REPORT CRPL-1-2, 3-1

ISSUED DECEMBER 23, 1947



U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
CENTRAL RADIO PROPAGATION LABORATORY
WASHINGTON, D. C.

# HIGH FREQUENCY RADIO PROPAGATION CHARTS FOR SUNSPOT MINIMUM AND SUNSPOT MAXIMUM

PREPARED FOR THE PROVISIONAL FREQUENCY BOARD,
INTERNATIONAL TELECOMMUNICATIONS UNION

Report No.
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CENTRAL RADIO PROPAGATION LABORATORY
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# HIGH-FREQUENCY RADIO PROPAGATION CHARTS

# FOR SUNSPOT MINIMUM AND SUNSPOT MAXIMUM

(Prepared for the Provisional Frequency Board, International Telecommunications Union)

The high-frequency radio propagation charts given in this report were prepared primarily for the use of the Provisional Frequency Board in allocating frequencies in the range 3 to 30 megacycles, with due consideration to possibilities of simultaneous and non-simultaneous sharing of frequencies.

The zero-muf and 4000-muf charts of Figs. 133 to 156 are included to aid in determining the highest muf (maximum usable frequency) for sunspot maximum and the lowest muf for sunspot minimum for any given path. These charts will be of most use for circuits more than 4000 km in length, and are to be used with the world map (Fig. 163) and transverse graticule (Fig. 164), according to procedures given in the National Bureau of Standards Circular 465 "Instructions for the Use of Basic Radio Propagation Predictions." The muf graphs of Figs. 157 to 162 are presented to facilitate the calculations of highest muf and lowest muf for paths less than 4000 km in length, dependent only upon the zone (E, I, or W), the length of the path, and the latitude of the midpoint of the path.

The basic principles in allocating frequencies for a given path are to allocate one frequency low enough to clear the lowest muf (e.g. 85% of lowest muf) and one frequency high enough to make adequate use of the highest muf (e.g. between 40% and 70% of the highest muf) with, if necessary, one or more interpolated frequencies to insure reliable communication throughout the sunspot cycle. These principles are extended in detail in Atlantic City Document 547-R, "Report of the Propagation Group"; the percentages given in that document may, however, need to be reviewed and revised.

In many cases, the lowest useful high frequency (luhf) need not be calculated. Where necessary, it may be sufficient to calculate a small number of representative paths between regions, and the luhf limitations thus calculated applied to similar paths in or between the regions.

The field-intensity graphs of Figs. 1 to 108 are plotted on azimuthal equidistant projections centered at the stations, with azimuths given with reference to the subsolar point. On each chart a heavy dashed line indicates the day-night line. The intensities were calculated by standard methods (c.f. IRPL Radio Propagation Handbook, Part I) except for certain modifications at the lower frequencies to take account of E-layer propagation.

In the case of 3 and 5 Mc, absorption values appropriate to E-layer propagation were used, as obtained from the U.S. Signal Corps Radio Propagation Unit Technical Report No. 6, March 1947, "Calculation of sky-wave field intensities, MUF, and LUHF." Also, to take account of E-layer effects, charts for 7 and 10 Mc at subsolar distances zero and 2500 km were modified in plotting; i.e., the field intensities were lowered to something under the values obtained by the standard method which ignores E-layer reflections.

These charts can be used to indicate, by inspection in a large number of cases, or by detailed examination in borderline cases, whether the field intensity of an undesired station will be great enough to cause serious interference; they may thus be used to investigate the possibility of simultaneous sharing. The charts show the worst (summer, sunspot minimum) and best (winter, sunspot maximum) cases, in regard to sharing.

Auxiliary graphs, Figs. 166 and 167, show seasonal corrections that may need to be applied. Fig. 166 presents corresponding winter and summer field intensities for a given frequency and various path lengths, and Fig. 167 presents winter and summer frequencies for a given field intensity. For example, the 7-Mc chart, summer, sunspot minimum (Fig. 27), shows a field intensity of 0.3 microvolt per meter at a distance of 8000 km, azimuth 140°. It is seen from Fig. 166 that the winter field intensity at 7 Mc will be 0.1 microvolt per meter, and from Fig. 167 that a frequency of 8.5 Mc is required to obtain the same field intensity in winter. For transequatorial paths, or for equinoctial conditions, the average of winter and summer values may be used. Thus, in the example above, the field intensity for 7 Mc at the equinox will be approximately 0.2 microvolt per meter, or the same field intensity will be obtained at 7.7 Mc.

Finally, the protection ratio graphs of Figs. 109 to 132 can be used to determine the interference range corresponding to a given service range and a given protection ratio M, which involves power, antenna gain, and type of service. M is given by:

$$M = R - G_w + G_u - G_r + P_u - P_w$$

where R = basic protection ratio, involving type of service, channel width, fading ratio, adjacent channel interference, etc.

- $G_w$ = power gain of wanted transmitting antenna.
- $G_u$ = power gain of unwanted transmitting antenna in direction of receiving station ( = 0 unless beam covers receiver).
- $G_r$ = power gain of receiving antenna in direction of wanted transmitter ( = 0 if beam covers both wanted and unwanted transmitter).

$P_w$ = power of wanted transmitting station (ratio to 1 kw).
$P_u$ = power of unwanted transmitting station (ratio to 1 kw).

All terms are logarithms of power ratios expressed in decibels. As an example of the use of these graphs, two circuits are compared to see whether the interference range of each transmitting station (for its respective service range) covers the other respective receiving station; if not, simultaneous operation is possible. Note that interference and service ranges are to be interchanged on these charts if M is negative.

Sunspot minimum and sunspot maximum charts in this report were prepared for sunspot numbers zero and 125 respectively.

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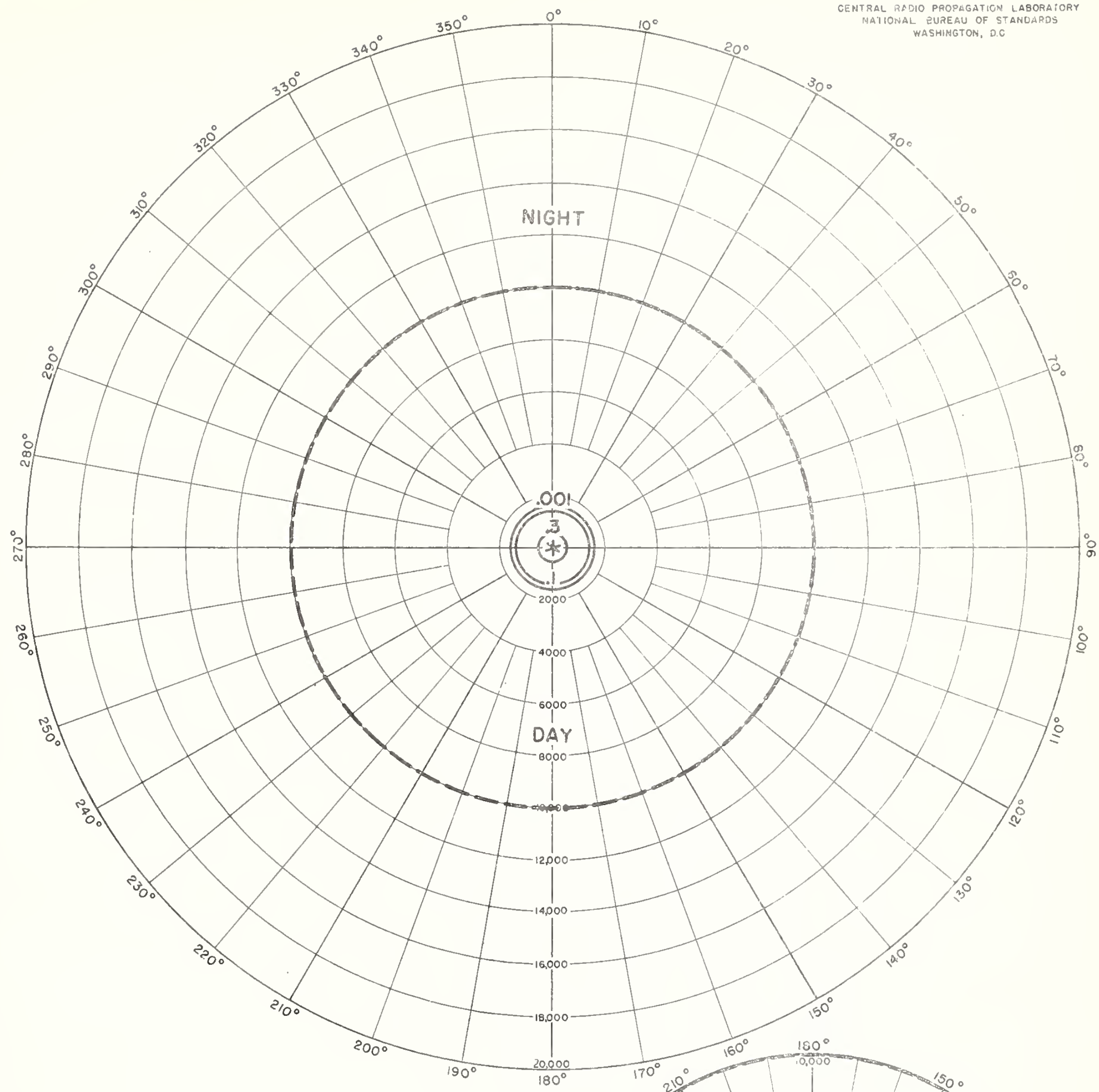
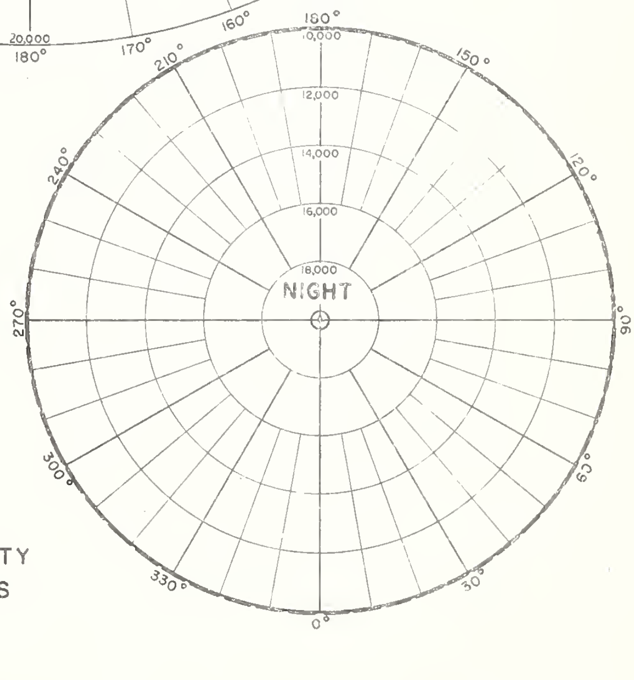



Fig. 1
FIELD INTENSITY, μv/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 0 km (0°)
SUNSPOT MINIMUM

✻ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

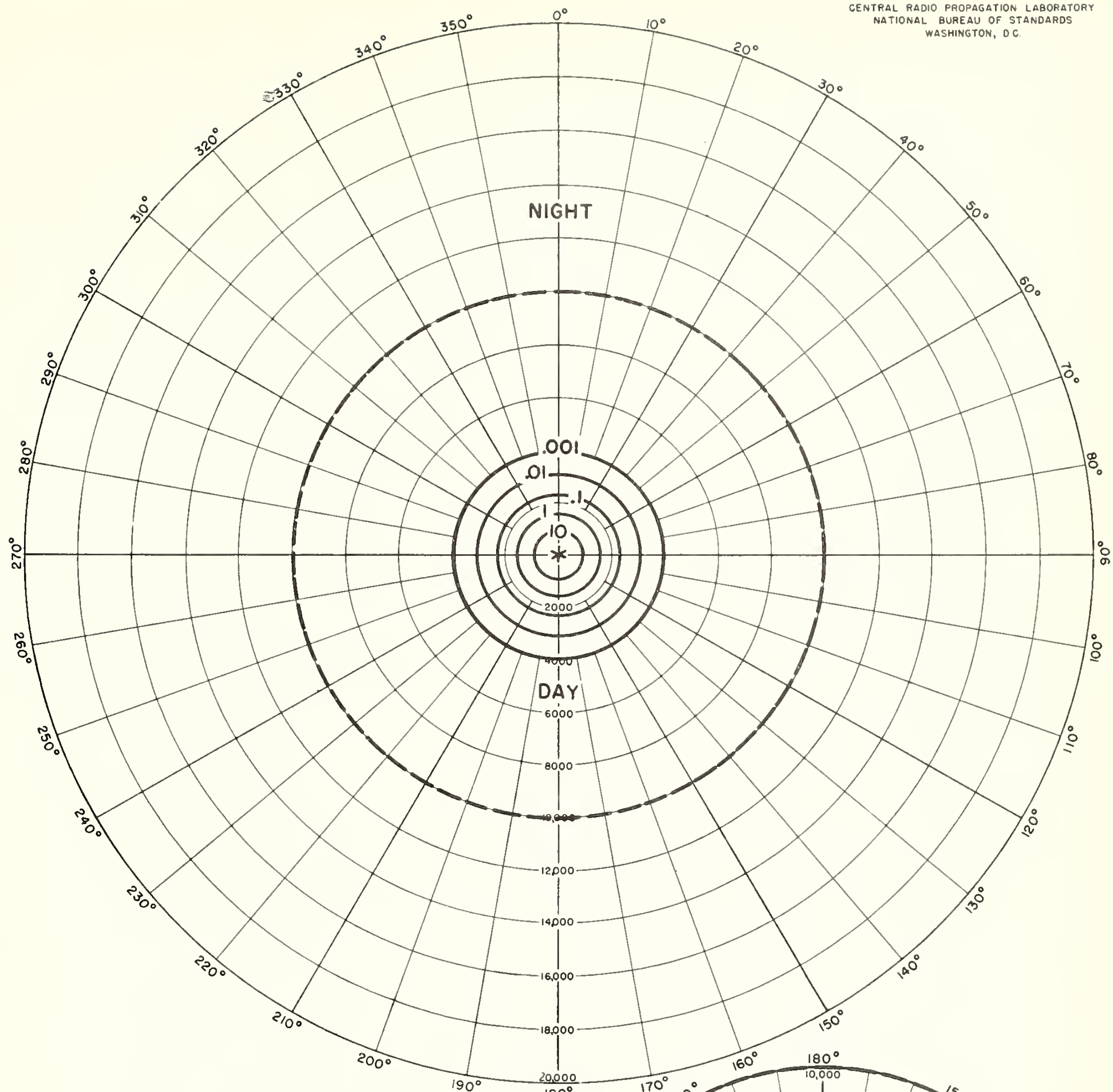
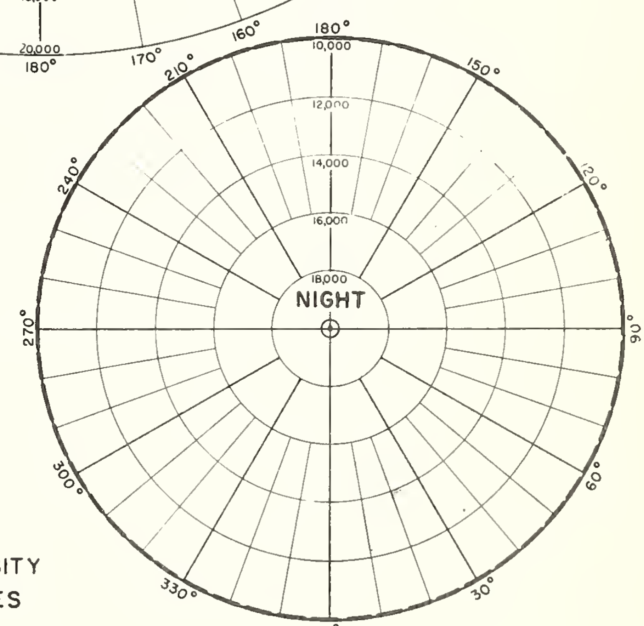



