F2**	**fxI**
195 UH	047	xxx	440 UH	063-F	xxx-F	070

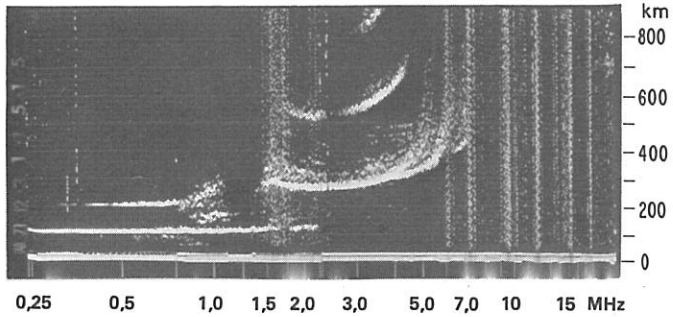
Fig. 6.1

TERRE ADÉLIE 3 January 1972 11.01 LT (135°E)

SUMMER DAY

fmin is low but varies regularly through the day. The E layer is very low and usually shows z traces. h'E can fall to 90 km. The z trace disappears when Lacuna or slant Es conditions are present. x traces from the E region are seldom seen. foE is easy to read except when Lacuna is present. Very little Es, mostly type c and h. h'F is abnormally low in summer, often near 180 km. The differences between the median values of fxI and fxF2 are as large as at night. Lacuna is a day time phenomenon at the station.

DUMONT D'URVILLE
31.12.1971
15.15 UT
00.15 LT



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
E	A	140 UH	100	017	008-G	L2
h'F	**foF1**	**M3 000 F1**	**h'F2**	**foF2**	**M3 000 F2**	**fxI**
260-Q				050-F	xxx-F	72

Fig. 6.2

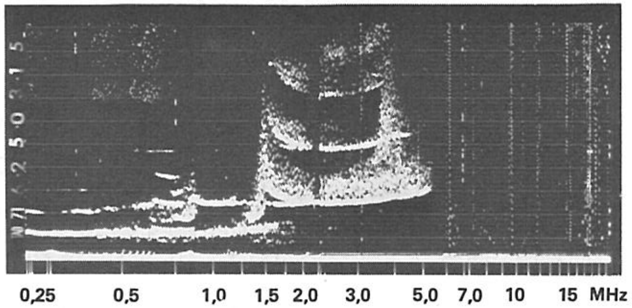
TERRE ADÉLIE 31 December 1971 00.15 LT (135°E)

SUMMER NIGHT

Note: E trace expected to be well above Es trace but probably not seen here. foE between 013 and 015. F layer tilted. Compare with Fig. 2.14-2.17 in Handbook.

Blanketing Es type ℓ predominates causing difficulties in measuring h'E. Numerous stratifications are present. fbEs exceeds foE on about 50% of occasions. foF1 is seldom seen between 21.00 and 03.00 LMT. foF2 is easy to read but there is usually some spread above fxF2.

DUMONT D'URVILLE
25.6.1971
03.15 UT
12.15 LT



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
E	100-H	150-H	120-Z	017	013 EG	C2S
h'F	**foF1**	**M3 000 F1**	**h'F2**	**foF2**	**M3 000 F2**	**fxI**
235-Q				036 DF	F	053

Fig. 6.3

TERRE ADÉLIE 25 June 1971 12.15 LT (135°E)

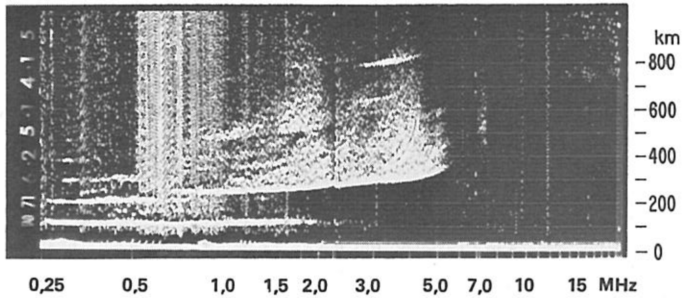
WINTER DAY

Note: z, o traces present in E; no x trace.

Very little absorption is observed in winter. h'E is usually near 100 km but the trace is often irregular, showing spurs, stratifications and spread as on the example shown. Es is seldom seen, when present usually type c or h. foF1 is seldom distinct and is transient. foF2 is seldom visible and the values found are not representative of average conditions. For example, a good median value of fxI of 10.2 MHz was found when median of 4 values of foF2 were only 064UF.

Editor's Note: The interpretation of this ionogram is not clear in the reproduction. In the original, it is more clear that the top end of the slant trace is hidden by the cusp Es trace so that foEs is 017. foEs is, of course, never measured from a slant trace. The cusp Es can be more clearly seen on the z mode which is always lower than the o-mode trace.

DUMONT D'URVILLE
25.6.1971
14.15 UT
23.15 LT



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
E			095	010	007	F4
h'F	**foF1**	**M3 000 F1**	**h'F2**	**foF2**	**M3 000 F2**	**fxI**
235				033 JF	F	54

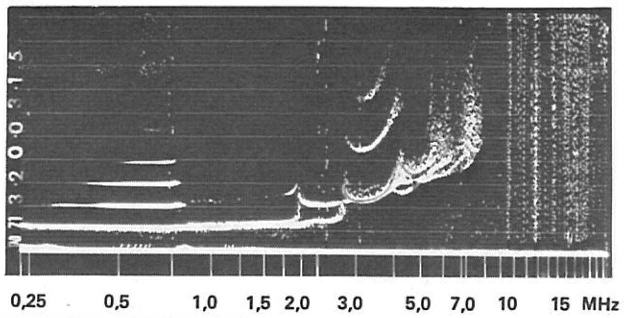
Fig. 6.4

TERRE ADÉLIE 25 June 1971 23.15 LT (135°E)

WINTER NIGHT

Absorption normally absent. Particle E (Night E) is often observed (50% of the time) but the values of foE are often blanketed. Particle E is found between midnight and sunrise. Es is always present. It is usually type f or, when particle E is present, type ℓ with h'Es close to 100 km. Auroral Es is frequently seen about 0400 LT (135°E). Much spread F is present but h'F is easily evaluated. fxI is the most important F-region parameter. The few foF2 values found represent abnormal conditions.

DUMONT D'URVILLE
20.III.1971
03.15 UT
12.15 LT



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
E	100	270	095	012 G	G	L5
h'F	**foF1**	**M3 000 F1**	**h'F2**	**foF2**	**M3 000 F2**	**fxI**
220	041	xxx	340 UH	066 UH	xxx UF	077

Fig. 6.5

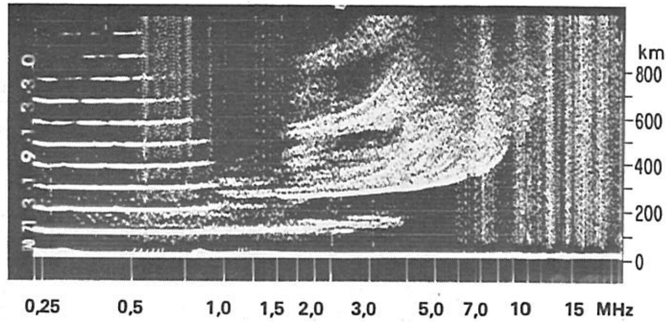
TERRE ADÉLIE 20 March 1971 12.15 LT (135°E)

EQUINOX DAY

Note: fbEs is seen clearly on z trace. fbEsZ = 008 but is not visible on o trace. There is no INAG ruling. Descriptive letter G is needed as foEs and fbEs less than foE. Optimum is fbEs = (fbEsZ + fB/2)ZG = 015ZG.

The absorption is usually maximum at the equinoxes. The example given with fmin = E is not representative. h'E varies smoothly during a day but its value from day-to-day can vary between 100 and 120 km. There are few problems in interpreting foE as Es is usually absent. Es when present is usually type h or c and is seldom blanketing. Good values of foF1 and M(3000)F1 can be observed between 0700 and 1600 LT (135°E). Spread F and tilted F layers are very common. About one-third of the values of foF2 are replaced by F and most of the remainder are uncertain (UF). The greatest values of foF2 are found between about 1200 and 1800 LT (135°E). fxI usually exceeds fxF2 by between 1 and 2 MHz. This is due to frequency spread.

DUMONT D'URVILLE
19.III.1971
13.30 UT
22.30 LT



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
E			095	021	010	F9
h'F	**foF1**	**M3 000 F1**	**h'F2**	**foF2**	**M3 000 F2**	**fxI**
280-Q				040-F	xxx-F	94

Fig. 6.6

TERRE ADÉLIE 19 March 1971 22.30 LT (135°E)

EQUINOX NIGHT

Note: Overhead trace is upper trace of multiple patterns which show downwards range spread. x trace is below o trace showing severe N/S tilt. (Fig. 2.12 in Handbook).

