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CRPL-F166 PART A

FOR OFFICIAL USE

PART A  
IONOSPHERIC DATA

ISSUED  
JUNE 1958

U. S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS  
CENTRAL RADIO PROPAGATION LABORATORY  
BOULDER, COLORADO



CRPL-F 166  
PART A

NATIONAL BUREAU OF STANDARDS  
CENTRAL RADIO PROPAGATION LABORATORY  
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Issued  
23 June 1958

## IONOSPHERIC DATA

### CONTENTS

	<u>Page</u>
Symbols, Terminology, Conventions . . . . .	ii
Predicted and Observed Sunspot Numbers. . . . .	v
World-Wide Sources of Ionospheric Data. . . . .	vi
Examples of Ionospheric Vertical Soundings Ft. Belvoir, Virginia; January 8, 1958. . . . .	ix
Tables of Ionospheric Data. . . . . . . . .	1
Graphs of Ionospheric Data. . . . . . . . .	13
Index of Tables and Graphs of Ionospheric Data in CRPL-F166 (Part A). . . . . . . . .	49

## SYMBOLS, TERMINOLOGY, CONVENTIONS

Beginning with data reported for January 1952, and continuing through December 1956, the symbols, terminology, and conventions for the determination of median values used in this report (CRPL-F series) conform as far as practicable to those adopted at the Sixth Meeting of the International Radio Consultative Committee (C.C.I.R.) in Geneva, 1951. Excerpts concerning symbols and terminology from Document No. 626-E of this Meeting are given on pages 2-7 of the report CRPL-F89, "Ionospheric Data," issued January 1952. Reprints of these pages are available upon request.

Beginning with data for January 1957, the symbols used are given in NBS Report 5033, "Summary of Changes in Ionospheric Vertical Soundings, Observing and Scaling Procedures - Effective 1 January 1957," which draws upon the First Report of the Special Committee on World-Wide Ionospheric Soundings (URSI/AGI), Brussels, Sept. 2, 1956. A list of these symbols is available upon request.

In the Second Report of the Special Committee on World-Wide Ionospheric Soundings of the URSI/AGI Committee, May 1957, a new descriptive letter was introduced:

M Measurement questionable because the ordinary and extraordinary components are not distinguishable.

There was an expansion in meaning of the following:

Z (1) (qualifying letter) Measurement deduced from the third magnetoionic component.  
(2) (descriptive letter) Third magnetoionic component present.

Beginning with data for January 1945, median values are published wherever possible. Where averages are reported, they are, at any hour, the average for all the days during the month for which numerical data exist.

The following conventions are used in determining the medians for hours when no measured values are given because of equipment limitations and ionospheric irregularities. Symbols used are those given above.

a. For all ionospheric characteristics:

Values missing because of A, C, F, H, L, N or R are omitted from the median count.

b. For critical frequencies and virtual heights:

Values of foF2 (and foE near sunrise and sunset) missing because of E are counted as equal to or less than the lower limit of the recorder. Values of h'F (and h'E near sunrise and sunset) missing for this reason are counted usually as equal to or greater than the median. Other characteristics missing because of E are omitted from the median count.

Values missing because of G are counted:

1. For foF2, as equal to or less than foF1.
2. For h'F2, as equal to or greater than the median.

The symbol W is included in the median count only when it replaces a height characteristic; the descriptive symbol D, only when it replaces a frequency characteristic.

Values missing for any other reason are omitted from the median count.

c. For MUF factor (M-factors):

Values missing because of G or W are counted as equal to or less than the median.

Values missing for any other reason are omitted from the median count.

d. For sporadic E (Es):

Values of fEs missing because of E or G are counted as equal to or less than the median foE, or equal to or less than the lower frequency limit of the recorder.

B for fEs is counted on the low side when there is a numerical value of a higher layer critical frequency; otherwise it is omitted from the median count.

S for fEs is counted on the low side at night; during the day it is omitted from the median count (beginning with data for November 1957).

Values of fEs missing for any other reason, and values of h'Es missing for any reason at all are omitted from the median count.

Beginning with data for November 1945, doubtful monthly median values for ionospheric observations at Washington, D.C., are indicated by parentheses, in accordance with the practice already in use for doubtful hourly values. The following are the conventions used to determine whether or not a median value is doubtful:

1. If the count is four or less, the data are considered insufficient and no median value is computed.
2. For the F2 layer, h'F or foEs, if the count is from five to nine, the median is considered doubtful. The E and F1 layers are so regular in their characteristics that, as long as the count is at least five, the median is not considered doubtful. A count of at least 5 is considered sufficient for an h'Es median.
3. For all layers, if more than half of the data used to compute the medians are doubtful (either doubtful or interpolated), the median is considered doubtful.

The same conventions are used by the CRPL in computing the medians from tabulations of daily and hourly data for stations other than Washington, beginning with the tables in IRPL-F18.

Ordinarily, a blank space in the fEs or foEs column of a table is the result of the fact that a majority of the readings for the month are below the lower limit of the recorder or less than the corresponding values of foE. Blank spaces at the beginning and end of columns of h'F2 or h'F1, foF1, h'E, and foE are usually the result of diurnal variation in these characteristics. Complete absence of medians of h'F1 and foF1 is usually the result of seasonal effects.

The dashed-line prediction curves of the graphs of ionospheric data are obtained from the predicted zero-muf contour charts of the CRPL-D series publications. The following points are worthy of note:

- a. Predictions for individual stations used to construct the charts may be more accurate than the values read from the charts since some smoothing of the contours is necessary to allow for the longitude effect within a zone. Thus, inasmuch as the predicted contours are for the center of each zone, part of the discrepancy between the predicted and observed values as given in the F series may be caused by the fact that the station is not centrally located within the zone.
- b. The final presentation of the predictions is dependent upon the latest available ionospheric and radio propagation data, as well as upon predicted sunspot number.
- c. There is no indication on the graphs of the relative reliability of the data; it is necessary to consult the tables for such information.
- d. The tables may contain median values of either foEs or fEs. The graph of median Es corresponds to the table. Percentage curves of fEs are estimated from values of foEs when necessary.

## PREDICTED AND OBSERVED SUNSPOT NUMBERS

The following predicted smoothed 12-month running-average Zürich sunspot numbers were used in constructing the contour charts:

Month	Predicted Sunspot Number										
	1958	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948
December	150*	150	42	11	15	33	53	86	108	114	
November	150*	150*	147	35	10	16	38	52	87	112	115
October	150*	150*	135	31	10	17	43	52	90	114	116
September	150*	150*	119	30	8	18	46	54	91	115	117
August	150*	150*	105	27	8	18	49	57	96	111	123
July	150*	150*	95	22	8	20	51	60	101	108	125
June	150*	150*	89	18	9	21	52	63	103	108	129
May	150*	150*	77	16	10	22	52	68	102	108	130
April	150*	150*	68	13	10	24	52	74	101	109	133
March	150*	150*	60	14	11	27	52	78	103	111	133
February	150*	150*	53	14	12	29	51	82	103	113	133
January	150*	150*	48	12	14	30	53	85	105	112	130

\*This number is believed representative of solar activity at a maximum portion of the current sunspot cycle.

The latest available information follows concerning the corresponding observed Zürich numbers beginning with the minimum of April 1954. Final numbers are listed through June 1957.

### Observed Sunspot Number

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1954				3	4	4	5	7	8	8	9	12
1955	14	16	19	23	29	35	40	46	55	64	73	81
1956	89	98	109	119	127	137	146	150	151	156	160	164
1957	170	172	174	181	186	188	191	194	196	198	200	

## WORLD - WIDE SOURCES OF IONOSPHERIC DATA

The ionospheric data given here in tables 1 to 72 and figures 1 to 144 were assembled by the Central Radio Propagation Laboratory for analysis and correlation, incidental to CRPL prediction of radio propagation conditions. The data are median values unless otherwise indicated. The following are the sources of the data in this issue:

**Commonwealth of Australia, Ionospheric Prediction Service of the Commonwealth Observatory:**

Brisbane, Australia  
Canberra, Australia  
Hobart, Tasmania  
Townsville, Australia

**Commonwealth of Australia, Department of the Interior:**  
Macquarie I.

**Australian Department of Supply and Shipping, Bureau of Mineral Resources, Geology and Geophysics:**  
Watheroo, Western Australia

**Meteorological Service of the Belgian Congo and Ruanda-Urundi:**  
Bunia, Belgian Congo  
Leopoldville, Belgian Congo

**Belgian Royal Meteorological Institute:**  
Dourbes, Belgium

**Escola Politecnica, University of São Paulo:**  
Sao Paulo, Brazil

**British Department of Scientific and Industrial Research, Radio Research Board:**  
Falkland Is.  
Inverness, Scotland  
Slough, England

**Defence Research Board, Canada:**  
Baker Lake, Canada  
Churchill, Canada  
Meanook, Canada  
Ottawa, Canada  
Resolute Bay, Canada  
Winnipeg, Canada

**Danish National Committee of URSI:**  
Narsarssuak, Greenland

General Direction of Posts and Telegraphs, Helsinki, Finland:  
Nurmijarvi, Finland

The Royal Netherlands Meteorological Institute:  
De Bilt, Holland  
Paramaribo, Surinam

Central Institute of Meteorology, Budapest, Hungary:  
Budapest, Hungary

National Institute of Geophysics, City University, Rome, Italy:  
Rome, Italy

Ministry of Postal Services, Radio Research Laboratories,  
Tokyo, Japan:  
Akita, Japan  
Tokyo (Kokubunji), Japan  
Wakkanai, Japan  
Yamagawa, Japan

Christchurch Geophysical Observatory, New Zealand Department  
of Scientific and Industrial Research:  
Campbell I.  
Christchurch, New Zealand  
Scott Base

Norwegian Defence Research Establishment, Kjeller per Lillestrom,  
Norway:  
Tromso, Norway

Telecommunication Administration, Oslo, Norway:  
Svalbard, Norway

Manila Observatory:  
Baguio, P. I.

South African Council for Scientific and Industrial Research:  
Capetown, Union of South Africa  
Johannesburg, Union of South Africa

Ebro Observatory:  
Tortosa, Spain

Research Institute of National Defence, Stockholm, Sweden:  
Kiruna, Sweden  
Lycksele, Sweden

Post, Telephone and Telegraph Administration, Berne, Switzerland:  
Schwarzenburg, Switzerland

United States Army Signal Corps:  
Adak, Alaska  
St. John's, Newfoundland

National Bureau of Standards (Central Radio Propagation Laboratory):

Chimbote, Peru  
Maui, Hawaii  
Panama Canal Zone  
Talara, Peru (Instituto Geofisico de Huancayo)  
Washington, D. C.

EXAMPLES OF IONOSPHERIC VERTICAL SOUNDINGS  
 Belvoir, Virginia; January 8, 1958  
 (Geomagnetic Latitude  $50^{\circ}$ N)

The following ionograms were obtained at the Belvoir, Virginia sounding station. They are typical of the day and night conditions for January at this geomagnetic latitude. Ionospheric data are scaled directly from these records onto the daily f-plot, a graph of frequency characteristics vs. time. The f-plot for the day represented by these soundings is found on the following page. Medians as found in the Tables of Ionospheric Data are calculated using hourly values taken from the f-plot or directly from the ionogram.

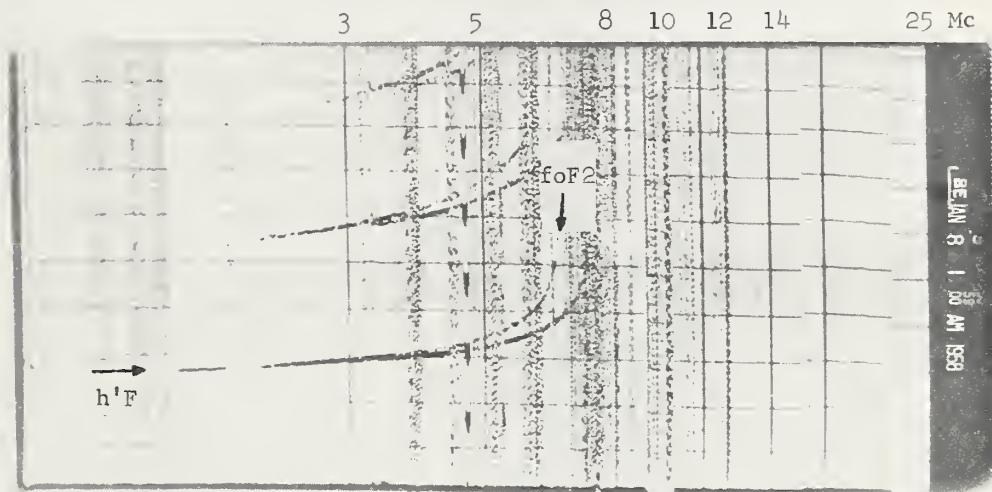


Fig. A. Belvoir, Virginia, January 8, 1958, 0100 hours,  $25^{\circ}$ W time.

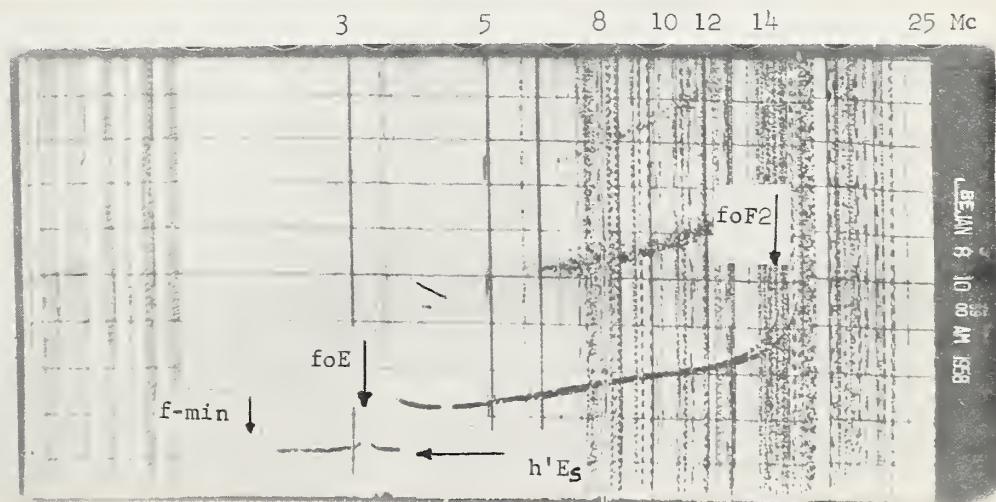


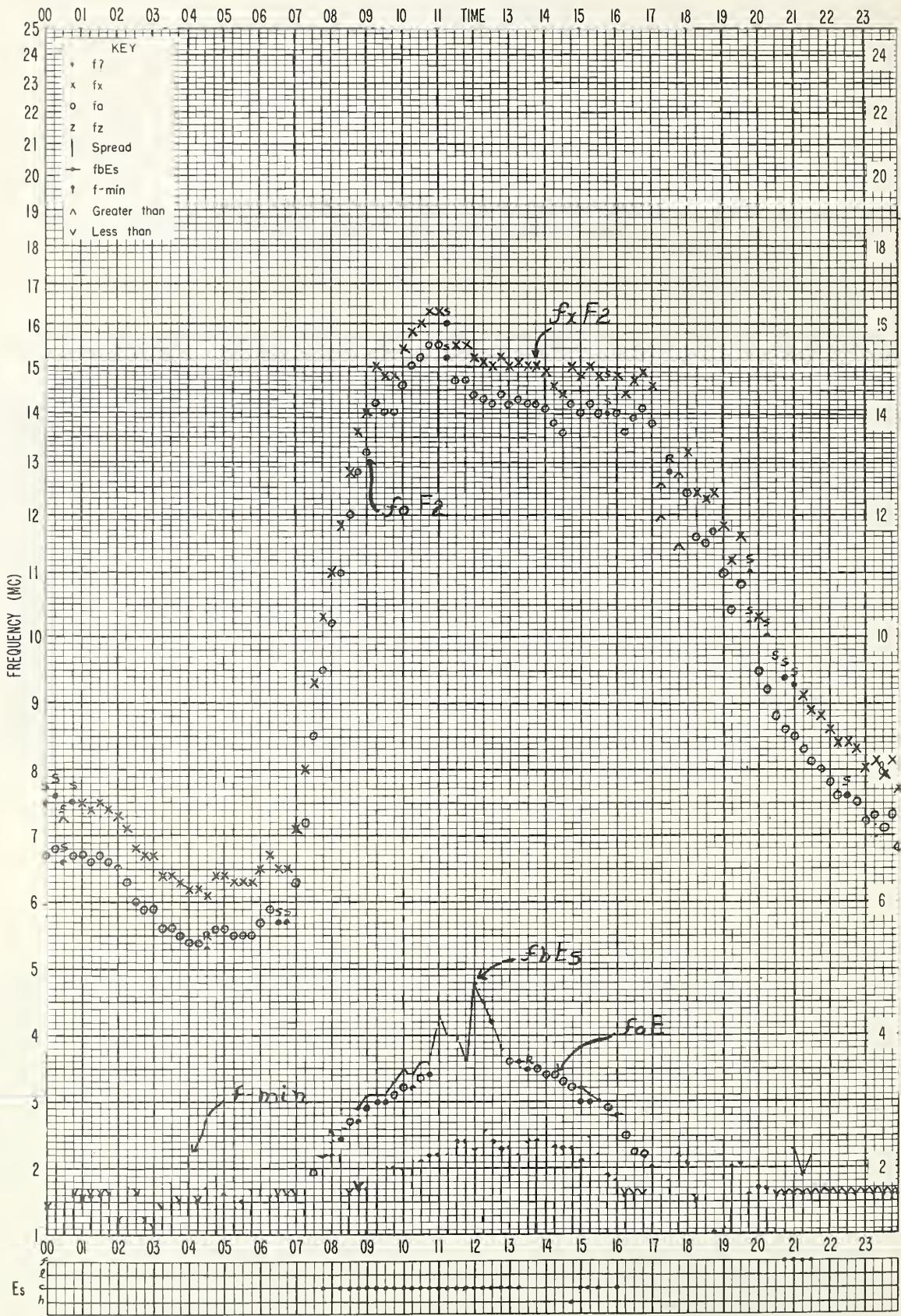
Fig. B. Belvoir, Virginia, January 8, 1958, 1000 hours,  $75^{\circ}$ W time.

Ft. Belvoir, Virginia

STATION IONBE

## f - PLOT OF IONOSPHERIC DATA

DATE JANUARY 8, 1958



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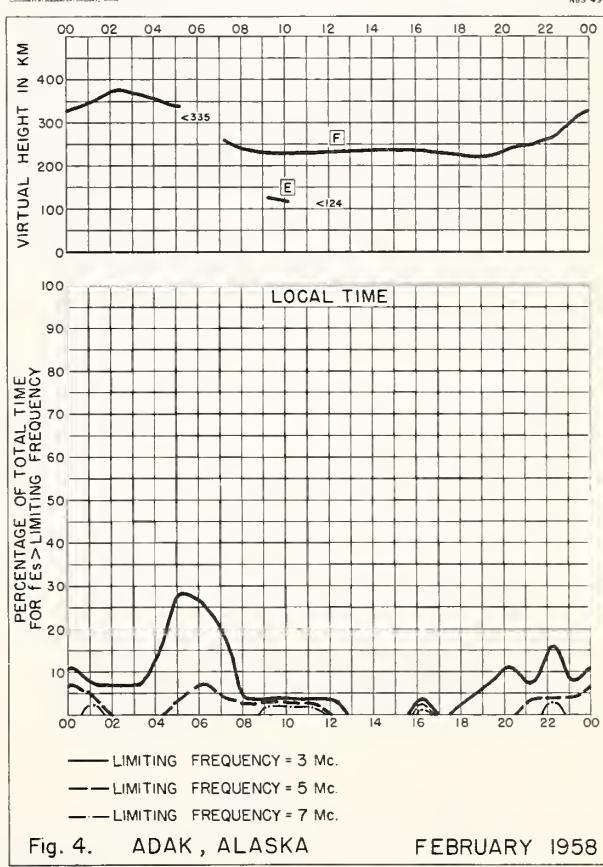
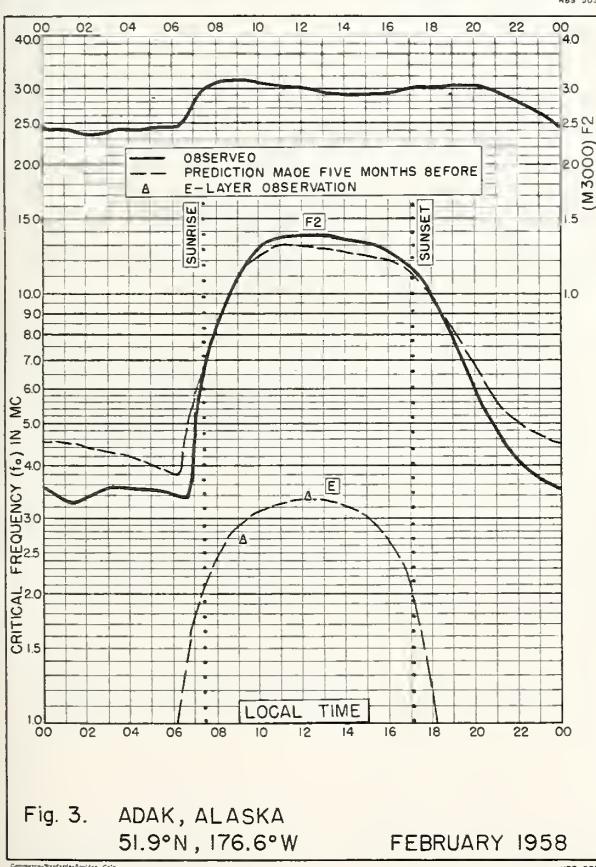
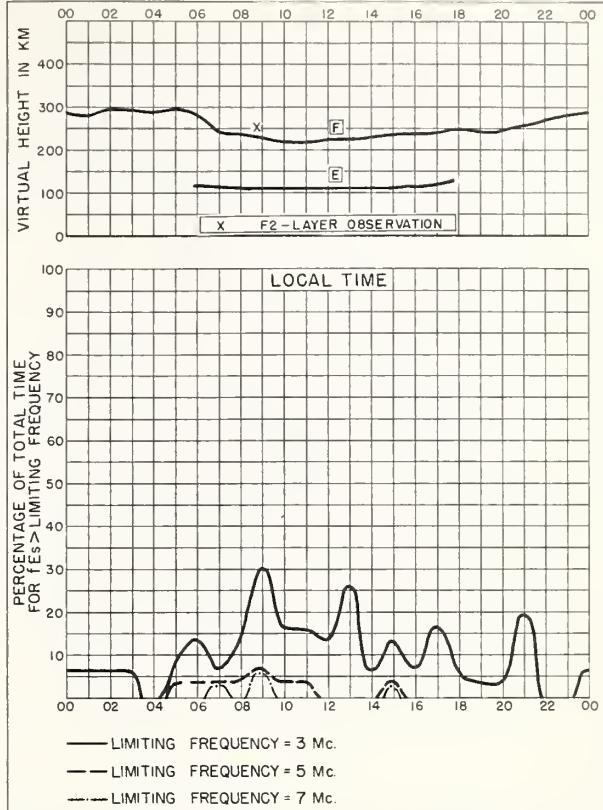
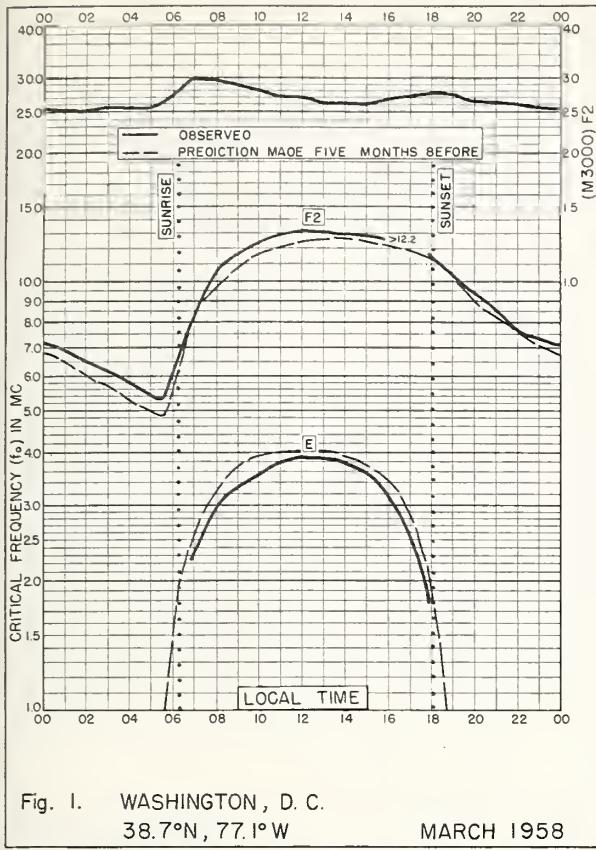