Fig. 2
FIELD INTENSITY, μv/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 0 km (0°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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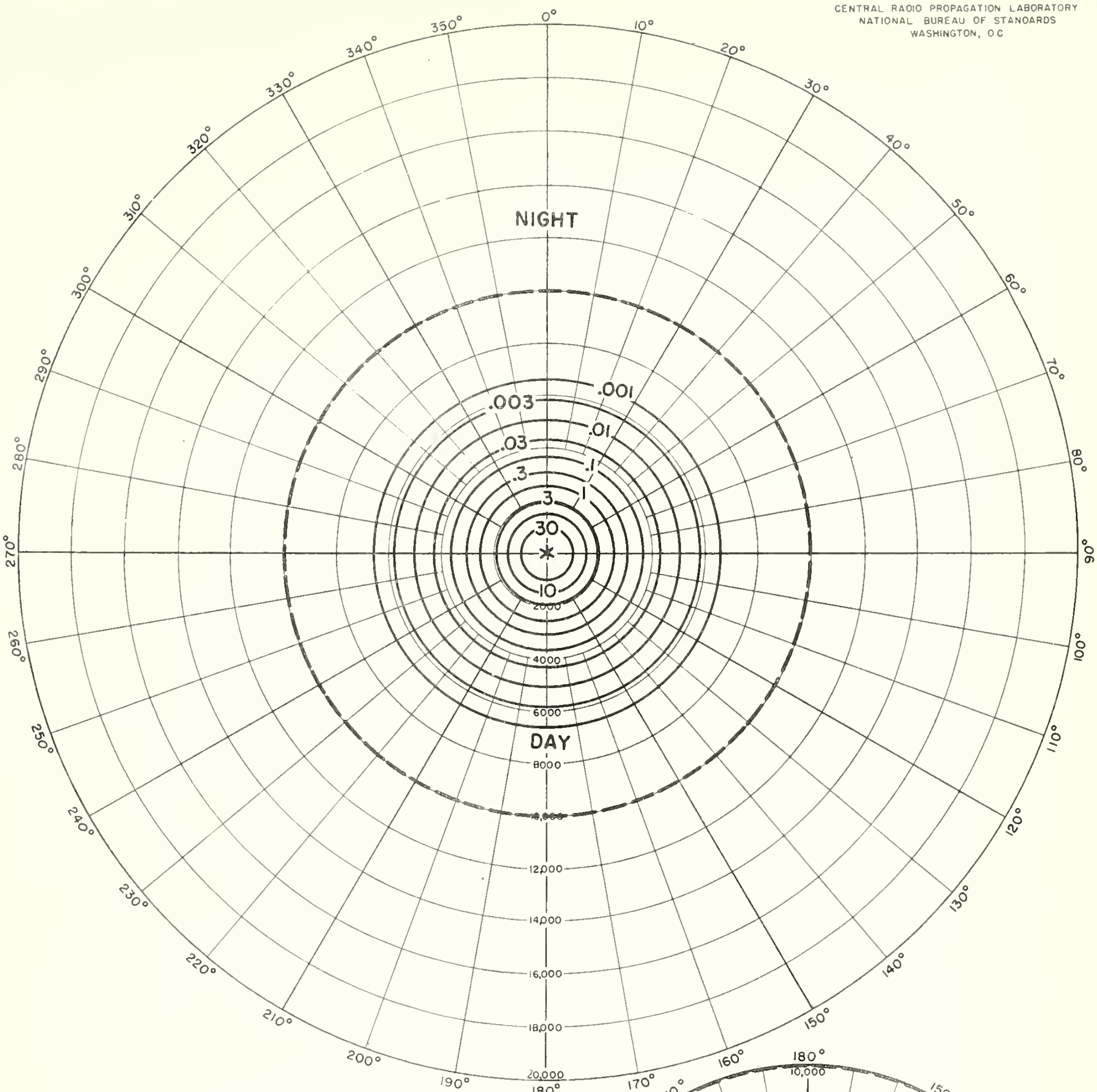
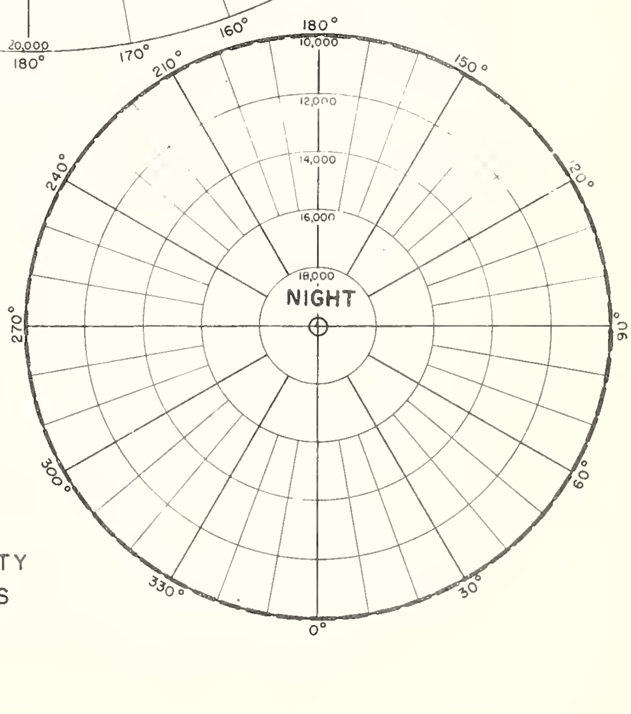



Fig. 3
FIELD INTENSITY, µV/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 0 km (0°)
SUNSPOT MINIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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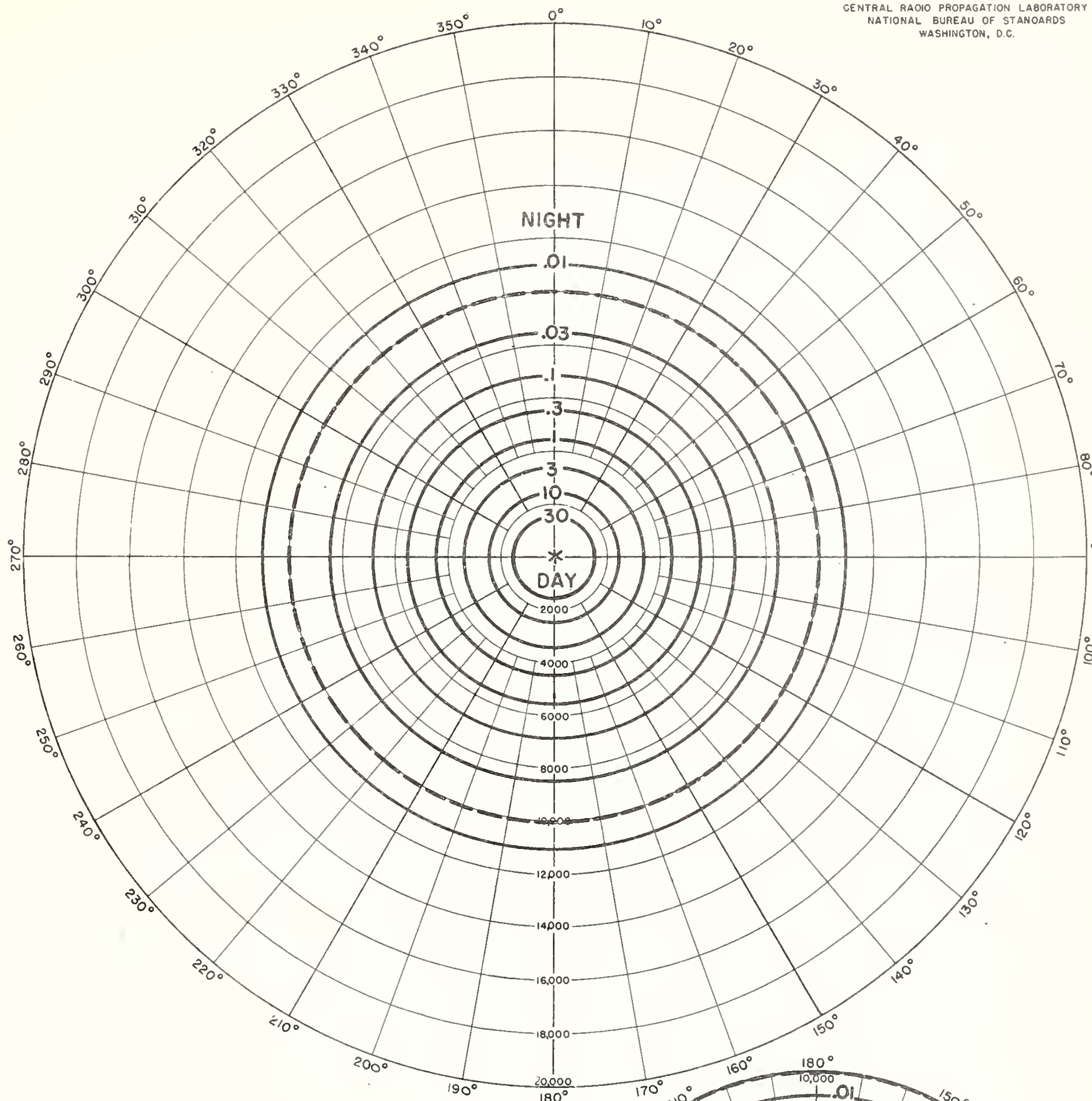
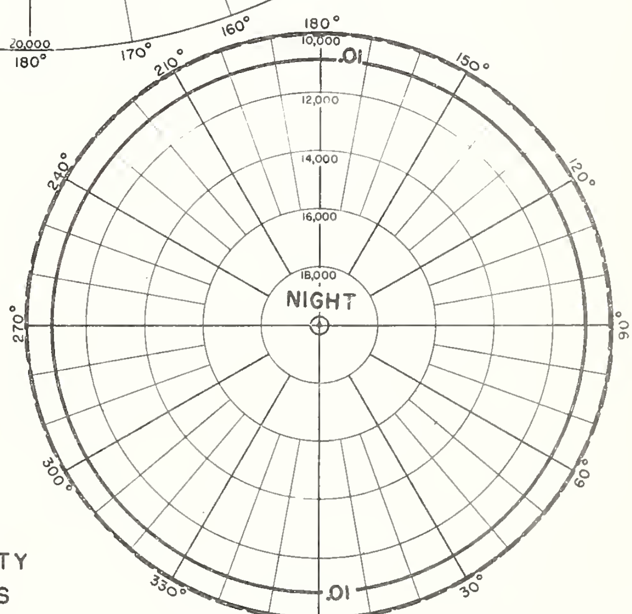



Fig. 4
FIELD INTENSITY, µv/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE, 0 km (0°)
SUNSPOT MINIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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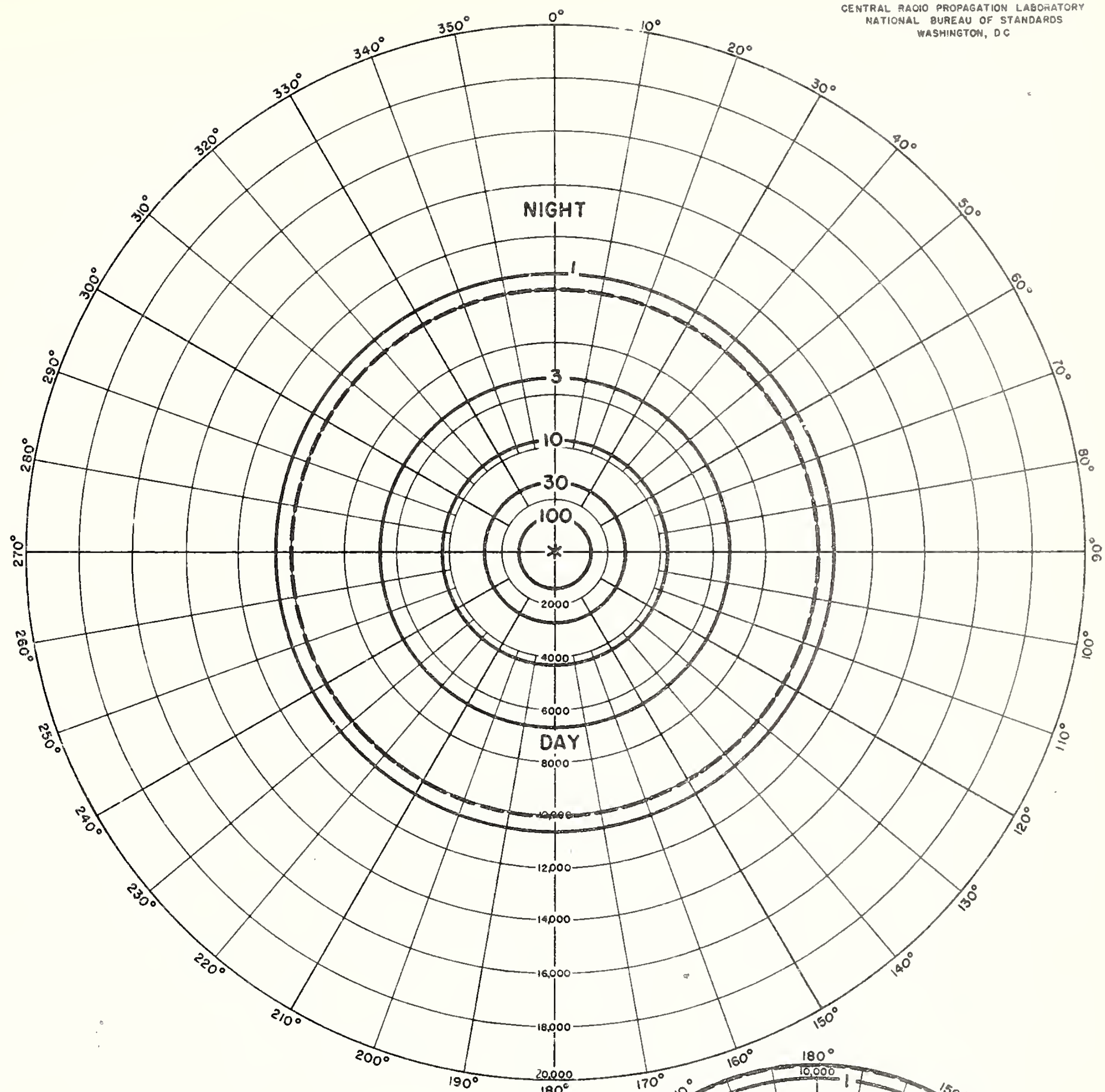
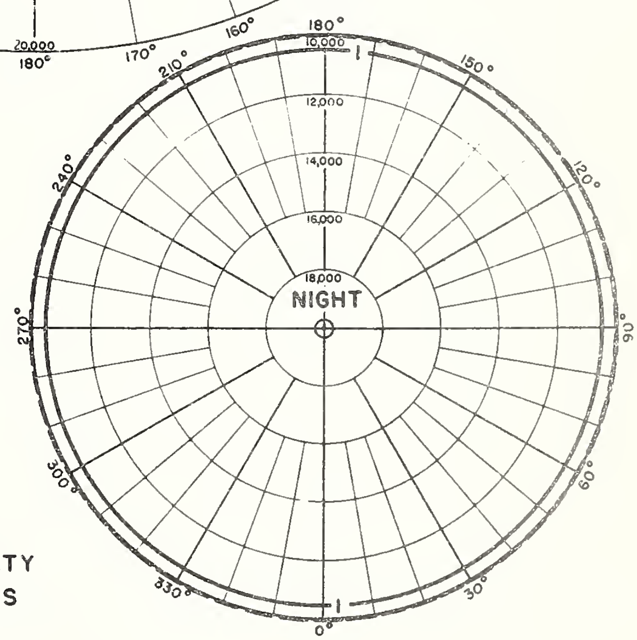