There is seldom enough absorption for fmin E. Very few examples of normal or particle E are observed mainly because of blanketing by Es. Es is always present and interferes with the interpretation of higher traces. Es traces are often diffuse and complicated, covering between 100 and 200 km. F traces are usually diffuse showing both range spread and frequency spread. Only a few values of foF2 are obtainable. Correspondingly few values of M(3000)F2 are available. fxI is therefore our main F2 parameter; the value of fxI exceeds fxF2 by at least 1 MHz.

SECTION 7. MAWSON STATION

AUSTRALIAN STATIONS

Editor's Notes on Australian Analyses:

Please note entries on analyses tables do not conform to international usage where all numerical entries should have three figures. Thus 1.6 MHz when read in 0.1 MHz units would read 016, if read in 0.05 MHz(E) units 160. Normal high latitude practice is to use 0.1 MHz units for all parameters other than foE. Australian stations also continue to use the original WWSC layout: qualifying letter, value, descriptive value in manual tabulations. This is discouraged for general use as it complicates punching the data for computer use. The Australian group can provide data in computer compatible form on request so this difficulty does not arise.

Entries marked "Observations" are contributed by the scaling group; Editor's comments are marked "Editor's Note".

Most of these ionograms should have shown numerical values of M(3000)F1 and M(3000)F2 if reduction was complete but these have not been included in the tabulation. Comments are added for some ionograms where M(3000) is likely to be measurable although at first glance it is not, as many high latitude groups do not measure M(3000) as often as possible.

It is a normal convention to put only foE values in a table at hours where foE is observable. For these hours Es type flat should not be used, h, c or ℓ being entered according to the observed values of h'E and h'Es when present for these types at these hours. The Australian group use (foE)EB and (foE)EA extensively when foE would be expected to be present but is not seen. It is then often not possible to say whether the Es type should be h, c or ℓ, so type f is used instead. Thus Australian tables have f entries at hours with limited foE values, a departure from normal practice. The entry f implies that there is no information as to whether h, c or ℓ would be more appropriate so that this practice is allowable by the rules.

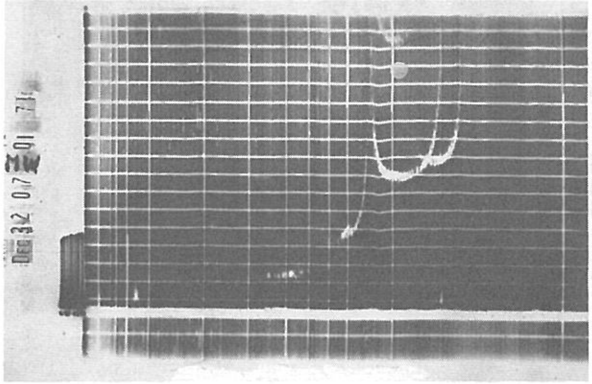
Vertical Incidence Soundings at Mawson

Operation of the IPS Type 3E ionosonde began at this station in February 1959. Vertical incidence data are published monthly in an Australian ionospheric data computer listing. Information about the station or the data is available from:

ASSISTANT SECRETARY
Ionospheric Prediction Service
P. O. Box 702
Darlinghurst, N.S.W. Australia 2010

Station name:	Mawson	
Geographic coordinates:	Lat. S 67.60°	E Long. 62.90°
Geomagnetic coordinates:	Lat. S 73.17°	E Long. 103.54°
Invariant latitude:	70.28°	
Magnetic dip:	68.92°	
Time Used:	60°E (UT + 4 hours)	
Ionosonde equipment type:	IPS 3E	
Routine sounding:	Every 15 minutes	
Recording medium:	35 mm film	
Data available:	Tables, computer printouts normally available 14 months after observations	

The ionograms for the Australian stations were selected and provided by Mr. G. D. Cole.



MAWSON

SUMMER DAY

1ST JANUARY, 1972

0701 U.T.

1101 L.T.

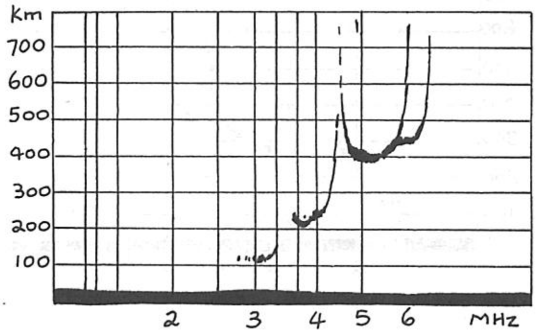
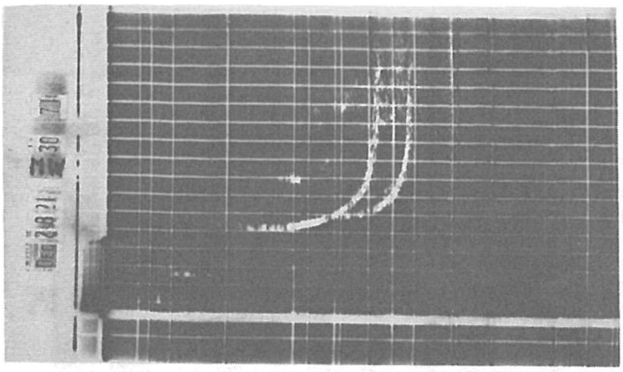
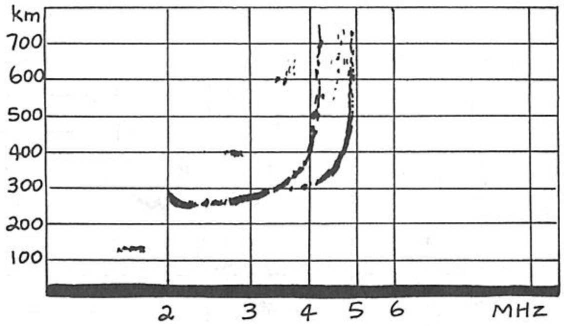


Fig. 7.1

fmin	h'E	foE	h'Es	foEs	fbEs	type Es
27	110	350R	G	E 35G	E 35G	
h'F	**foF1**	**M3000 F1**	**h'F2**	**foF2**	**M3000 F2**	**fxI**
200	45		380	62		69X





MAWSON

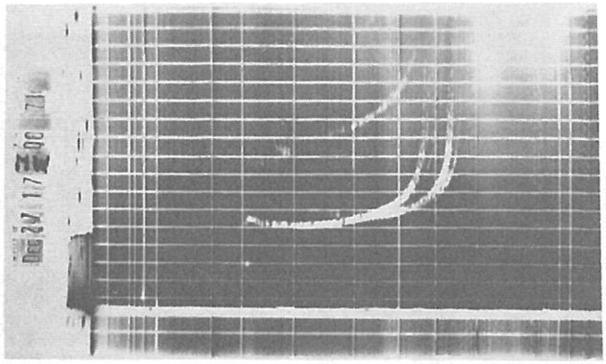
SUMMER NIGHT

28TH DECEMBER, 1971

2130 U.T.
0230 L.T. (29TH)

Fig. 7.2

fmin	h'E	foE	h'Es	foEs	fbEs	type Es
14	A	U190R	120	E 18G	U 18R	f
h'F	foF1	M3000 F1	h'F2	foF2	M3000 F2	fxI
250				42 F		50



MAWSON

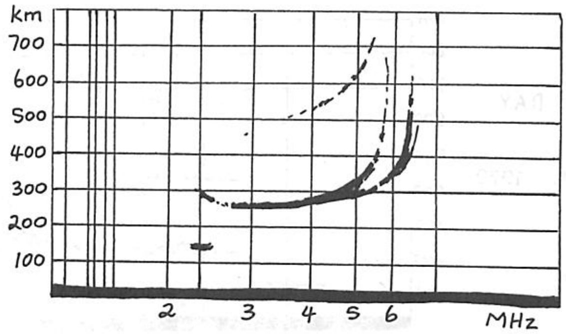
SUMMER NIGHT

27TH DECEMBER, 1971

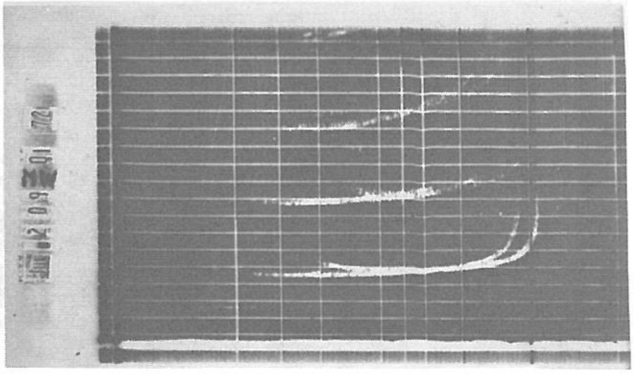
1700 U.T.