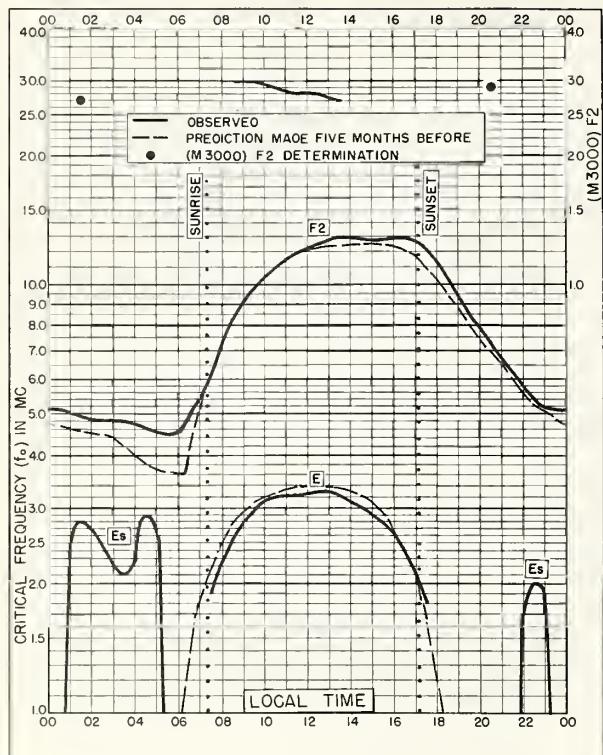


Fig. 5. WINNIPEG, CANADA  
49.9°N, 97.4°W FEBRUARY 1958

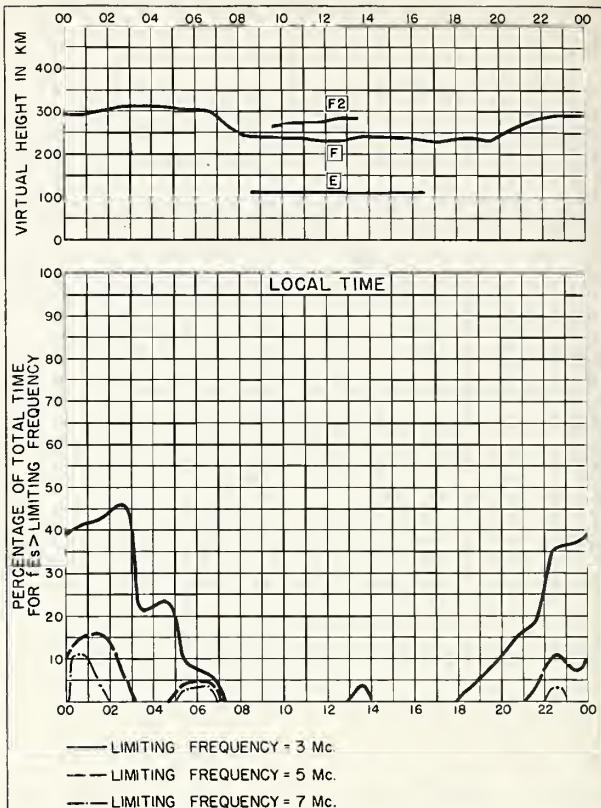


Fig. 6. WINNIPEG, CANADA FEBRUARY 1958

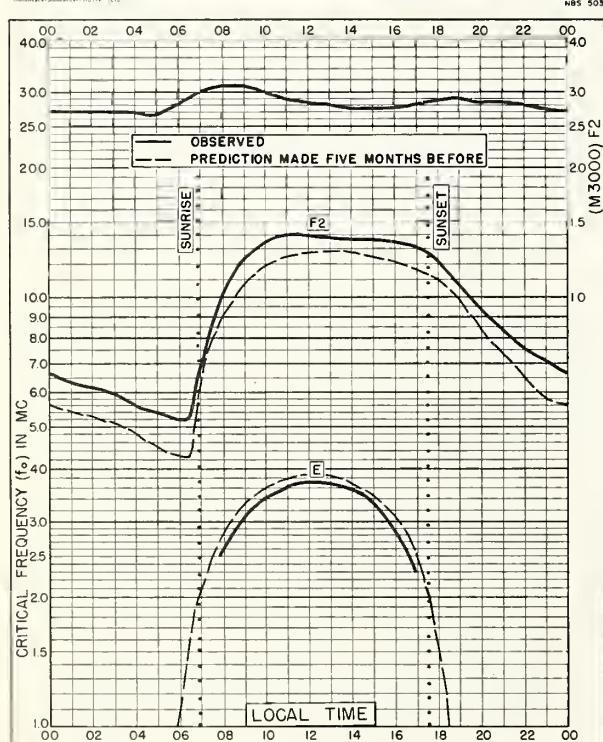


Fig. 7. WASHINGTON, D. C.  
38.7°N, 77.1°W FEBRUARY 1958

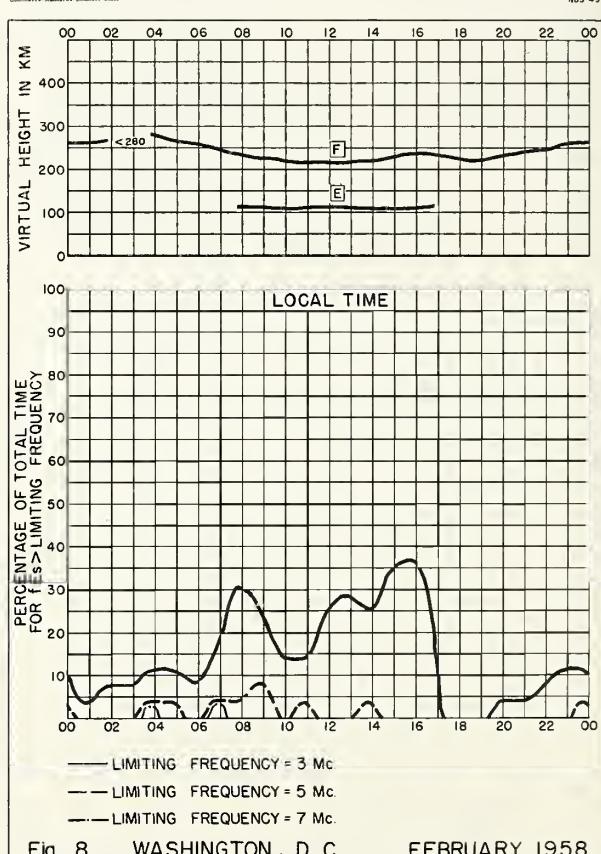
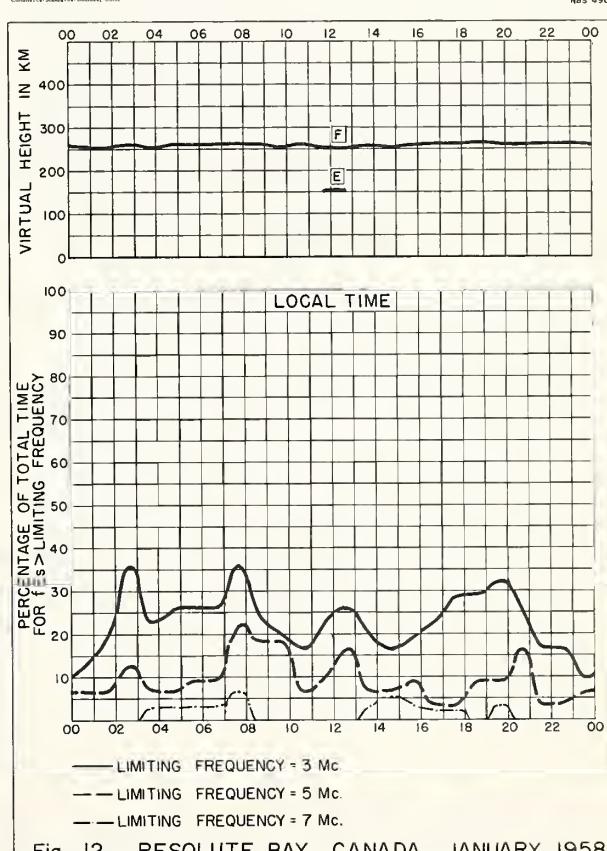
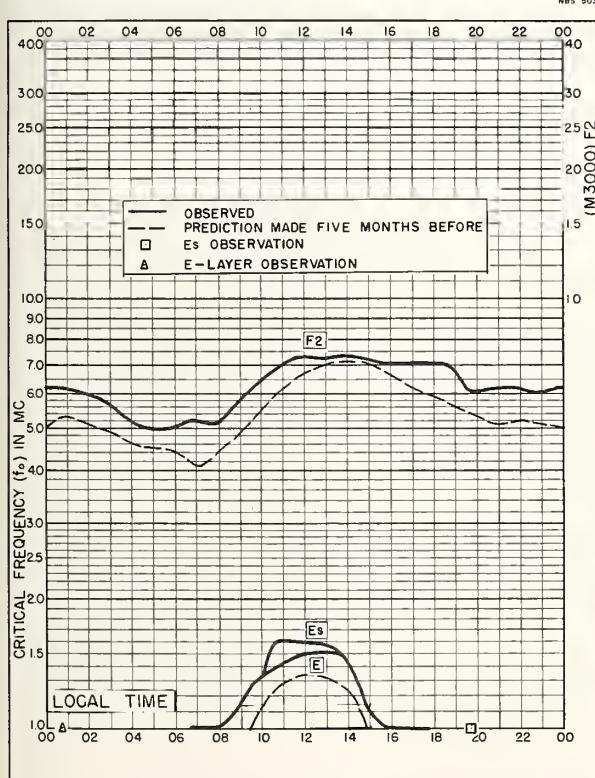
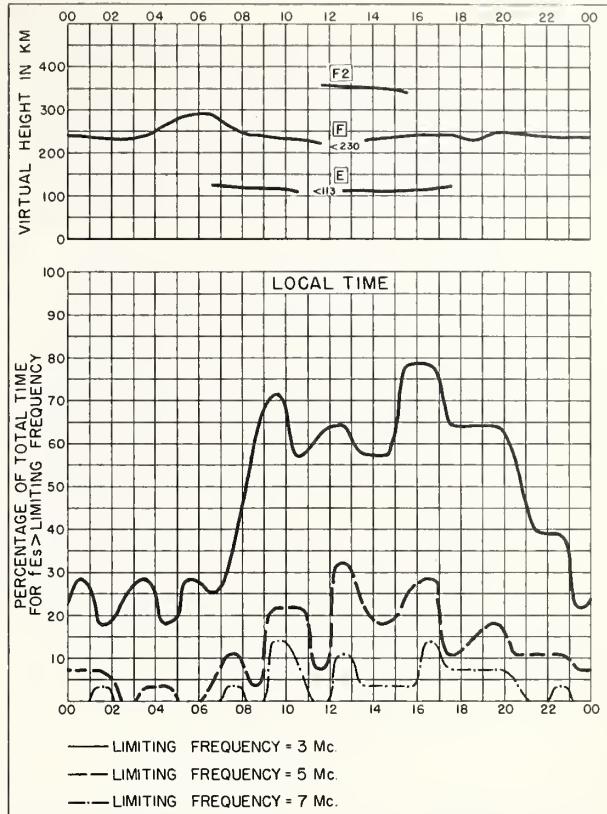
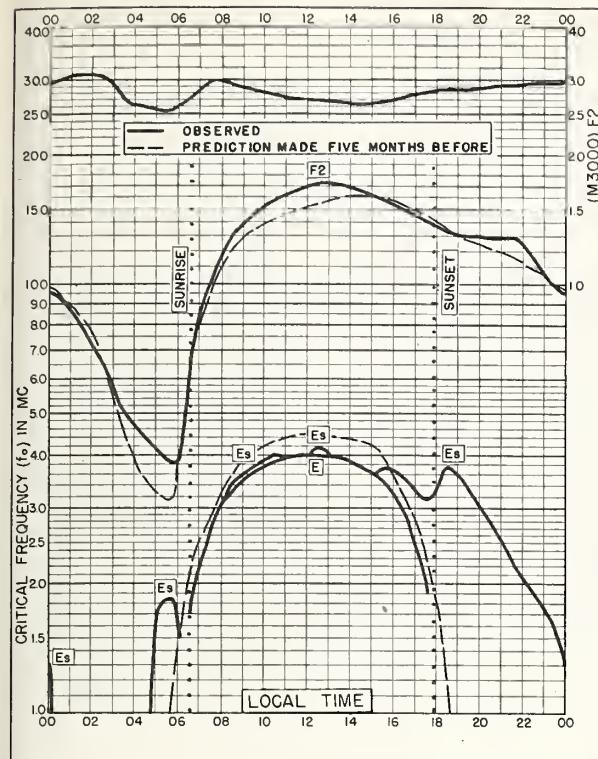
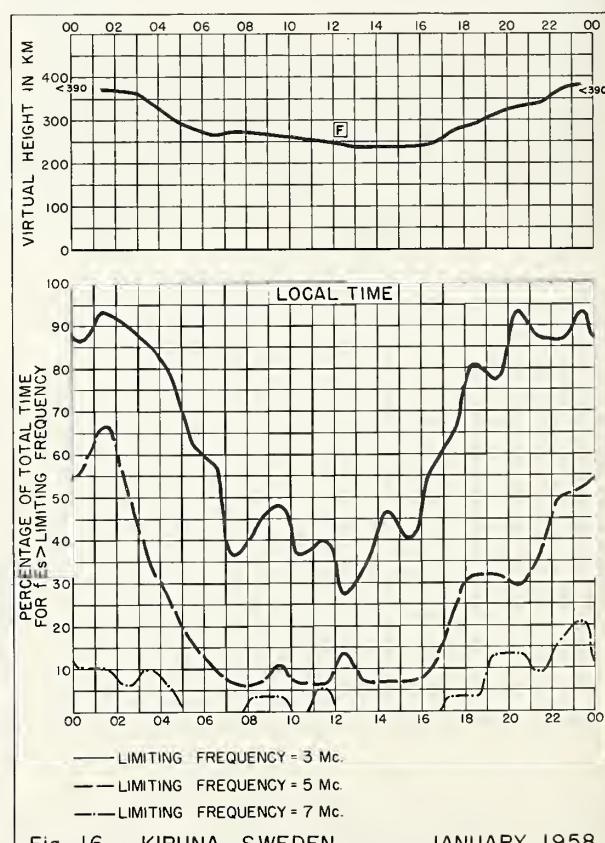
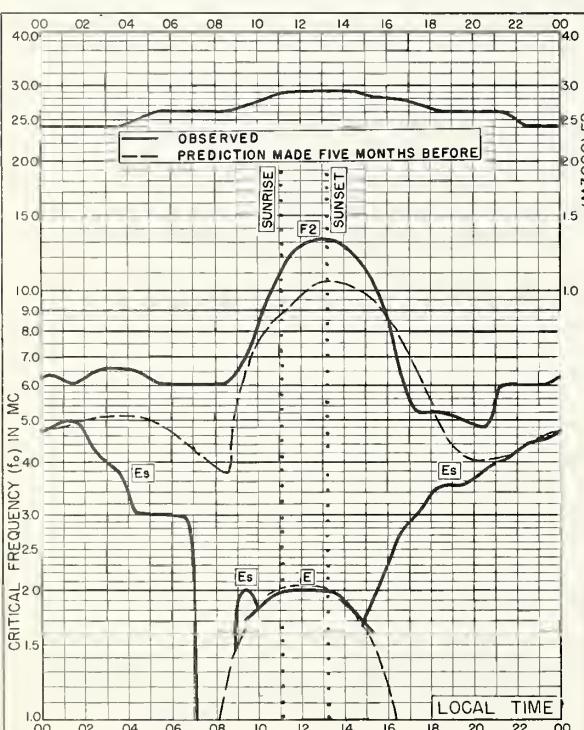
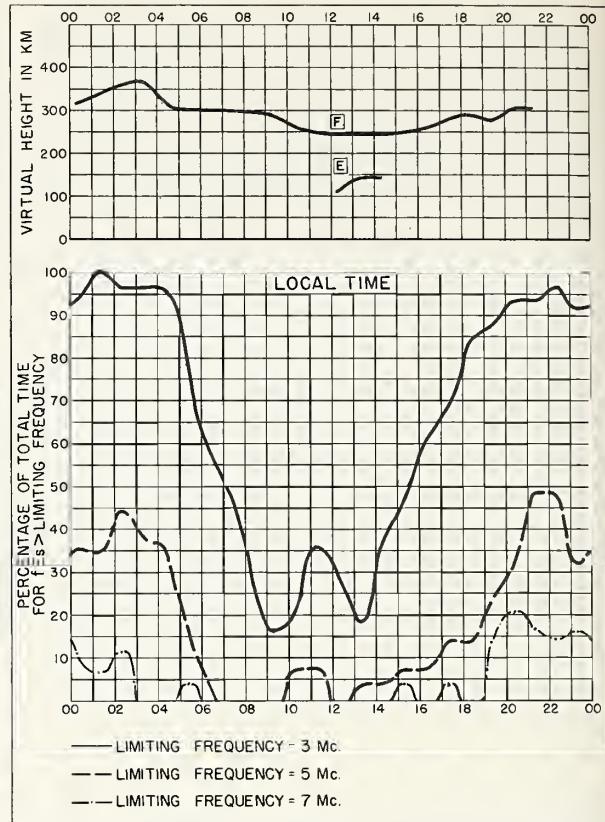
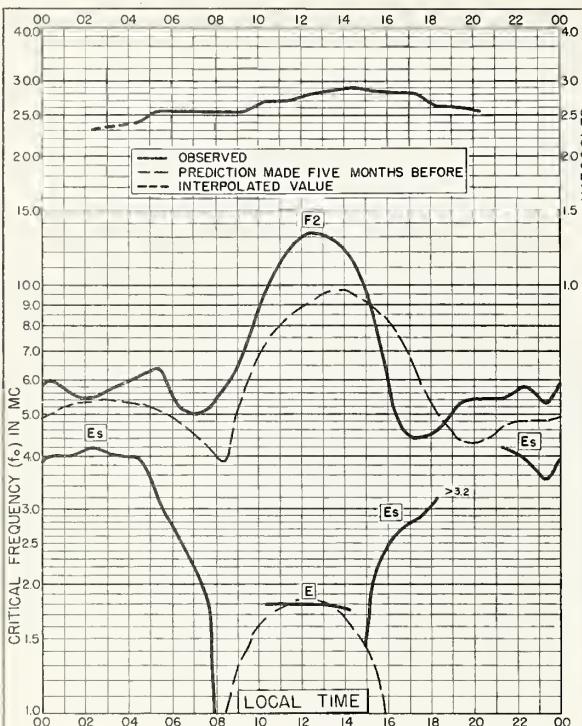
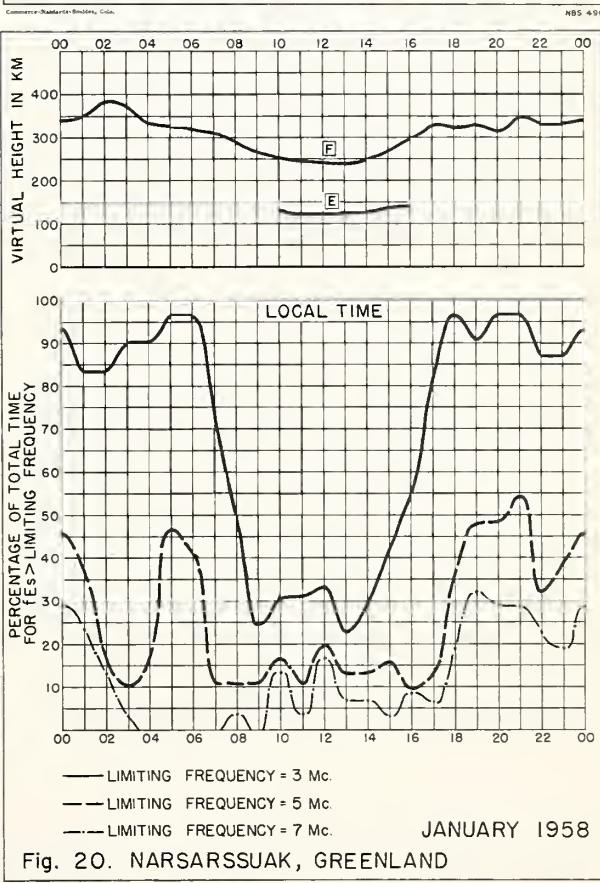
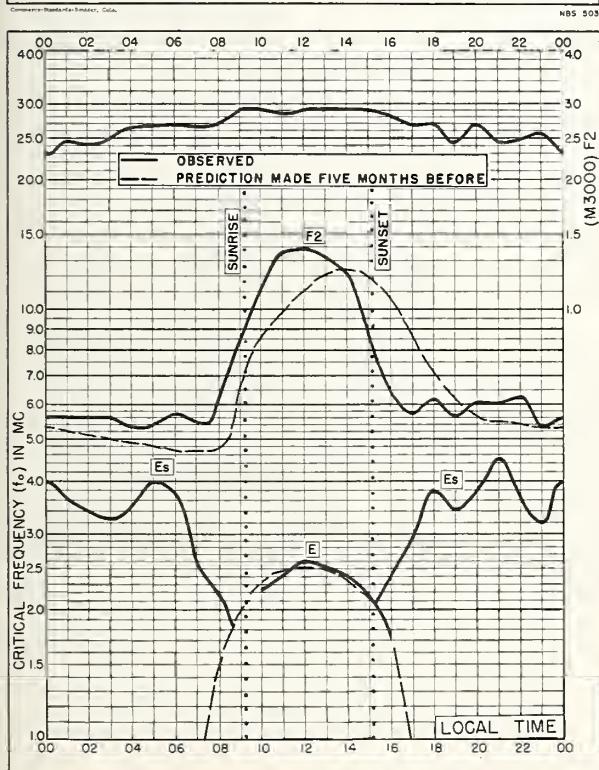
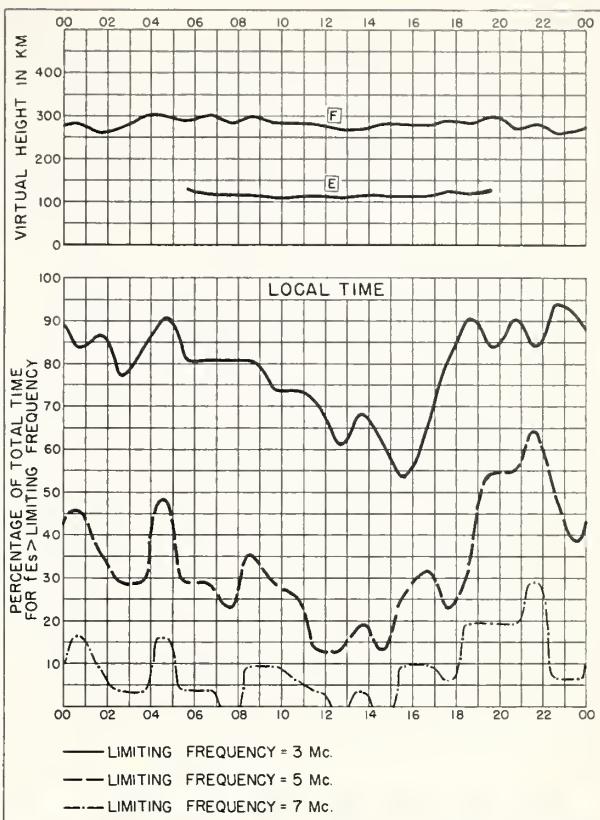
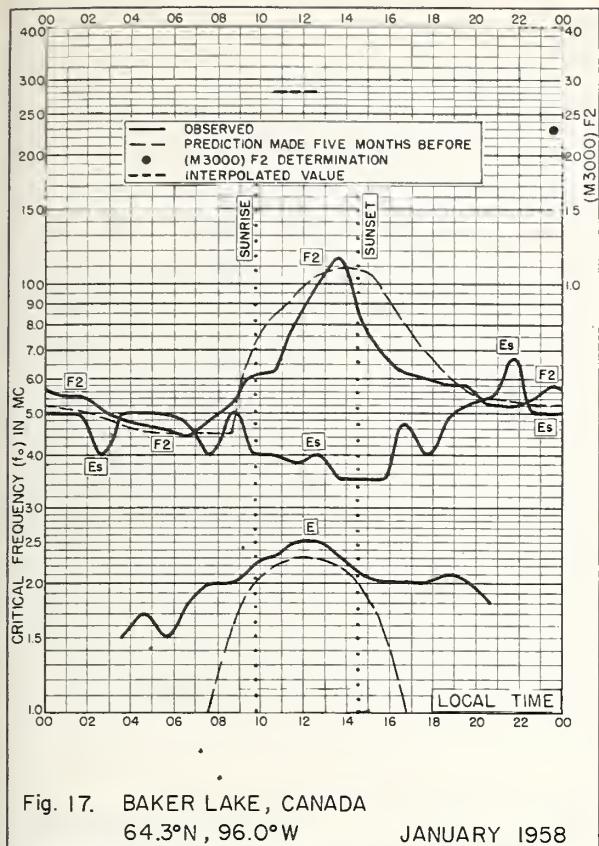
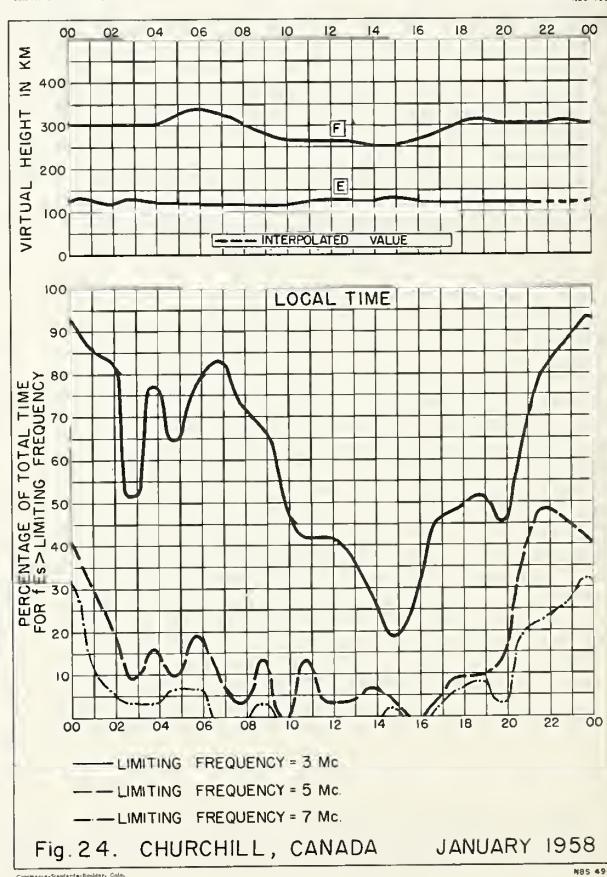
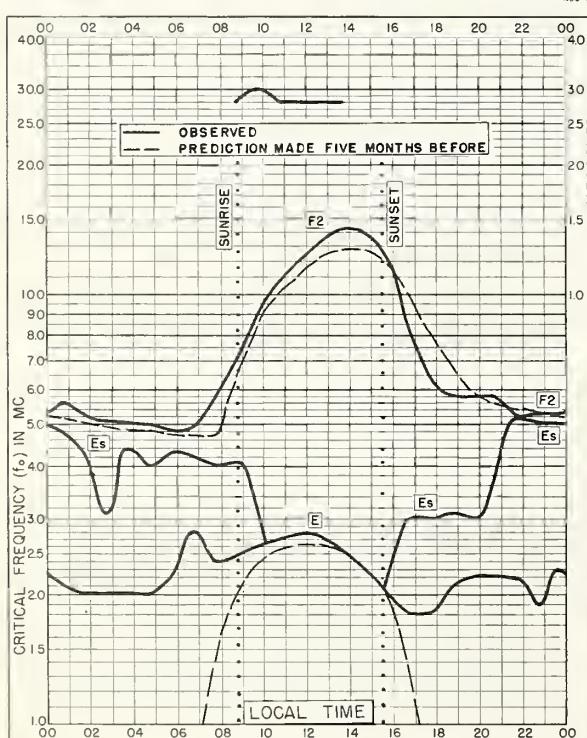
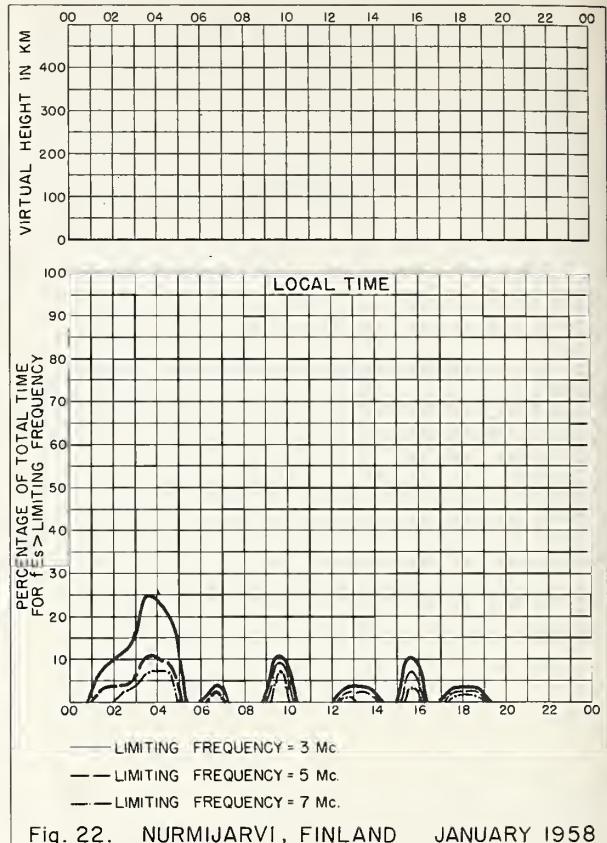
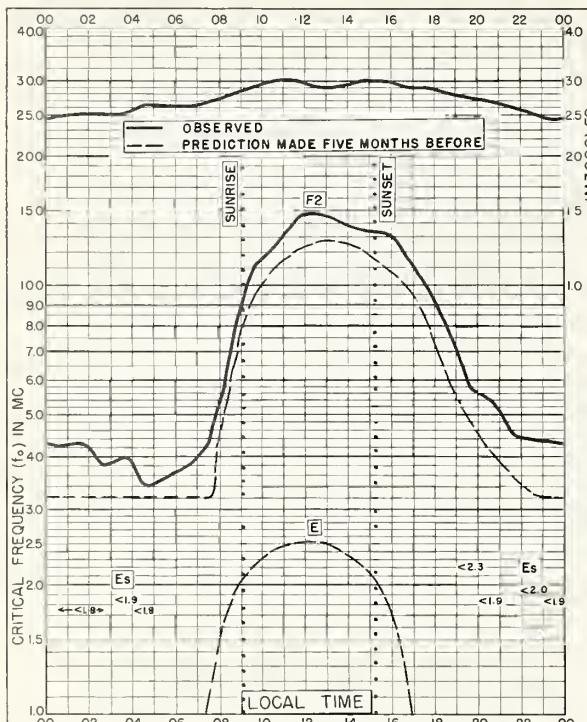


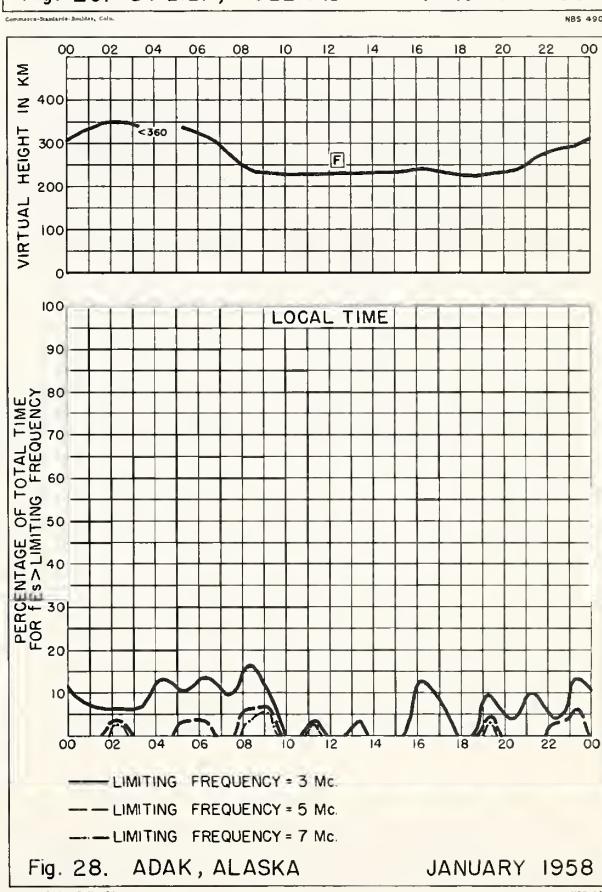
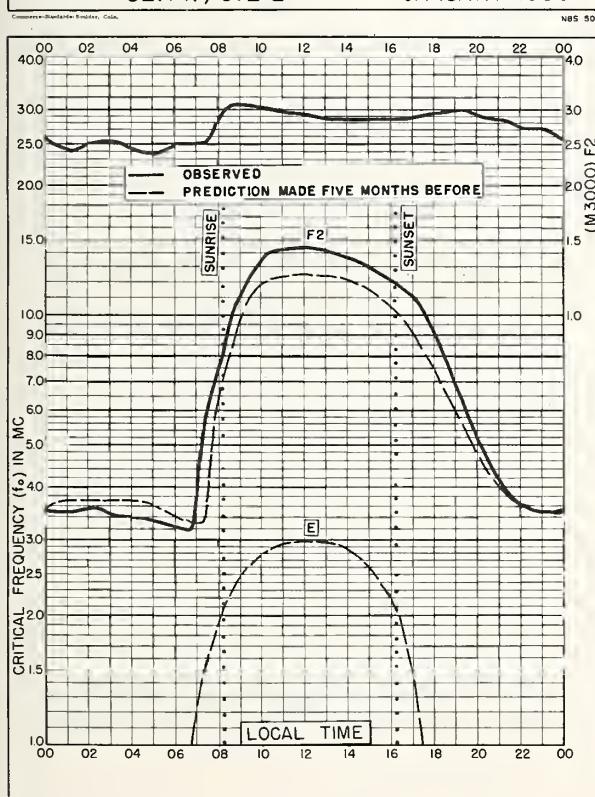
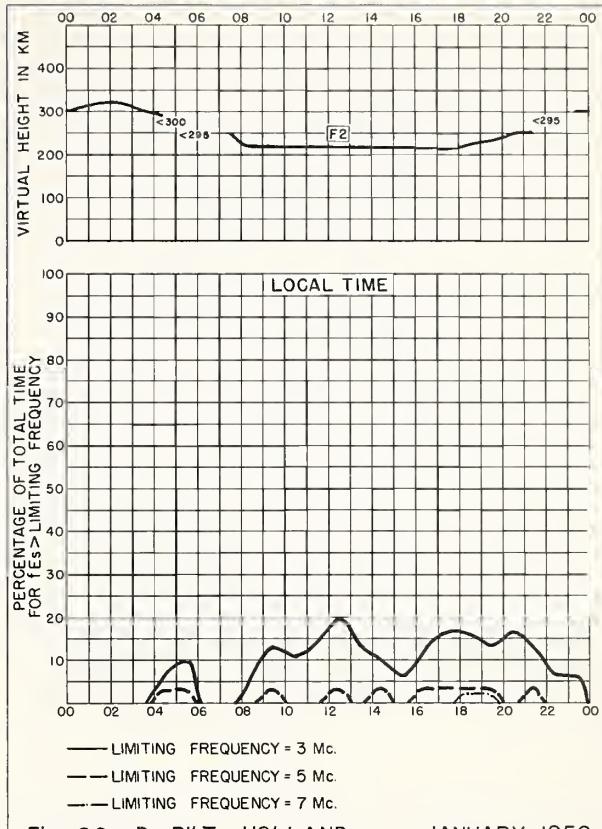
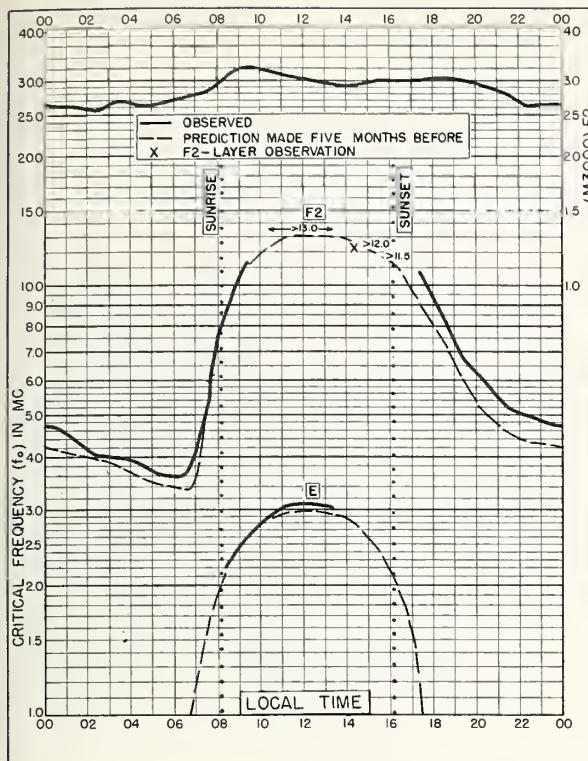
Fig. 8. WASHINGTON, D. C. FEBRUARY 1958