Fig. 5
FIELD INTENSITY, μV/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE, 0 km (0°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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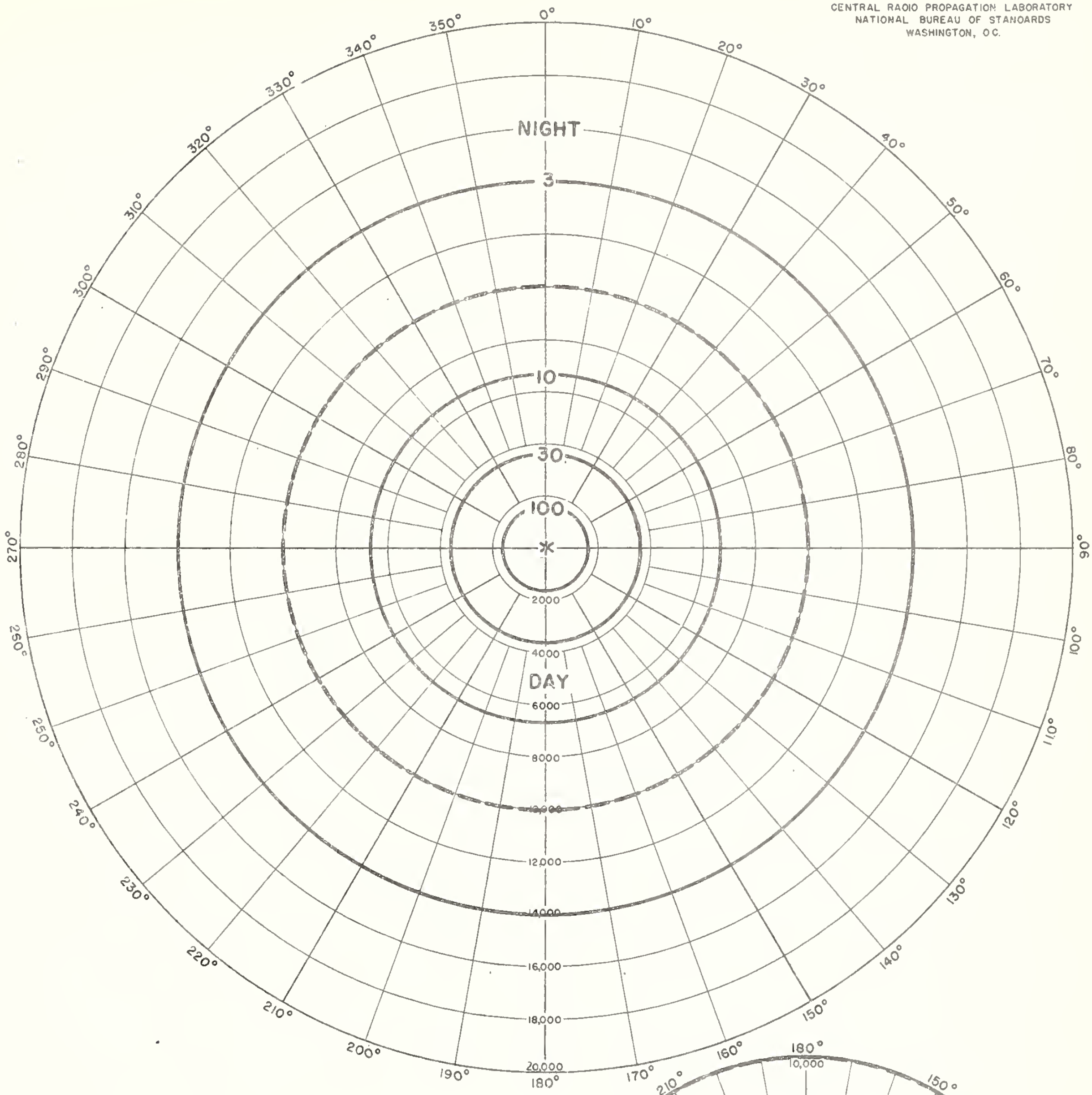
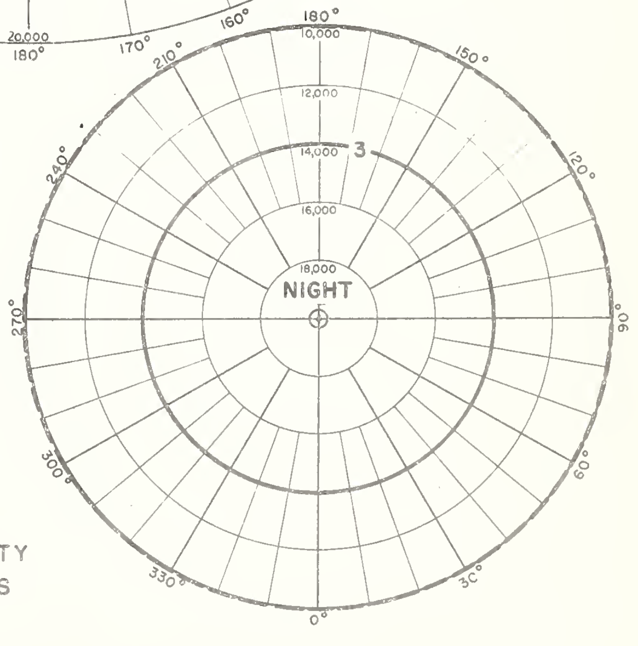



Fig. 6
FIELD INTENSITY, μV/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 0 km (0°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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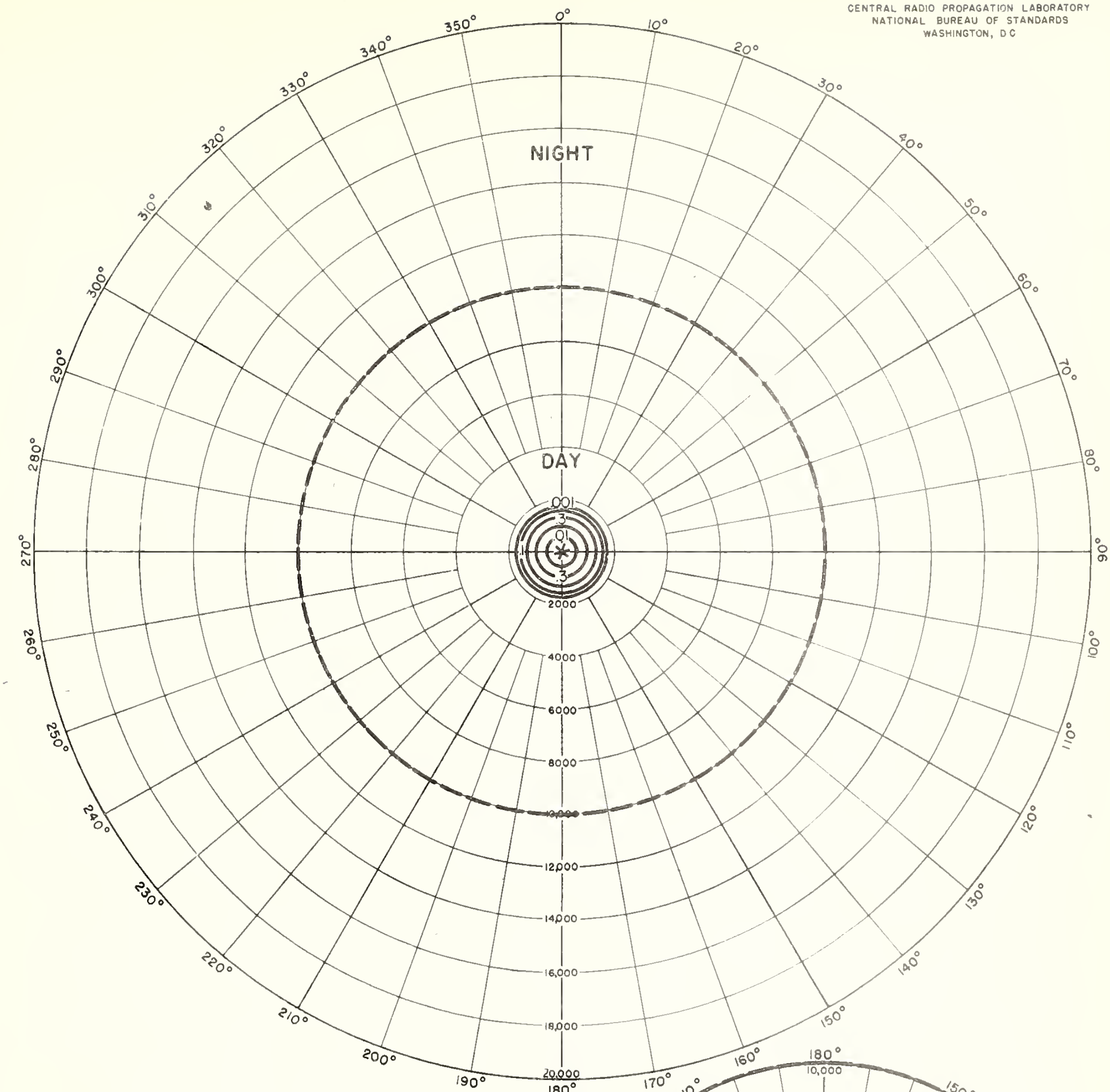
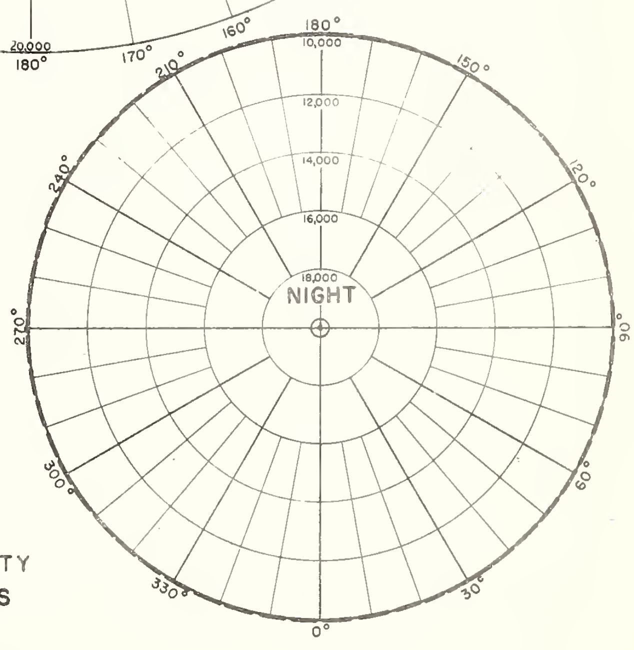



Fig. 7
FIELD INTENSITY, μV/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 0 km (0°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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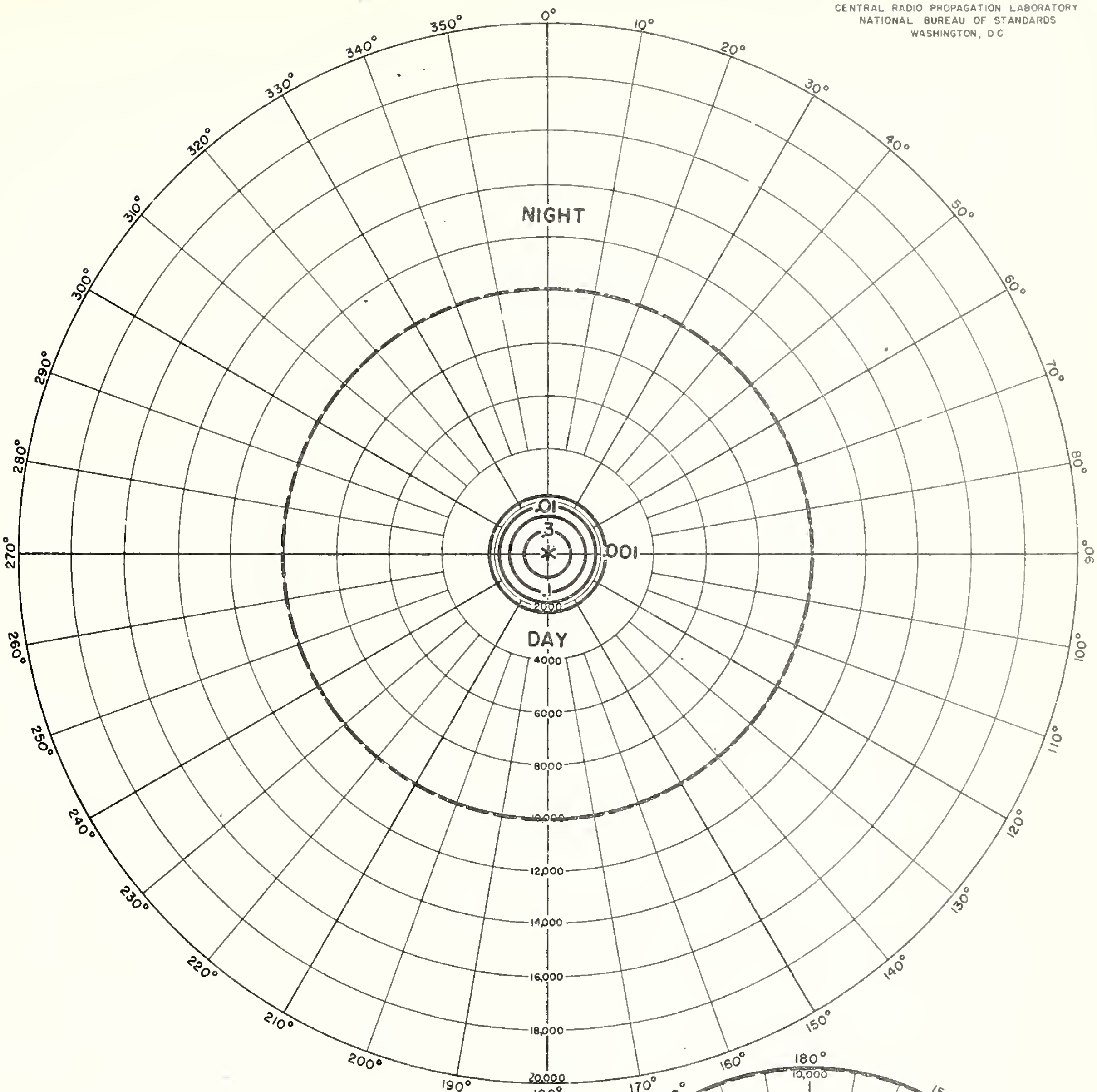
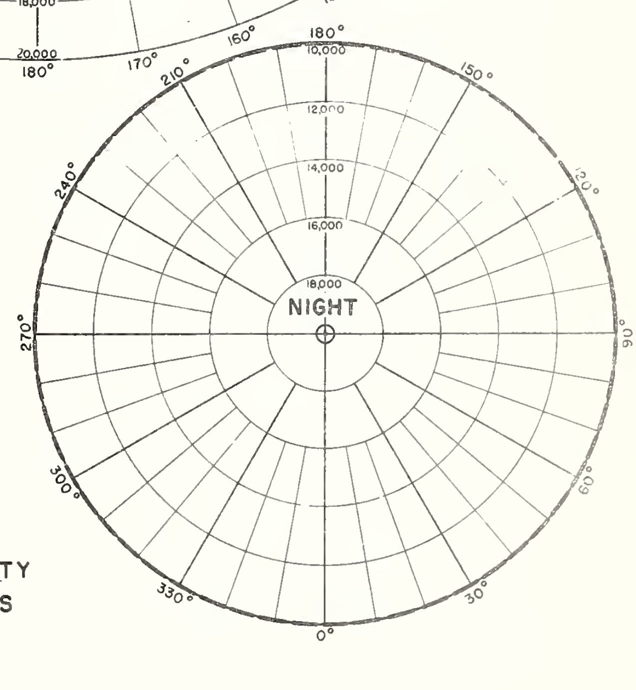