2100 L.T.

Fig. 7.3



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
22	B	U220B	135	23	E 22 B	f
h'F	foF1	M3000 F1	h'F2	foF2	M3000 F2	fxI
250				57 F		69



MAWSON

WINTER DAY

2ND JULY, 1972

0901 U.T.
1301 L.T.

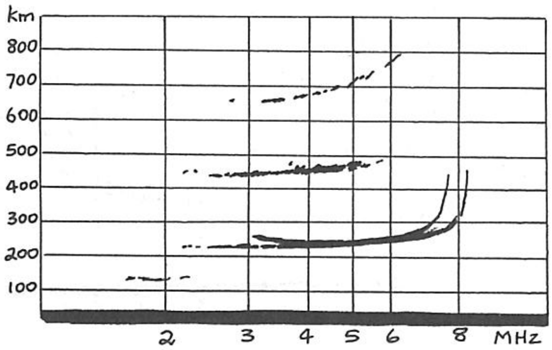
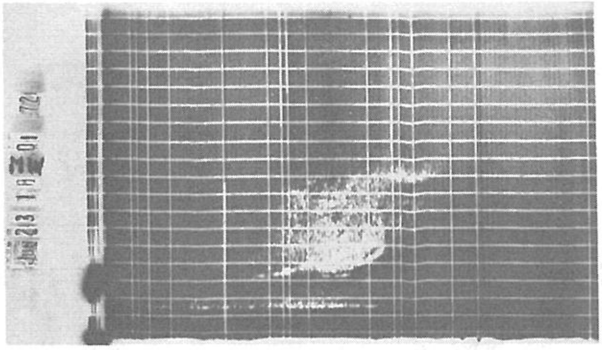


Fig. 7.4

fmin	h'E	foE	h'Es	foEs	fbEs	typeEs
16	A	E 220A	130	22	22	f
h'F	foF1	M3000F1	h'F2	foF2	M3000F2	fxI
220				75		82X

Editor's Note: foE is usually expected to be present so Es type can be deduced from h'Es-h'E. In this case optimum analysis would give Es type c or h depending on value of h'E usually found. If foE not usually seen, better to leave foE entry blank in which case f appropriate.



MAWSON

WINTER NIGHT

23RD JUNE, 1972

1801 U.T.
2201 L.T.

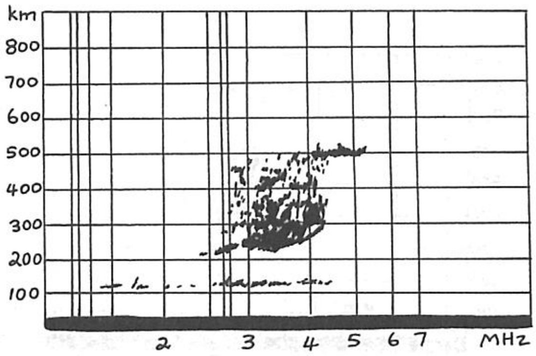
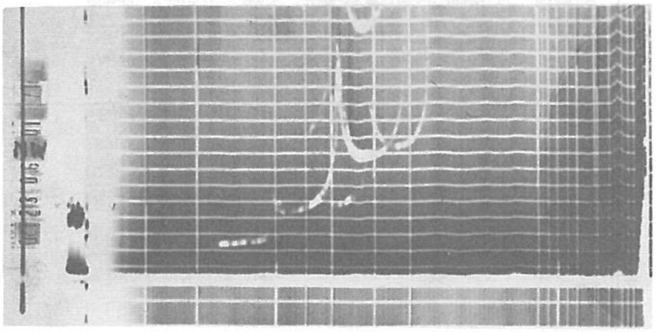


Fig. 7.5

fmin	h'E	foE	h'Es	foEs	fbEs	type Es
12	A	A	120	37	23	f
h'F	foF1	M3000 F1	h'F2	foF2	M3000 F2	fxI
210				F		55

Editor's Note: A very tilted layer, fxF2 is probably below 4.1 MHz, foF2 above 3.1 MHz suggesting foF2 between 3.1 and 3.5. Possible to interpret this as foF2 = 033UF as shape of lower edge strongly suggests o and x traces present. If sequence suggests doubt on whether x present, foF2 = F. Quick sequence, e.g., from gain runs, is essential to analyze this type of record which could be due to auroral Es seen at oblique incidence.



MAWSON

23RD OCTOBER, 1971

0601 U.T.

1001 L.T.

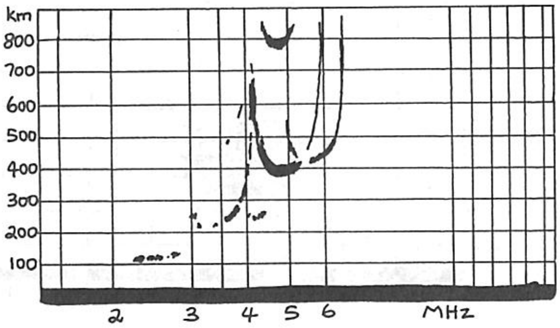
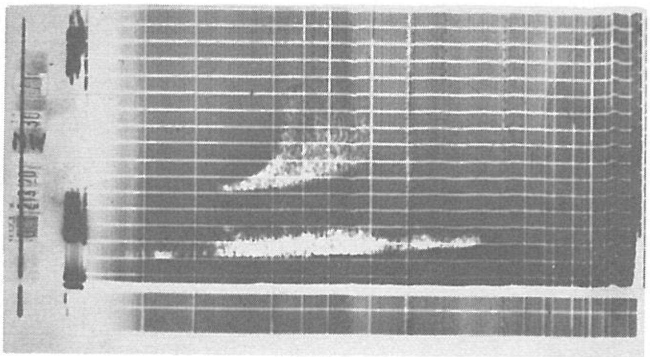


Fig. 7.6

fmin	h'E	foE	h'Es	foEs	fbEs	type Es
22	110	295	G	E 29G	E 29G	
h'F	foF1	M3000F1	h'F2	foF2	M3000F2	fxI
205	42		375	58		65X



MAWSON

23RD OCTOBER 1971

2030 U.T.
0030 L.T. (24TH)

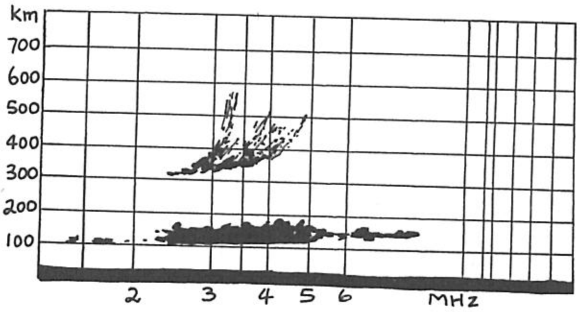


Fig. 7.7

fmin	h'E	foE	h'Es	foEs	fbEs	type Es
14	B	E 140B	100	78	23	f
h'F	foF1	M3000 F1	h'F2	foF2	M3000 F2	fxI
300				U 32F		50

Editor's Note: This Es trace is not horizontal and shows much broadening with ftEs for thick part of trace near fxF2. Most likely to be an auroral trace with slant rising from it. fmin low so ftEs probably x mode, prefer foEs = 046JA types a,s.

SECTION 8. BYRD STATION

Ionograms from United States operated ionosondes

The ionograms reproduced for the following station have been selected and provided by Raymond O. Conkright and Lucile Hayden of World Data Center A, Boulder, Colorado.

BYRD -- Operations began July 1957. This station was operated by NBS, ESSA and NOAA and closed December 1970.

Station name:	Byrd	
Geographic coordinates:	Lat. S 80.00°	E Long. 240.0°
Geomagnetic coordinates:	Lat. S 79.50°	E Long. 336.21°
Invariant latitude:	67.82°	
Magnetic dip:	75.1°S	
Time used:	120°W (UT - 8 hours)	
Ionosonde equipment type:	C 3/4	
Frequency range:	0.25-20.0 MHz	
Sweep time:	30 sec	
Approximate peak power:	20 kW	
Pulse repetition rate:	60 Hz	
Pulse length:	50 μsec	
Aerial type:	Vertical Delta	
Routine sounding:	Quarter hourly	
Height range:	700 km	
Height scale:	Linear	
Frequency scale:	Logarithmic	

Enquiries about this station should be addressed to:

Raymond O. Conkright
World Data Center A for
Solar-Terrestrial Physics
Boulder, Colorado U.S.A. 80302

Fig. 8.1

Editor's Notes on Es Sequence BYRD STATION, April 17-18, 1966.

April 17, 1966, 2300 LT (120°W). Es-r with second order trace showing retardation at low frequency end and low Es. Other weak Es traces present types a and r. Retardation indicates thick layer with foE near 150 which must be Es-k with foE = 150UK. h'E = A. (Expanded record suggests h'E = 120UA). Type r2, ℓ,k.