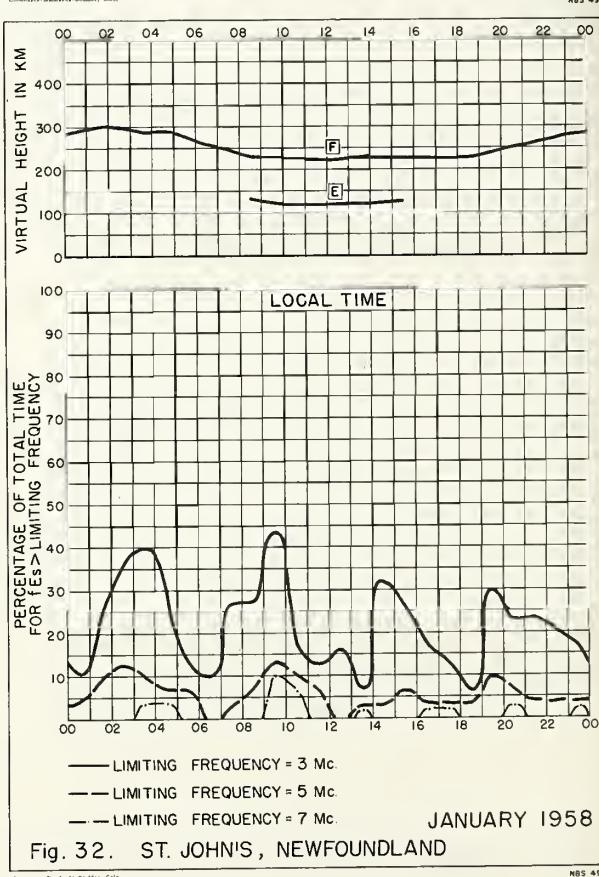
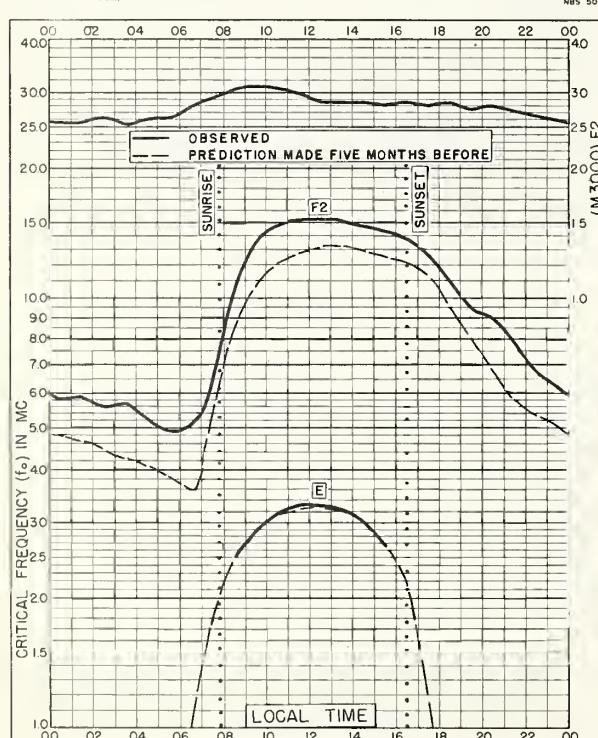
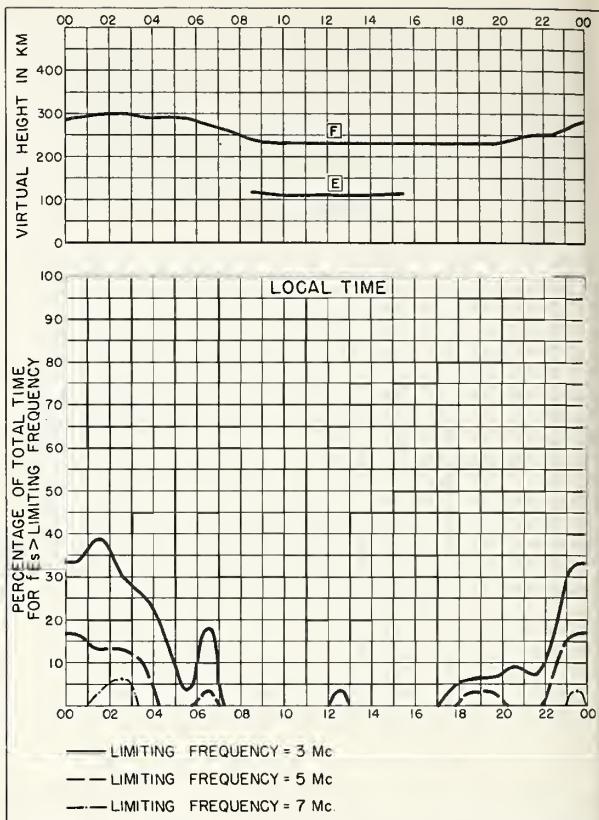
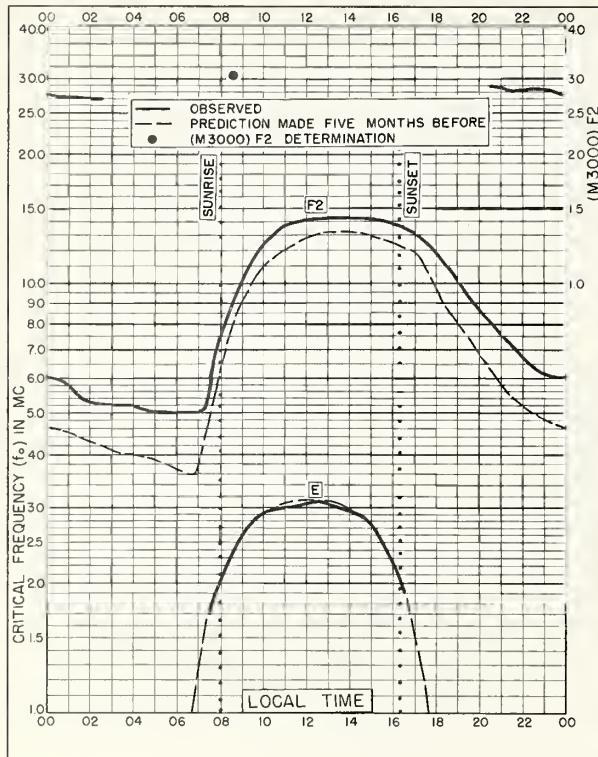


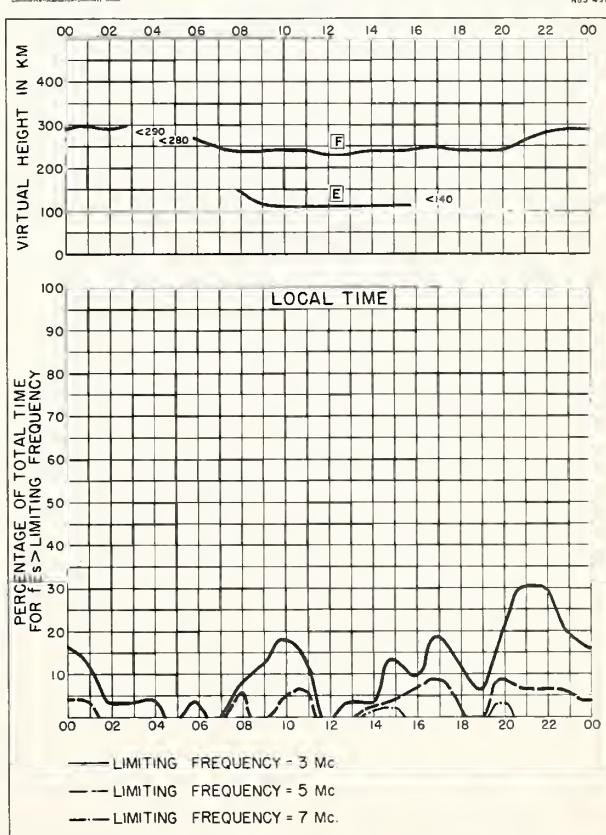
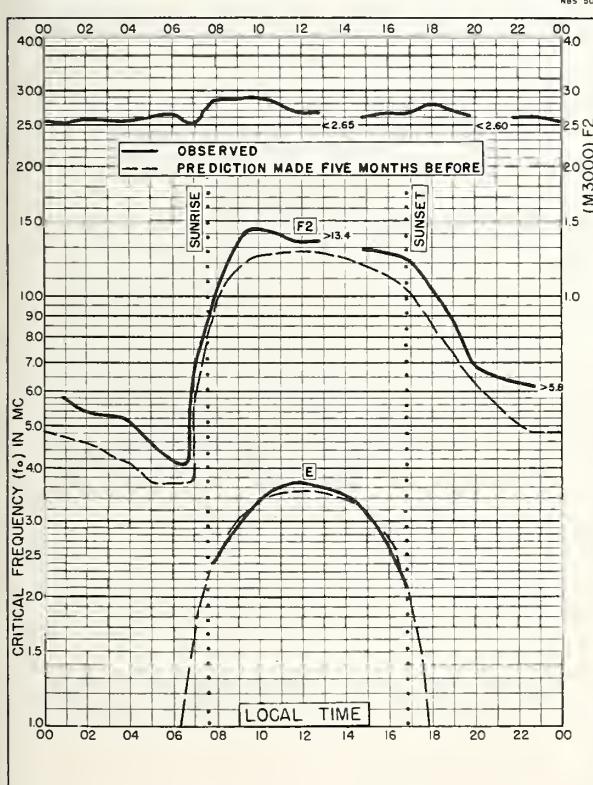
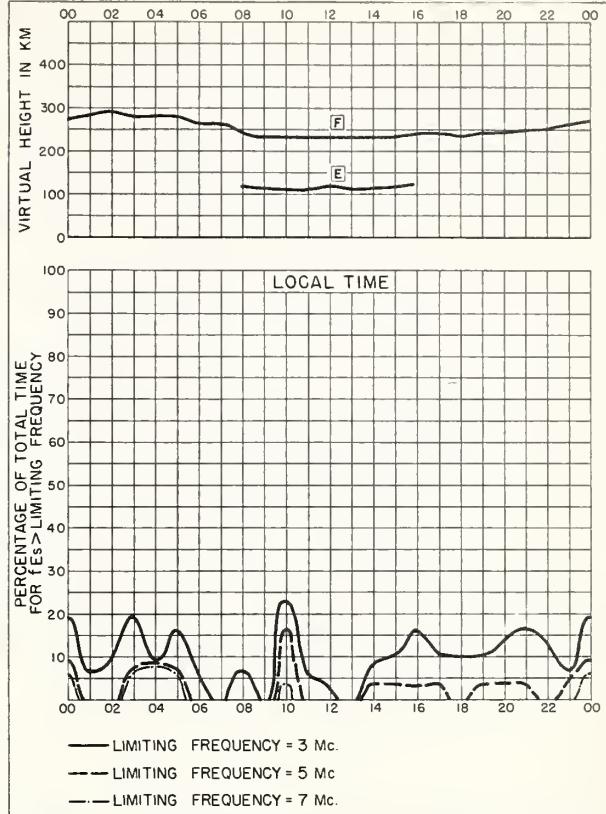
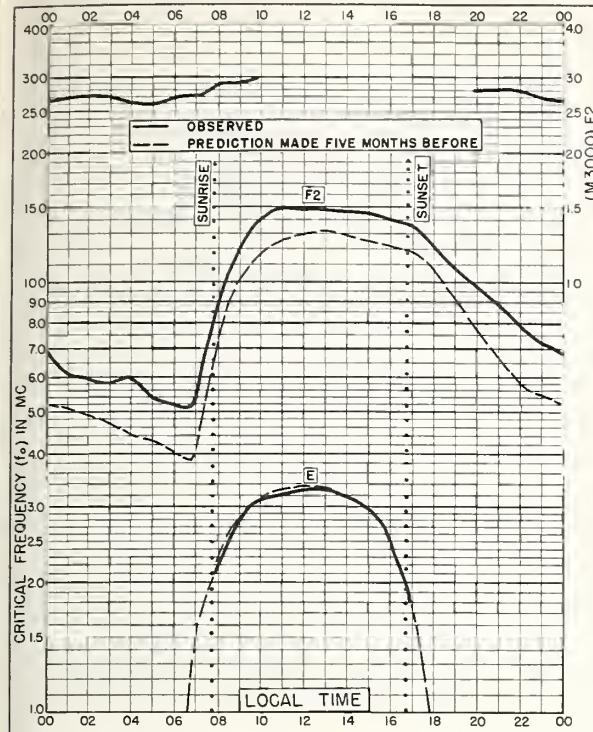


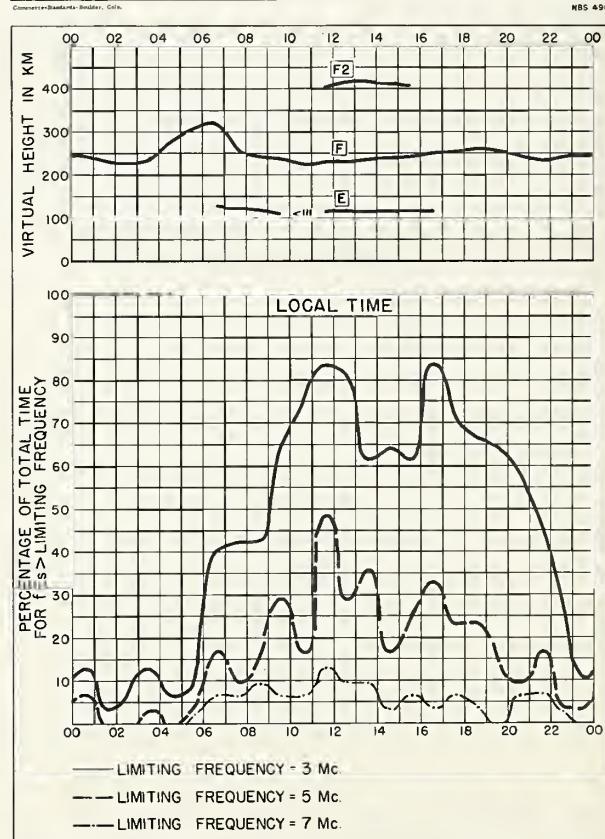
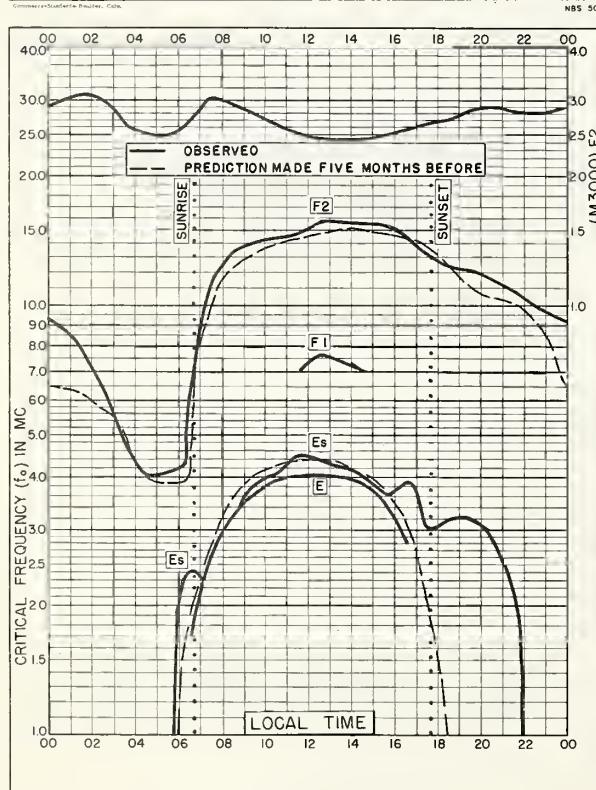
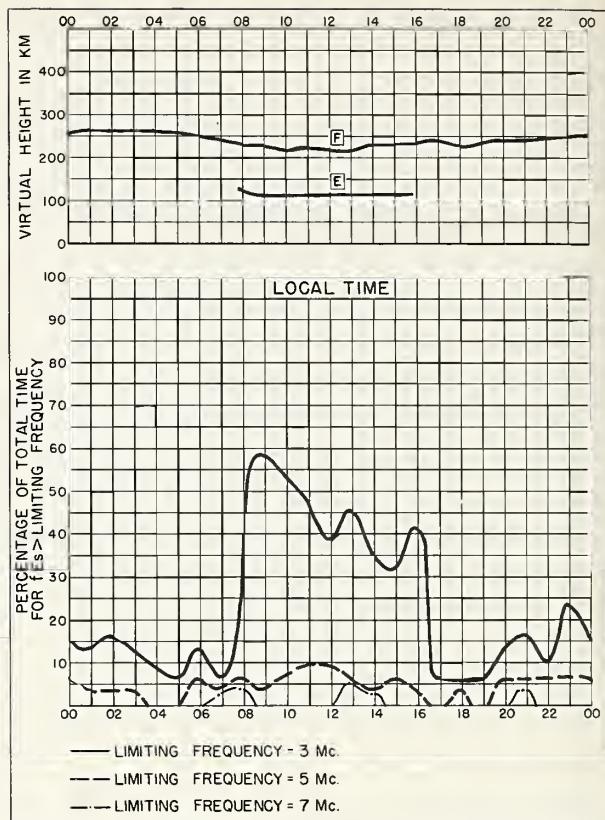
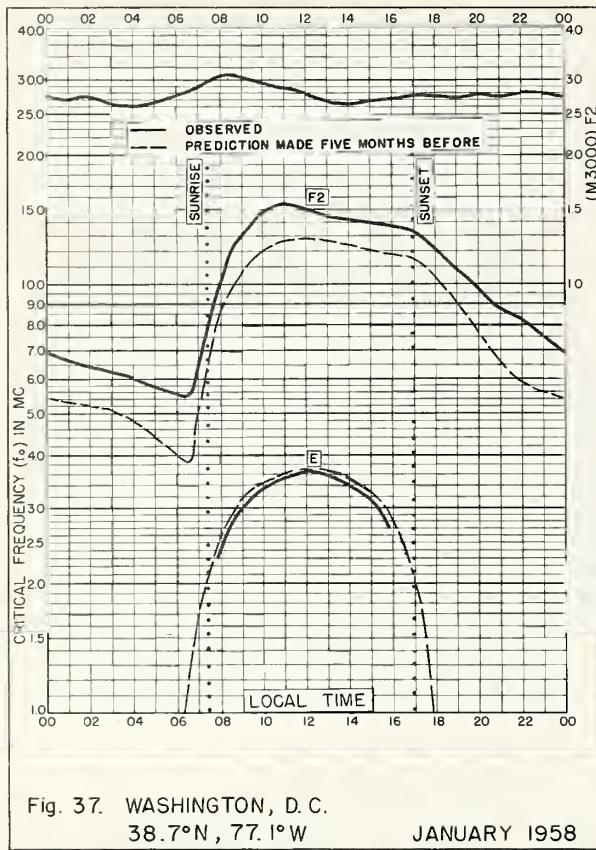