Fig. 8
FIELD INTENSITY, µV/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 0 km (0°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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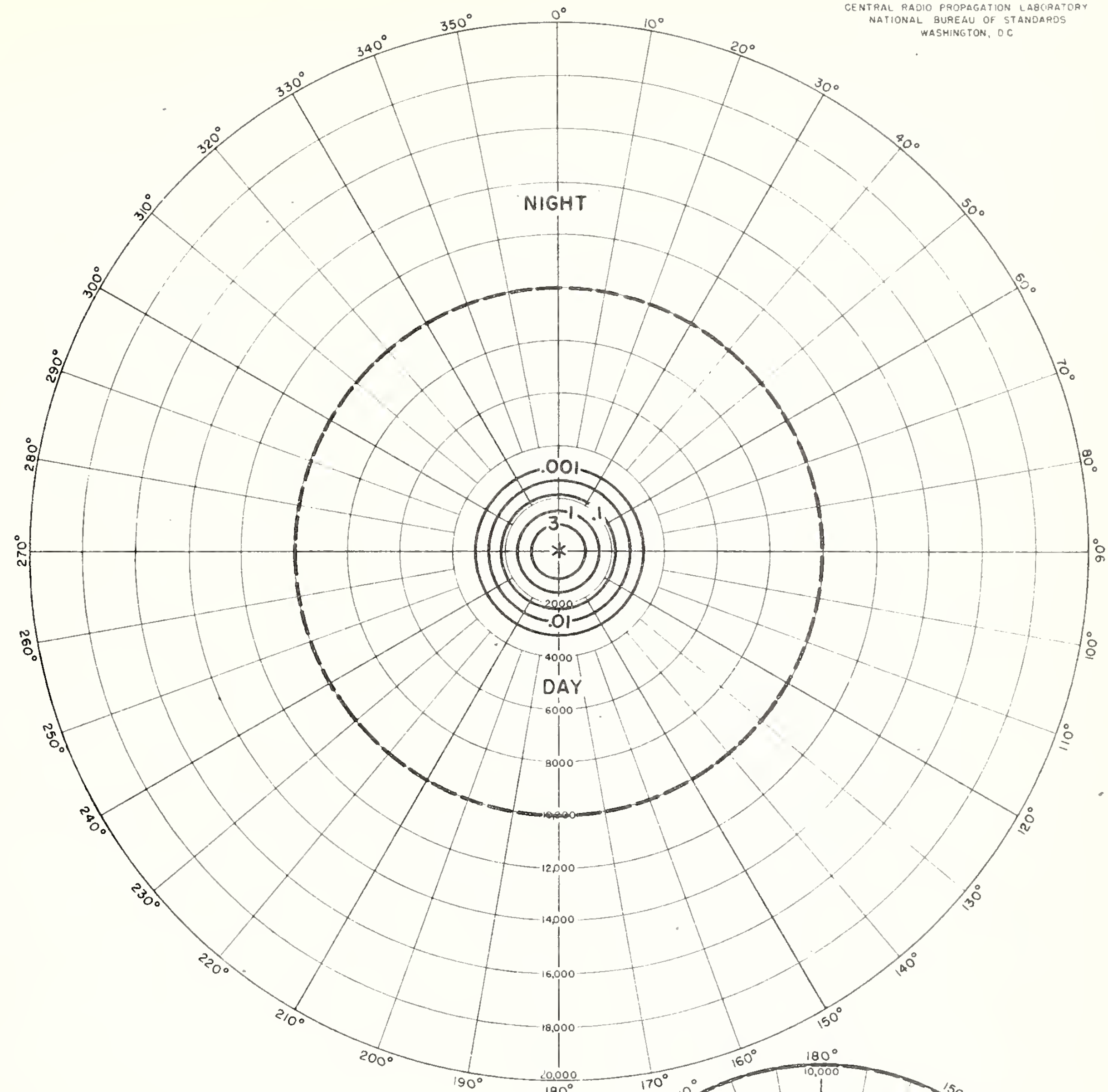
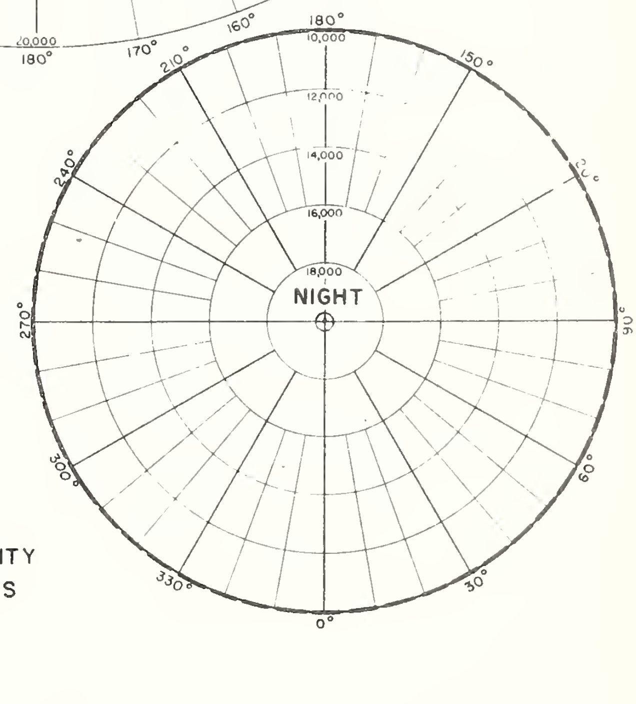



Fig. 9
FIELD INTENSITY, μv/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 0 km (0°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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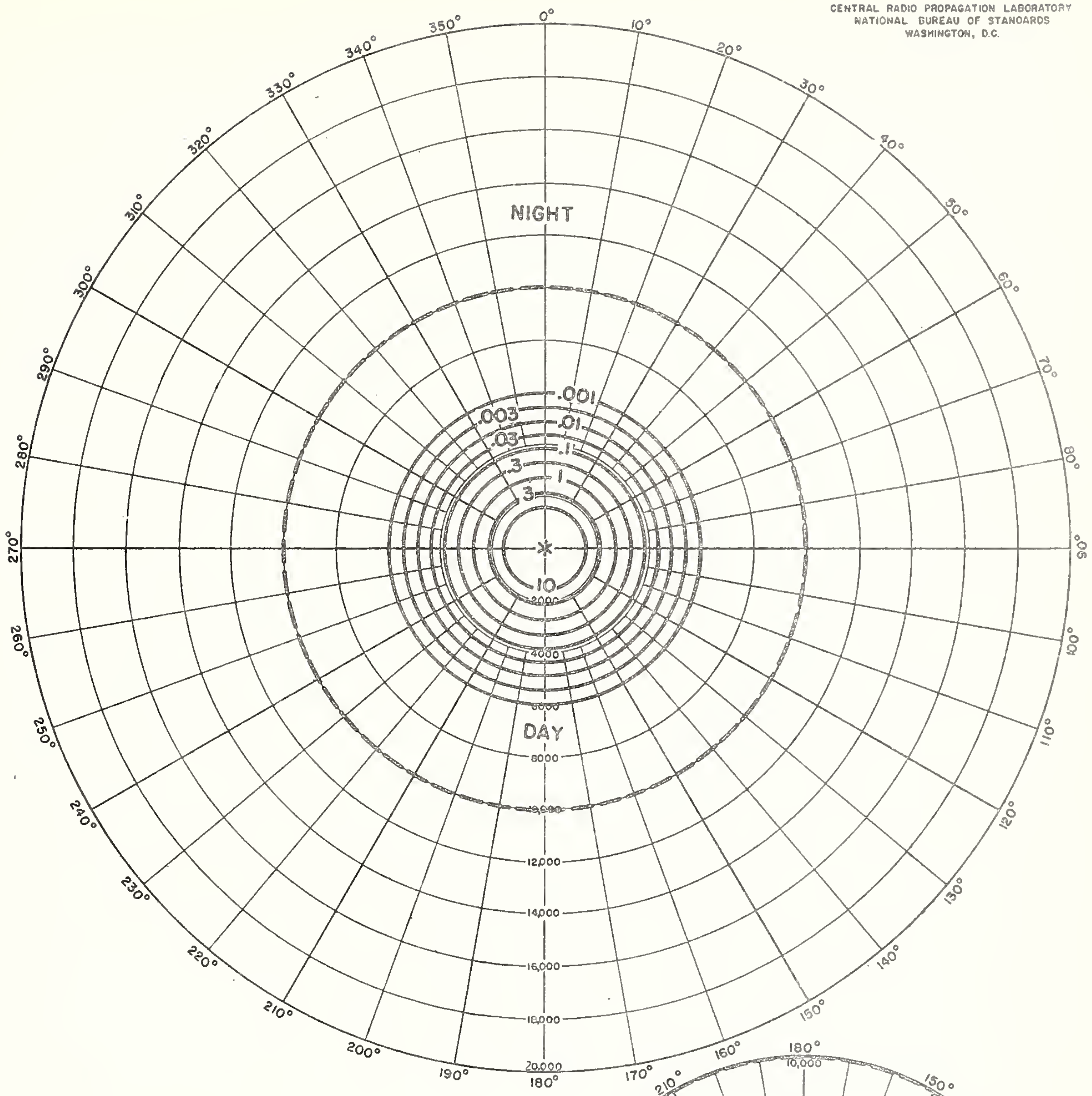
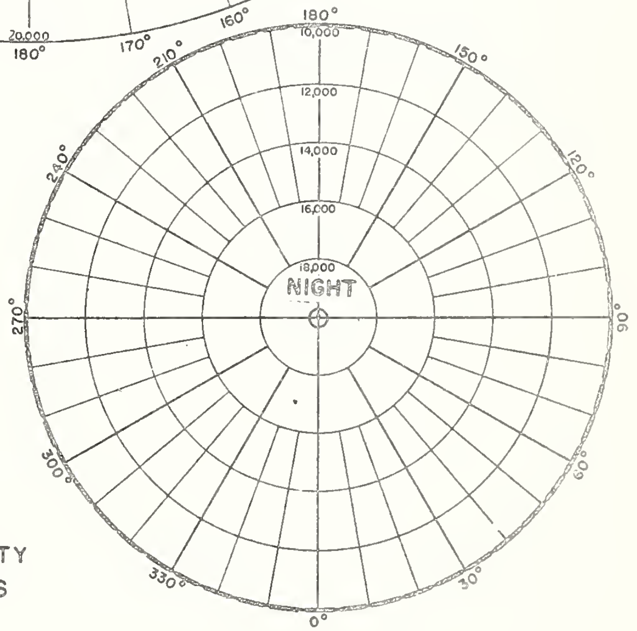