April 18, 1966, 0000 LT (120°W). Es-a. Es-h with retardation at low frequency end and shape of pattern indicate Es-k with foE = 160UK. foEs from high = 019 confirmed by x trace. fbEs = 017. Types h,k,a.

0015 LT (120°W). Retardation at fbEs and weak 2E trace show Es-k with foE = 130-K. Hence flat trace is Es-ℓ. General pattern Es-a. foEs from low trace 018, fbEs 010. Types ℓ,k,a, foF2 = 044.

0100 LT (120°W). No trace of particle E. Es-f and Es-a. F pattern breaks up into two with foF2 probably near 022 and 036, respectively. Apparently nearing trough condition. Lower o-x pair most nearly correct so foF2 = 022UF. (U mainly interpretation).

0130 LT (120°W). Es-f and two Es-a structures. Type ℓ,a,a. Two F structures. o and x traces suggest foF = 045 more nearly overhead. foF2 = 045UF.

0200 LT (120°W). Large increase in absorption. Es-a, Es-d, foF2 = 021UR. fxI deduced from o-trace scatter, fxI = 0520B.

0300 LT (120°W). Difficult. fmin as high as 020, Es-d still present, Es-r with foEs = 026 strong enough to screen foF2 near 022. Hence foF2 is ---A. (fxI more likely to be absent due to absorption judging by previous record.) Hence prefer fxI ---B.

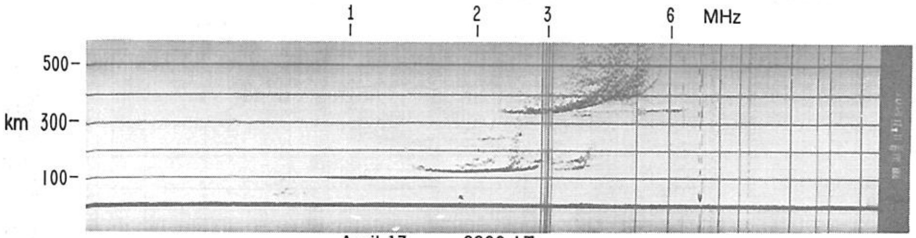
0400 LT (120°W). Expanded scale pattern clearly shows Es-k. Lack of scatter near foEs on main ionogram shows this also. Es-k (particle E) with foE = 380-K. This is a thick layer so F parameters best replaced by G. foEs = fbEs = 038-K.

0430 LT (120°W). Es-r with short length of Es-f near fmin. Es-a also. Types r,f,a.

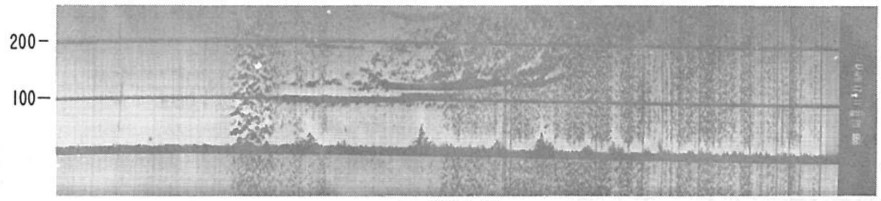
0445 LT (120°W). Es-r with short possible second order. However not blanketing so probably not a true second order trace. Retardation at low frequency end of F trace, hence Es-k also typical Es cusp. Types r,k2,c. foE = 135UK, fxI deduced from o-trace. Es-k confirmed by second order trace.

0500 LT (120°W). Es-r and Es-k. Second order Es-k gives foE-K slightly less than foEs but consistent with low frequency boundary of Es cusp. x trace suggests no Es-r. Hence foE value could be either 250 or 270. Adopt more certain 250UK with U for interpretation doubt. In practice these small differences have little scientific importance so 270-K would be acceptable.

BYRD STATION APRIL 1966 (120° WMT)

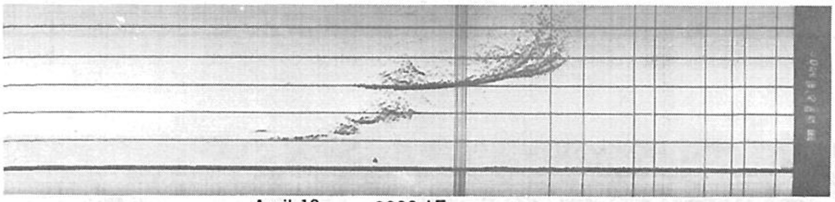


April 17 2300 LT

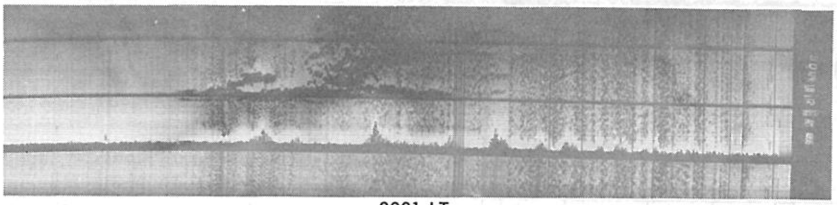


2301 LT

fo	QUA	DES	fbEs	foEs	QUA	DES	h'Es	QUA	DES	TYPE OF Es	foE	QUA	DES	h'E	QUA	DES	foE2	h'E2	foF1	F1 M3000	QUA	DES	foF2	F2 M3000	QUA	DES	fmI	fxI	QUA	DES	h'F	QUA	DES	h'F2	QUA	DES
009			023	027			120			$r^2\ell k$	150	U	$\bar{A}$	125	U	$\bar{A}$							044		U	F	042	057			330					

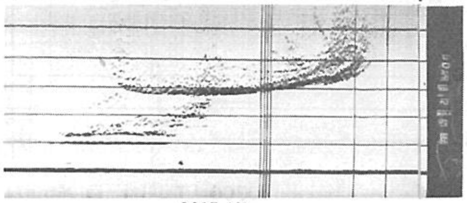


April 18 0000 LT



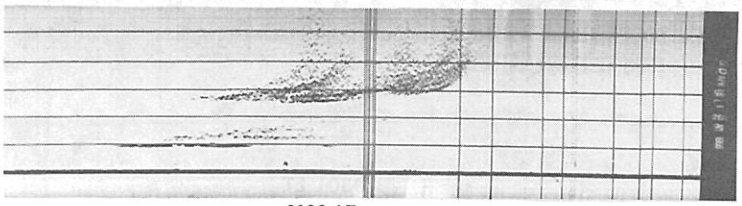
0001 LT

fo	QUA	DES	fbEs	foEs	QUA	DES	h'Es	QUA	DES	TYPE OF Es	foE	QUA	DES	h'E	QUA	DES	foE2	h'E2	foF1	F1 M3000	QUA	DES	foF2	F2 M3000	QUA	DES	fmI	fxI	QUA	DES	h'F	QUA	DES	h'F2	QUA	DES
010			018	021			160			hka			A	130									044		U	F	043	058			280					



0015 LT

fo	QUA	DES	fbEs	foEs	QUA	DES	h'Es	QUA	DES	TYPE OF Es	foE	QUA	DES	h'E	QUA	DES	foE2	h'E2	foF1	F1 M3000	QUA	DES	foF2	F2 M3000	QUA	DES	fmI	fxI	QUA	DES	h'F	QUA	DES	h'F2	QUA	DES
010			010	018			125			ℓka	130			230	E	A							044				044	054			270					



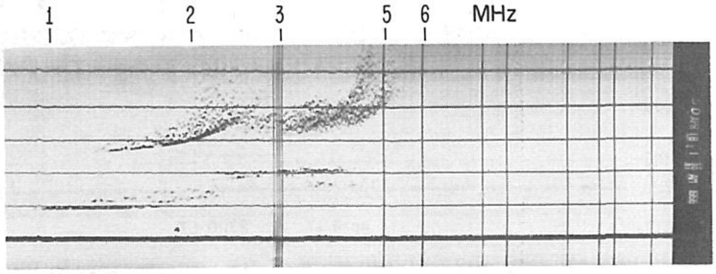
0100 LT

fo	QUA	DES	fbEs	foEs	QUA	DES	h'Es	QUA	DES	TYPE OF Es	foE	QUA	DES	h'E	QUA	DES	foE2	h'E2	foF1	F1 M3000	QUA	DES	foF2	F2 M3000	QUA	DES	fmI	fxI	QUA	DES	h'F	QUA	DES	h'F2	QUA	DES
008			010	017			096			ℓa			A			A							022		U	F	019	056			270					

Es Sequence

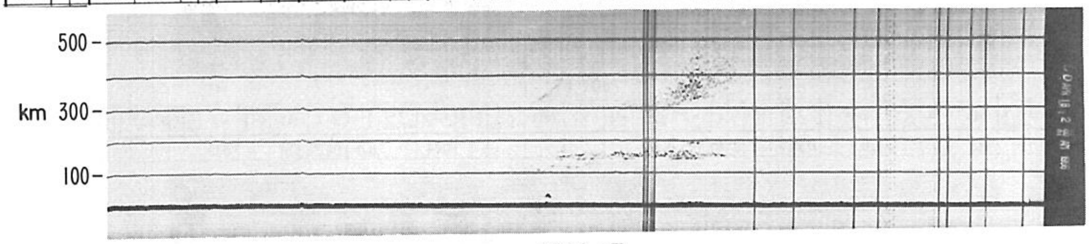
Fig. 8.1 (cont'd.)