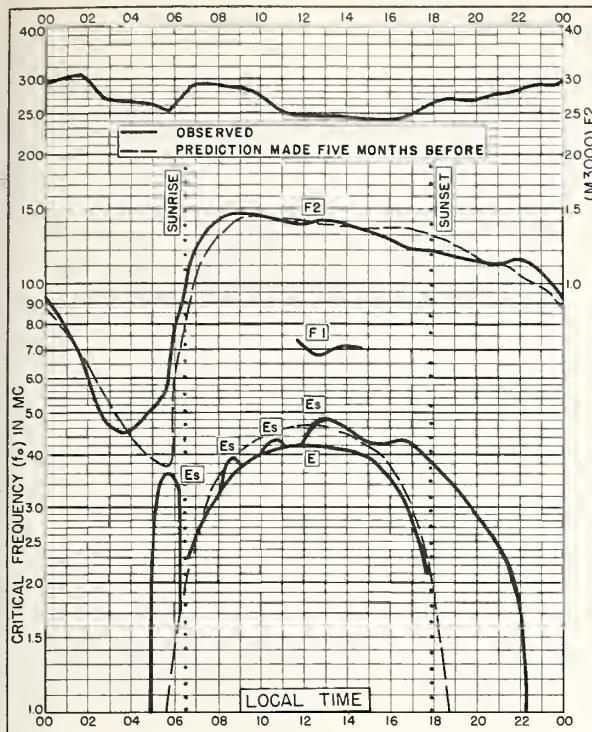


Fig. 41. PANAMA CANAL ZONE  
9.4°N, 79.9°W JANUARY 1958

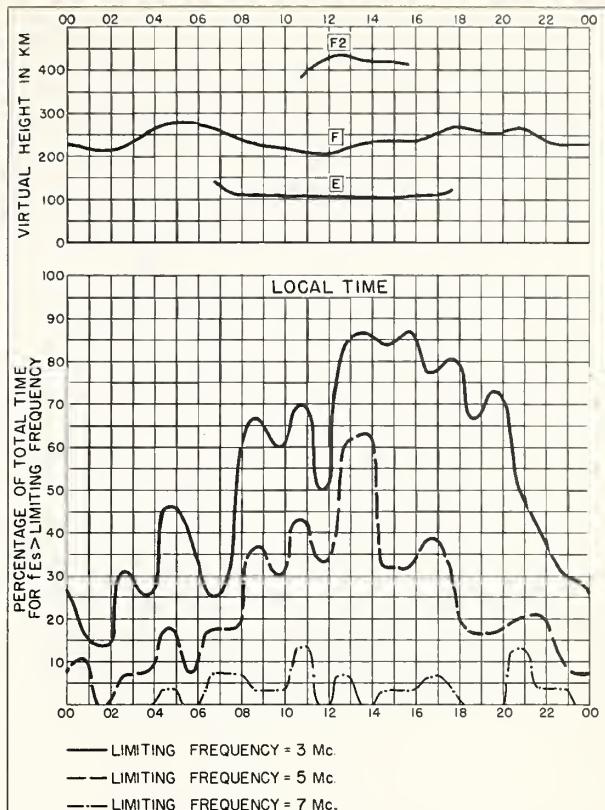


Fig. 42. PANAMA CANAL ZONE JANUARY 1958

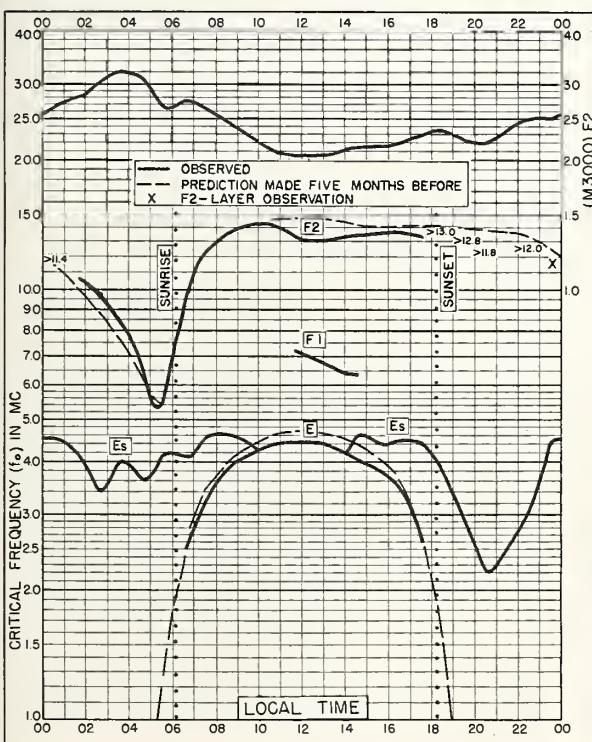


Fig. 43. TALARA, PERU  
4.6°S, 81.3°W JANUARY 1958

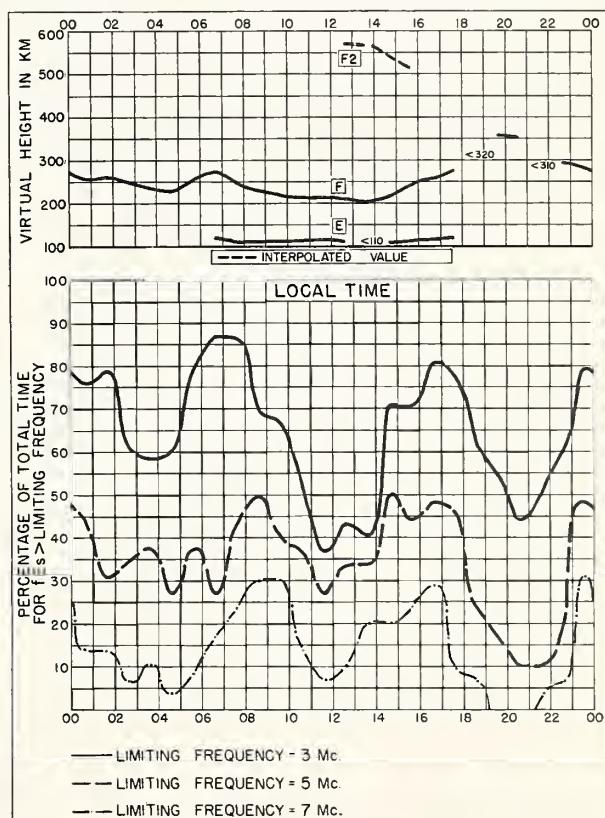


Fig. 44. TALARA, PERU JANUARY 1958

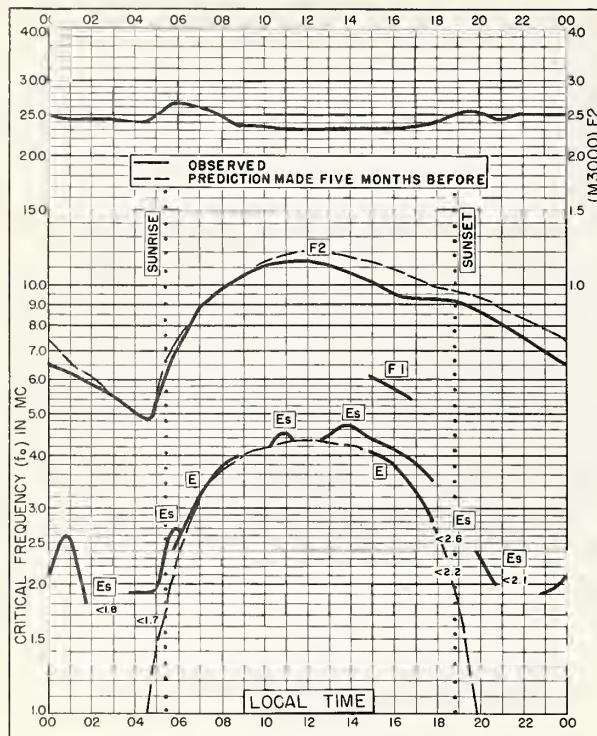


Fig. 45. JOHANNESBURG, UNION OF S. AFRICA  
26.2°S, 28.0°E JANUARY 1958

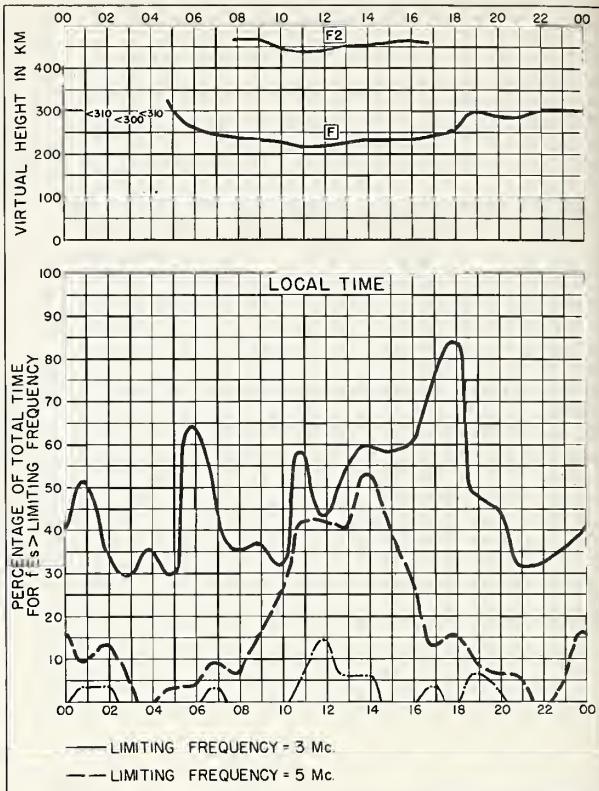


Fig. 46. JOHANNESBURG, UNION OF S. AFRICA

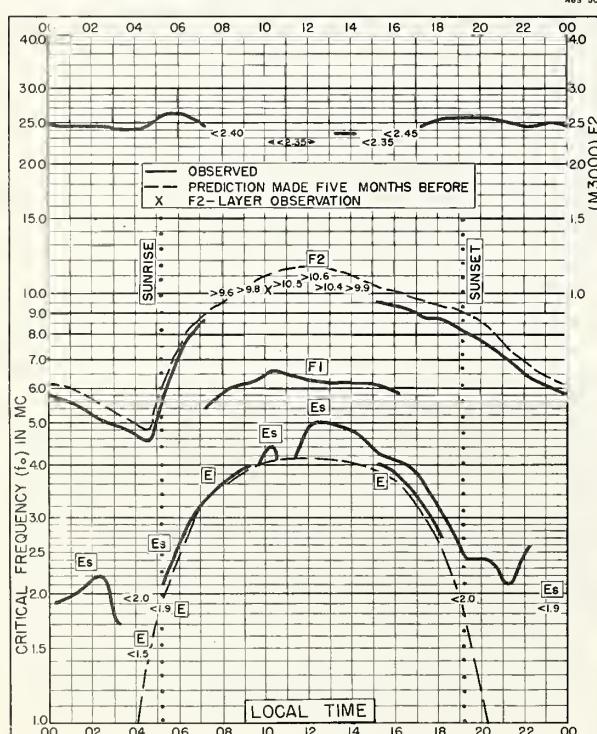


Fig. 47. CAPETOWN, UNION OF S. AFRICA  
34.1°S, 18.3°E JANUARY 1958

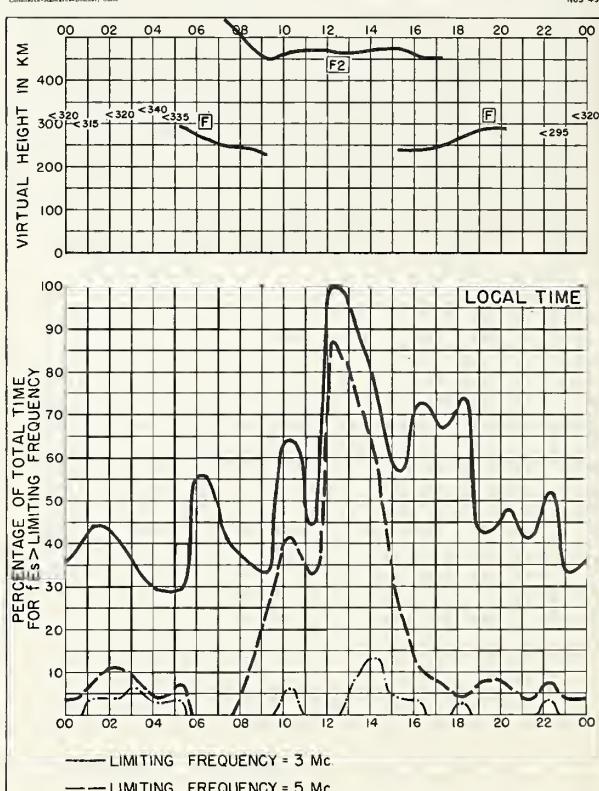


Fig. 48. CAPETOWN, UNION OF S. AFRICA

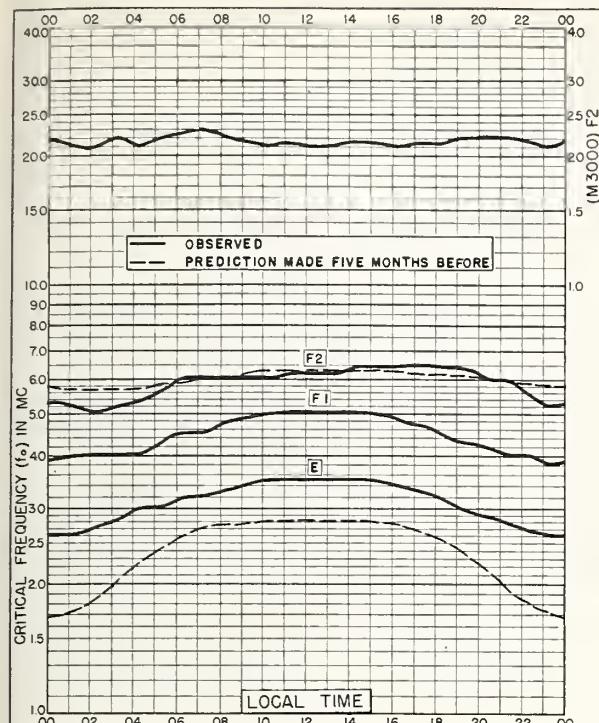


Fig. 49. SCOTT BASE  
77.8°S, 166.8°E JANUARY 1958

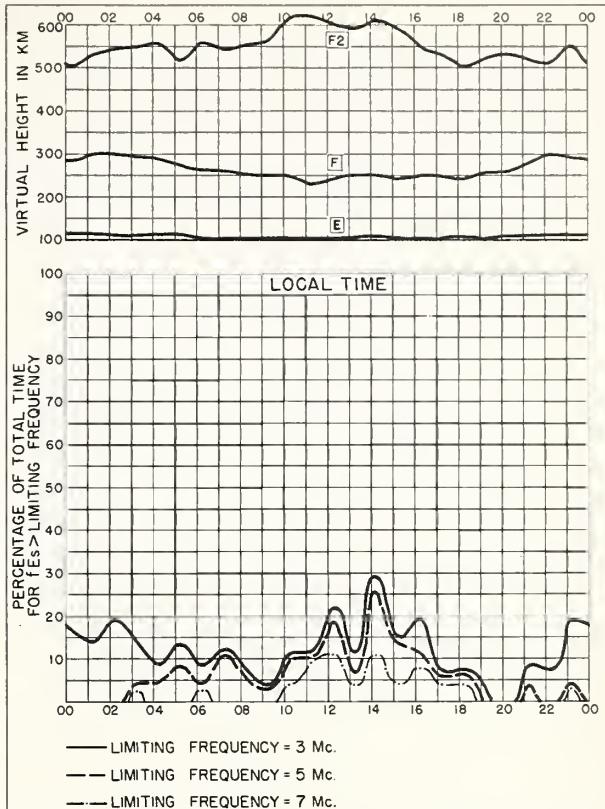


Fig. 50. SCOTT BASE JANUARY 1958

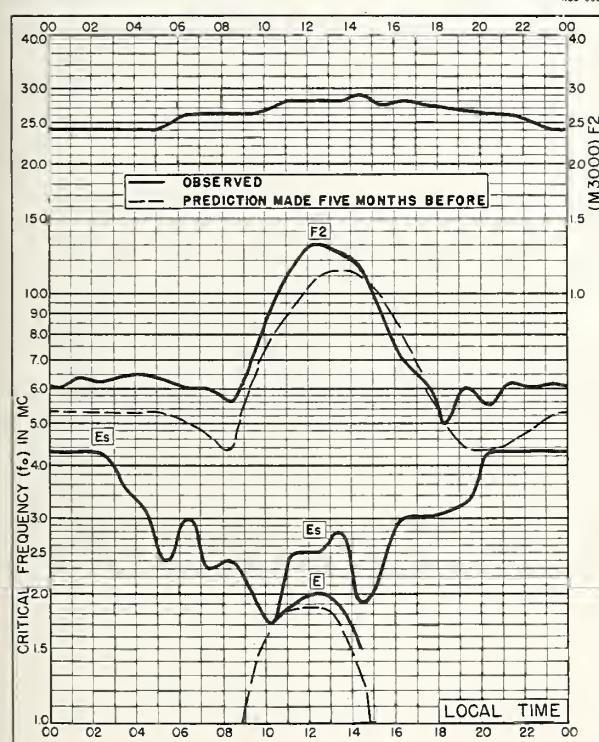


Fig. 51. KIRUNA, SWEDEN  
67.8°N, 20.3°E DECEMBER 1957

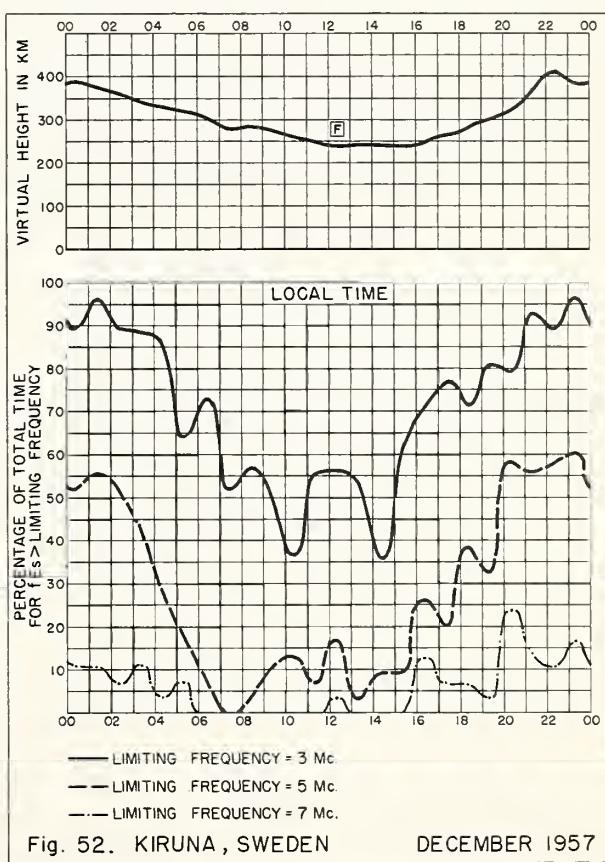


Fig. 52. KIRUNA, SWEDEN DECEMBER 1957

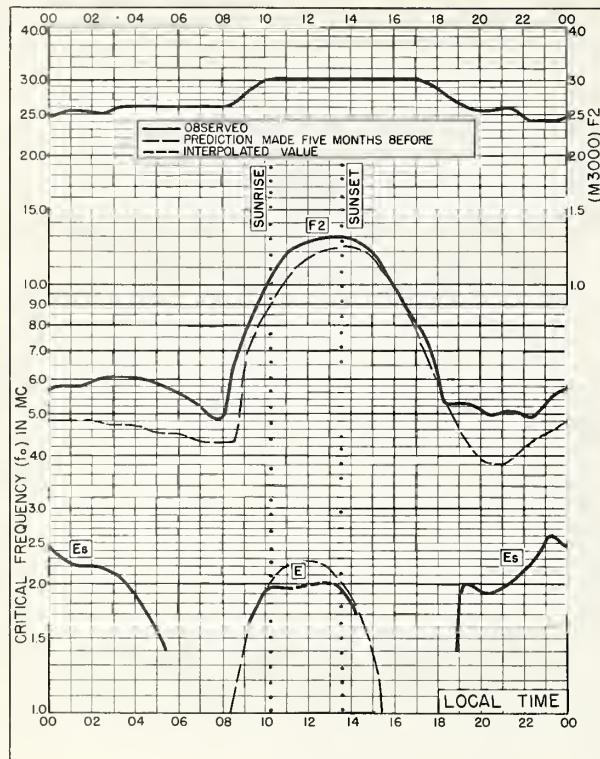


Fig. 53. LYCKSELE, SWEDEN

64.6°N, 18.8°E DECEMBER 1957

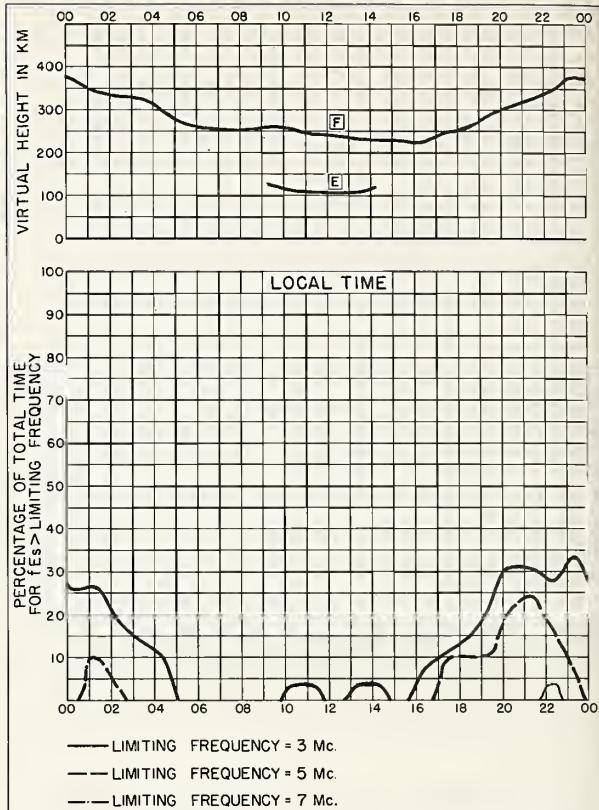


Fig. 54. LYCKSELE, SWEDEN DECEMBER 1957

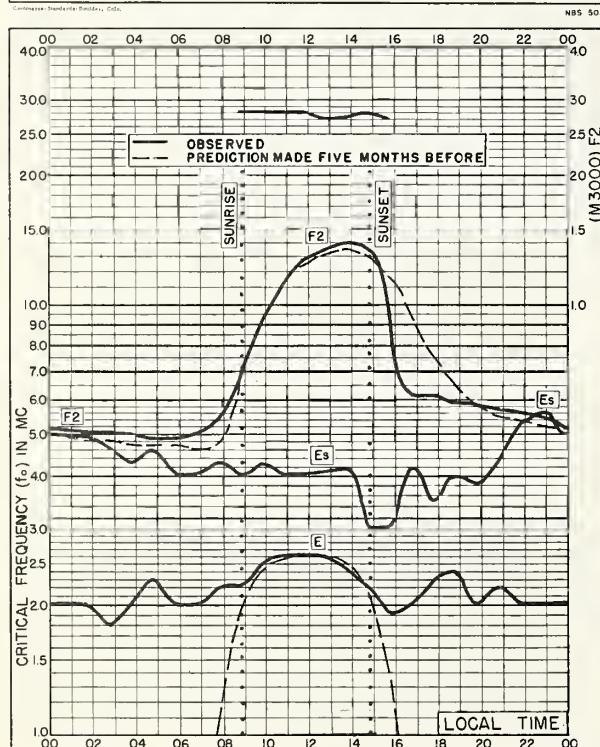


Fig. 55. CHURCHILL, CANADA

58.8°N, 94.2°W DECEMBER 1957

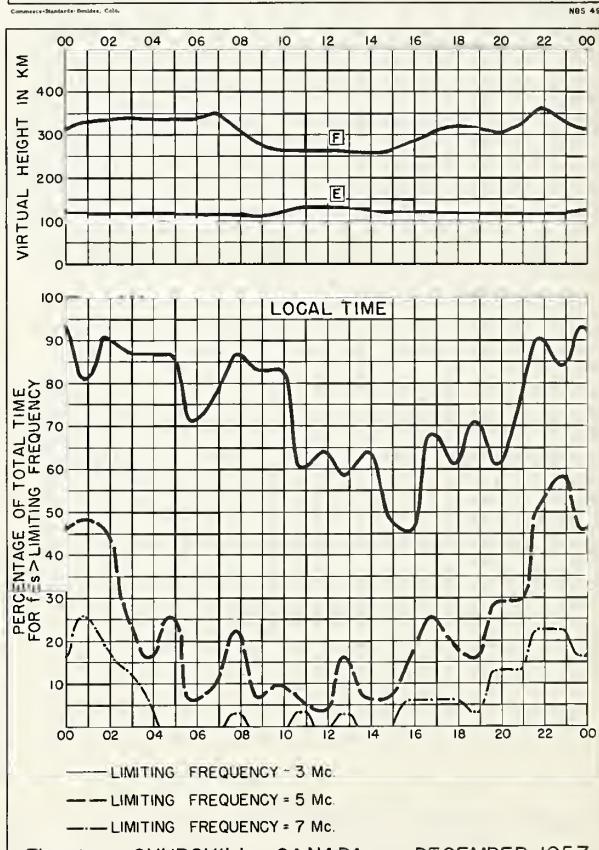


Fig. 56. CHURCHILL, CANADA DECEMBER 1957

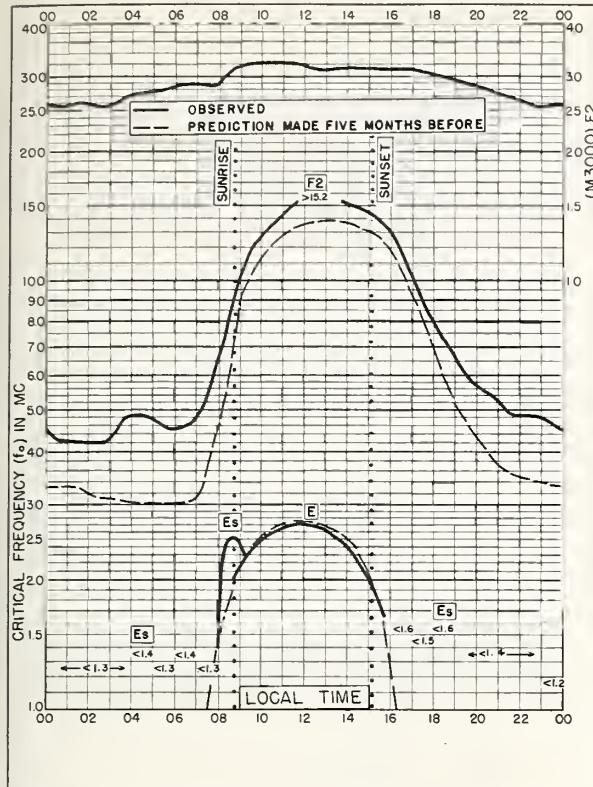


Fig. 57. INVERNESS, SCOTLAND  
57.4°N, 4.2°W DECEMBER 1957

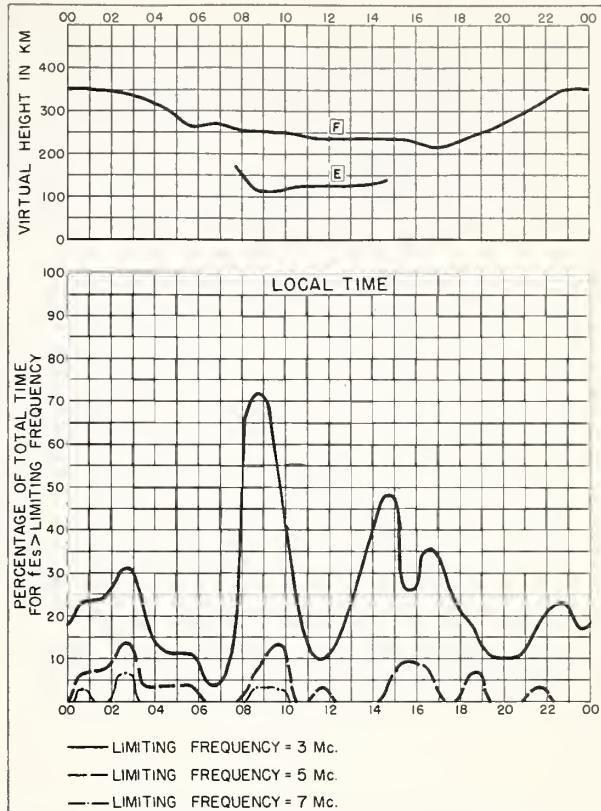


Fig. 58. INVERNESS, SCOTLAND DECEMBER 1957

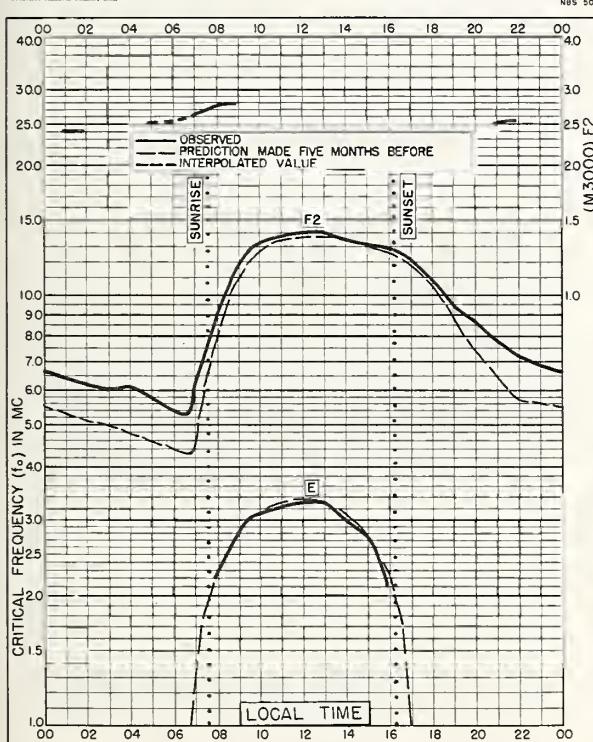


Fig. 59. OTTAWA, CANADA  
45.4°N, 75.9°W DECEMBER 1957

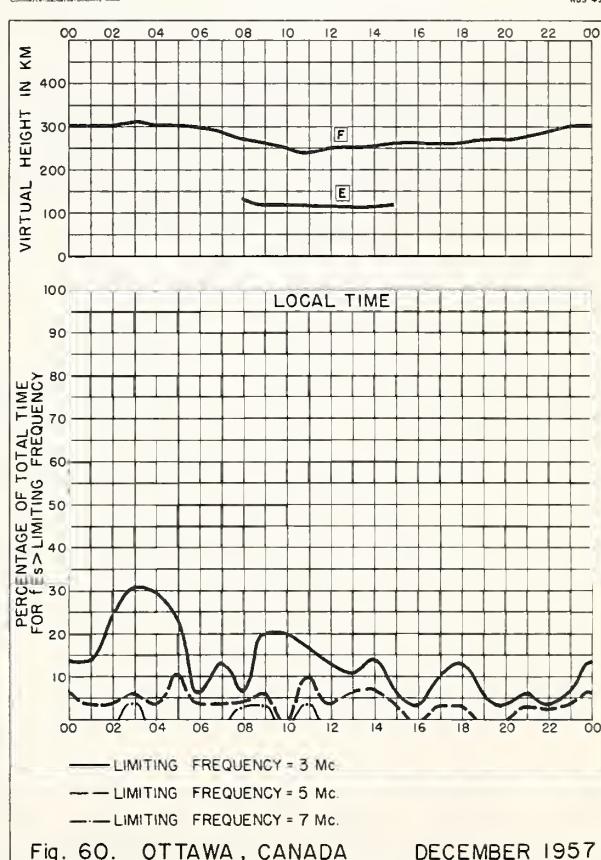
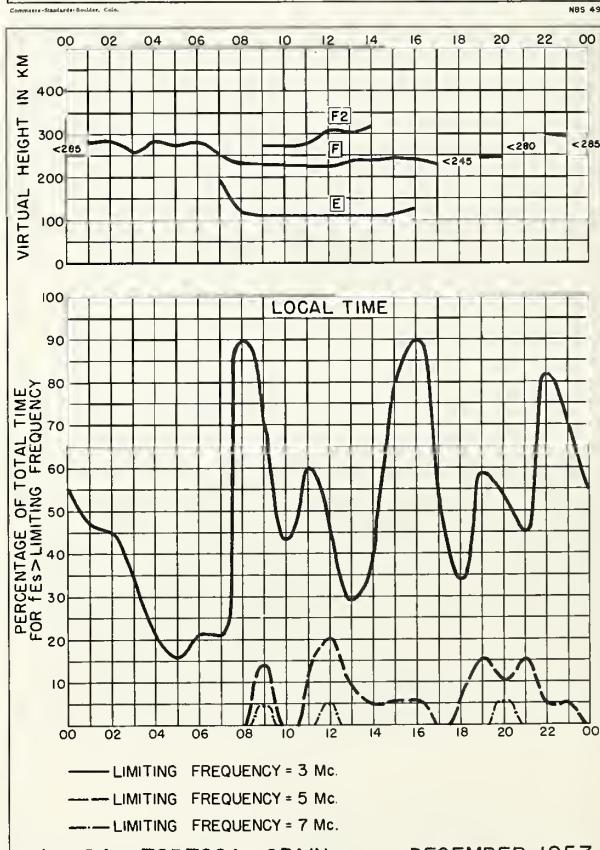
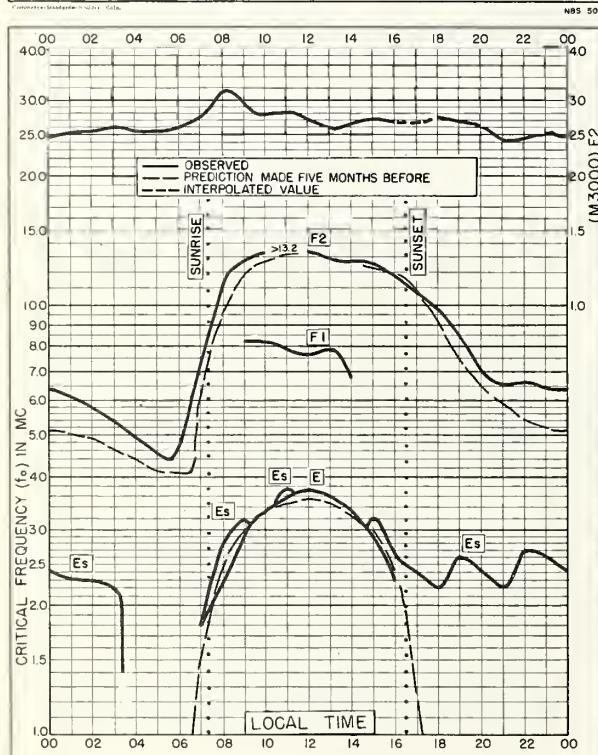
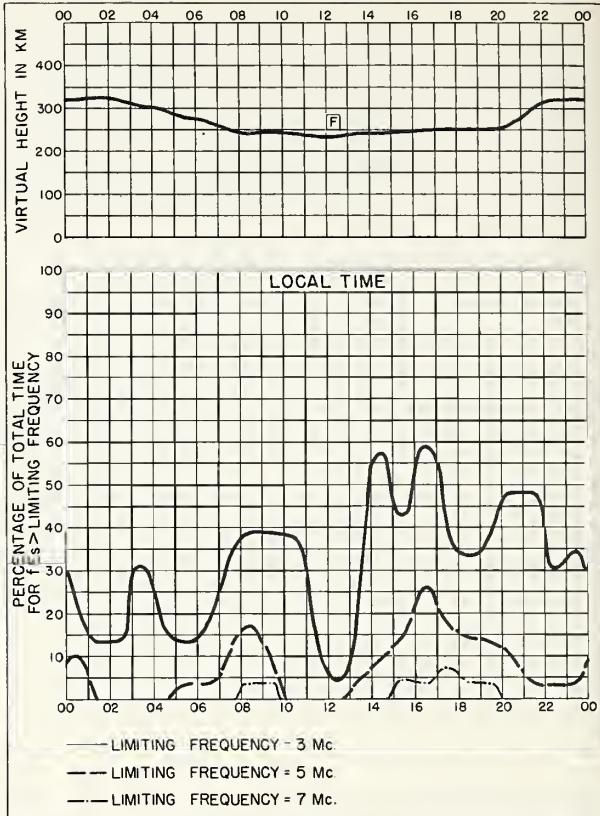
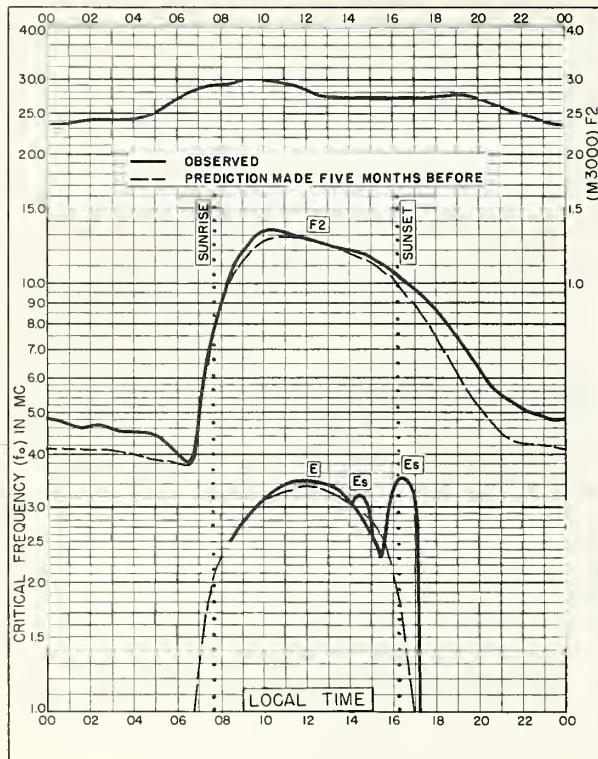
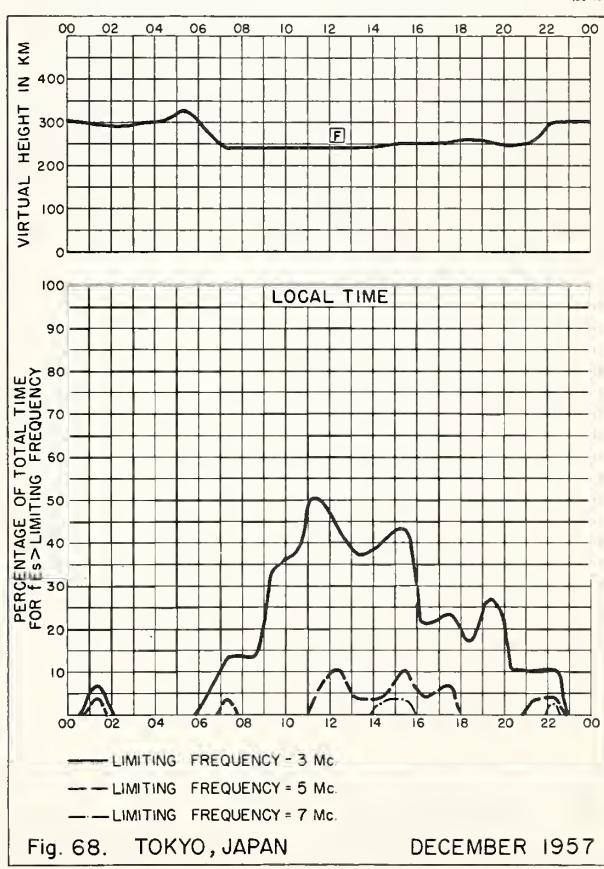
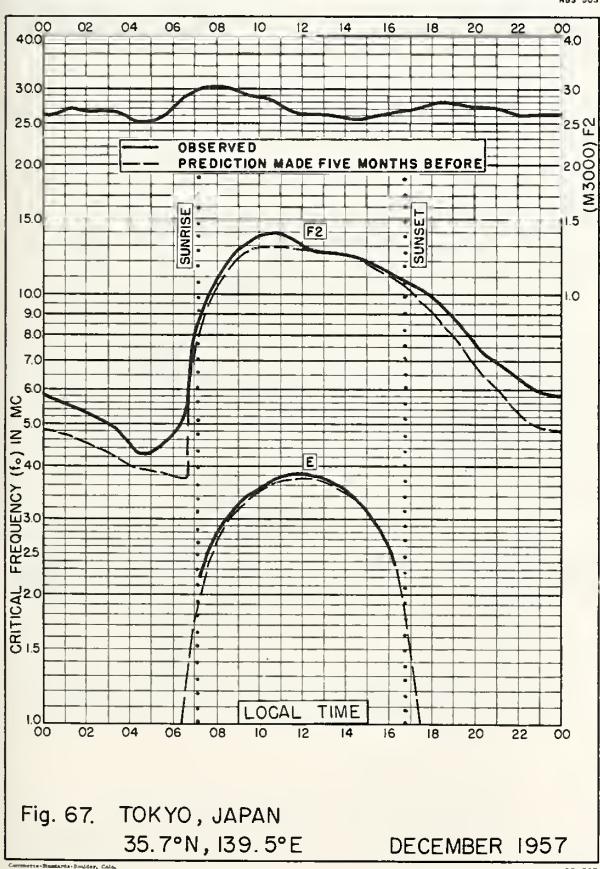
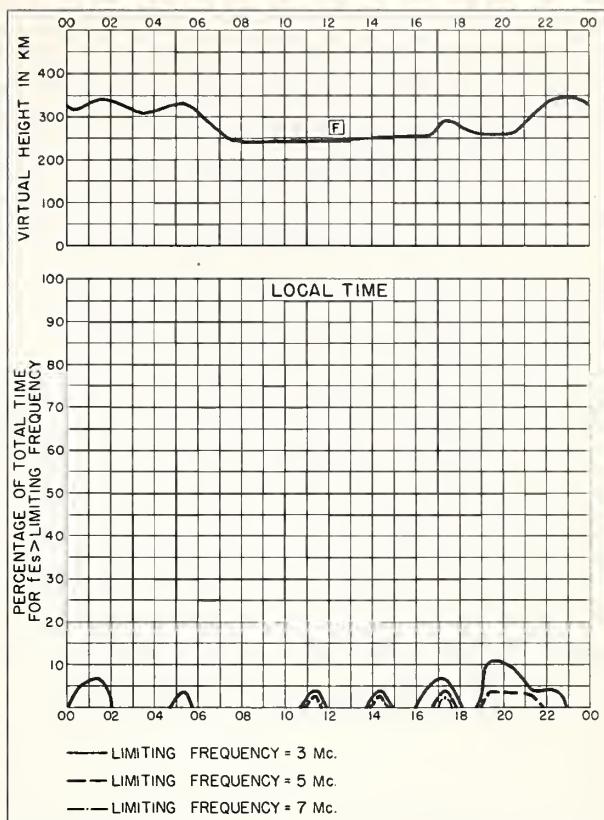
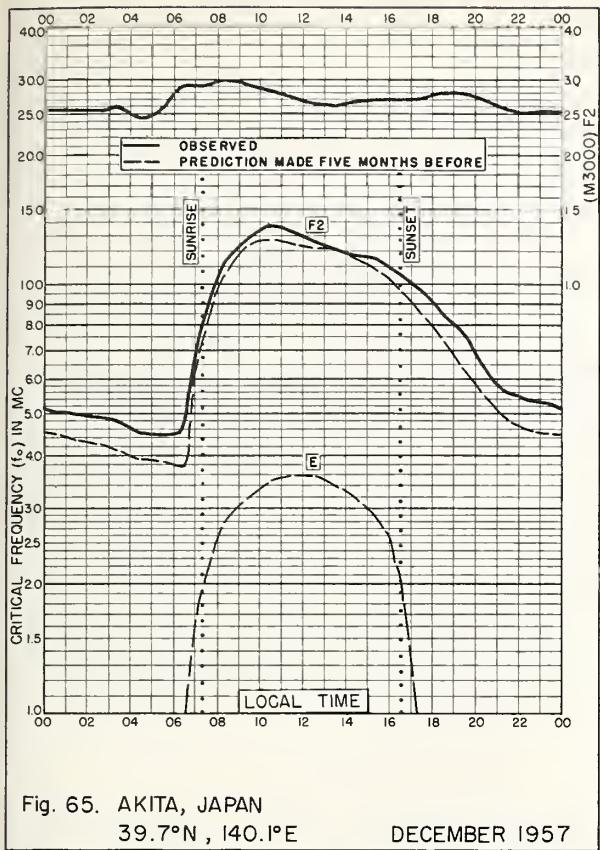
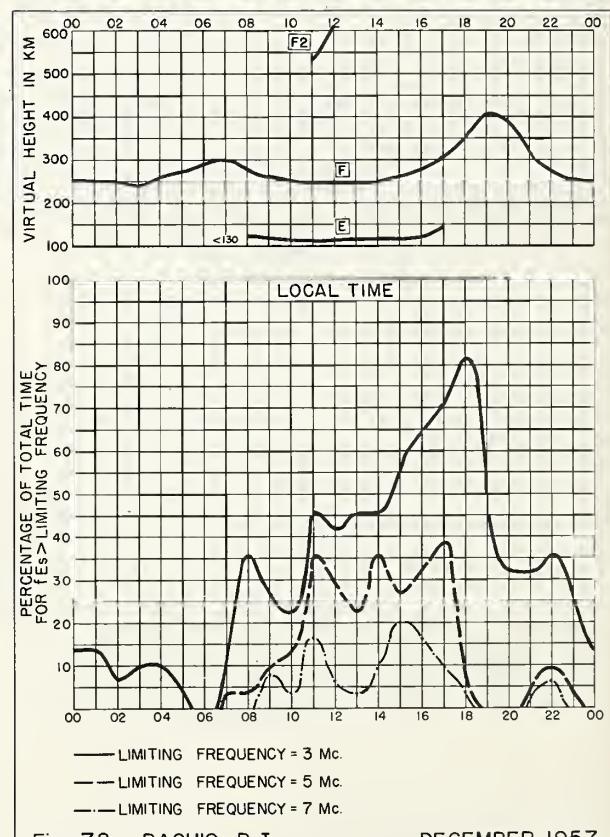
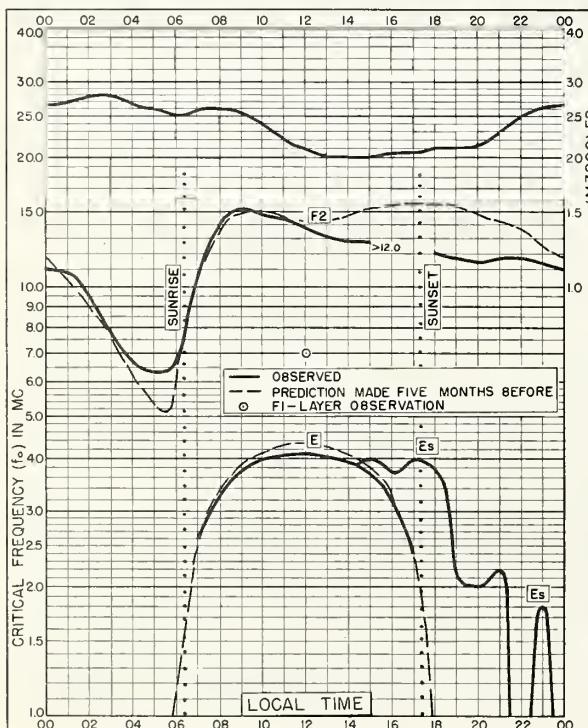
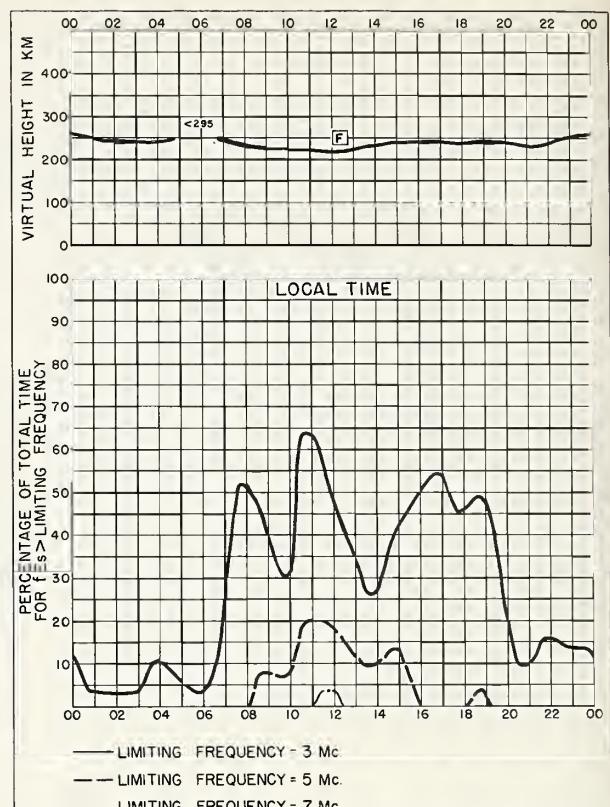
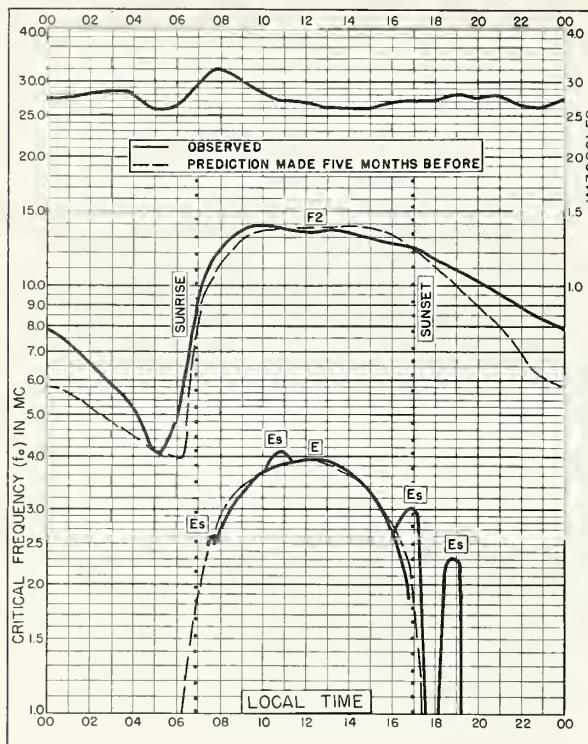
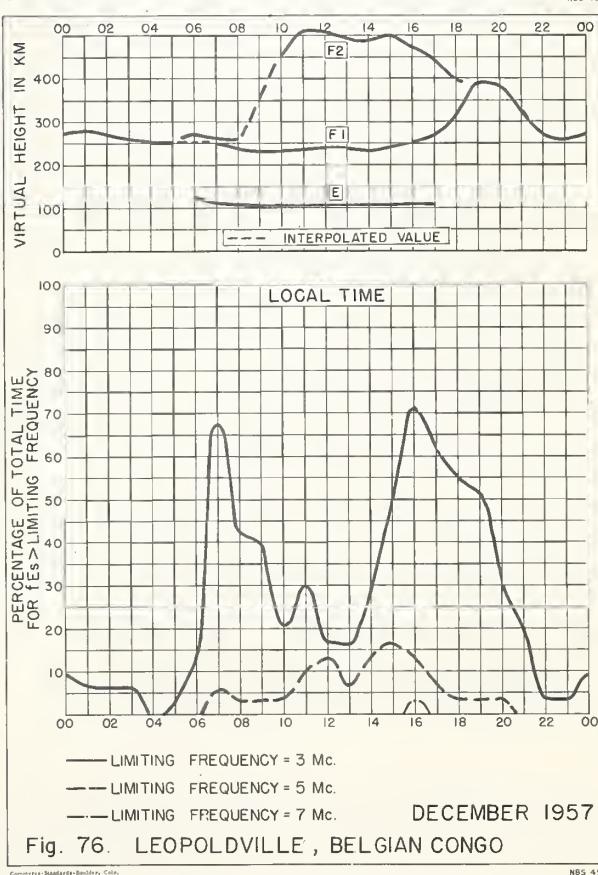
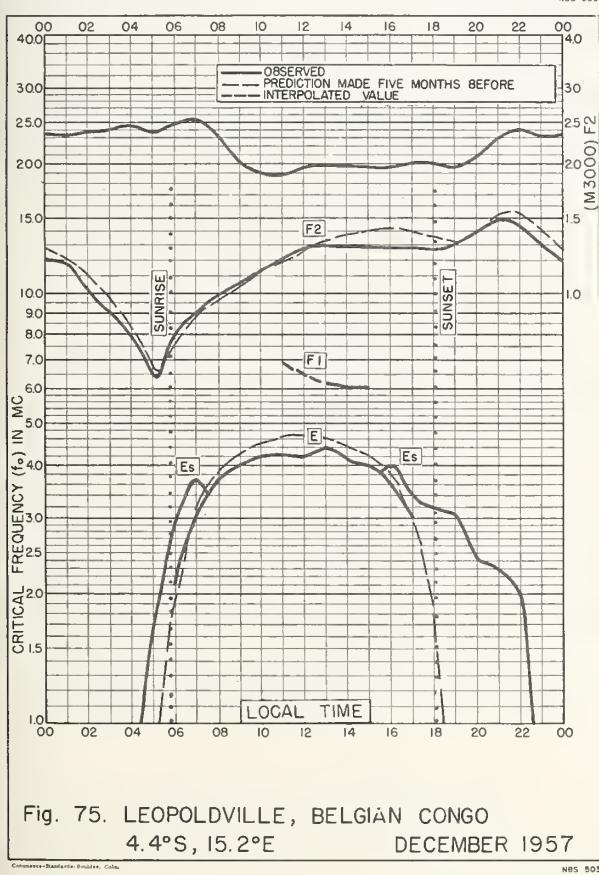
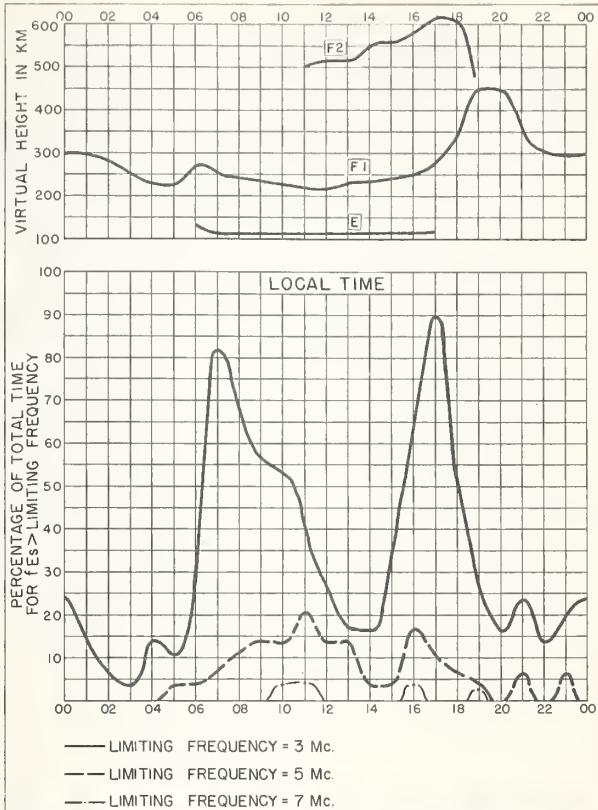
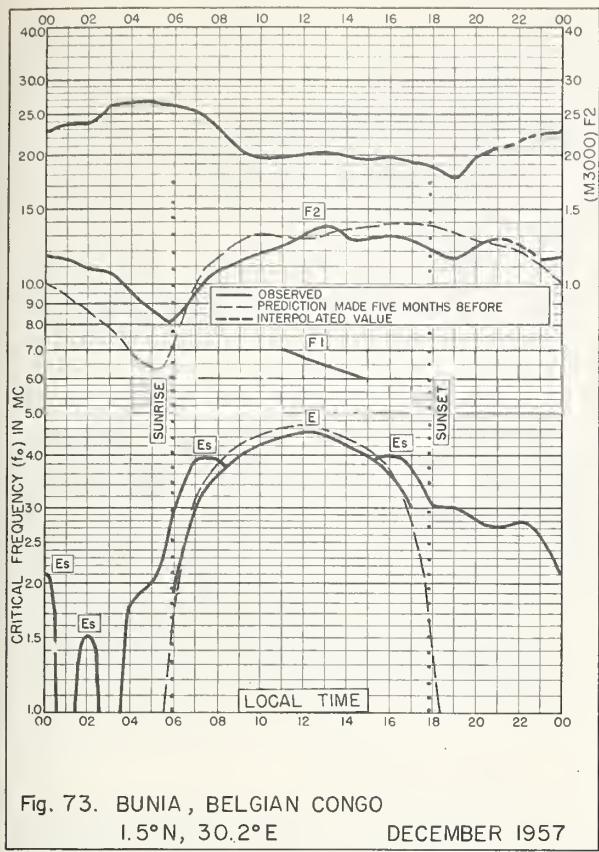