Fig. 10
FIELD INTENSITY, μV/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE, 0 km (0°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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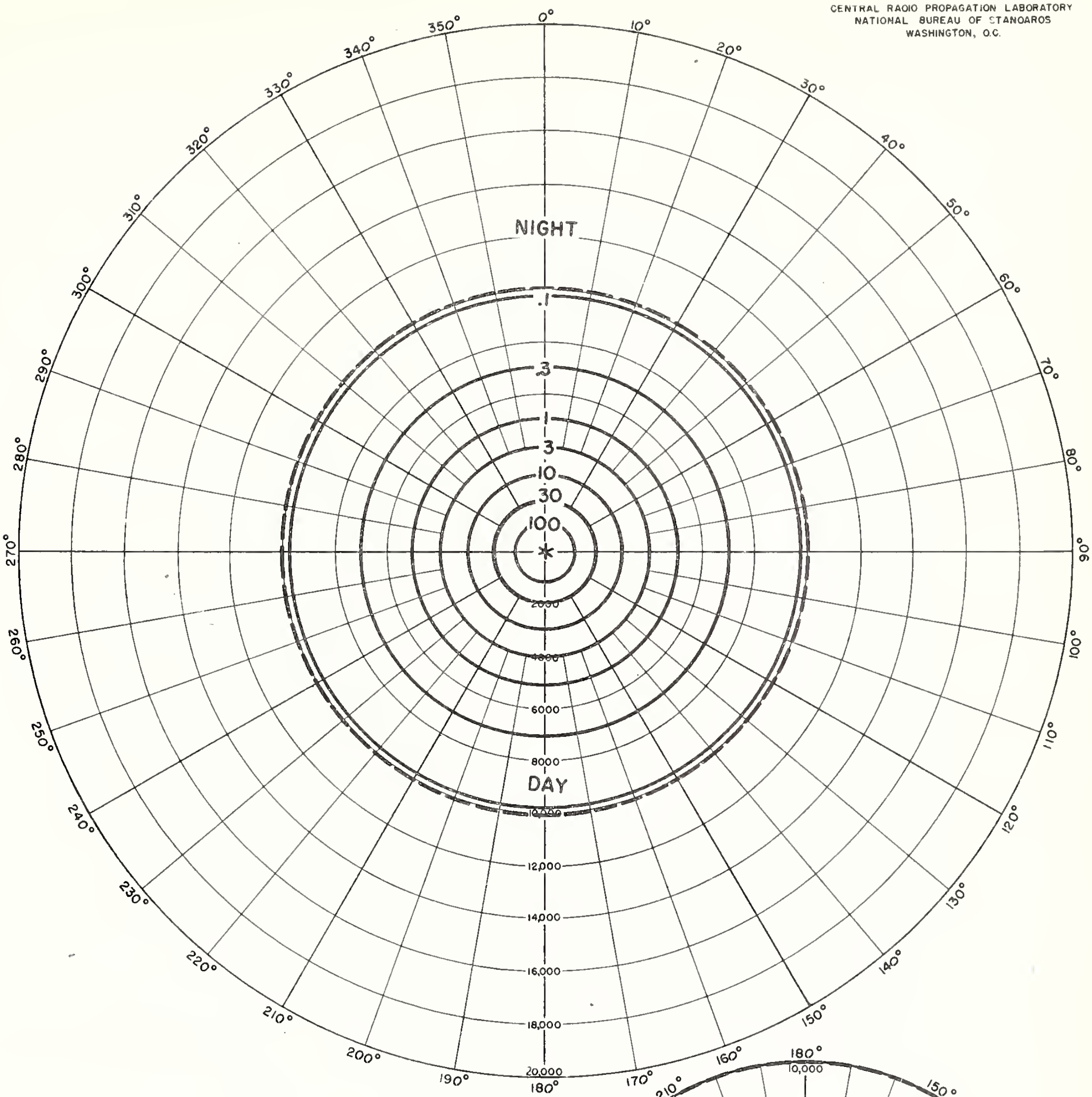
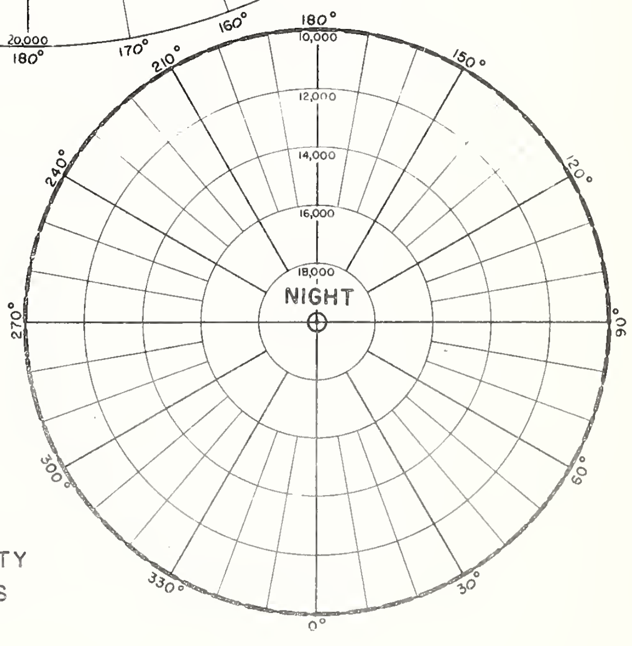



Fig. 11
FIELD INTENSITY, μV/m, I KW, 15 Mc
SUBSOLAR DISTANCE, 0 km (0°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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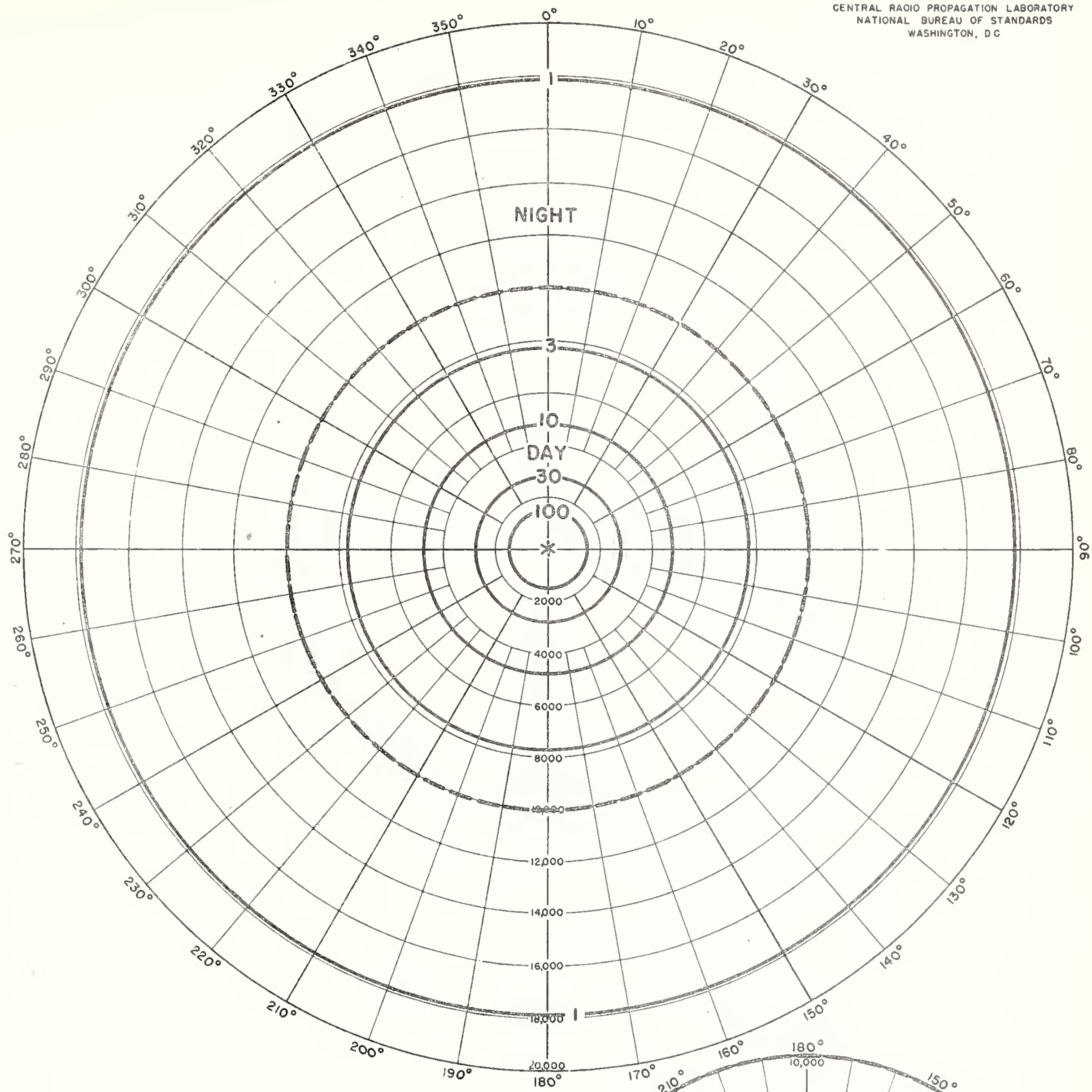
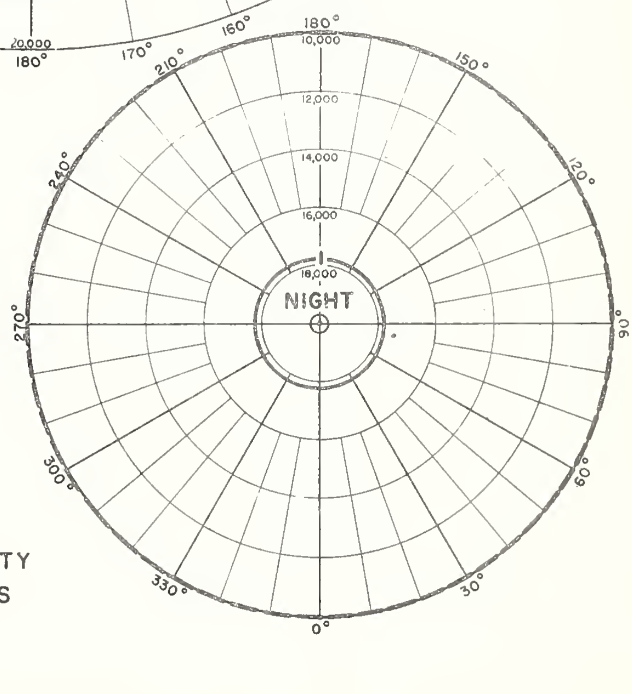



Fig. 12
FIELD INTENSITY, μV/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 0 km (0°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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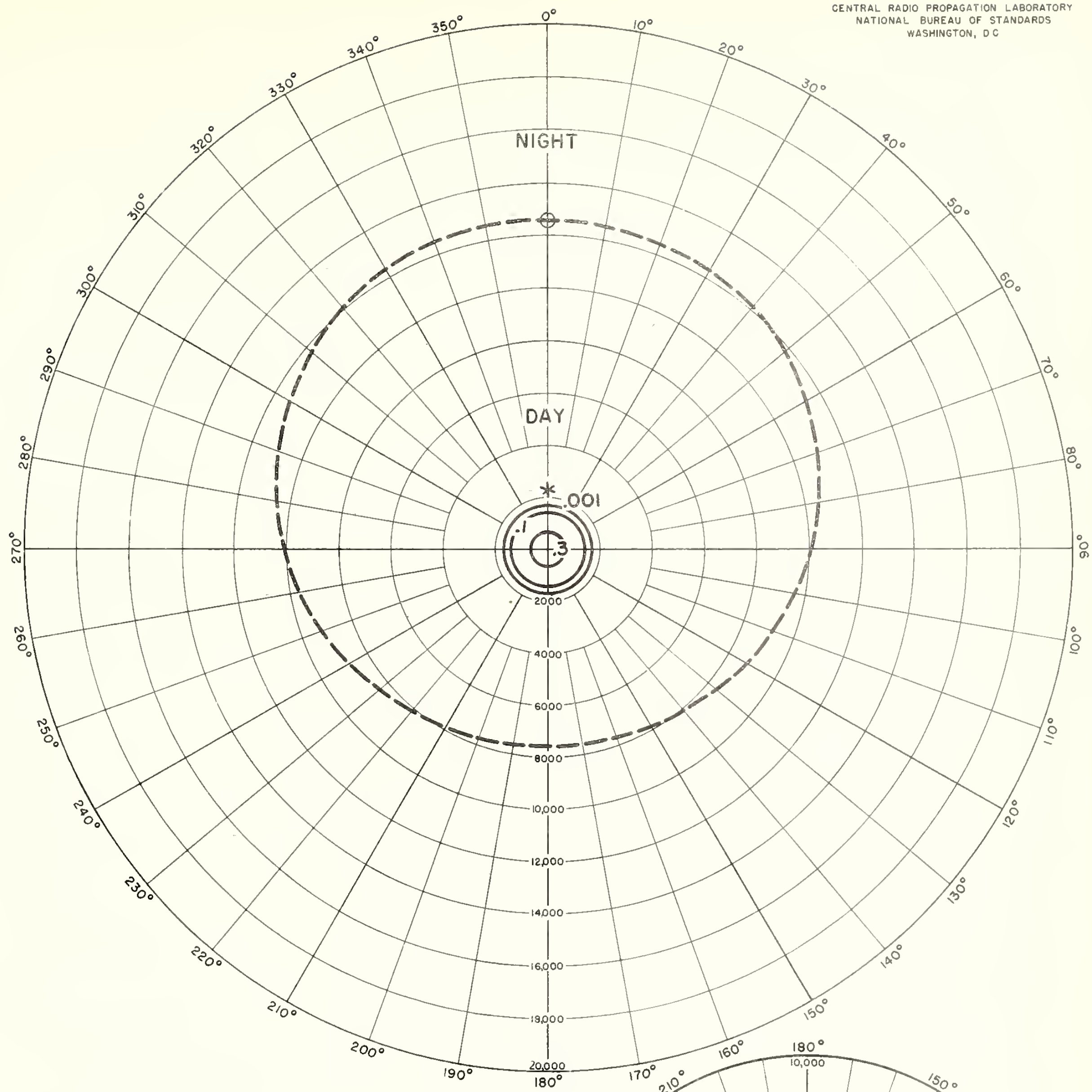
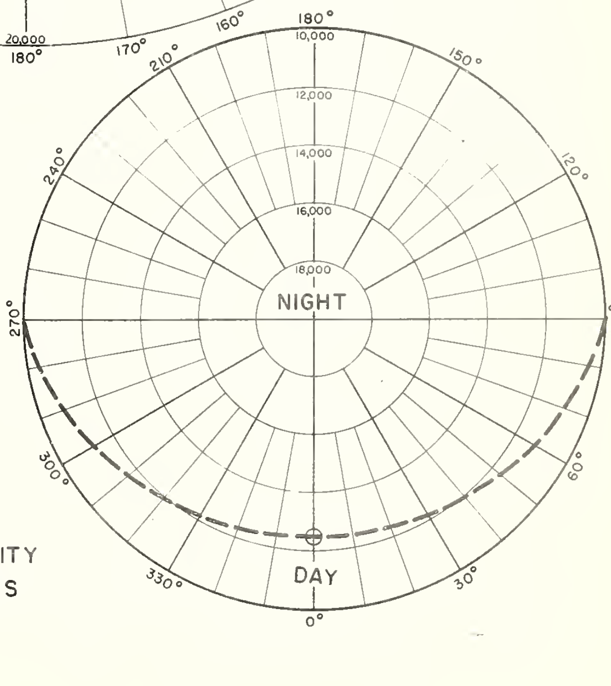