BYRD STATION APRIL 1966 (120° WMT)

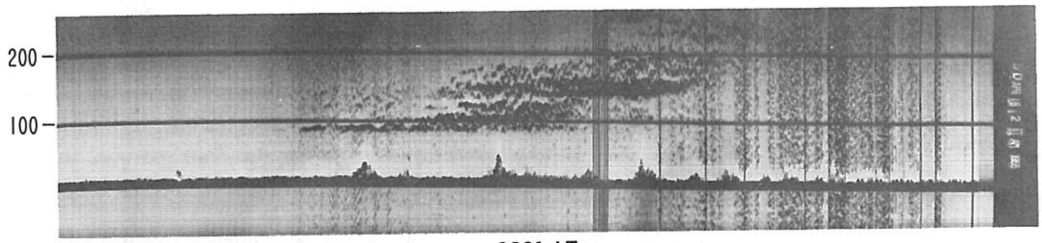


April 18 0130 LT

fo	QUA	DES	fbEs	foEs	QUA	DES	h'Es	QUA	DES	TYPE OF Es	foE	QUA	DES	h'E	QUA	DES	foE2	h'E2	foF1	F1 M3000	QUA	DES	foF2	F2 M3000	QUA	DES	fmI	fxI	QUA	DES	h'F	QUA	DES	h'F2	QUA	DES
009			012	016			097			ℓaa			A			A							045		U	F	019	054			320					

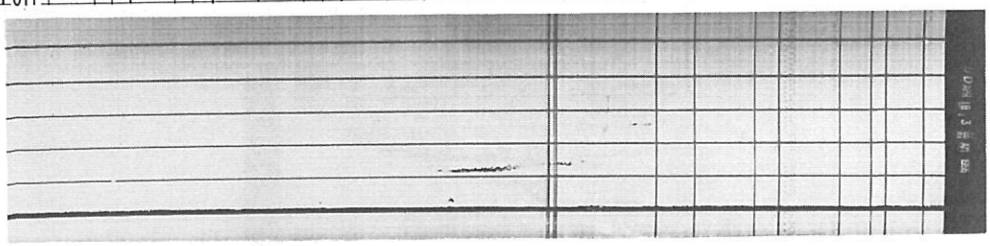


0200 LT

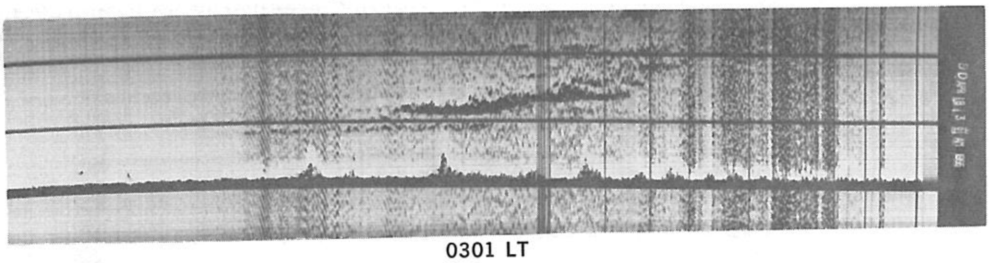


0201 LT

fo	QUA	DES	fbEs	foEs	QUA	DES	h'Es	QUA	DES	TYPE OF Es	foE	QUA	DES	h'E	QUA	DES	foE2	h'E2	foF1	F1 M3000	QUA	DES	foF2	F2 M3000	QUA	DES	fmI	fxI	QUA	DES	h'F	QUA	DES	h'F2	QUA	DES
017			EB 017	037	J	A	140			ad			B			B							021		U	R	021	052	0	B	320	E	B			



0300 LT



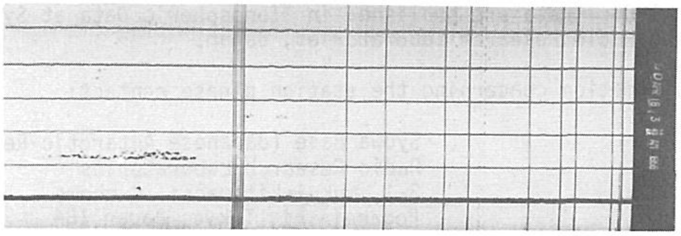
0301 LT

fo	QUA	DES	fbEs	foEs	QUA	DES	h'Es	QUA	DES	TYPE OF Es	foE	QUA	DES	h'E	QUA	DES	foE2	h'E2	foF1	F1 M3000	QUA	DES	foF2	F2 M3000	QUA	DES	fmI	fxI	QUA	DES	h'F	QUA	DES	h'F2	QUA	DES
018			EB 018	026			108						B			B										A				B			B			

Es Sequence

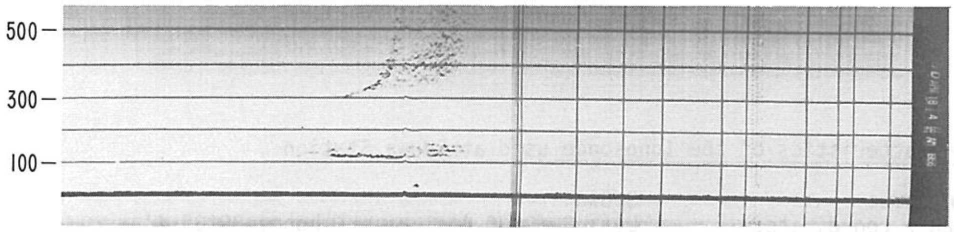
Fig. 8.1 (cont'd.)

BYRD STATION APRIL 1966 (120° WMT)

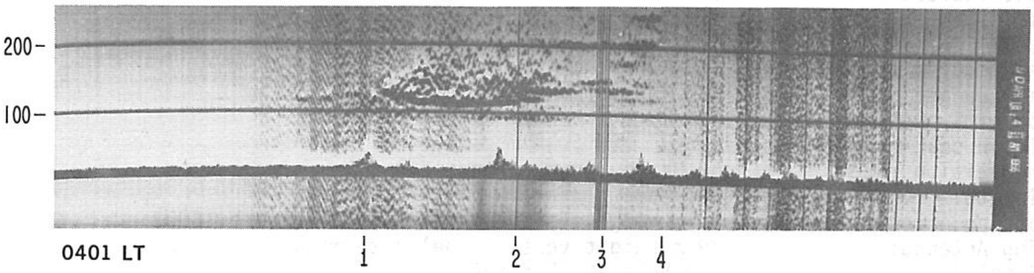


April 18 0345 LT

fo	QUA	DES	fbEs	foEs	QUA	DES	h'Es	QUA	DES	TYPE OF Es	foE	QUA	DES	h'E	QUA	DES	foE2	h'E2	foF1	F1 M3000	QUA	DES	foF2	F2 M3000	QUA	DES	fmI	fxI	QUA	DES	h'F	QUA	DES	h'F2	QUA	DES
014			016	019	J	A	115			ra													016								350	E	A			

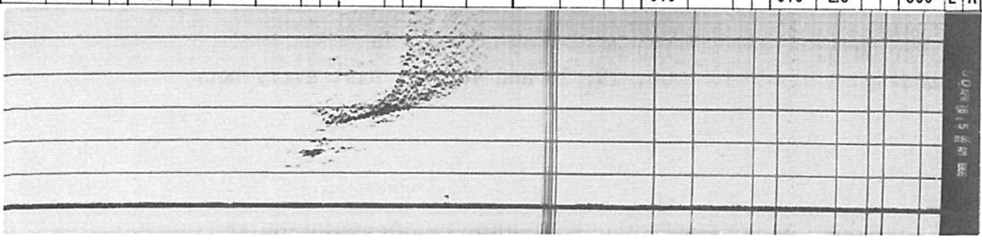


0400 LT

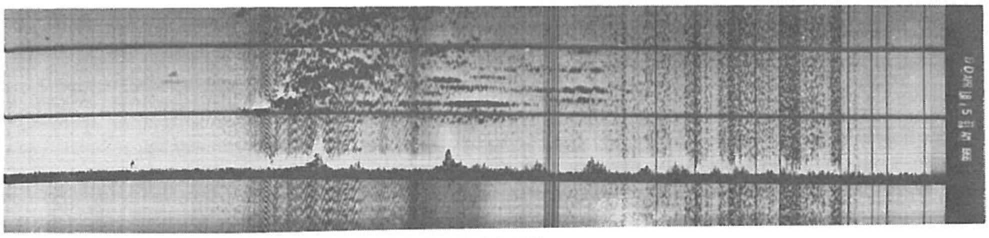


0401 LT

fo	QUA	DES	fbEs	foEs	QUA	DES	h'Es	QUA	DES	TYPE OF Es	foE	QUA	DES	h'E	QUA	DES	foE2	h'E2	foF1	F1 M3000	QUA	DES	foF2	F2 M3000	QUA	DES	fmI	fxI	QUA	DES	h'F	QUA	DES	h'F2	QUA	DES
012			014	015			120			ra													016				016	2.3			300	E	A			