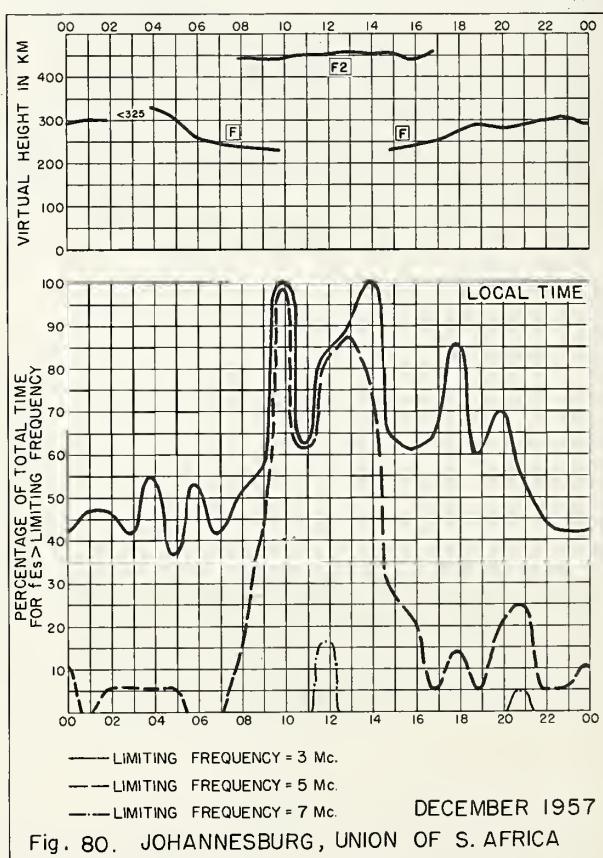
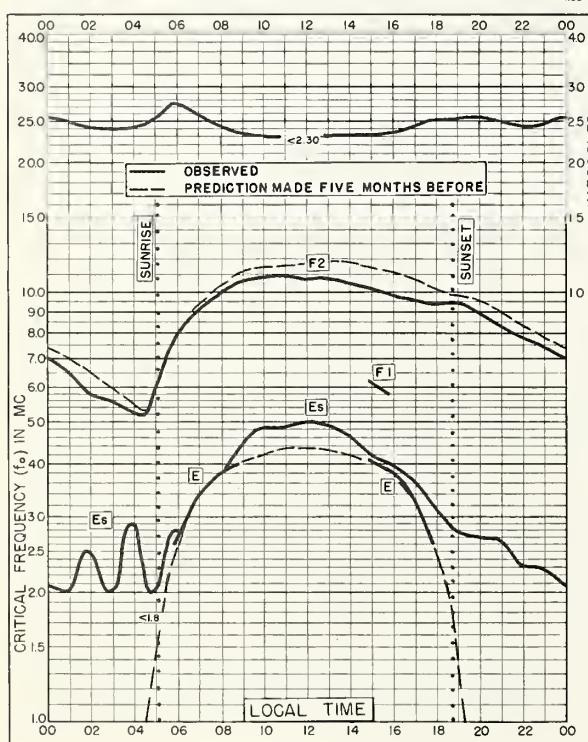
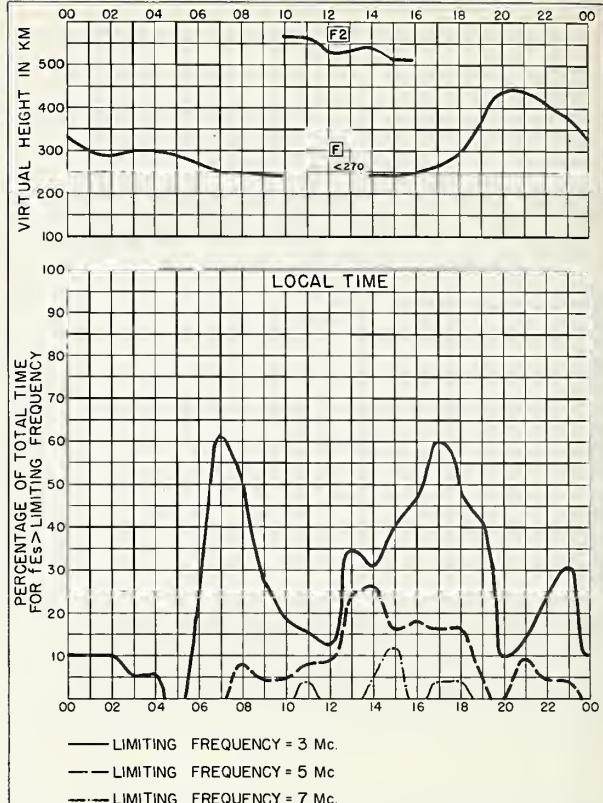
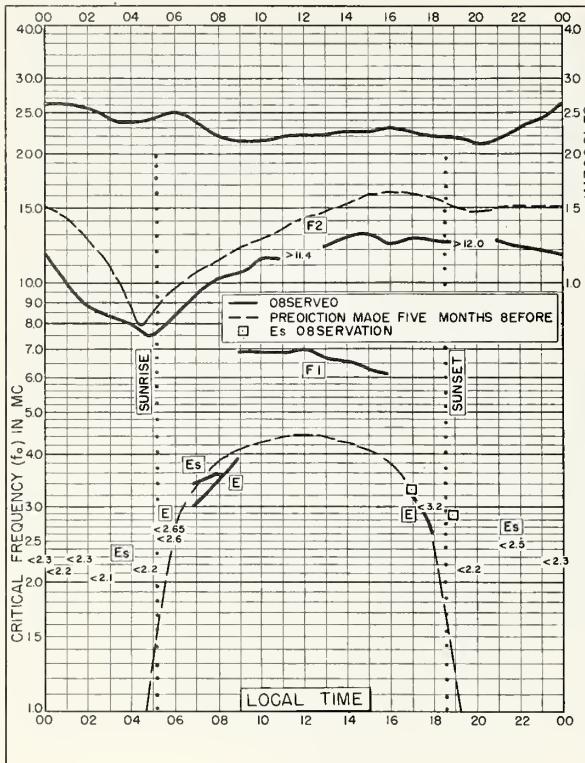
Fig. 60. OTTAWA, CANADA DECEMBER 1957











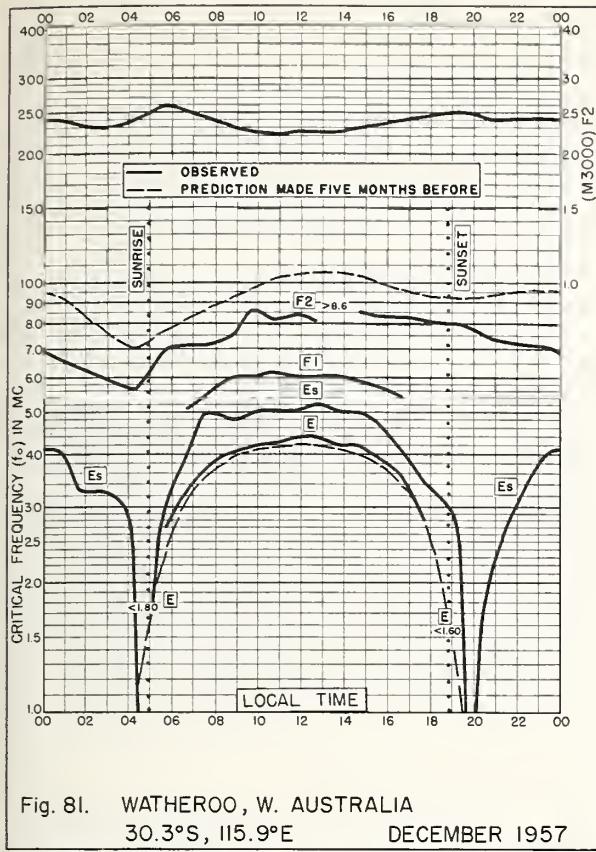


Fig. 81. WATHEROO, W. AUSTRALIA  
30.3°S, 115.9°E DECEMBER 1957

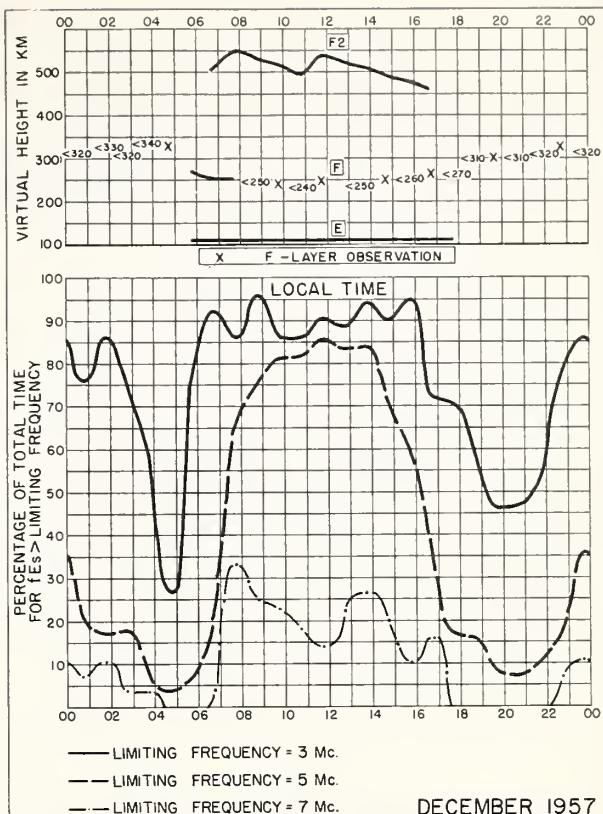


Fig. 82. WATHEROO, W. AUSTRALIA

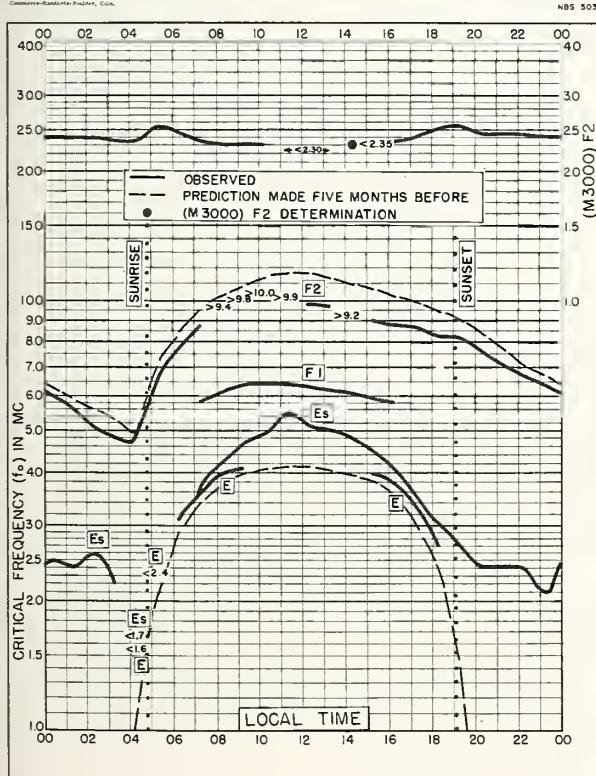


Fig. 83. CAPE TOWN, UNION OF S. AFRICA  
34.1°S, 18.3°E DECEMBER 1957

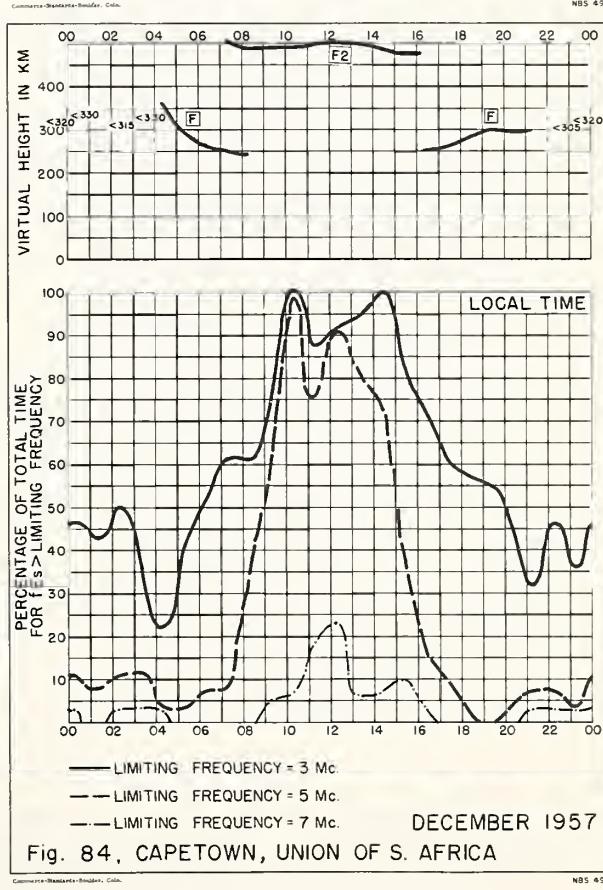
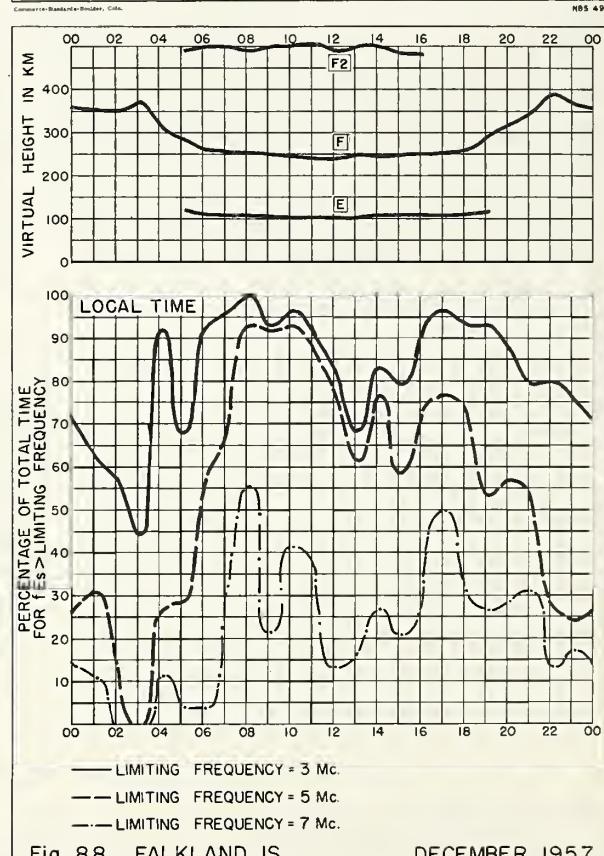
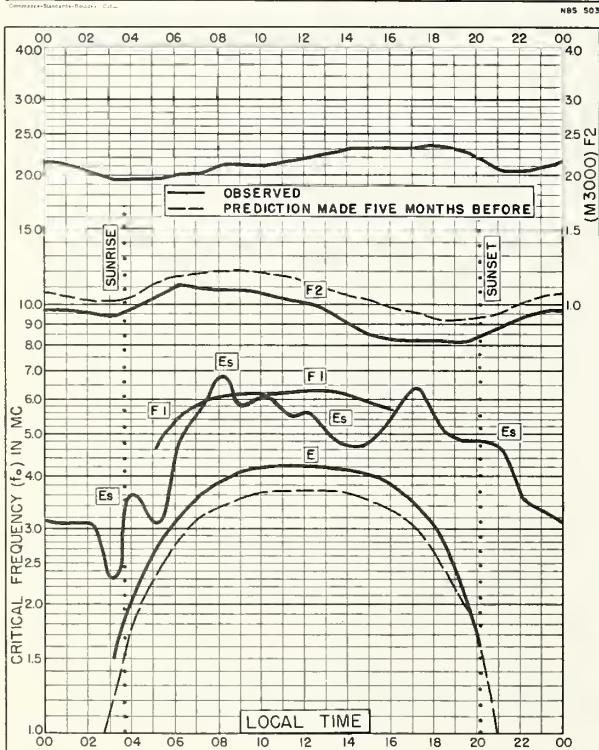
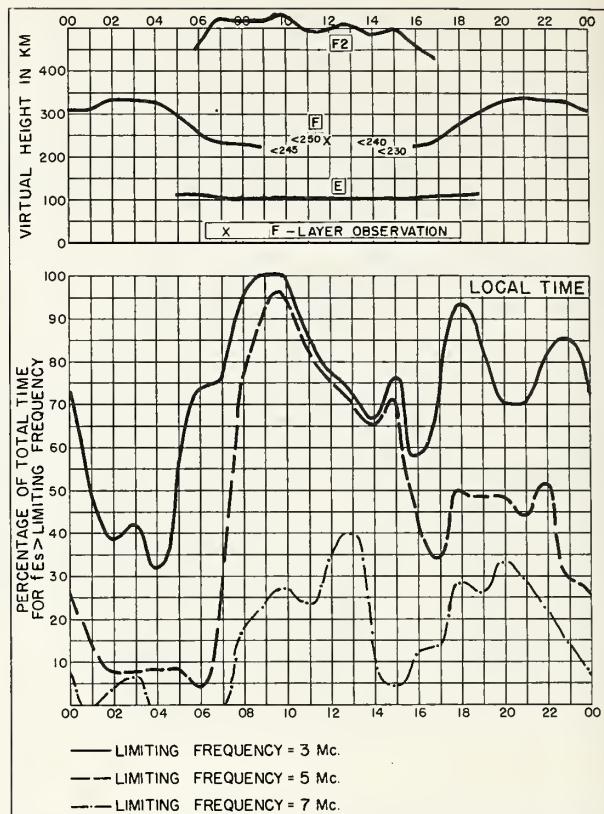
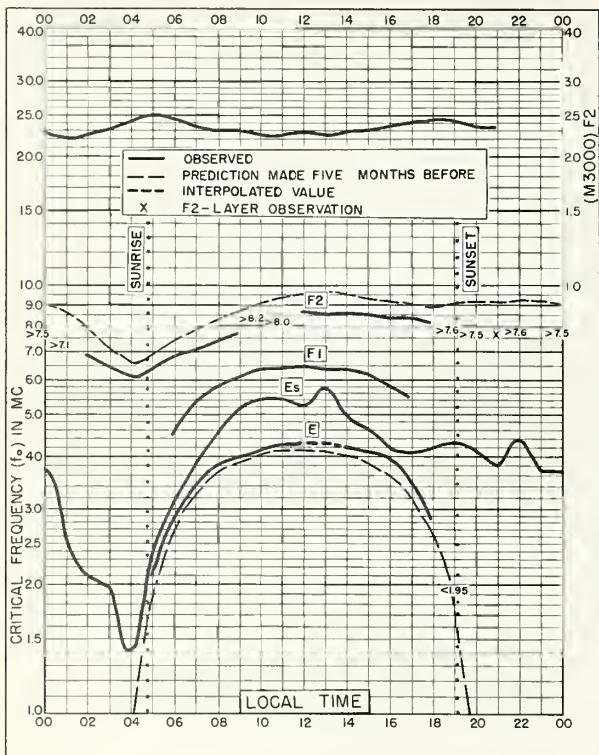