Fig. 13
FIELD INTENSITY, $\mu v/m$, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 2500 km (22° 30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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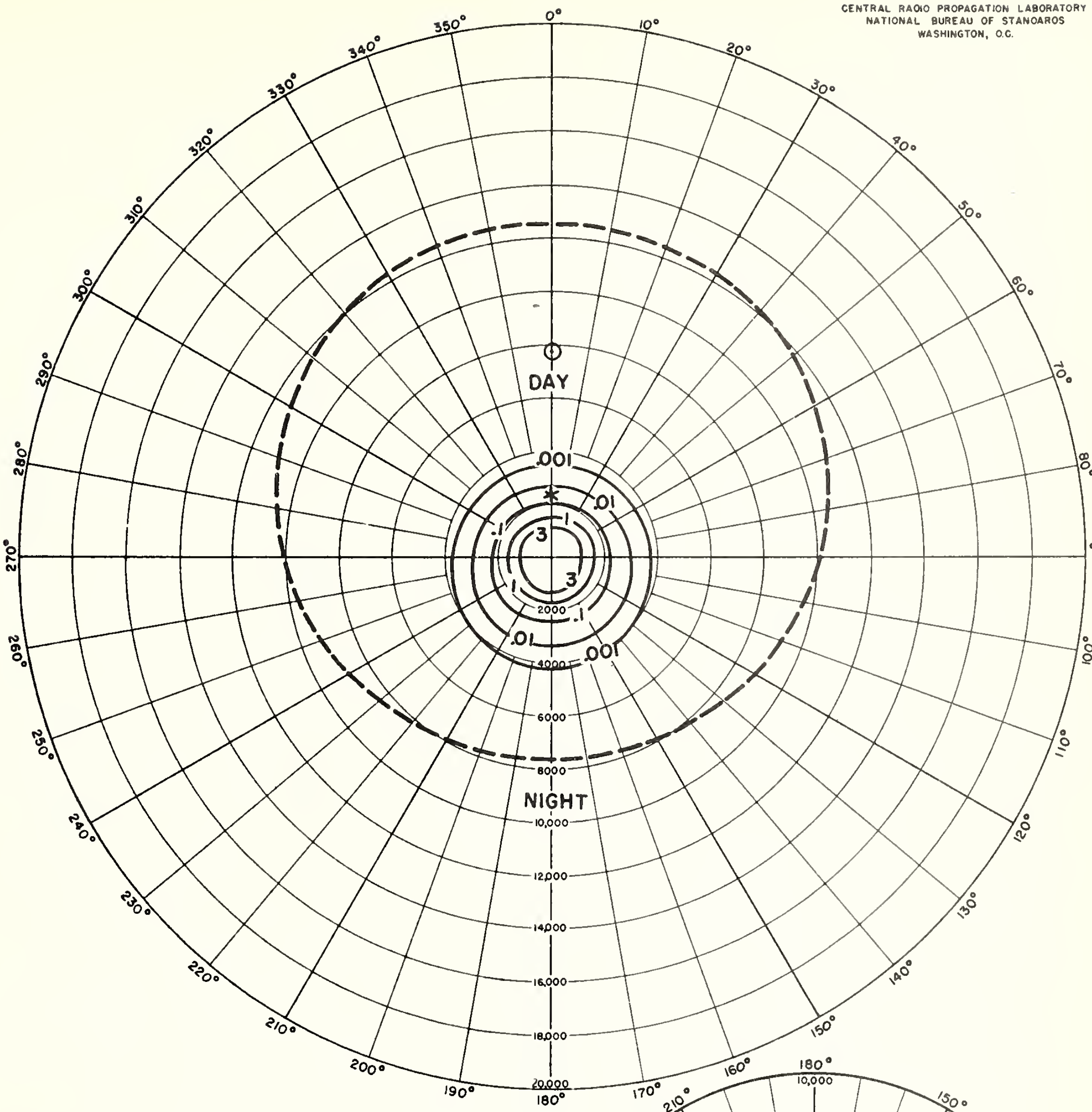
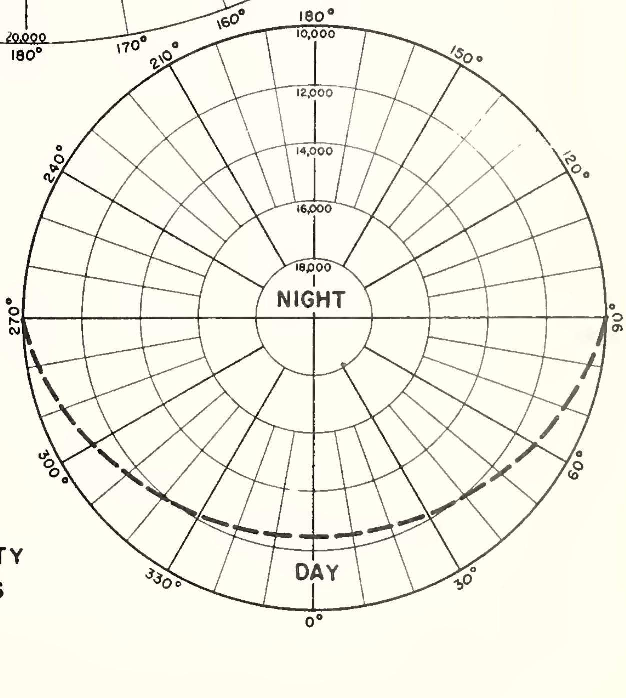



Fig. 14
FIELD INTENSITY, μv/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 2500 km (22° 30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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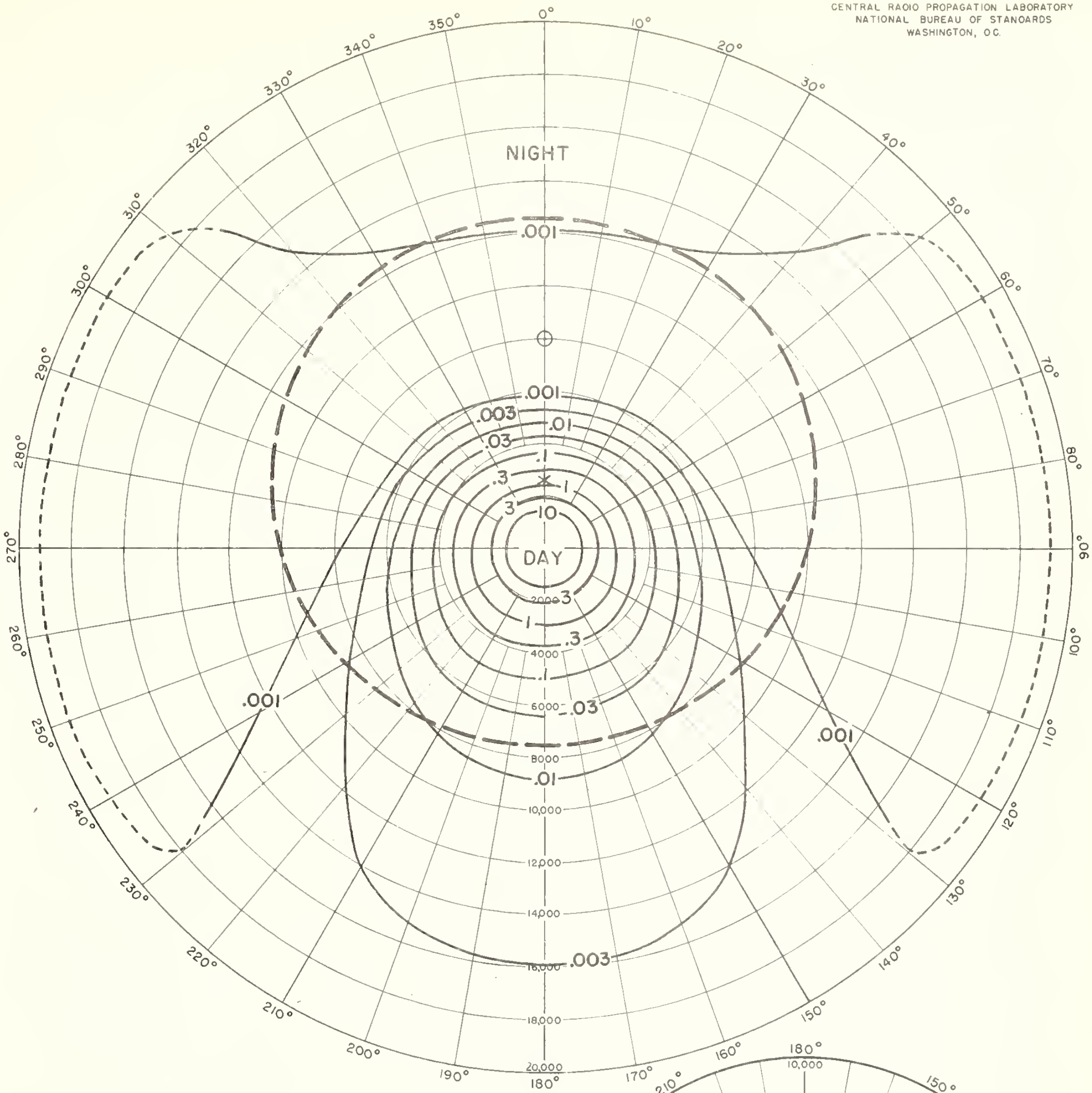
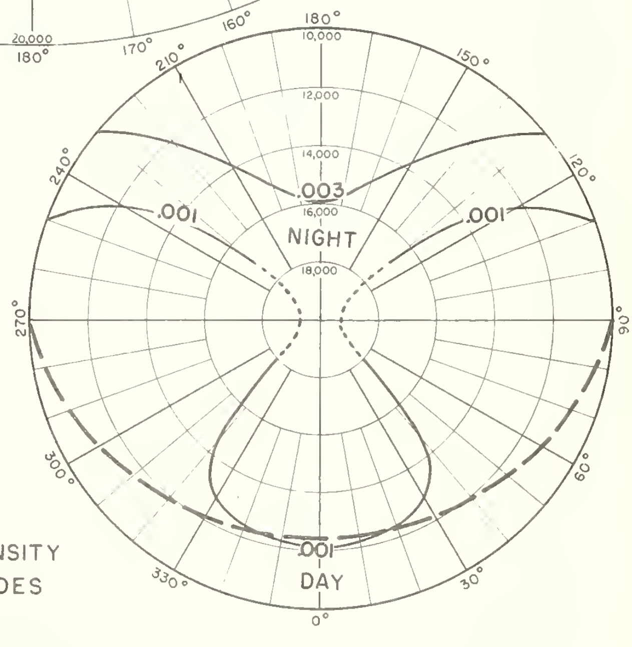



Fig. 15
FIELD INTENSITY, μV/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 2500 km (22° 30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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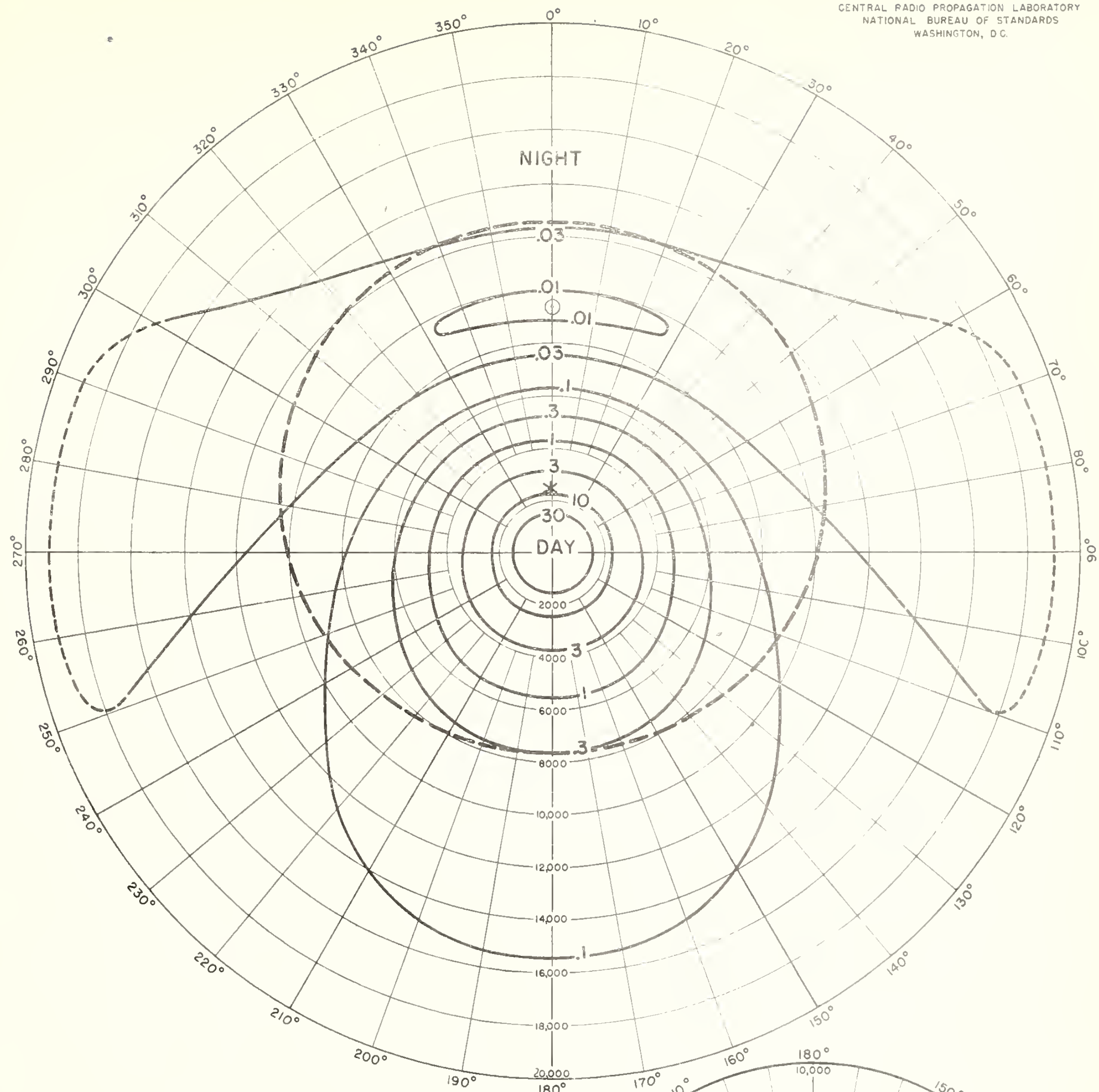
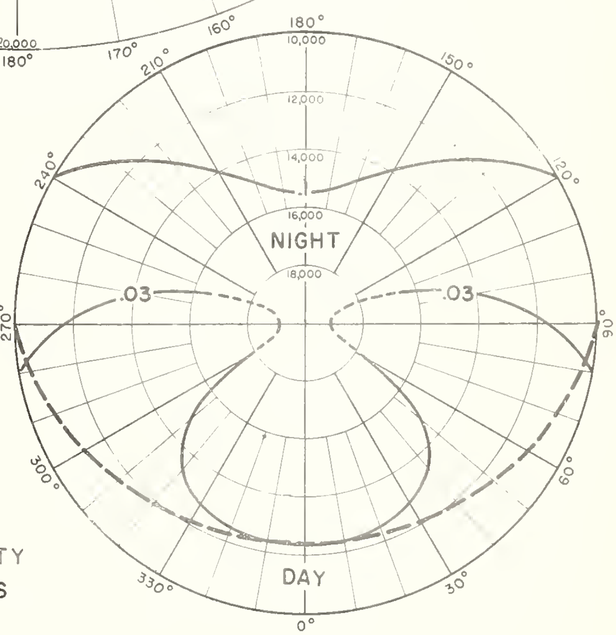



Fig. 16
FIELD INTENSITY, μv/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE, 2500 km (22° 30')
SUNSPOT MINIMUM