0500 LT



0501 LT

fo	QUA	DES	fbEs	foEs	QUA	DES	h'Es	QUA	DES	TYPE OF Es	foE	QUA	DES	h'E	QUA	DES	foE2	h'E2	foF1	F1 M3000	QUA	DES	foF2	F2 M3000	QUA	DES	fmI	fxI	QUA	DES	h'F	QUA	DES	h'F2	QUA	DES
008			010	011						a													016			F	016	022			240	U	A			

Es Sequence

Fig. 8.1 (cont'd.)

SECTION 9. SYOWA BASE

Operation began at this station in February 1959. The station was closed between February 1961 and January 1966. Data are published in "Ionospheric Data at Syowa Station", a semiannual publication issued by the Radio Research Laboratories, Japan.

For information concerning the station please contact:

Syowa Base (Japanese Antarctic Research Expedition)
Radio Research Laboratories
2-1, Nukui-kitamachi 4-chome
Koganei-shi, Tokyo, Japan 184

Information concerning the station data is available from:

World Data Center C2 for Ionosphere
Radio Research Laboratories
2-1, Nukui-kitamachi 4-chome
Koganei-shi, Tokyo, Japan 184

Main Characteristics of the Ionosonde used at Syowa Station

Station name:	Syowa	
Geographic coordinates:	Lat. S 69°00.4'	E Long. 39°35.4'
Geomagnetic coordinates:	Lat. S 69.6°	E Long. 77.1°
Invariant latitude:	66.08°	
Magnetic dip:	65.26°S	
Time used:	45°E (UT + 3 hours)	
Ionosonde equipment type:	PIR-9	
Frequency Range:	500 kHz ∿ 15 MHz	
Duration of Sweep:	30 sec	
Approximate peak power:	10 kW	
Pulse repetition rate:	50 Hz (by power frequency)	
Pulse length:	100 μsec	
Transmitting Antenna	30 m height vertical delta terminated by 600Ω	
Receiving Antenna:	29 m height vertical delta terminated by 600Ω	
Power Supply:	100 Volt AC, 2.5 KVA	
Recording Method:	35 mm film running	
Height range:	900 km	
Height scale:	every 50 km	
Frequency scale:	every 1 MHz	
Total Receiver Gain:	120 dB	
Routine sounding:	00, 15, 30 and 45 min. past every hour	