Fig. 84. CAPE TOWN, UNION OF S. AFRICA



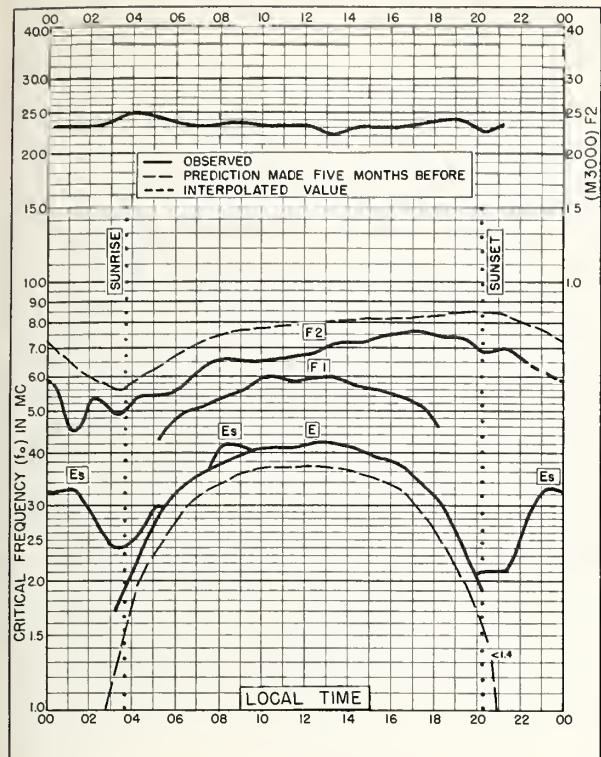


Fig. 89. CAMPBELL I.  
52.5°S, 169.2°E      DECEMBER 1957

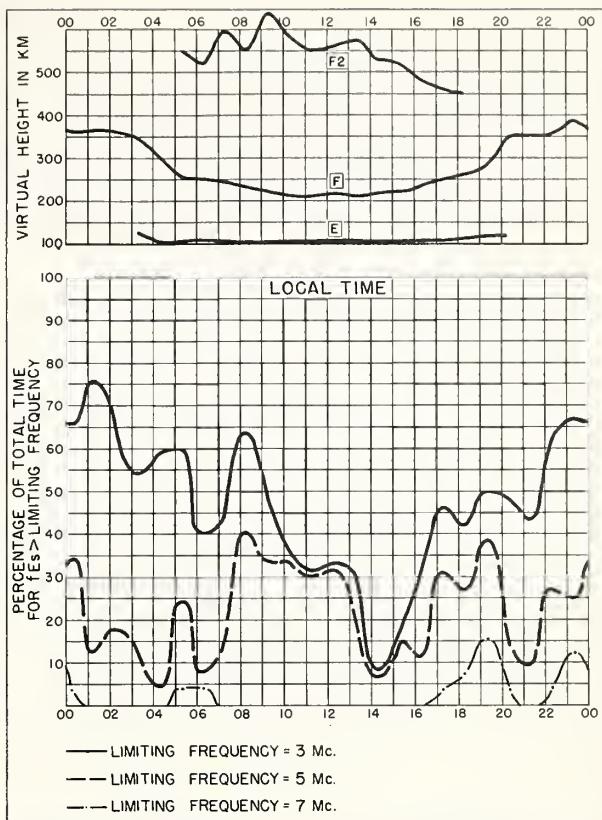


Fig. 90. CAMPBELL I.      DECEMBER 1957

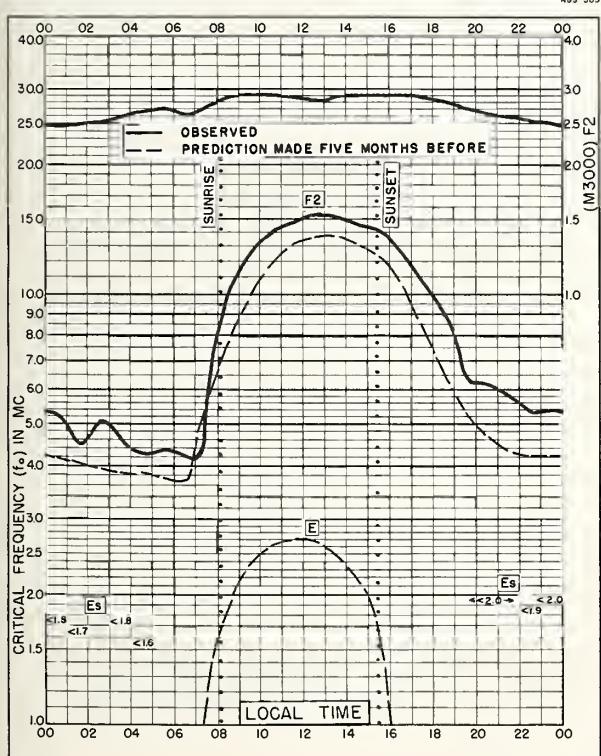


Fig. 91. NURMIJARVI, FINLAND  
60.5°N, 24.6°E      NOVEMBER 1957

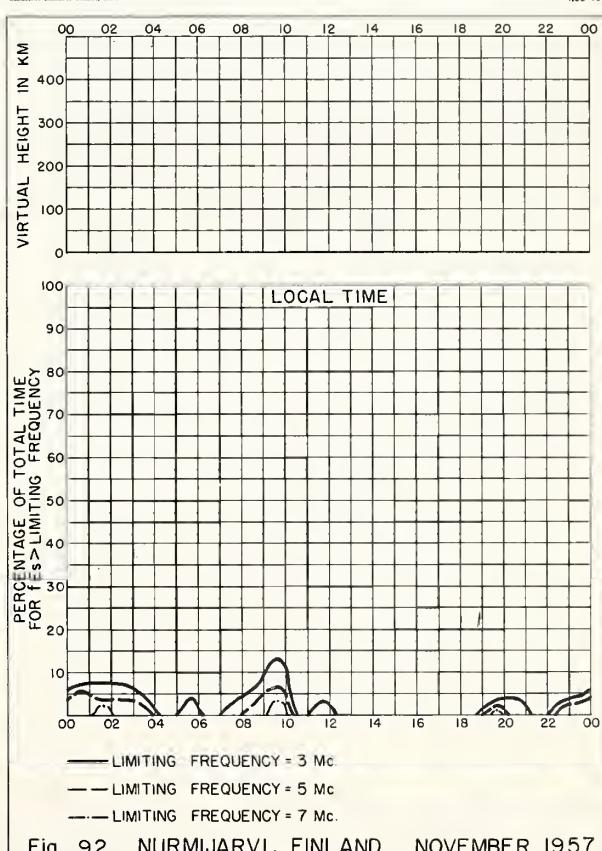


Fig. 92. NURMIJARVI, FINLAND      NOVEMBER 1957

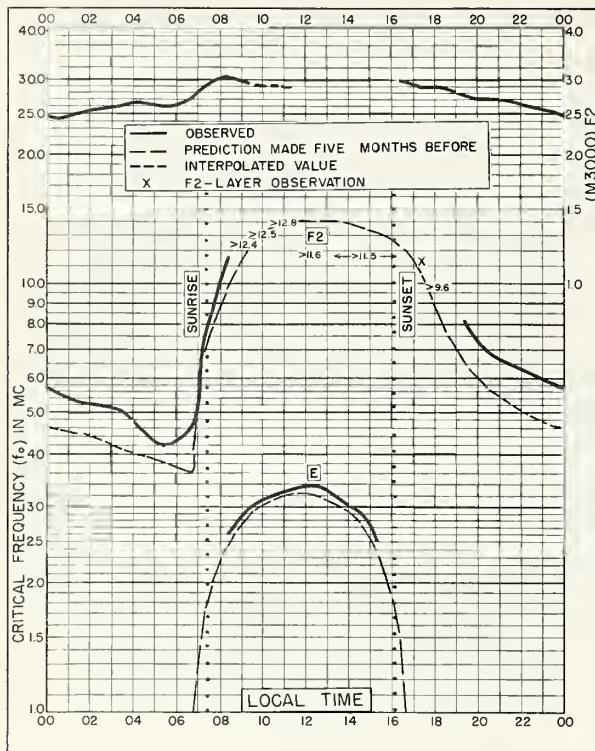


Fig. 93. De BILT, HOLLAND  
52.1°N, 5.2°E NOVEMBER 1957

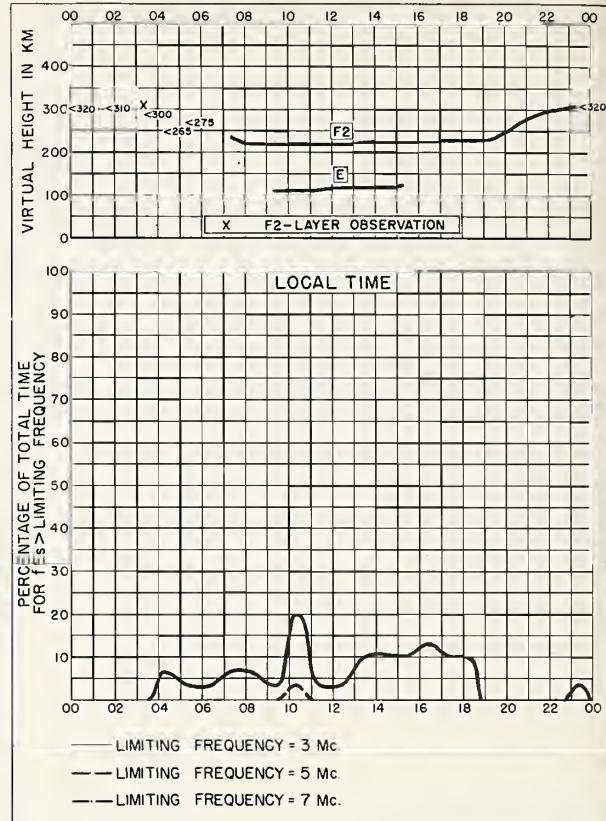


Fig. 94. De BILT, HOLLAND NOVEMBER 1957

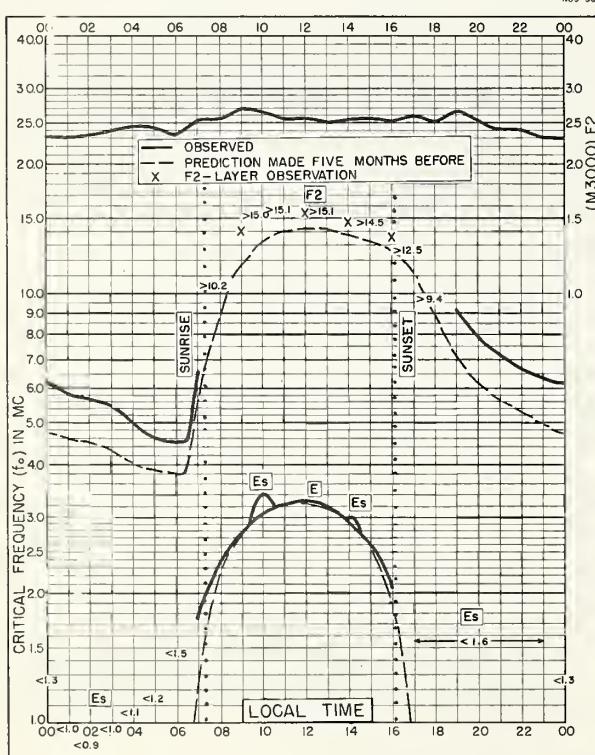


Fig. 95. SLOUGH, ENGLAND  
51.5°N, 0.6°W NOVEMBER 1957

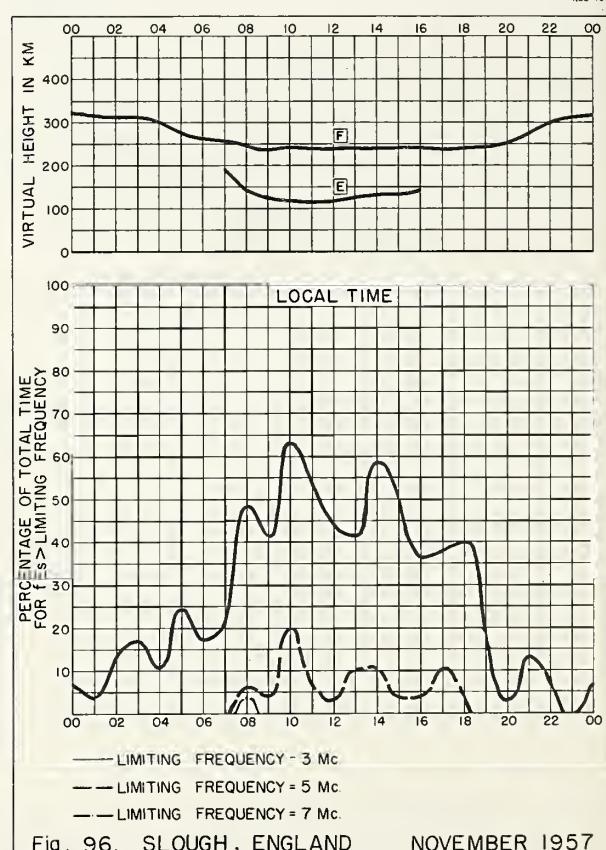
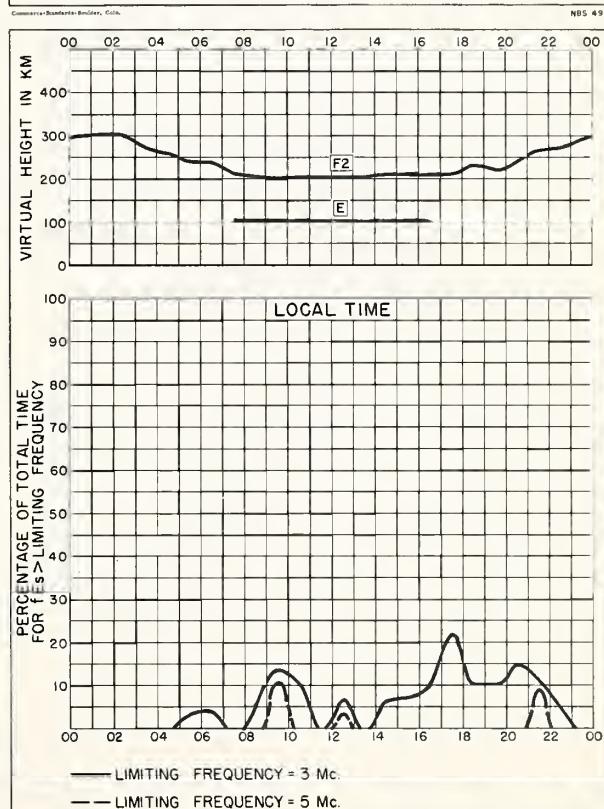
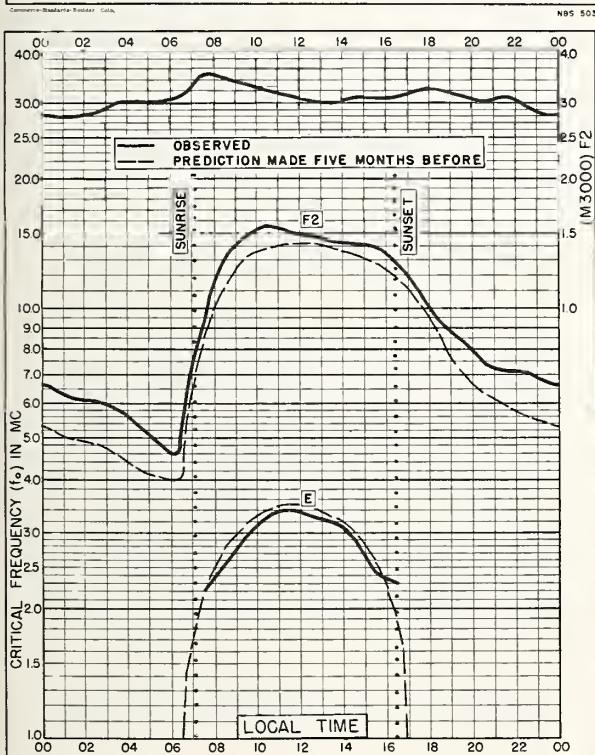
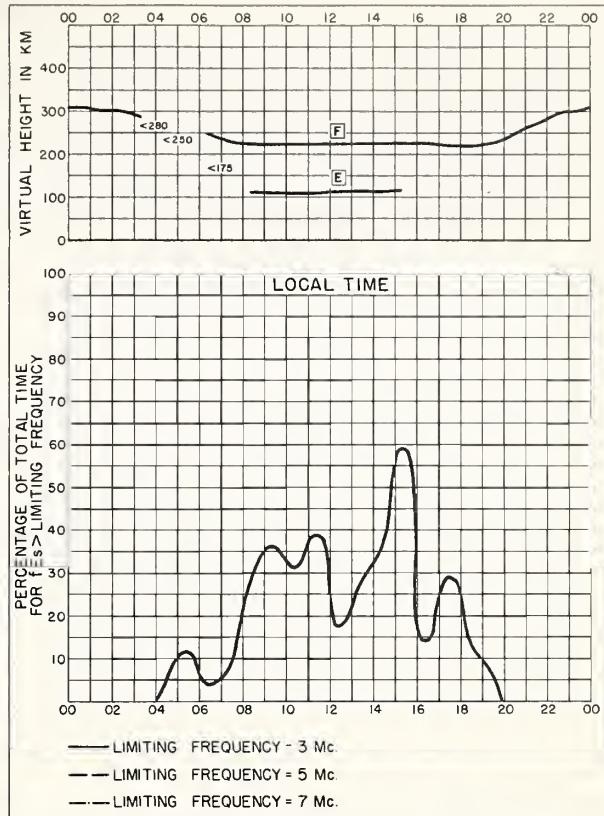
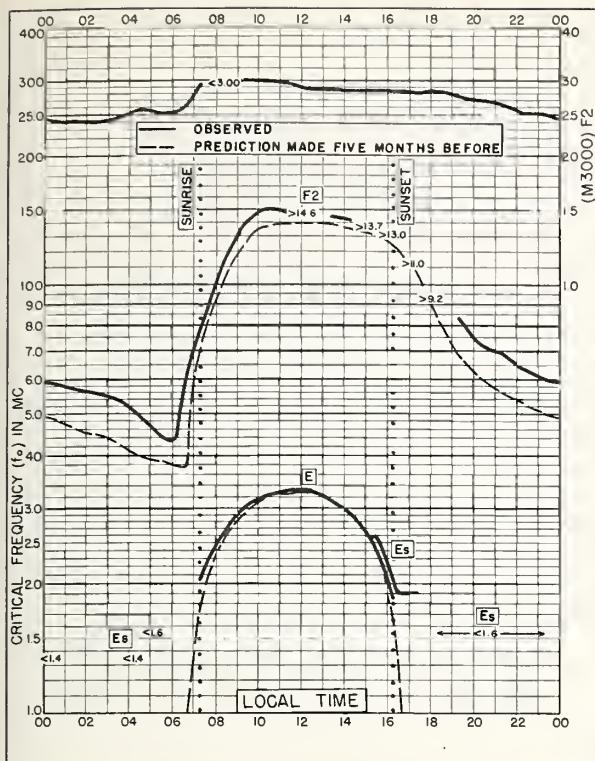


Fig. 96. SLOUGH, ENGLAND NOVEMBER 1957



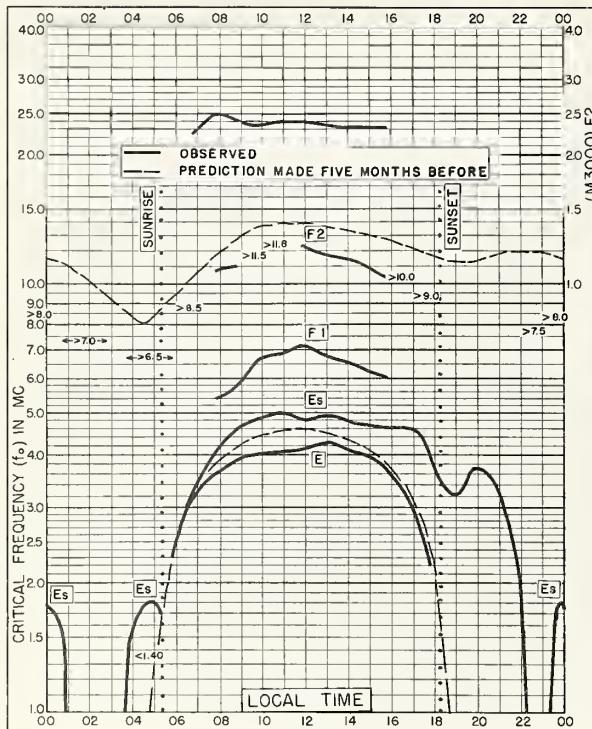
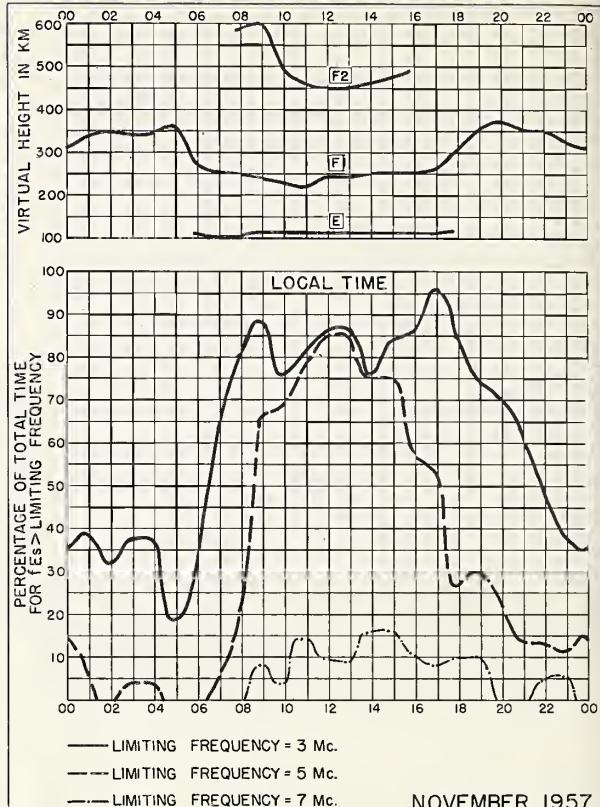


Fig. 101. TOWNSVILLE, AUSTRALIA  
19.3°S, 146.7°E NOVEMBER 1957



NOVEMBER 1957  
Fig. 102. TOWNSVILLE, AUSTRALIA

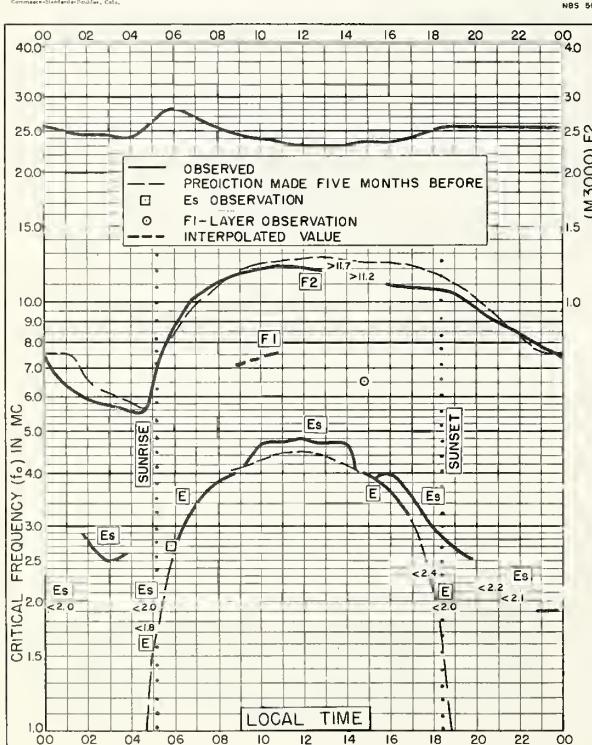
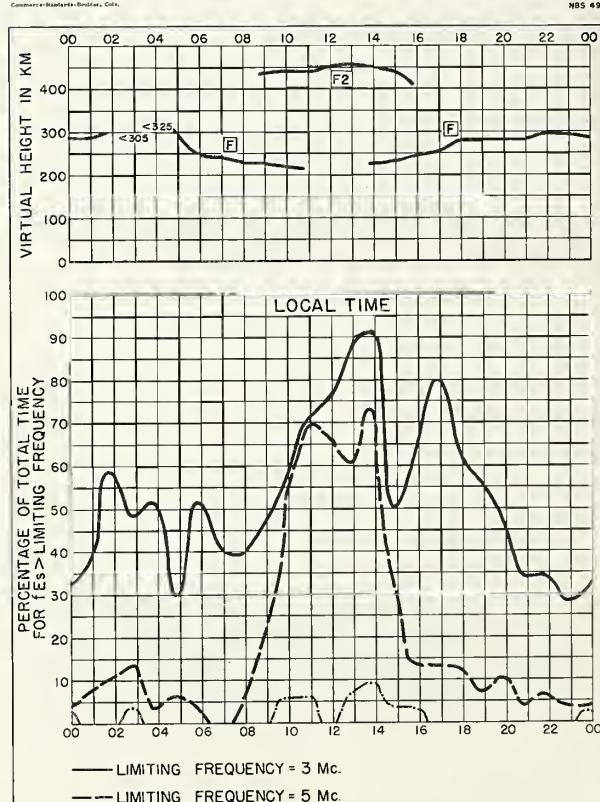