✱ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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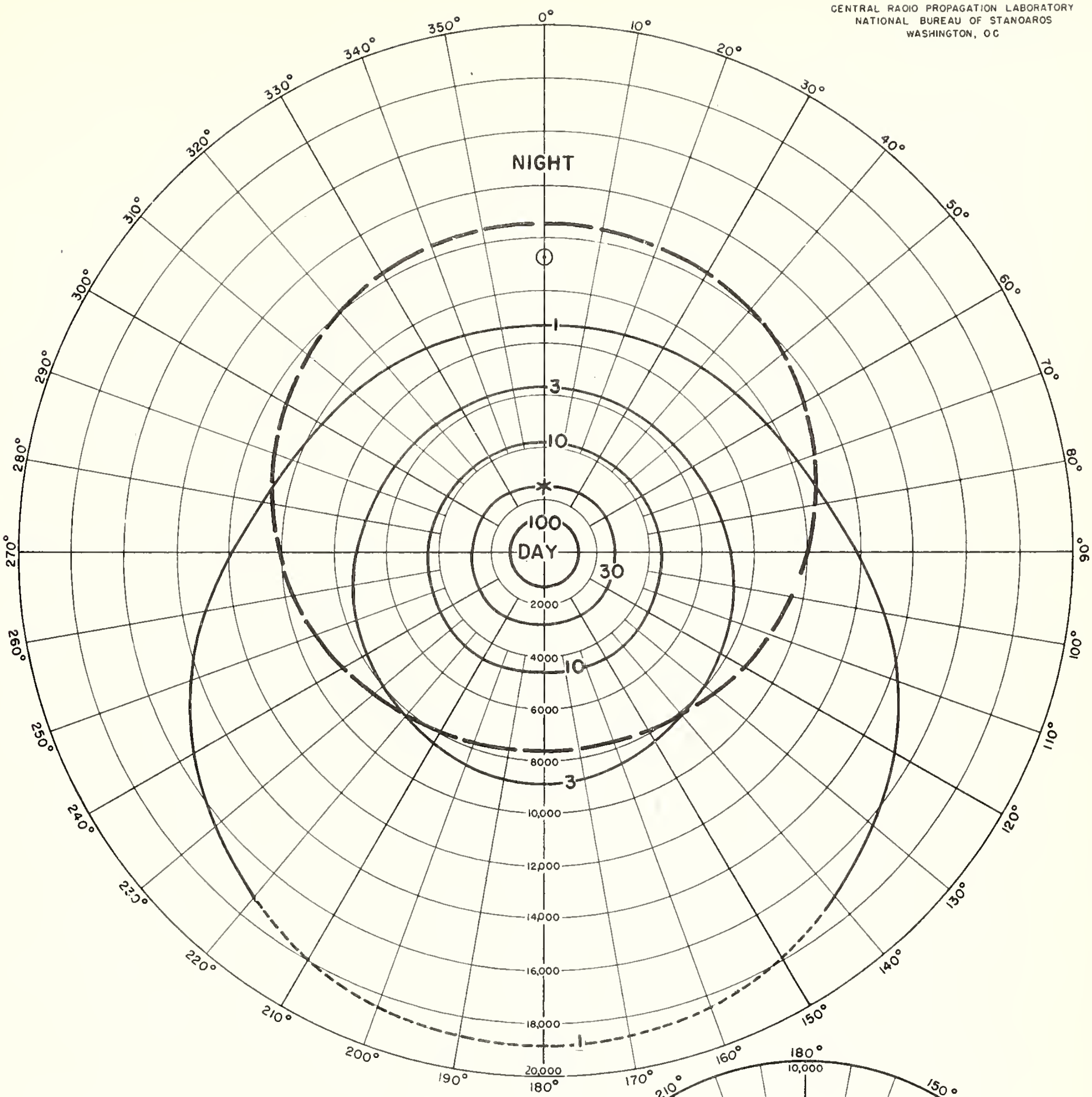
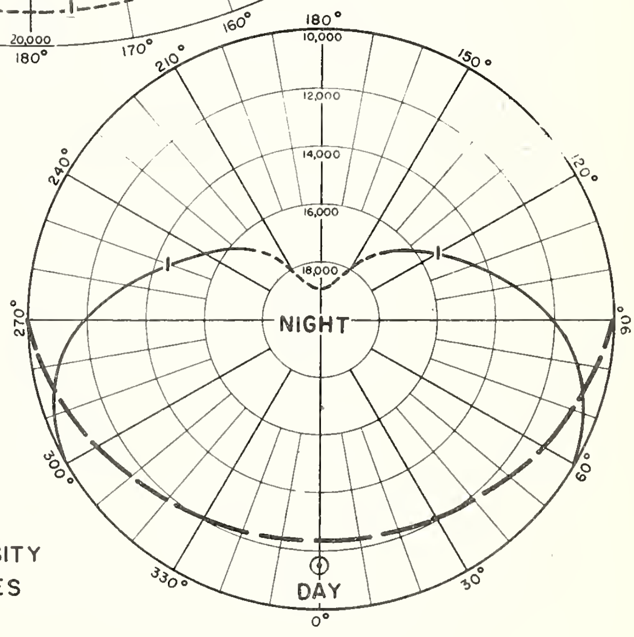



Fig. 17
FIELD INTENSITY, μV/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE, 2500 km (22° 30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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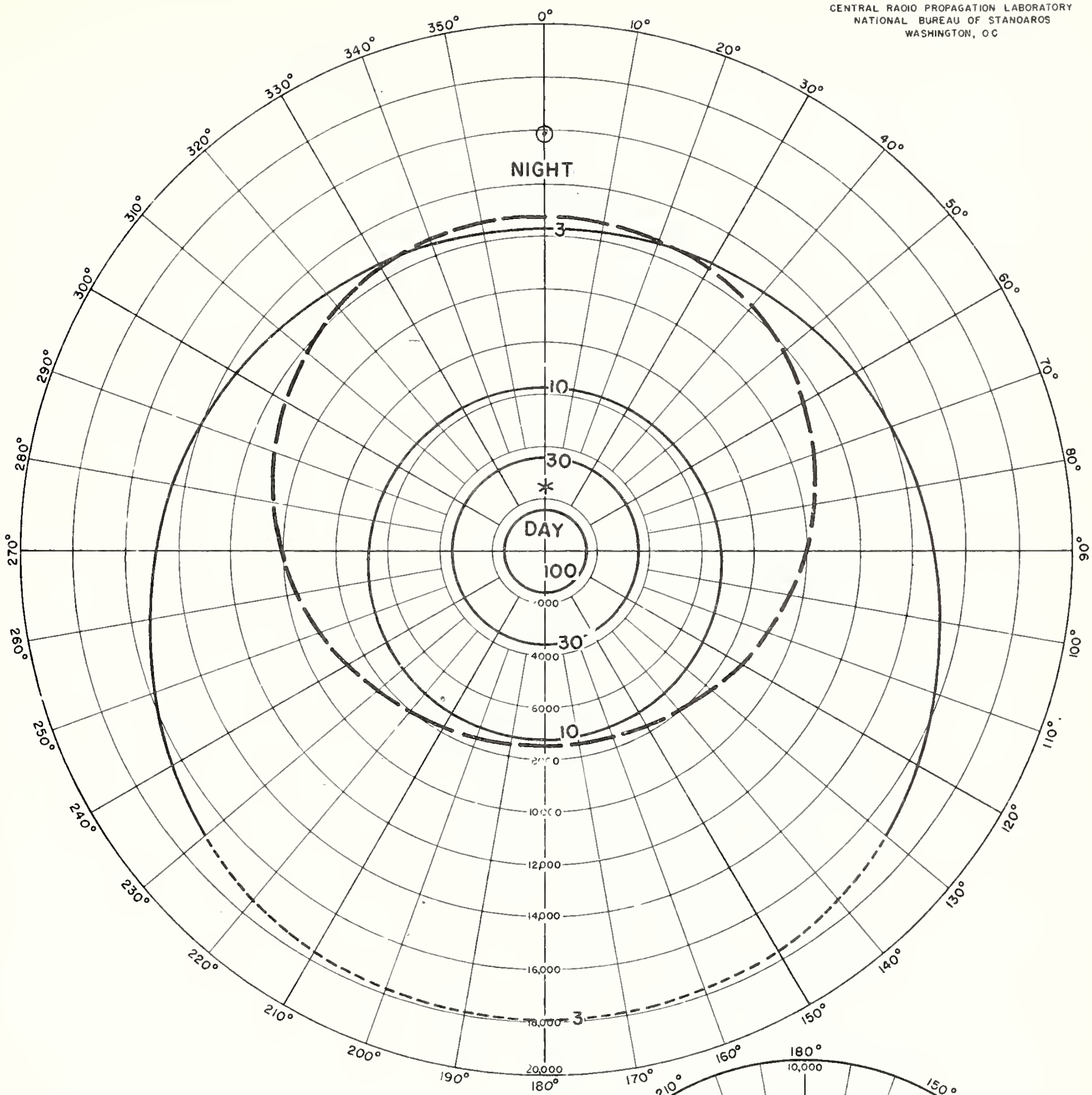
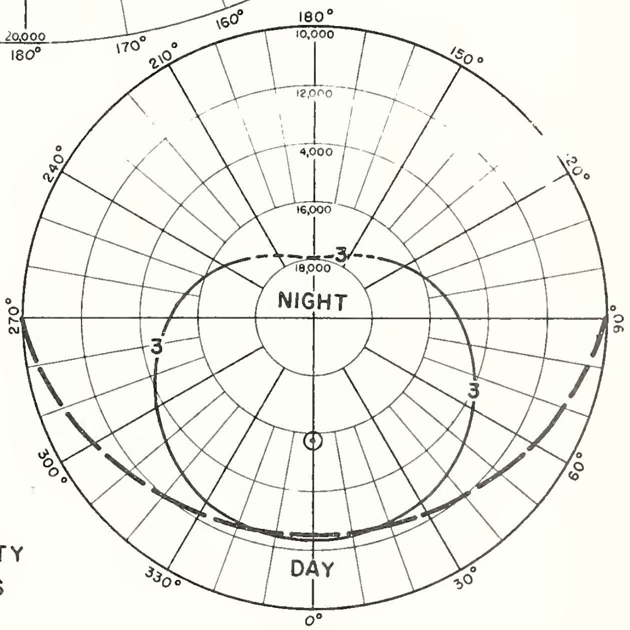



Fig. 18
FIELD INTENSITY, µv/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 2500 km (22°30')
SUNSPOT MINIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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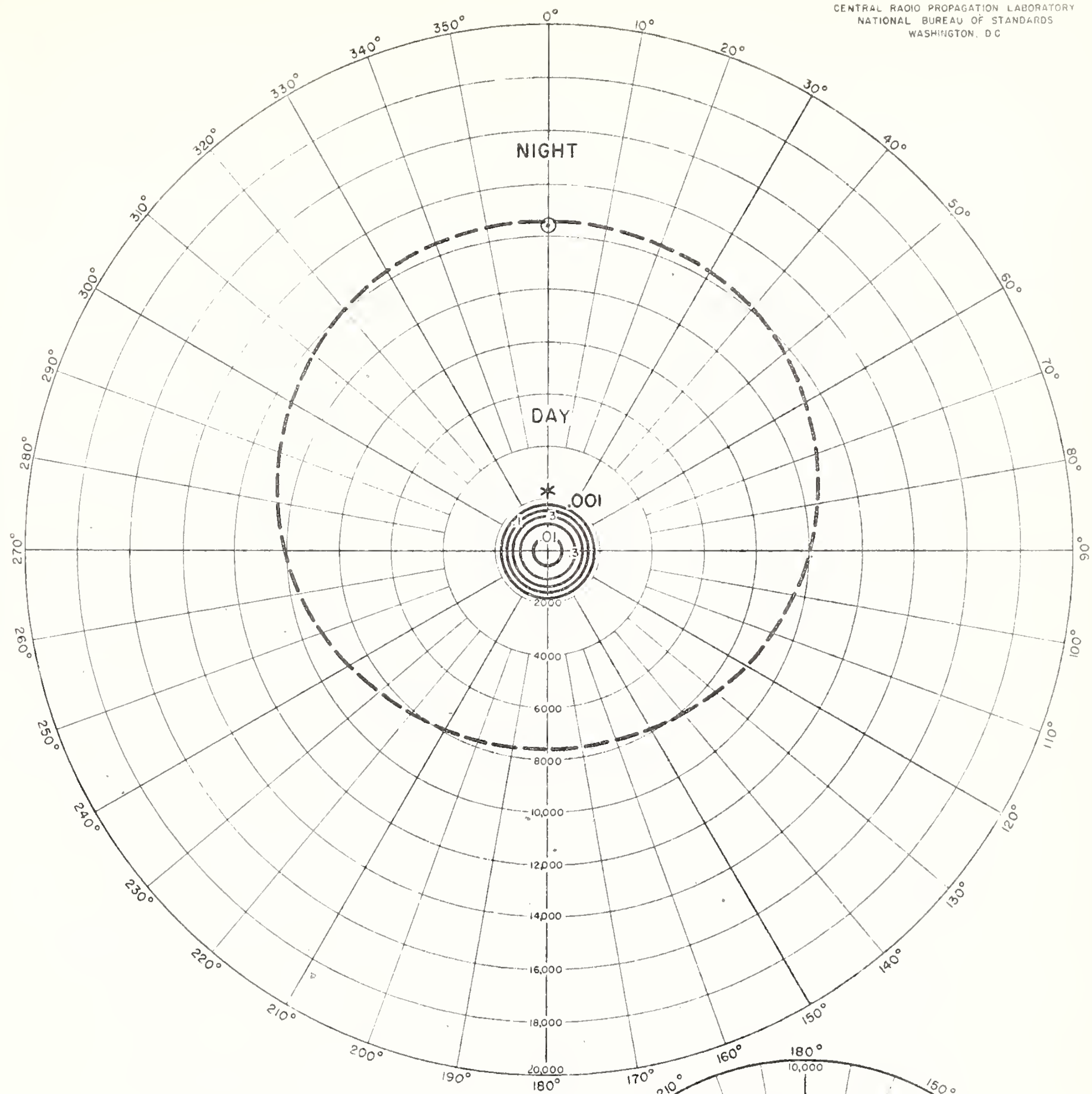
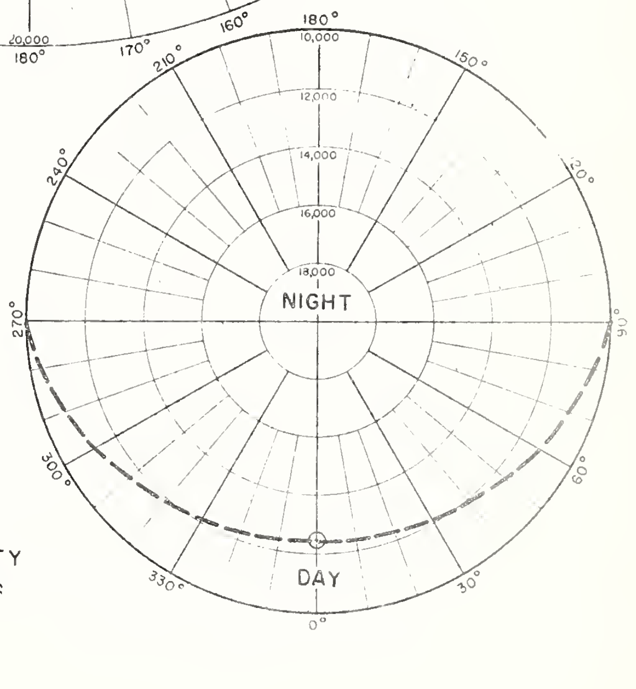