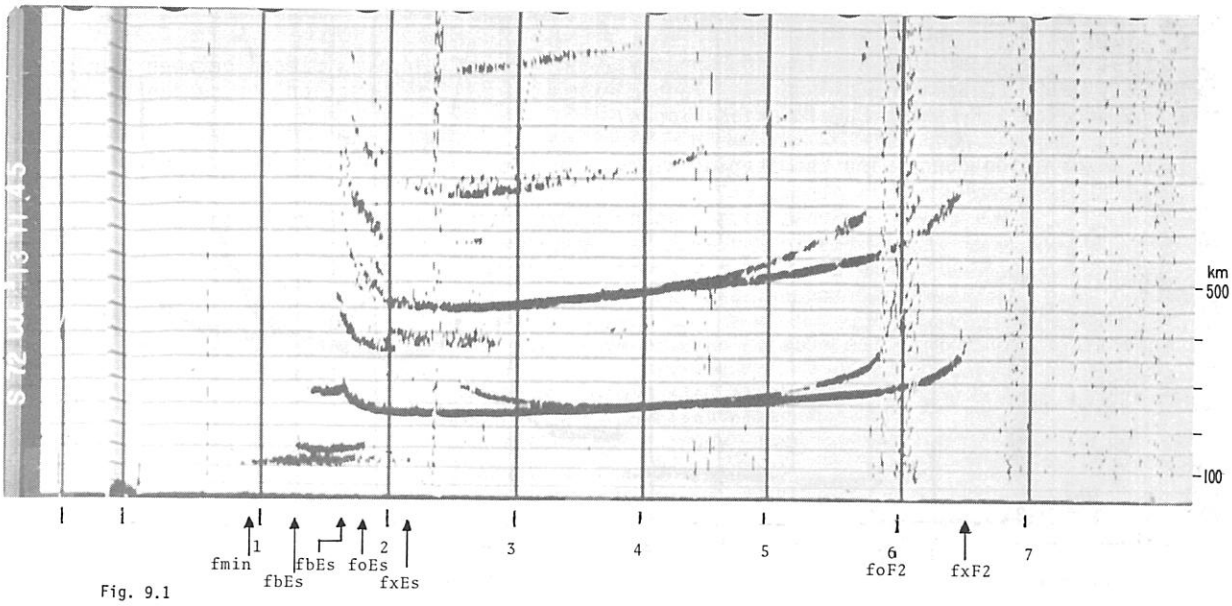


Fig. 9.1

1145 LT (45°E) Jul. 13, 1972 - SYOWA

fmin --- 009
foE --- A
foEs --- 018
fbEs --- 016E
foF2 --- 060

h'E --- A
h'Es --- 140
h'F --- 225
type of Es : h,ℓ

DAYTIME IONOGRAM IN WINTER - SYOWA STATION

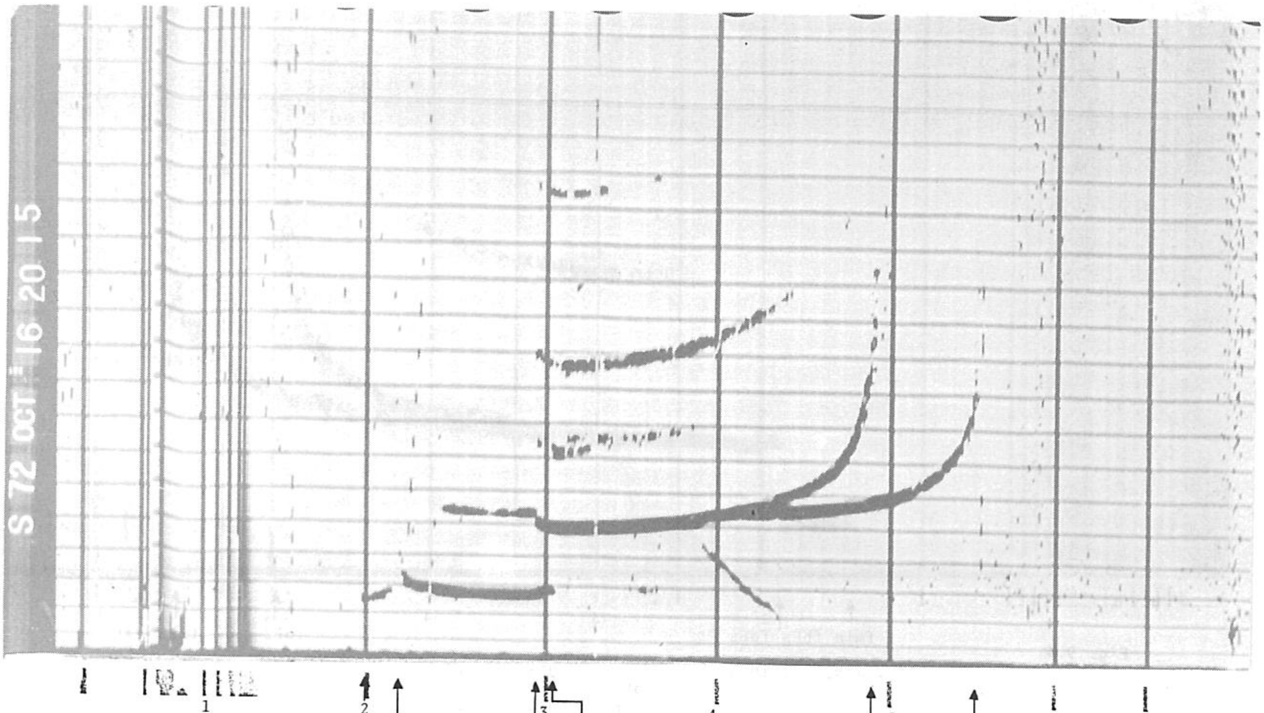


Fig. 9.2

2015, OCT, 16, 1972

fmin --- 020
foE --- 230
foEs --- 030
fbEs --- 029
foF2 --- 049

h'E --- 120EB
h'Es --- 130
h'F --- 240
type of Es : h

NIGHTTIME IONOGRAM IN WINTER - SYOWA STATION

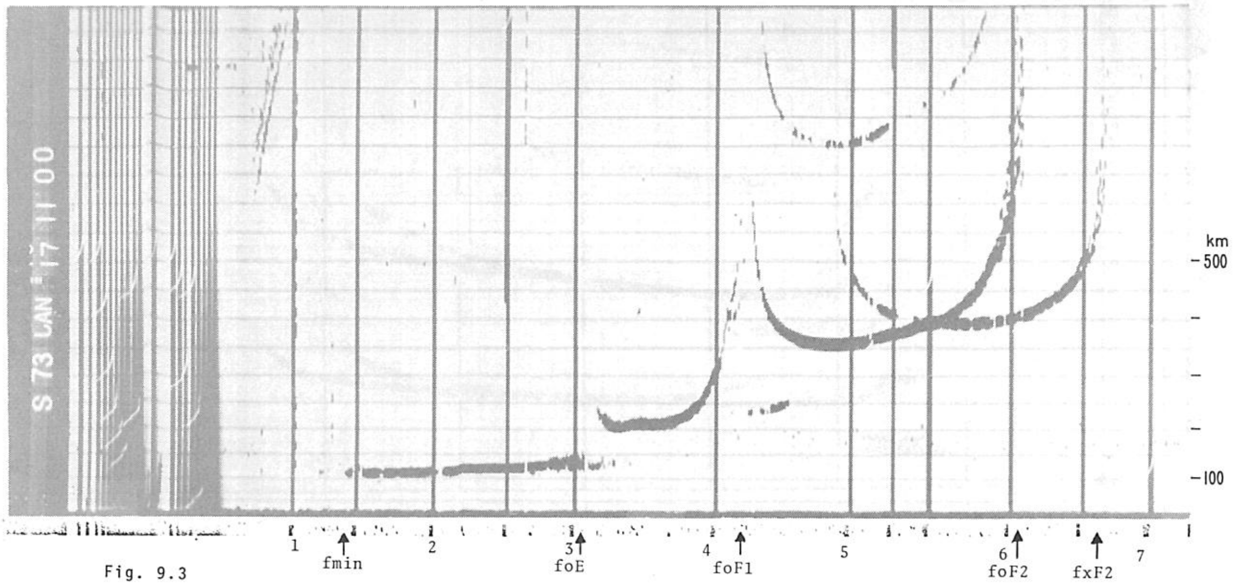


Fig. 9.3

1100, JAN. 17, 1973

fmin --- 014
foE --- 305
foEs --- G
fbEs --- G
foF1 --- 430
foF2 --- 061

h'E --- 100
h'Es --- G
h'F --- 200
h'F2 --- 350

DAYTIME IONOGRAM IN SUMMER - SYOWA STATION

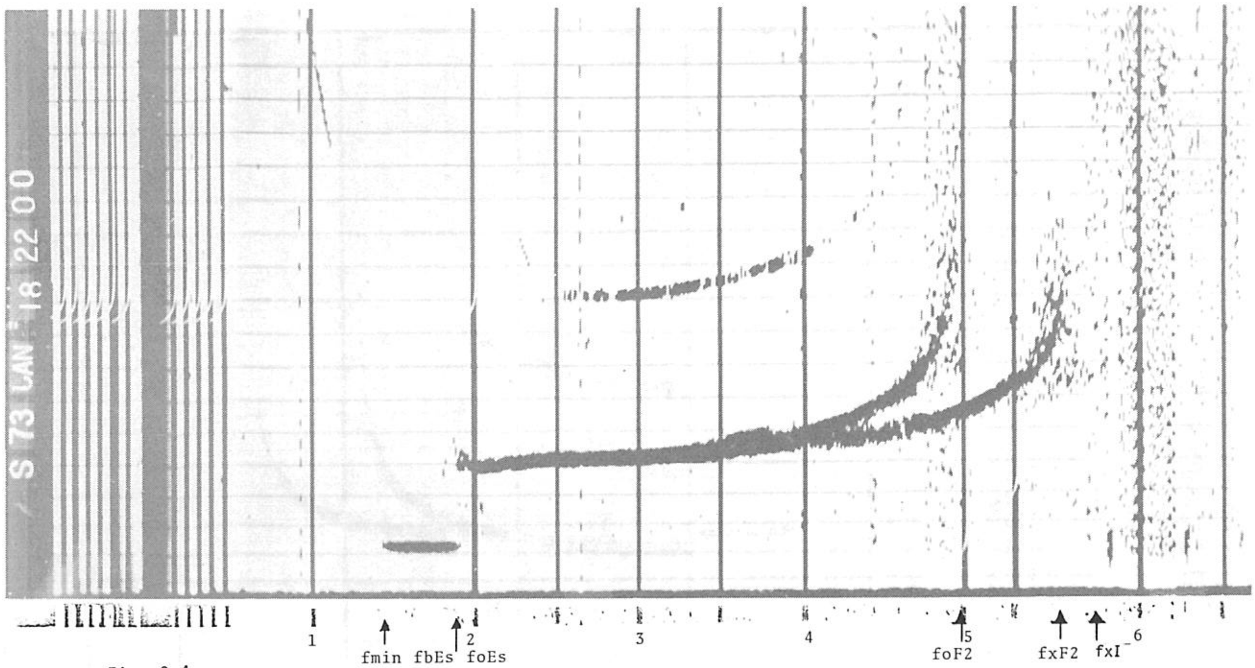


Fig. 9.4

2200, JAN. 18, 1973

fmin --- 015
foE --- A
foEs --- 019
fbEs --- 019
foF2 --- 050-F

h'E --- A
h'Es --- 100
h'F --- 240
type of Es : ℓ

NIGHTTIME IONOGRAM IN SUMMER - SYOWA STATION

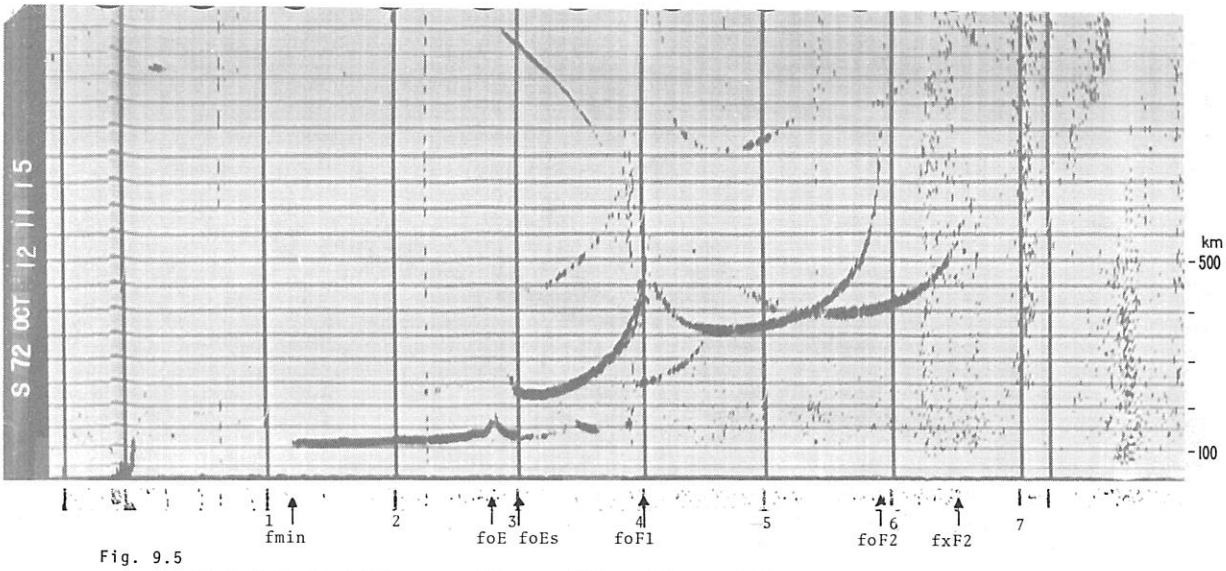


Fig. 9.5

1115, OCT, 12, 1972

fmin --- 013
foE --- 275
foEs --- 030
fbEs --- G
foF1 --- 400
foF2 --- 059

h'E --- 100
h'Es --- 125
h'F --- 215
h'F2 --- 350
type of Es : h

DAYTIME IONOGRAM IN SPRING - SYOWA STATION

Editor's Note: Concur with interpretation of Es type. This is very close to an Es cusp condition and on a less good ionogram would probably be called cusp. The layer is slightly tilted so for scientific purposes either h or c would have been acceptable. Note Es trace at top of cusp is a little higher than E trace, hence "h" type.