Fig. 103. JOHANNESBURG, UNION OF S. AFRICA  
26.2°S, 28.0°E NOVEMBER 1957



NOVEMBER 1957  
Fig. 104. JOHANNESBURG, UNION OF S. AFRICA

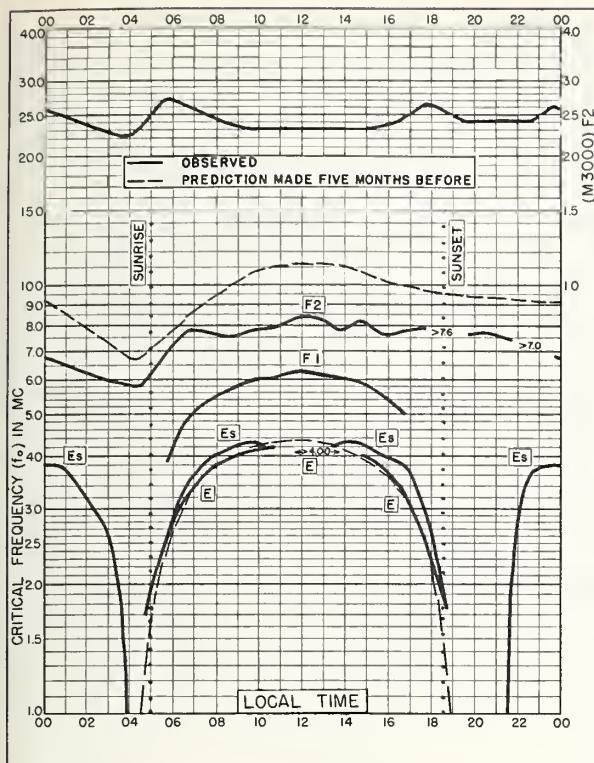


Fig. 105. WATHEROO, W. AUSTRALIA  
30.3°S, 115.9°E NOVEMBER 1957

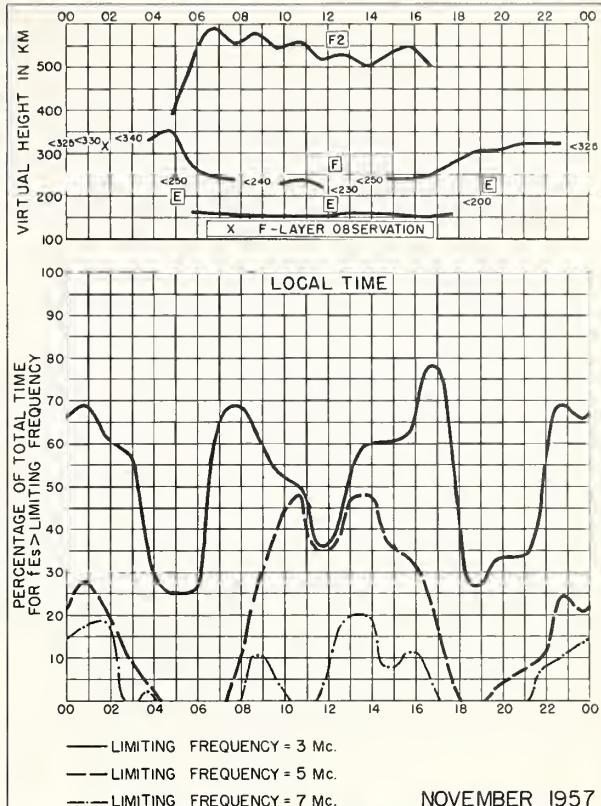


Fig. 106. WATHEROO, W. AUSTRALIA

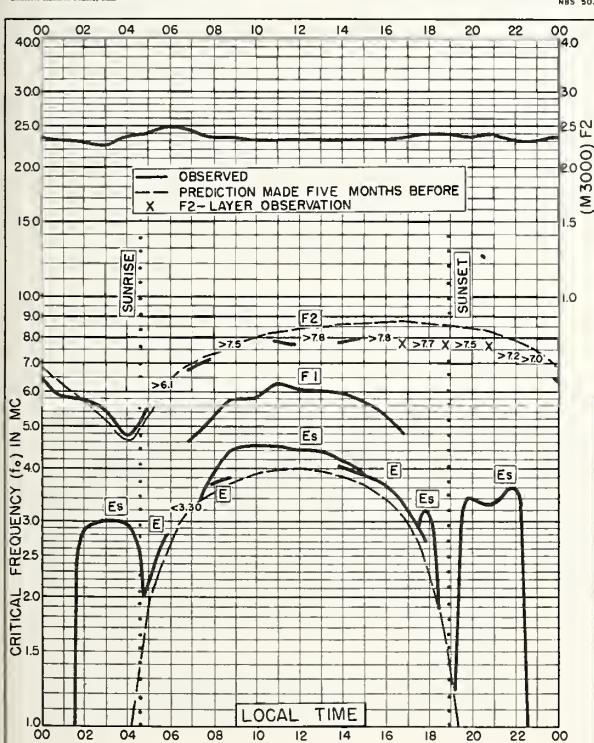


Fig. 107. HOBART, TASMANIA  
42.9°S, 147.2°E NOVEMBER 1957

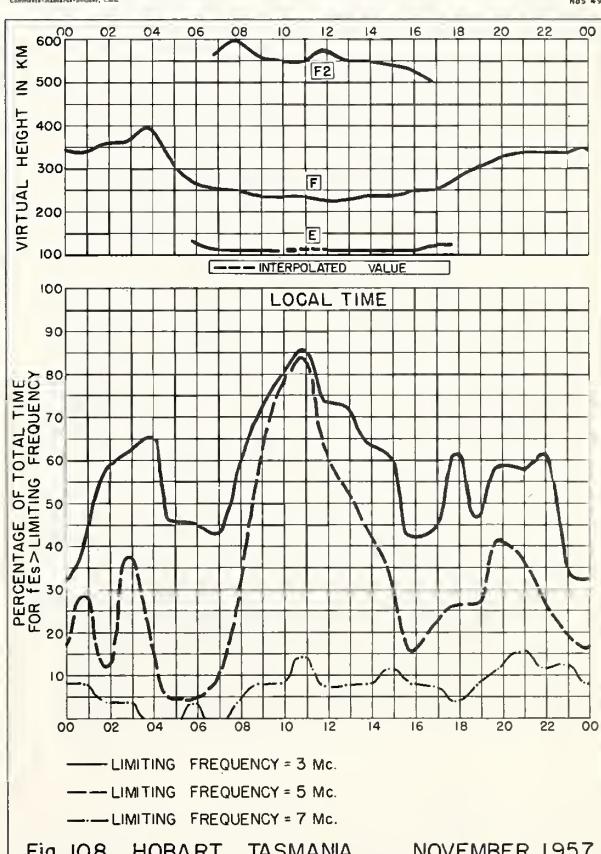


Fig. 108. HOBART, TASMANIA NOVEMBER 1957

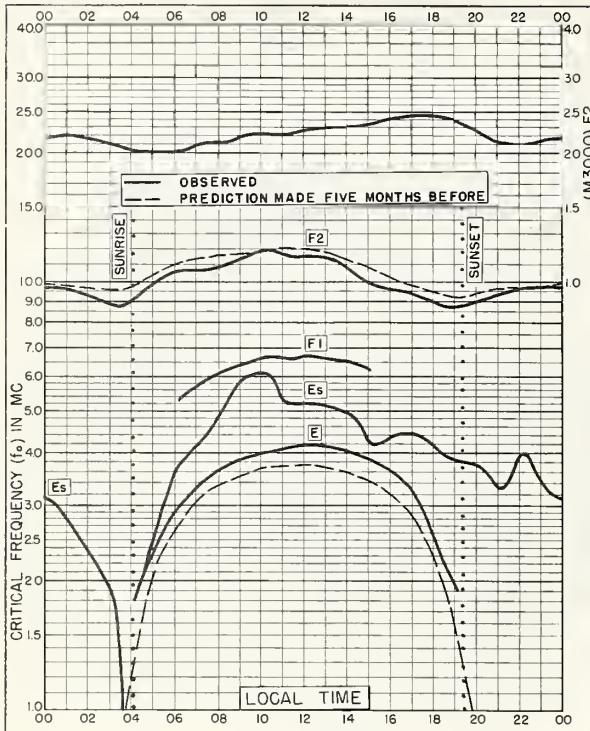


Fig. 109. FALKLAND IS.  
51.7°S, 57.8°W NOVEMBER 1957

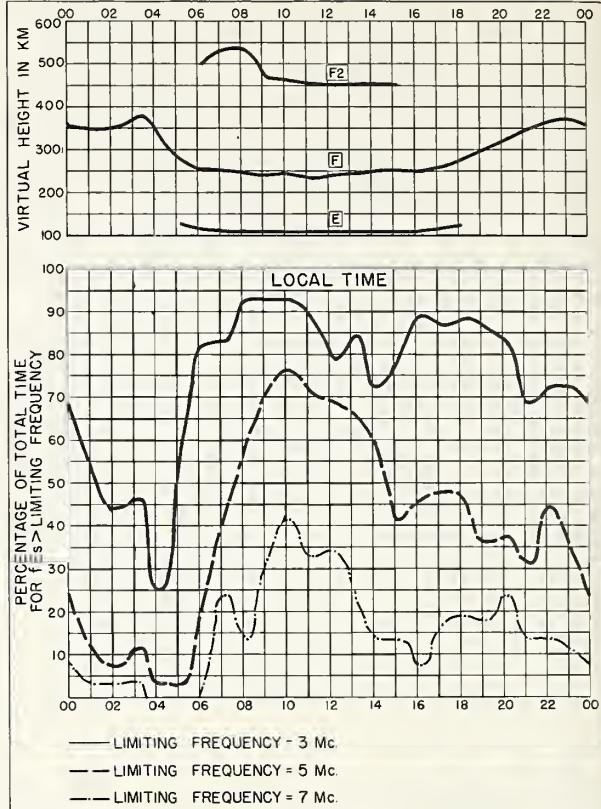


Fig. 110. FALKLAND IS. NOVEMBER 1957

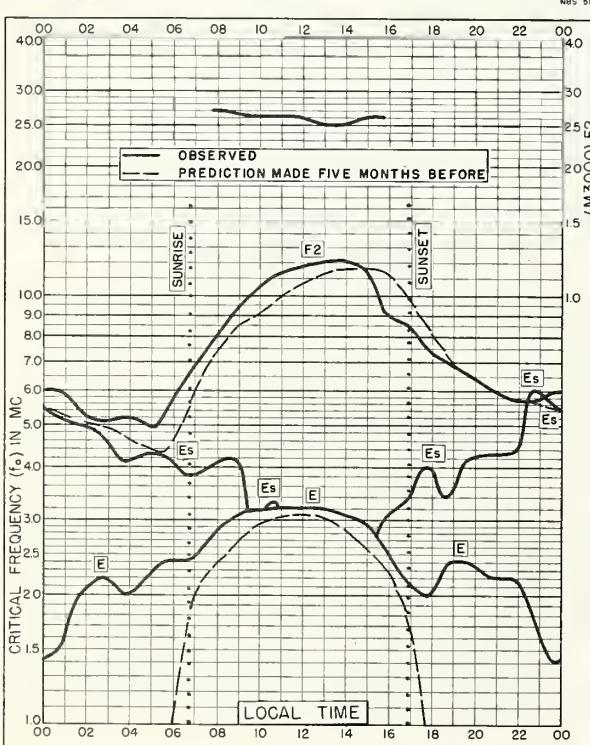


Fig. 111. CHURCHILL, CANADA  
58.8°N, 94.2°W OCTOBER 1957

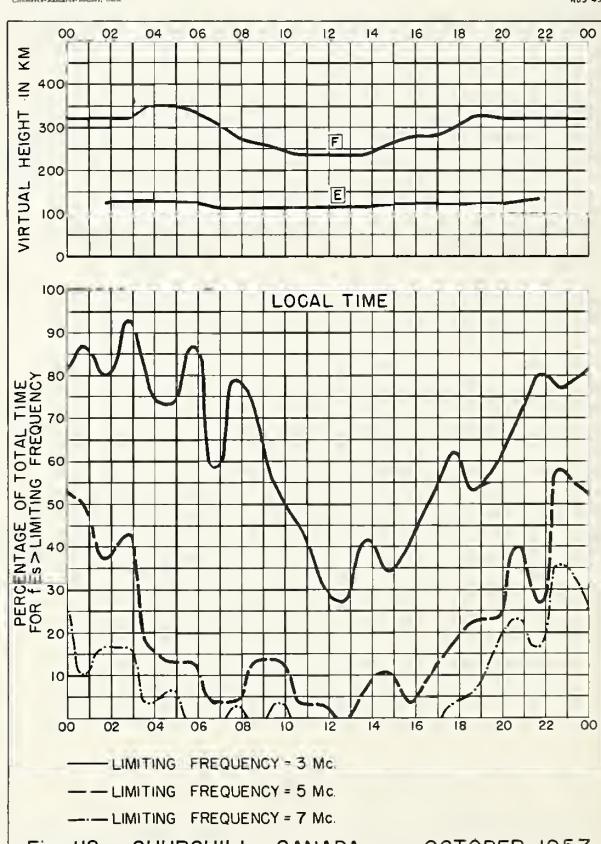
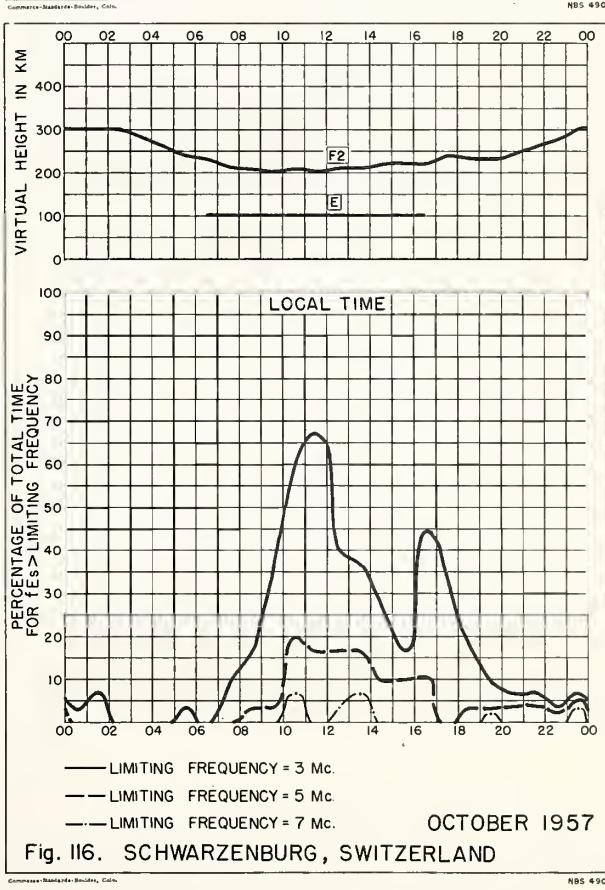
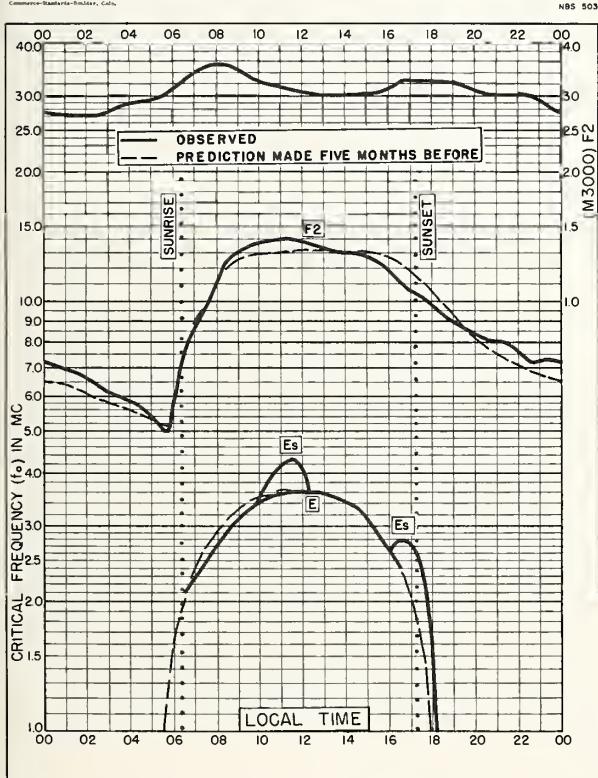
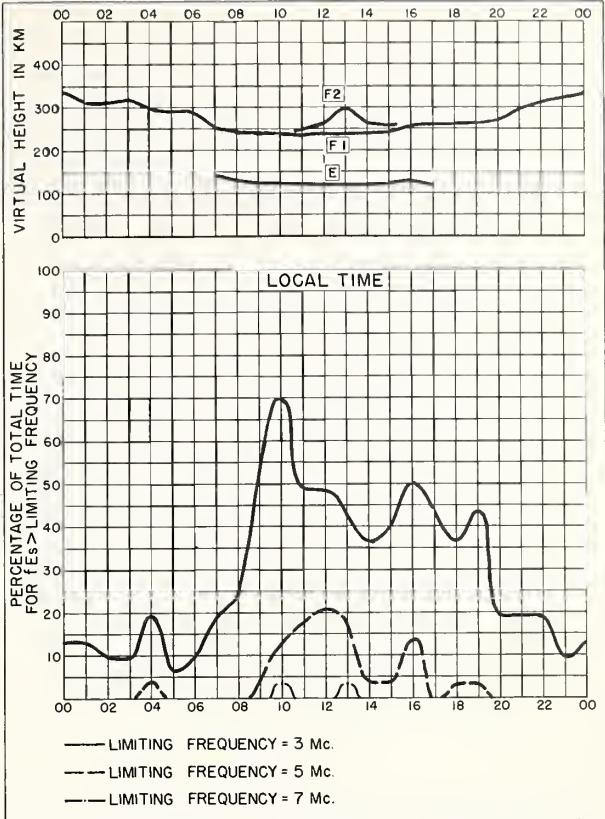
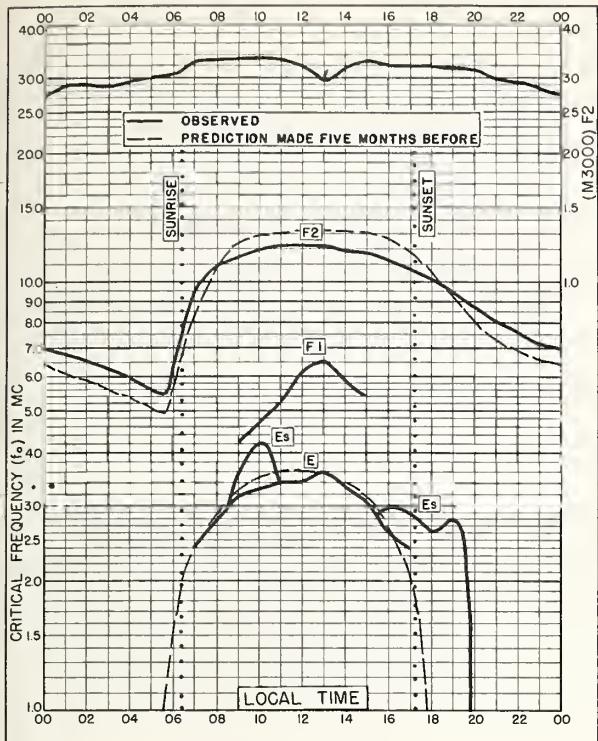


Fig. 112. CHURCHILL, CANADA OCTOBER 1957



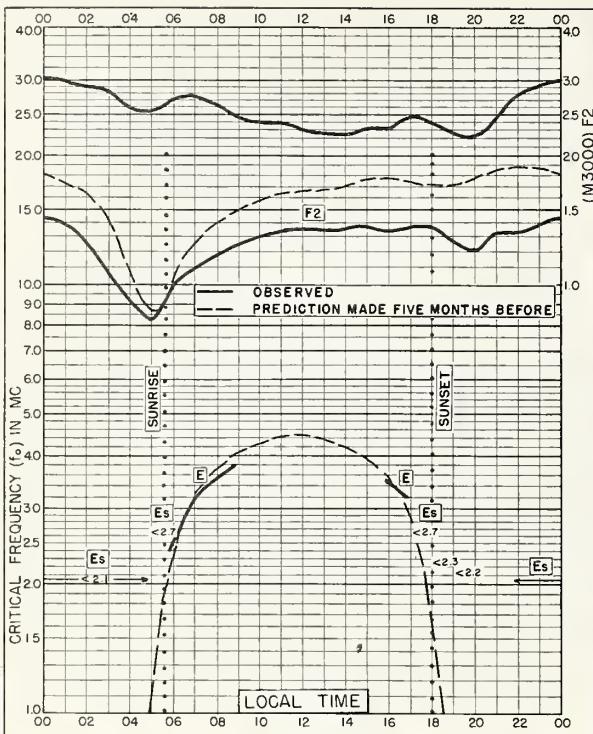


Fig. 117. SAO PAULO, BRAZIL  
23.5°S, 46.5°W OCTOBER 1957

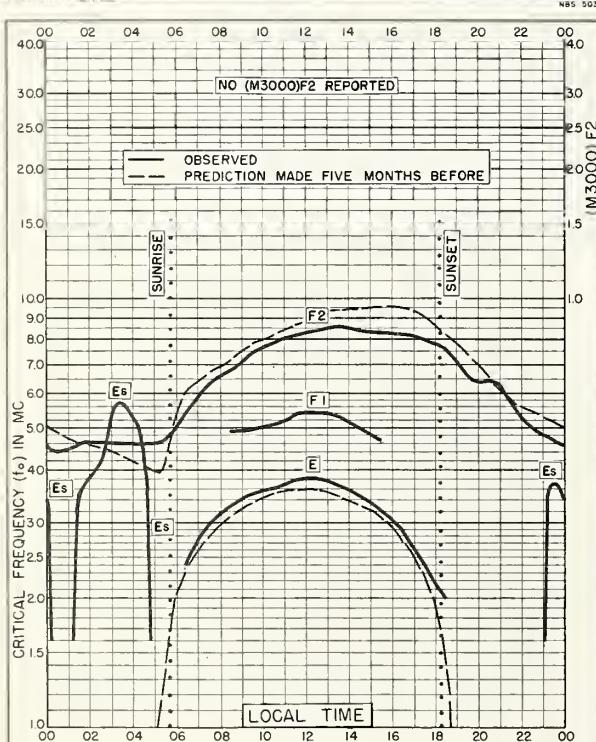
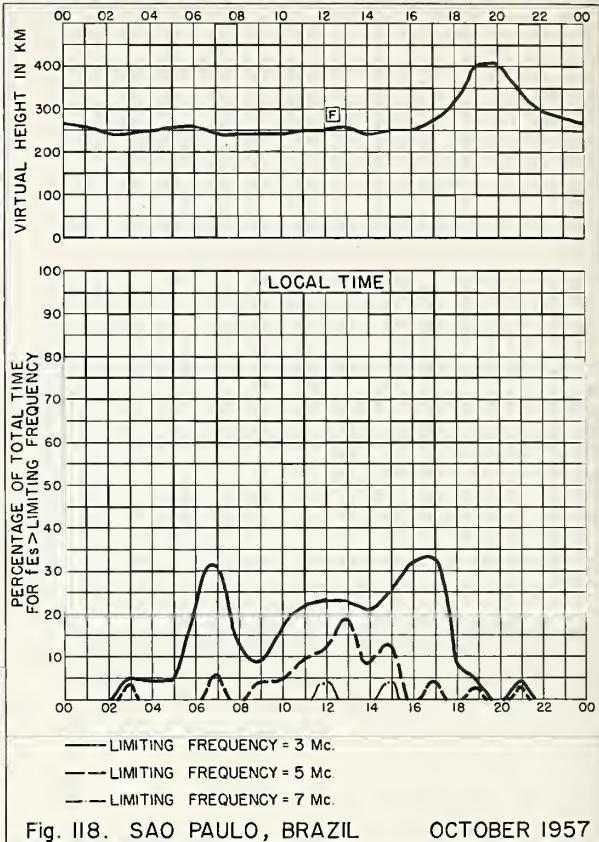
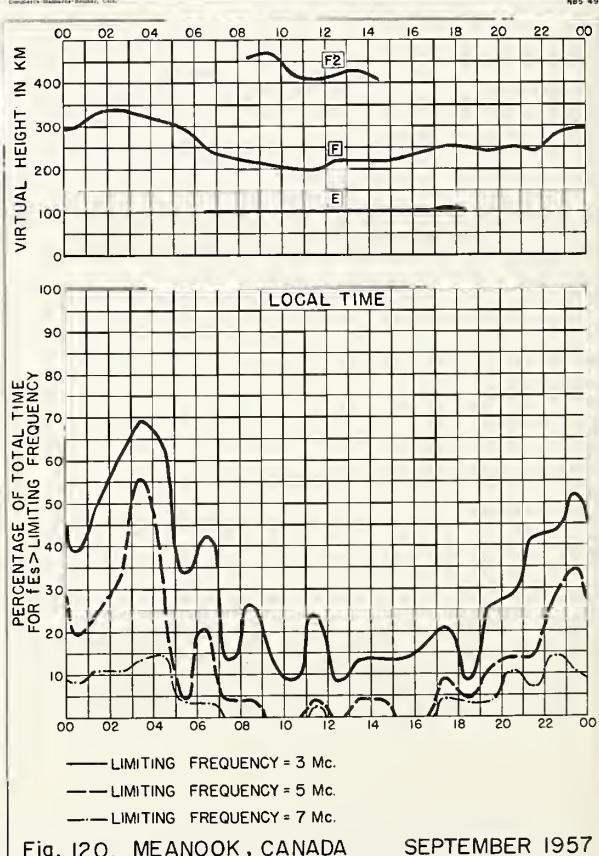


Fig. 119. MEANOOK, CANADA  
54.6°N, 113.3°W SEPTEMBER 1957



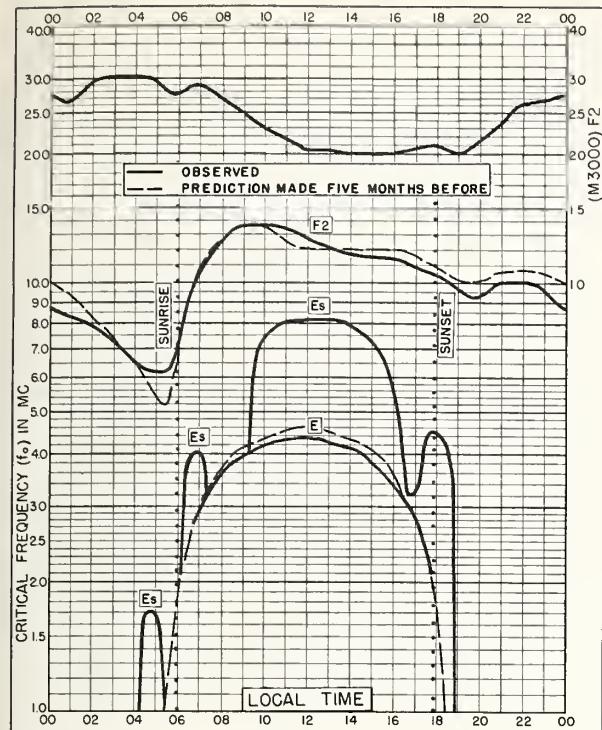


Fig. I21. CHIMBOTE, PERU

9.1°S, 78.6°W

SEPTEMBER 1957

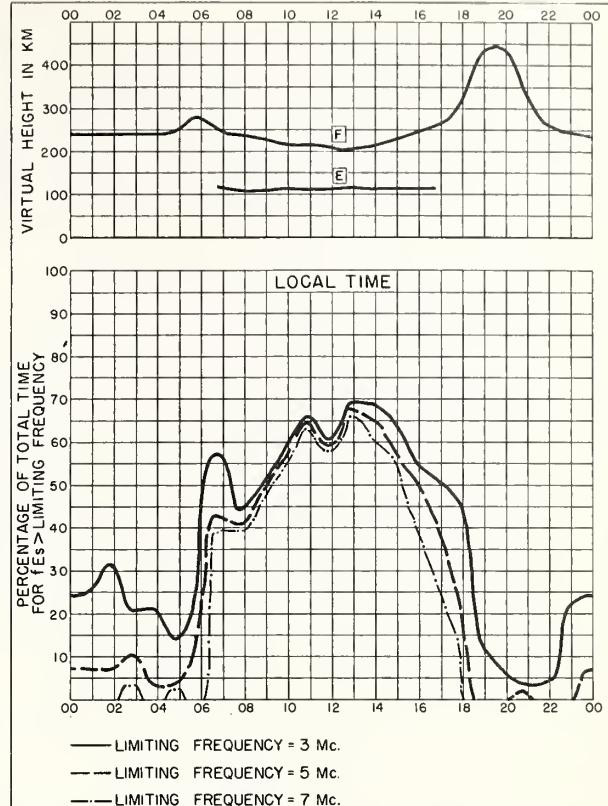


Fig. I22. CHIMBOTE, PERU

SEPTEMBER 1957

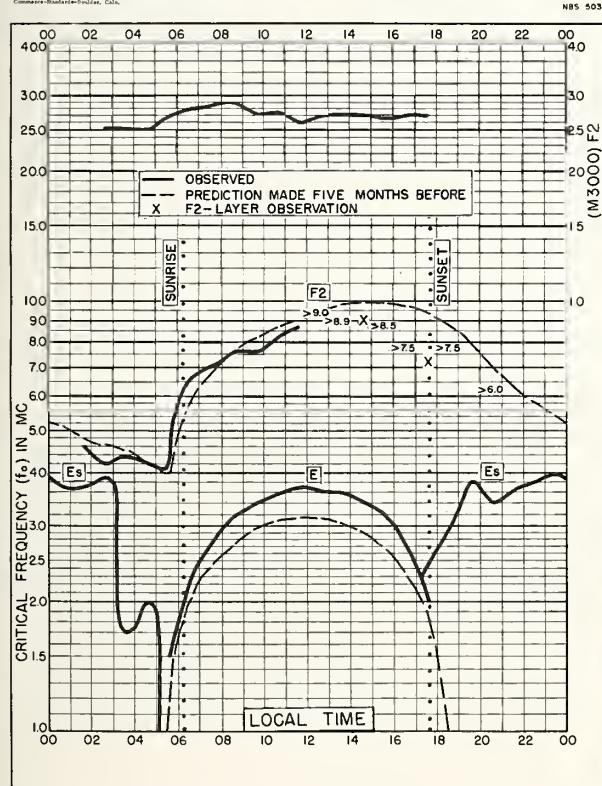


Fig. I23. MACQUARIE I.

54.5°S, 159.0°E

SEPTEMBER 1957

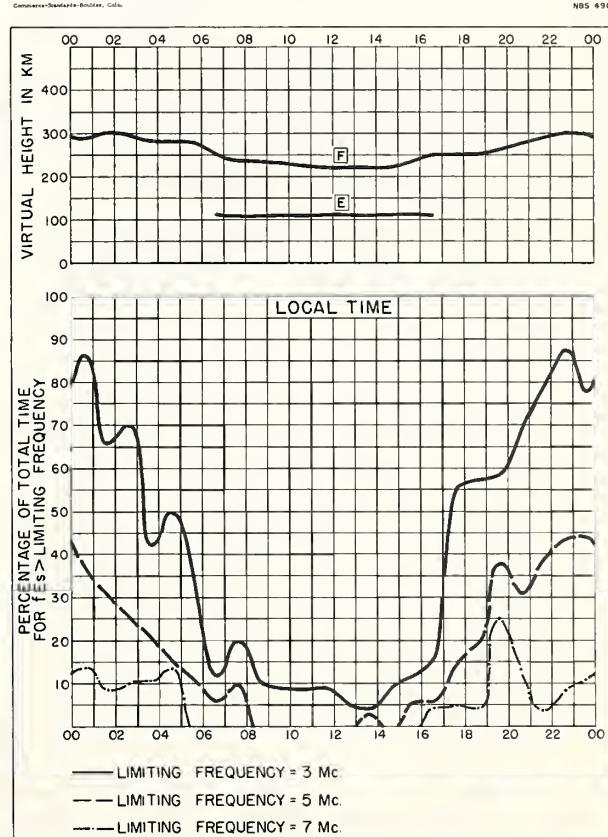
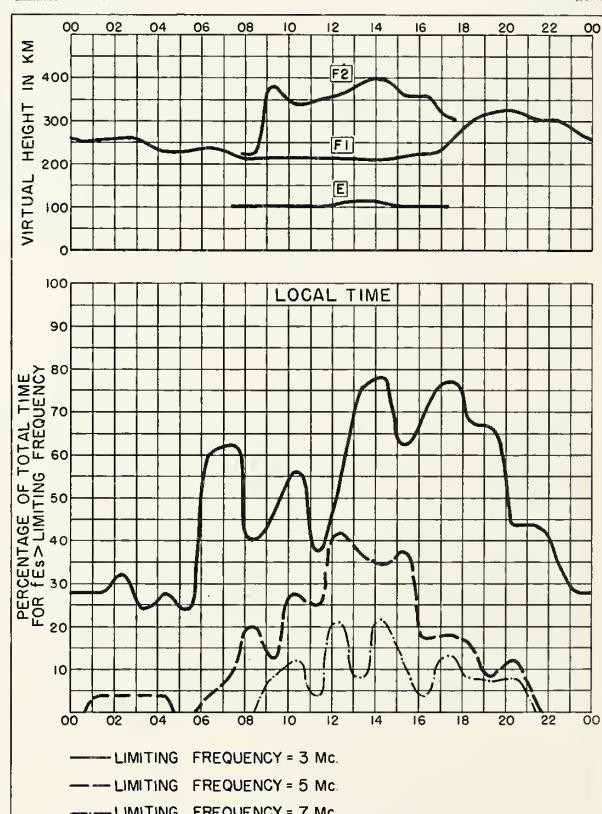
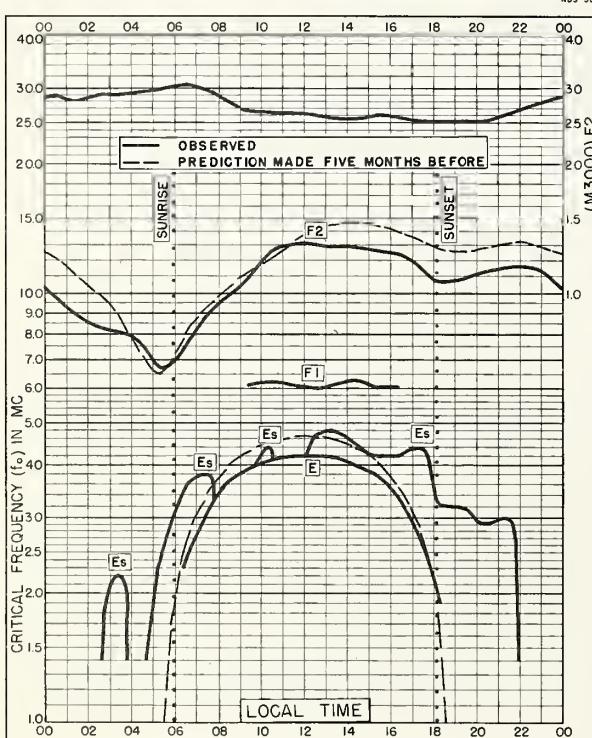
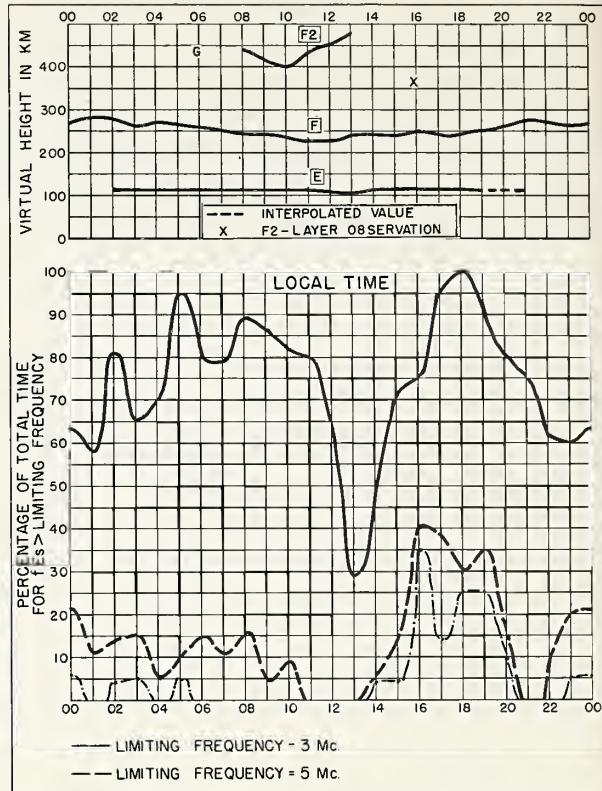
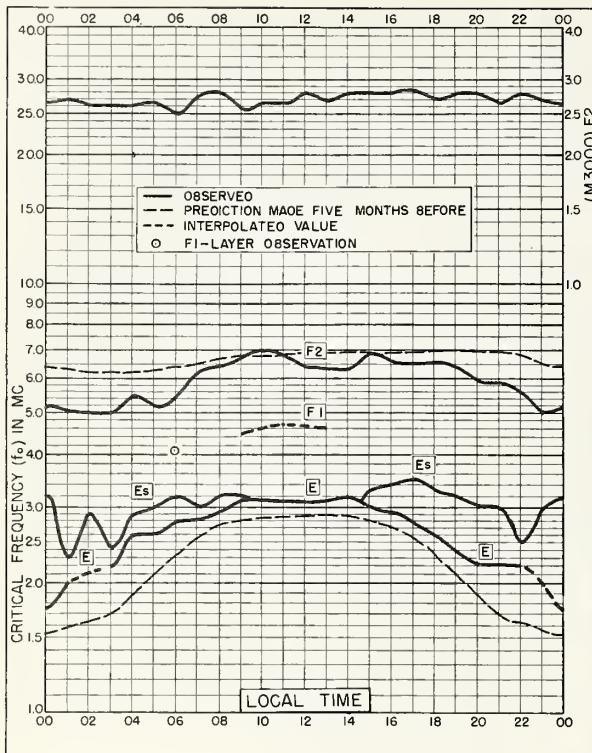