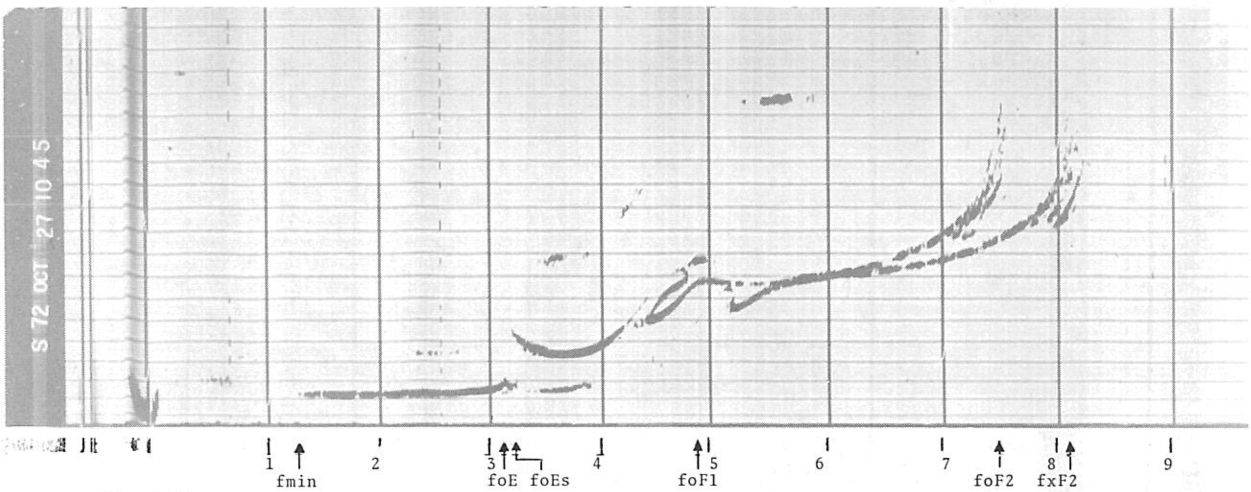


Fig. 9.6

1045, OCT, 27, 1972

fmin --- 013
foE --- 315
foEs --- 032
fbEs --- G
foF1 --- 490DL
foF2 --- 075-F

h'E --- 100
h'Es --- 125EG
h'F --- 205
h'F2 --- 380
type of Es : h

EXAMPLE OF REFLECTION FROM TILTED LAYER - SYOWA STATION

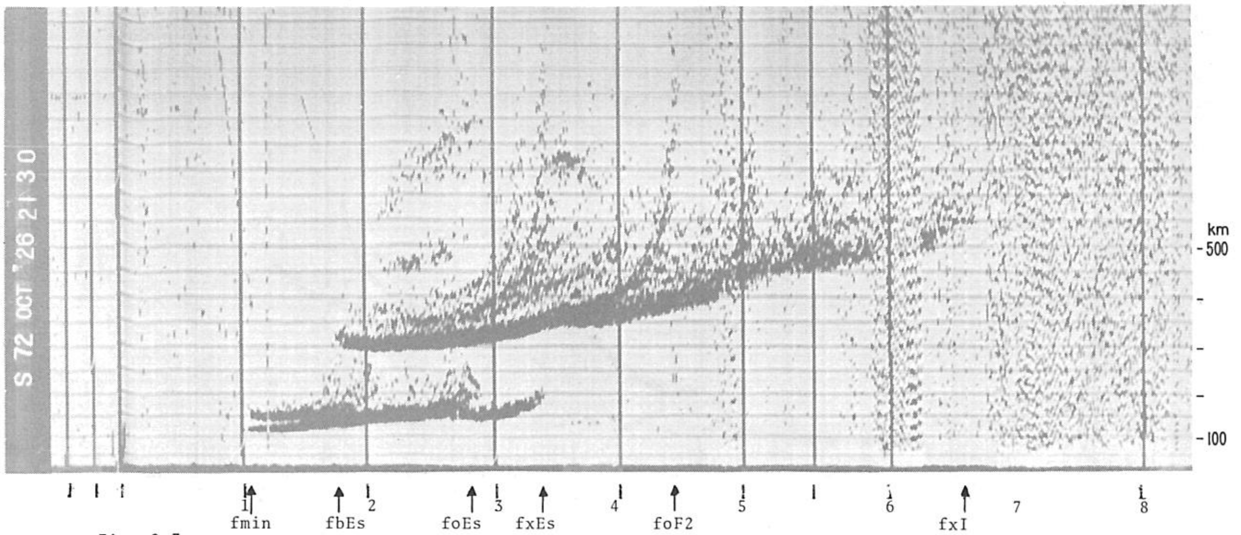


Fig. 9.7

2130, OCT. 26, 1972

fmin --- 011
foE --- A
foEs --- 027
fbEs --- 017
foF2 --- 045-F
fxI --- 066

h'E --- A
h'Es --- 115
h'F --- 295
type of Es : r

EXAMPLE OF FREQUENCY SPREAD - SYOWA STATION

<u>Editor's Note</u>: This is a border line case in which particle E is probably present at fbEs. Analysis as given is acceptable especially as Es trace is complex below fbEs. Difference in height h'Fx and h'F and retardation at fbEs taken together could give a doubtful particle E, fbEs = 017UK; foE = 170UK also acceptable.

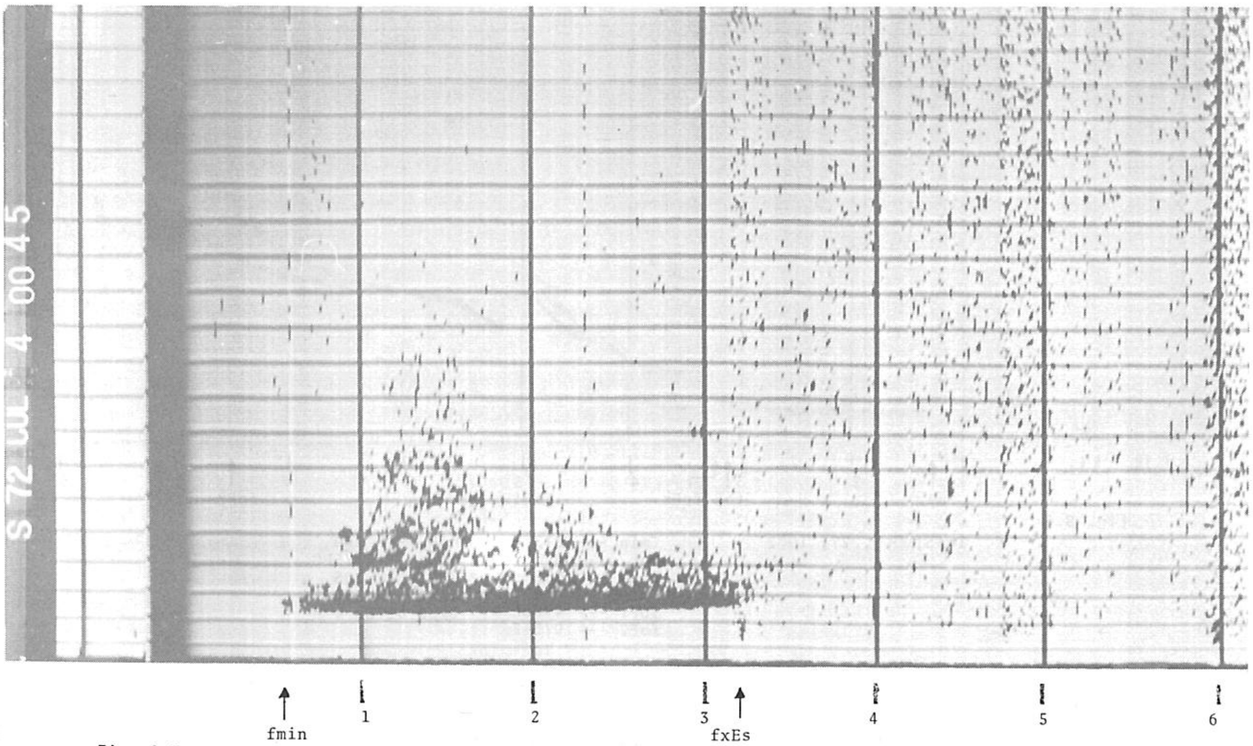


Fig. 9.8

0045, JUL. 4. 1972

fmin --- 006
foEs --- 027JA
fbEs --- 027AA

foF2 --- A
h'Es --- 120
h'F --- A

Es type a

EXAMPLE OF SPREAD Es - SYOWA STATION