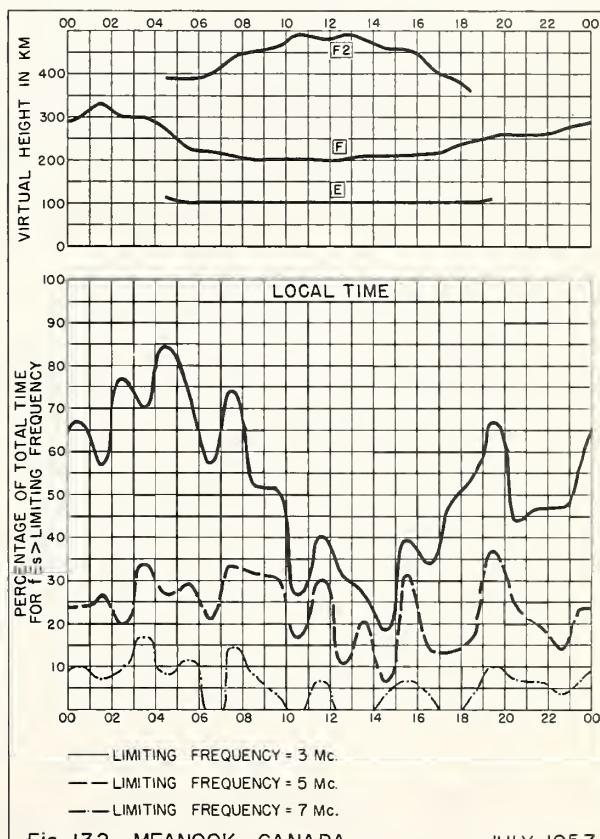
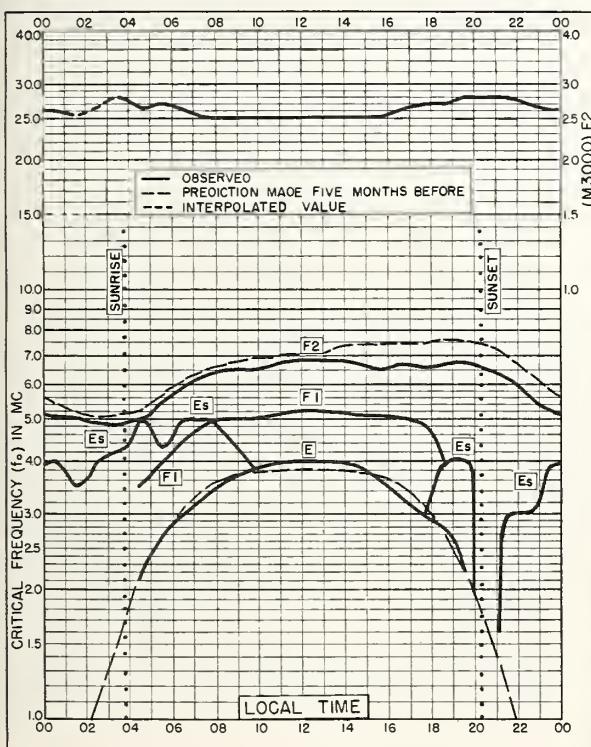
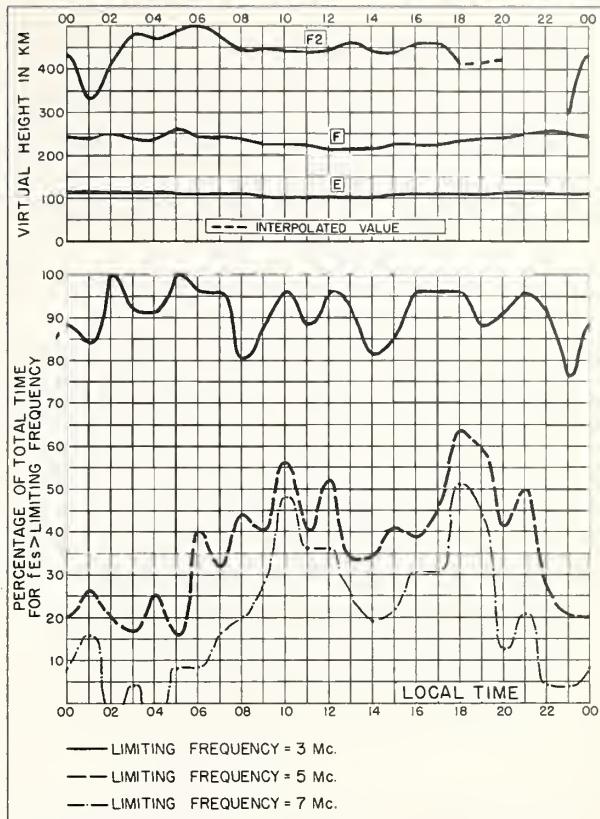
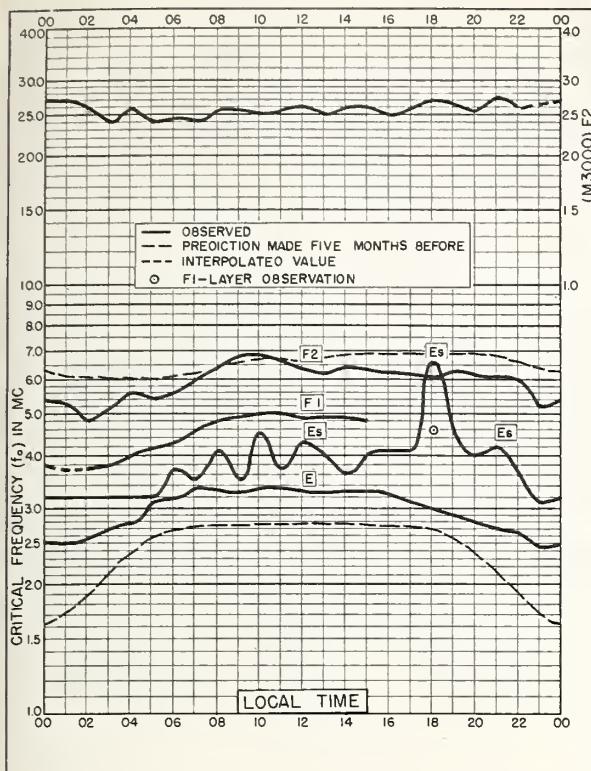
Fig. I24. MACQUARIE I.

SEPTEMBER 1957

NBS 503

NBS 490





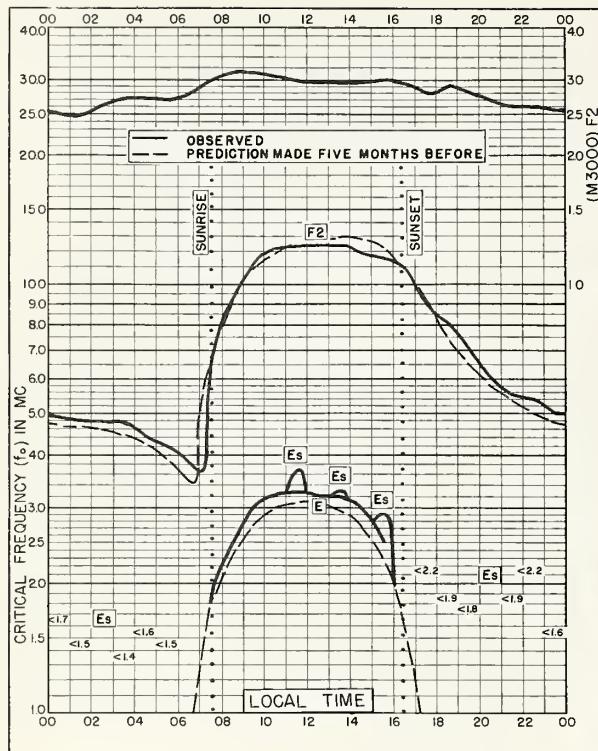


Fig. 133. CHRISTCHURCH, NEW ZEALAND  
43.6°S, 172.8°E JUNE 1957

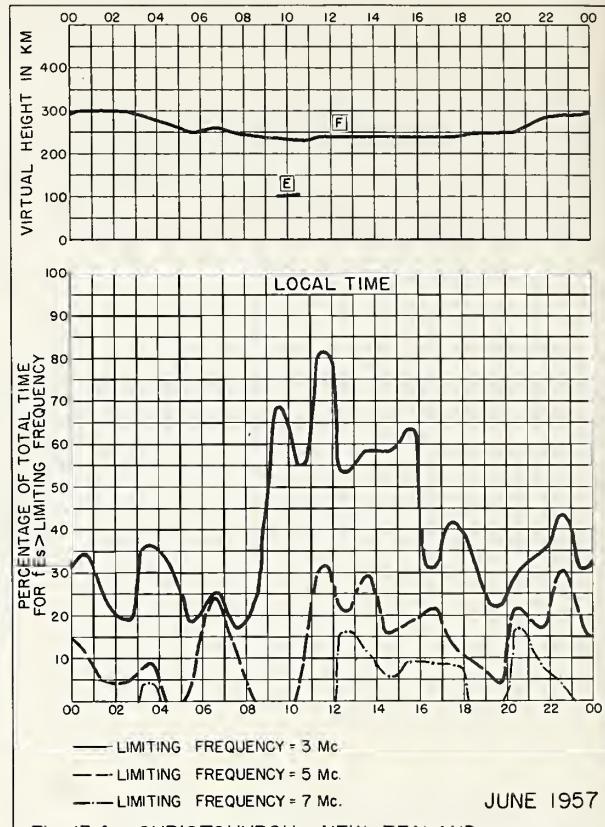


Fig. 134. CHRISTCHURCH, NEW ZEALAND

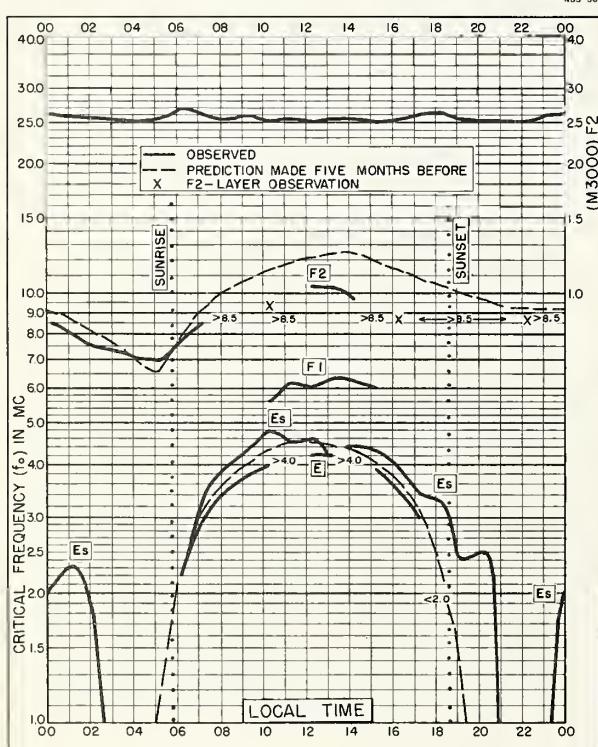


Fig. 135. BRISBANE, AUSTRALIA  
27.5°S, 152.9°E FEBRUARY 1957

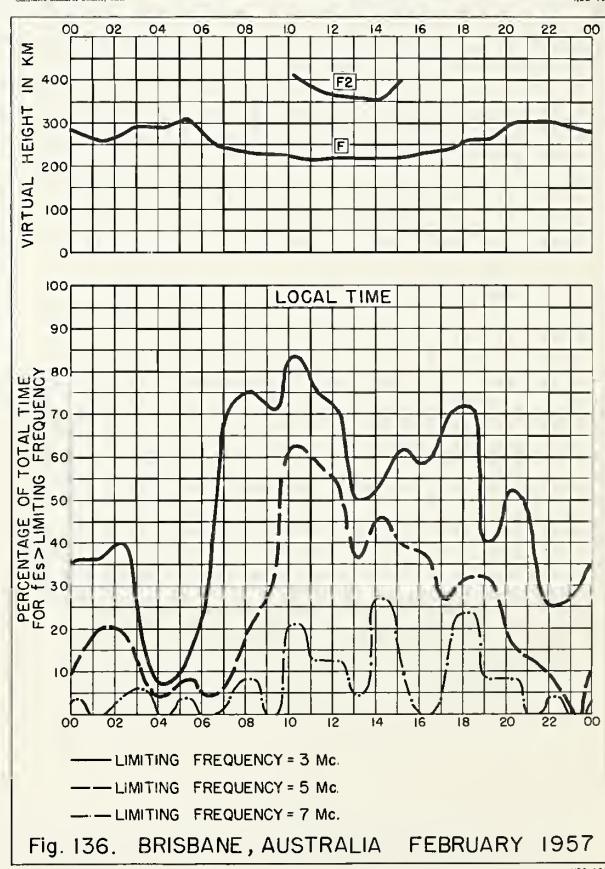
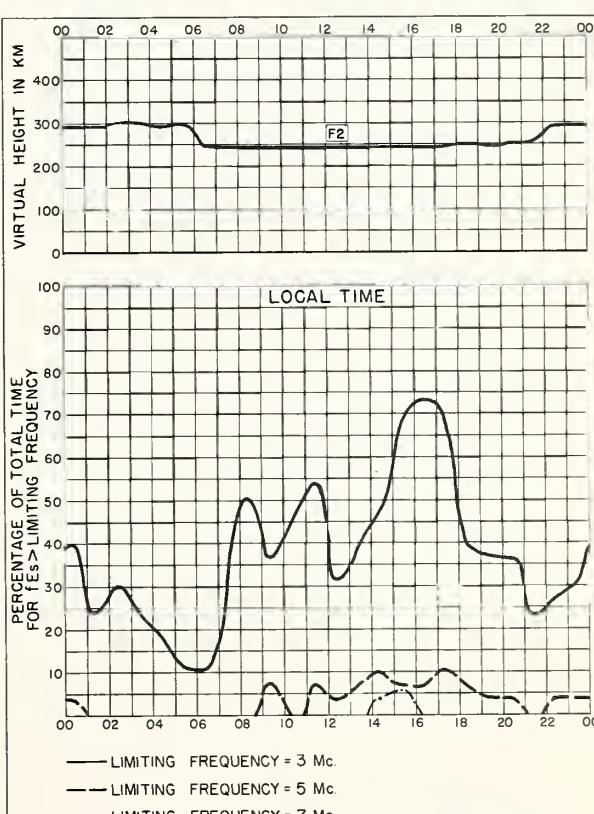
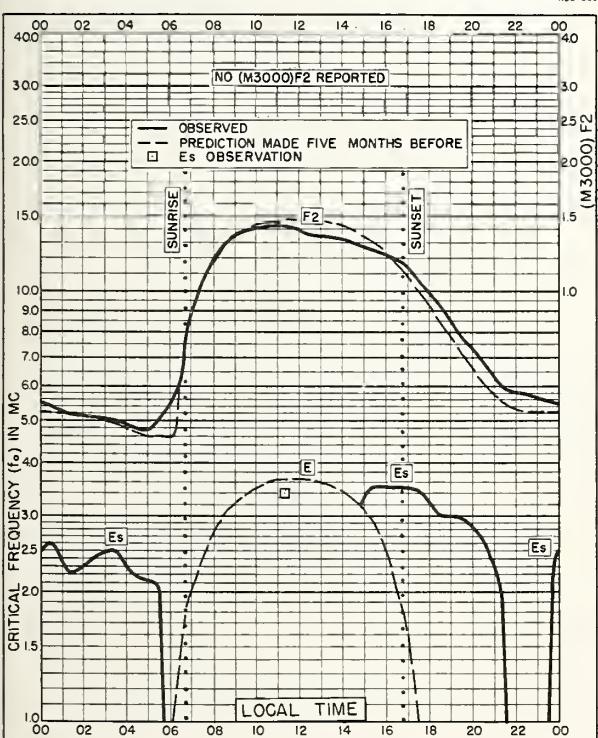
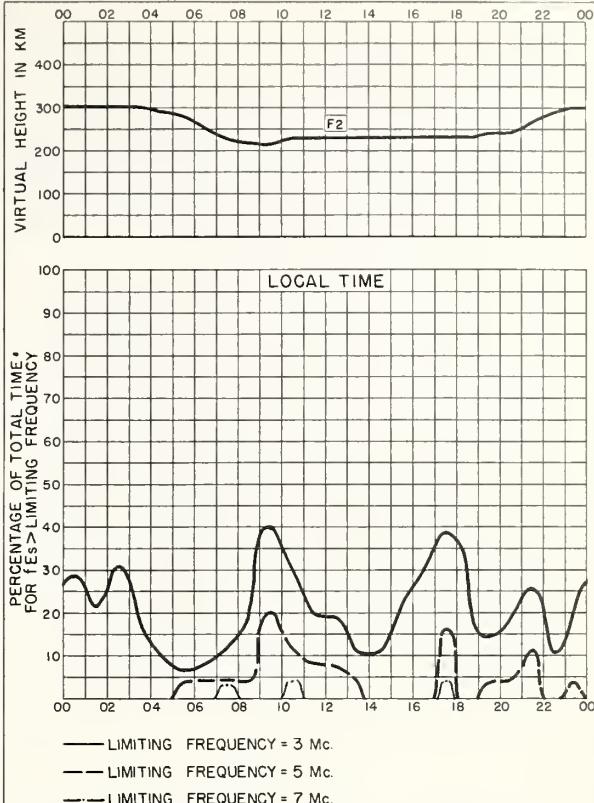
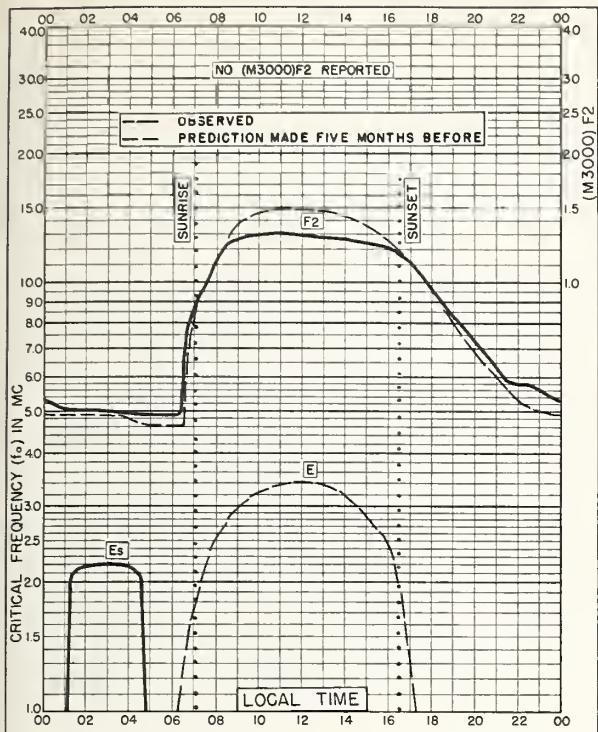


Fig. 136. BRISBANE, AUSTRALIA FEBRUARY 1957



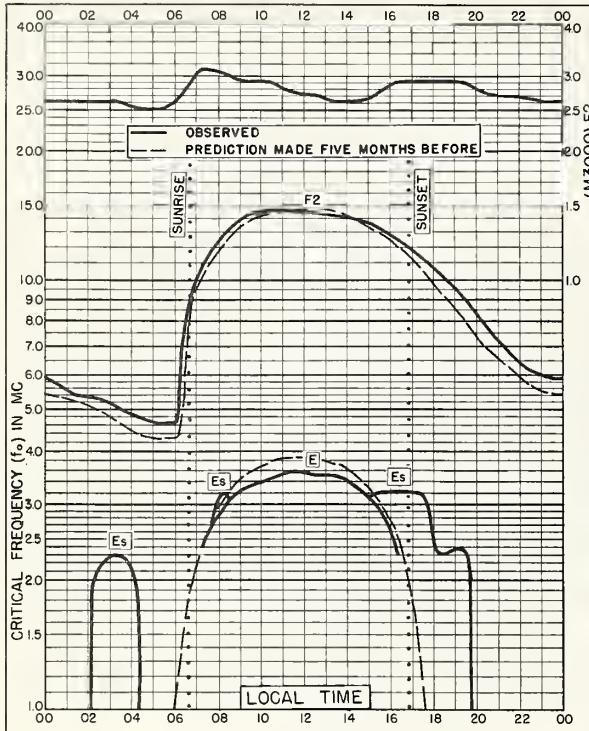


Fig. 141. TOKYO, JAPAN  
35.7°N, 139.5°E NOVEMBER 1956

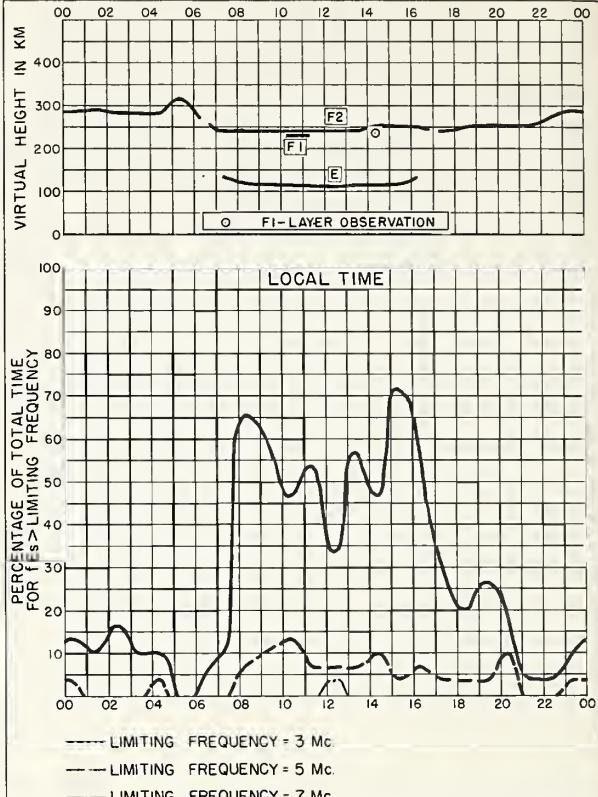


Fig. 142. TOKYO, JAPAN NOVEMBER 1956

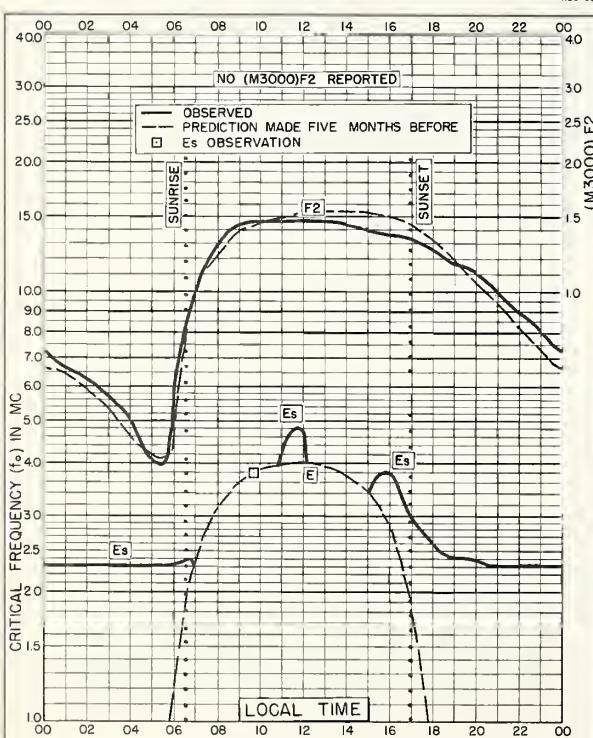


Fig. 143. YAMAGAWA, JAPAN  
31.2°N, 130.6°E NOVEMBER 1956

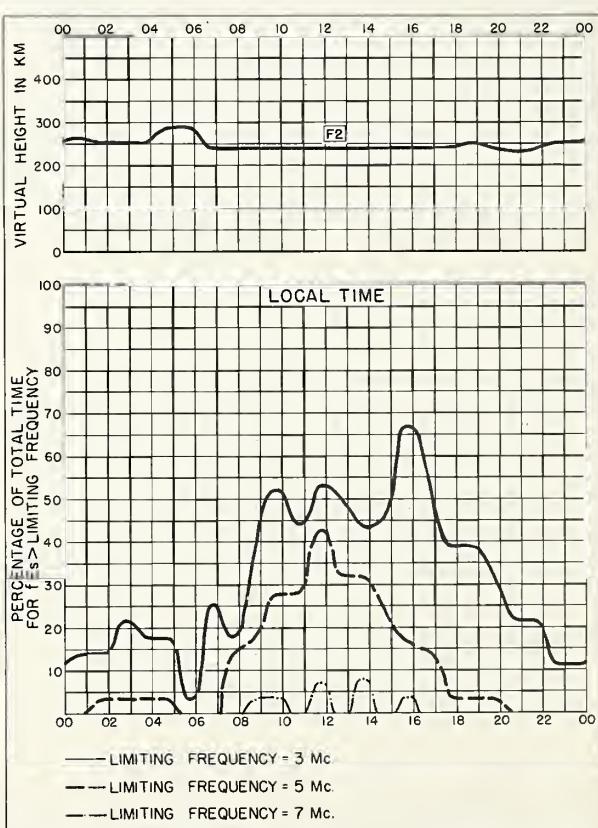


Fig. 144. YAMAGAWA, JAPAN NOVEMBER 1956

Index of Tables and Graphs of Ionospheric Data

in CRPL-F 166 (Part A)

	<u>Table page</u>	<u>Figure page</u>
Adak, Alaska		
February 1958 . . . . .	1	13
January 1958. . . . .	3	19
Akita, Japan		
December 1957 . . . . .	6	29
November 1956 . . . . .	12	47
Baguio, P. I.		
December 1957 . . . . .	6	30
Baker Lake, Canada		
January 1958. . . . .	2	17
Brisbane, Australia		
February 1957 . . . . .	12	46
Budapest, Hungary		
October 1957. . . . .	10	41
Bunia, Belgian Congo		
December 1957 . . . . .	7	31
Campbell I.		
December 1957 . . . . .	8	35
Canberra, Australia		
December 1957 . . . . .	8	34
Capetown, Union of S. Africa		
January 1958. . . . .	4	24
December 1957 . . . . .	7	33
Chimbote, Peru		
September 1957. . . . .	11	43
Christchurch, New Zealand		
June 1957 . . . . .	12	46
Churchill, Canada		
January 1958. . . . .	2	18
December 1957 . . . . .	5	26
October 1957. . . . .	10	40
De Bilt, Holland		
January 1958. . . . .	3	19
November 1957 . . . . .	8	36
Dourbes, Belgium		
November 1957 . . . . .	9	37
Falkland Is.		
December 1957 . . . . .	8	34
November 1957 . . . . .	10	40
Hobart, Tasmania		
November 1957 . . . . .	9	39
Inverness, Scotland		
December 1957 . . . . .	5	27

Index (CRPL-F166 (Part A), continued)

	<u>Table page</u>	<u>Figure page</u>
Johannesburg, Union of S. Africa		
January 1958. . . . .	4	24
December 1957 . . . . .	7	32
November 1957 . . . . .	9	38
Kiruna, Sweden		
January 1958. . . . .	2	16
December 1957 . . . . .	5	25
Leopoldville, Belgian Congo		
December 1957 . . . . .	7	31
Lycksele, Sweden		
December 1957 . . . . .	5	26
Macquarie I.		
September 1957. . . . .	11	43
Maui, Hawaii		
February 1958 . . . . .	1	15
January 1958. . . . .	4	22
Meanook, Canada		
September 1957. . . . .	10	42
July 1957 . . . . .	11	45
Narsarssuak, Greenland		
January 1958. . . . .	2	17
Nurmijarvi, Finland		
January 1958. . . . .	2	18
November 1957 . . . . .	8	35
Ottawa, Canada		
January 1958. . . . .	3	21
December 1957 . . . . .	5	27
Panama Canal Zone		
January 1958. . . . .	4	23
Paramaribo, Surinam		
August 1957 . . . . .	11	44
Resolute Bay, Canada		
January 1958. . . . .	1	15
Rome, Italy		
January 1958. . . . .	3	21
St. John's, Newfoundland		
January 1958. . . . .	3	20
Sao Paulo, Brazil		
December 1957 . . . . .	7	32
October 1957. . . . .	10	42
Schwarzenburg, Switzerland		
November 1957 . . . . .	9	37
October 1957. . . . .	10	41
Scott Base		
January 1958. . . . .	5	25
Slough, England		
November 1957 . . . . .	8	36

Index (CRPL-F166 (Part A), concluded)

	<u>Table page</u>	<u>Figure page</u>
Svalbard, Norway		
August 1957 . . . . .	11	44
July 1957 . . . . .	11	45
Talara, Peru		
January 1958. . . . .	4	23
Tokyo, Japan		
December 1957 . . . . .	6	29
November 1956 . . . . .	12	48
Tortosa, Spain		
December 1957 . . . . .	6	28
Townsville, Australia		
November 1957 . . . . .	9	38
Tromso, Norway		
January 1958. . . . .	2	16
Wakkanai, Japan		
December 1957 . . . . .	6	26
November 1956 . . . . .	12	47
Washington, D. C.		
March 1958. . . . .	1	13
February 1958 . . . . .	1	14
January 1958. . . . .	4	22
Watheroo, W. Australia		
December 1957 . . . . .	7	33
November 1957 . . . . .	9	39
Winnipeg, Canada		
February 1958 . . . . .	1	14
January 1958. . . . .	3	20
Yamagawa, Japan		
December 1957 . . . . .	6	30
November 1956 . . . . .	12	48



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