Fig. 19
FIELD INTENSITY, μV/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 2500 km (22° 30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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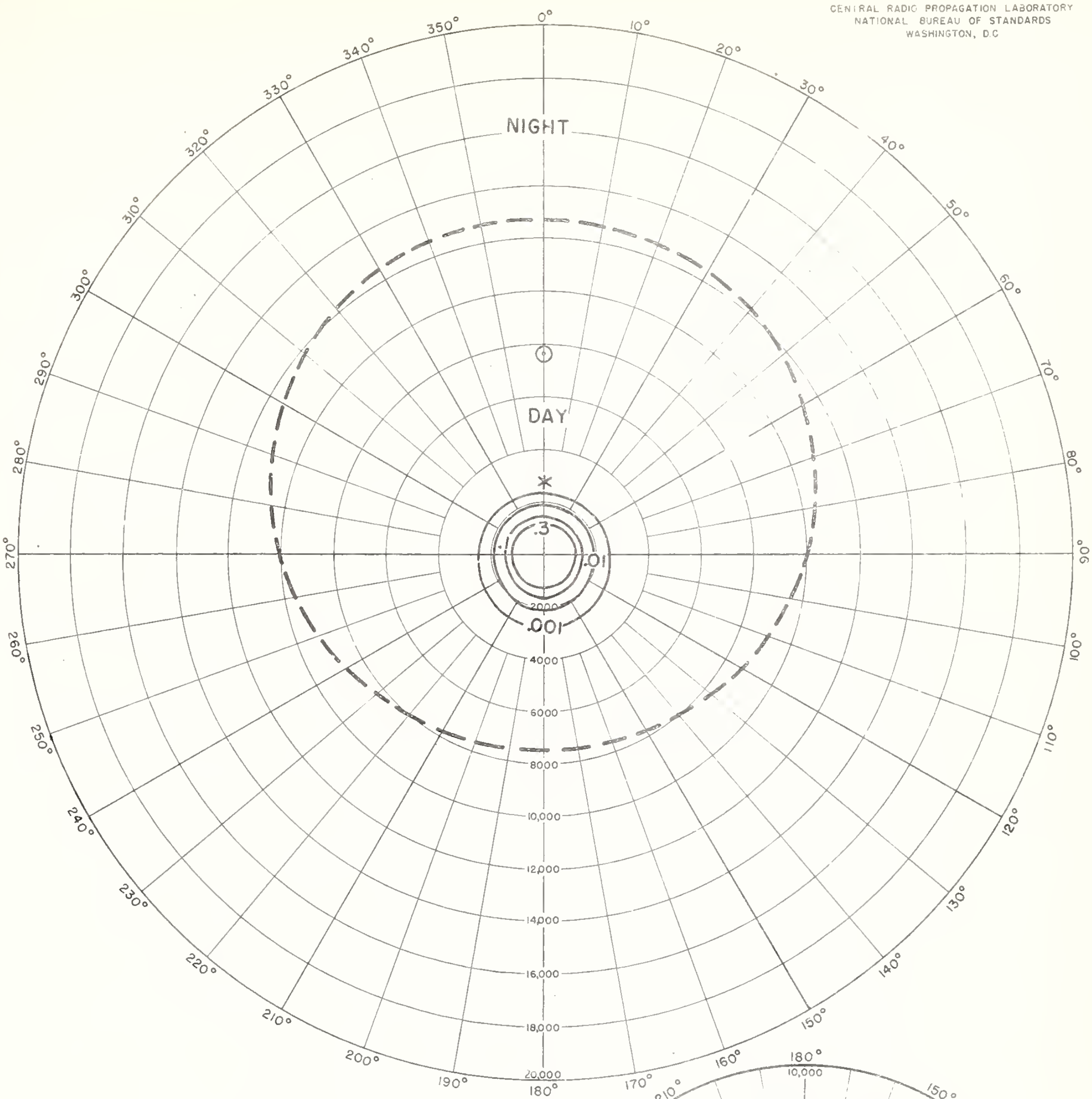
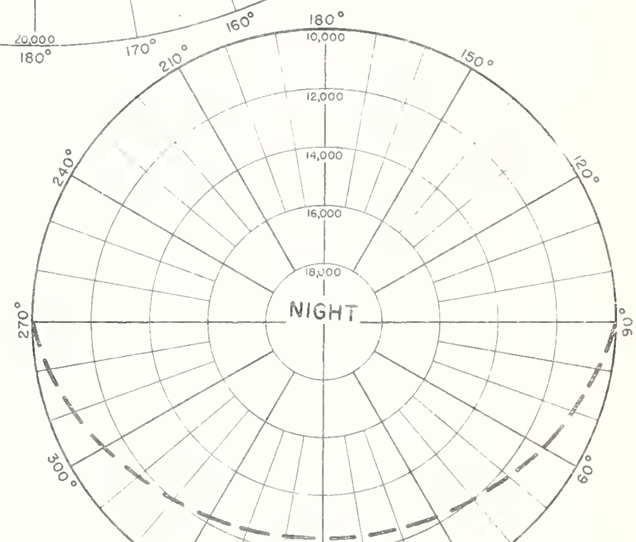



Fig. 20
FIELD INTENSITY, μV/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 2500 km (22° 30')
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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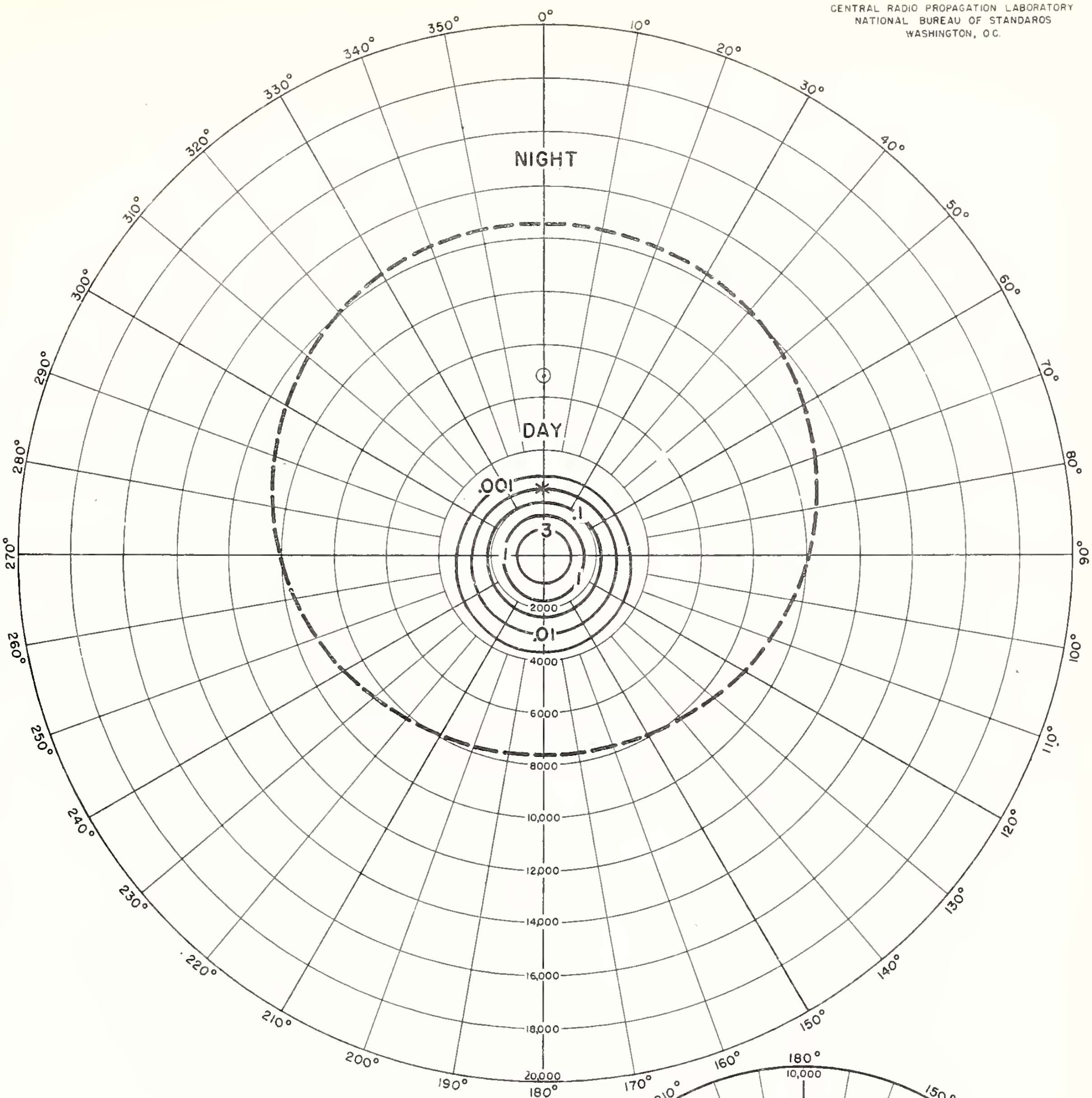
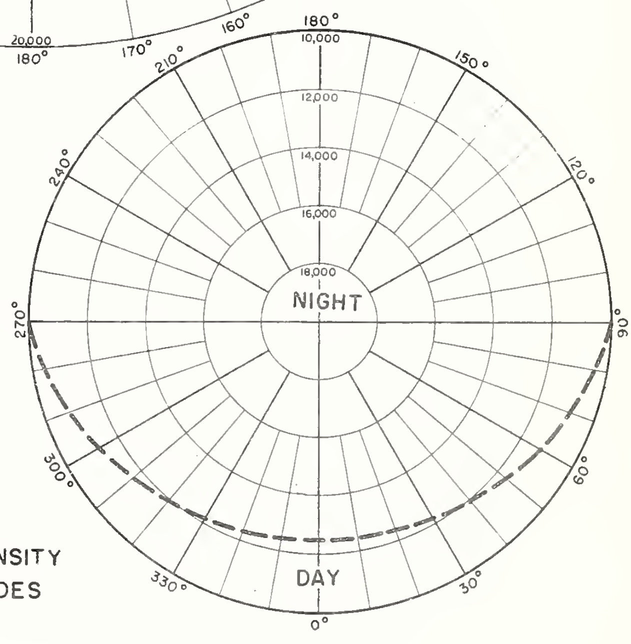



Fig. 21
FIELD INTENSITY, $\mu$v/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 2500 km (22°30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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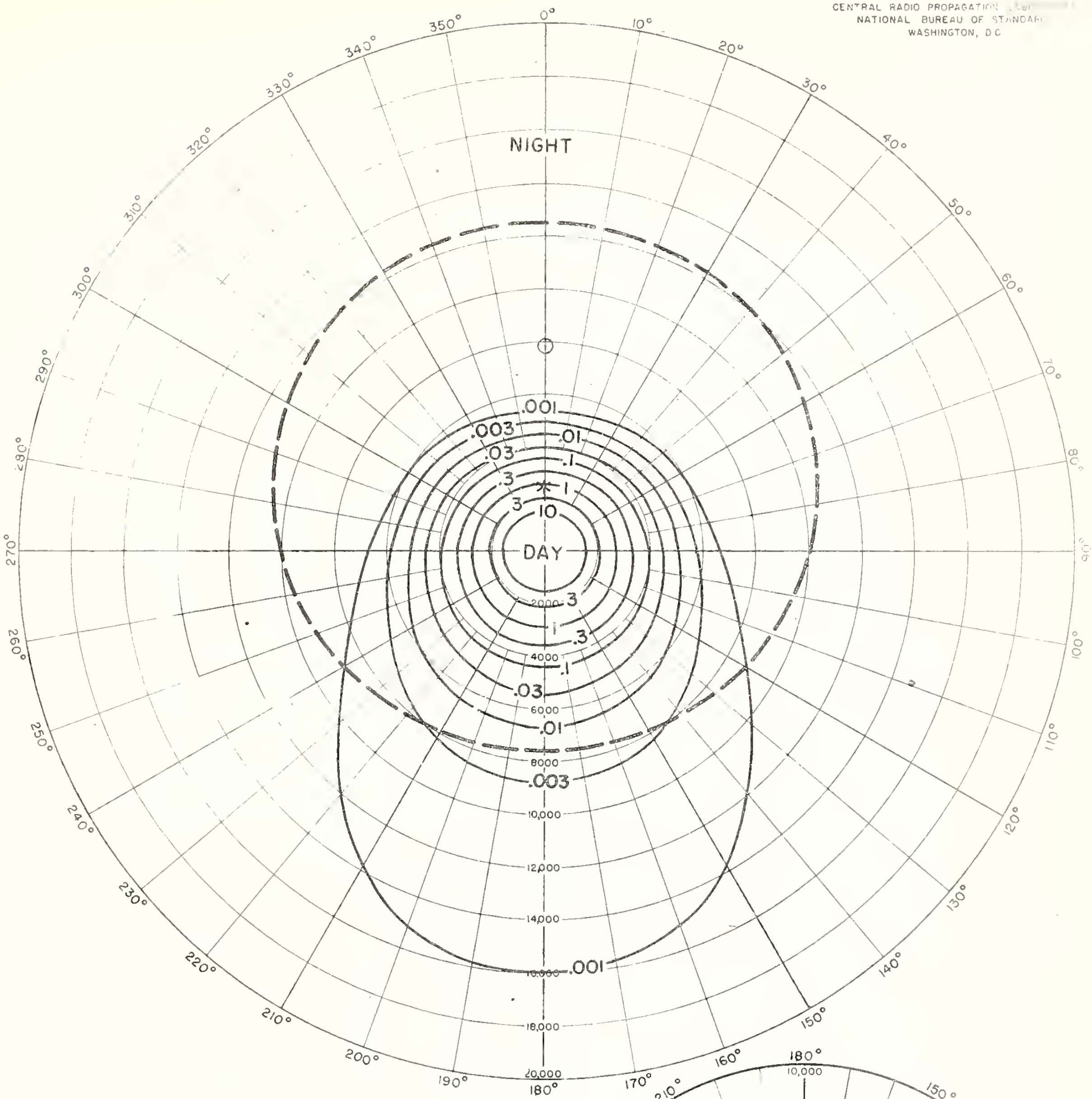
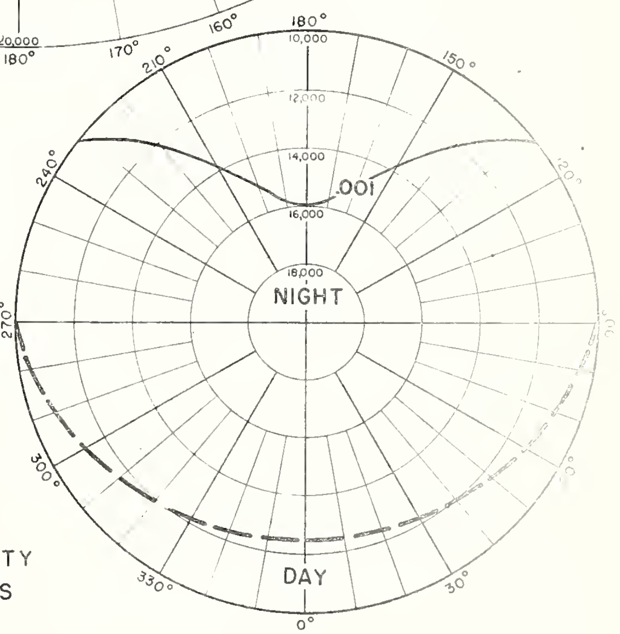



Fig. 22
FIELD INTENSITY, μv/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE, 2500km(22°30')
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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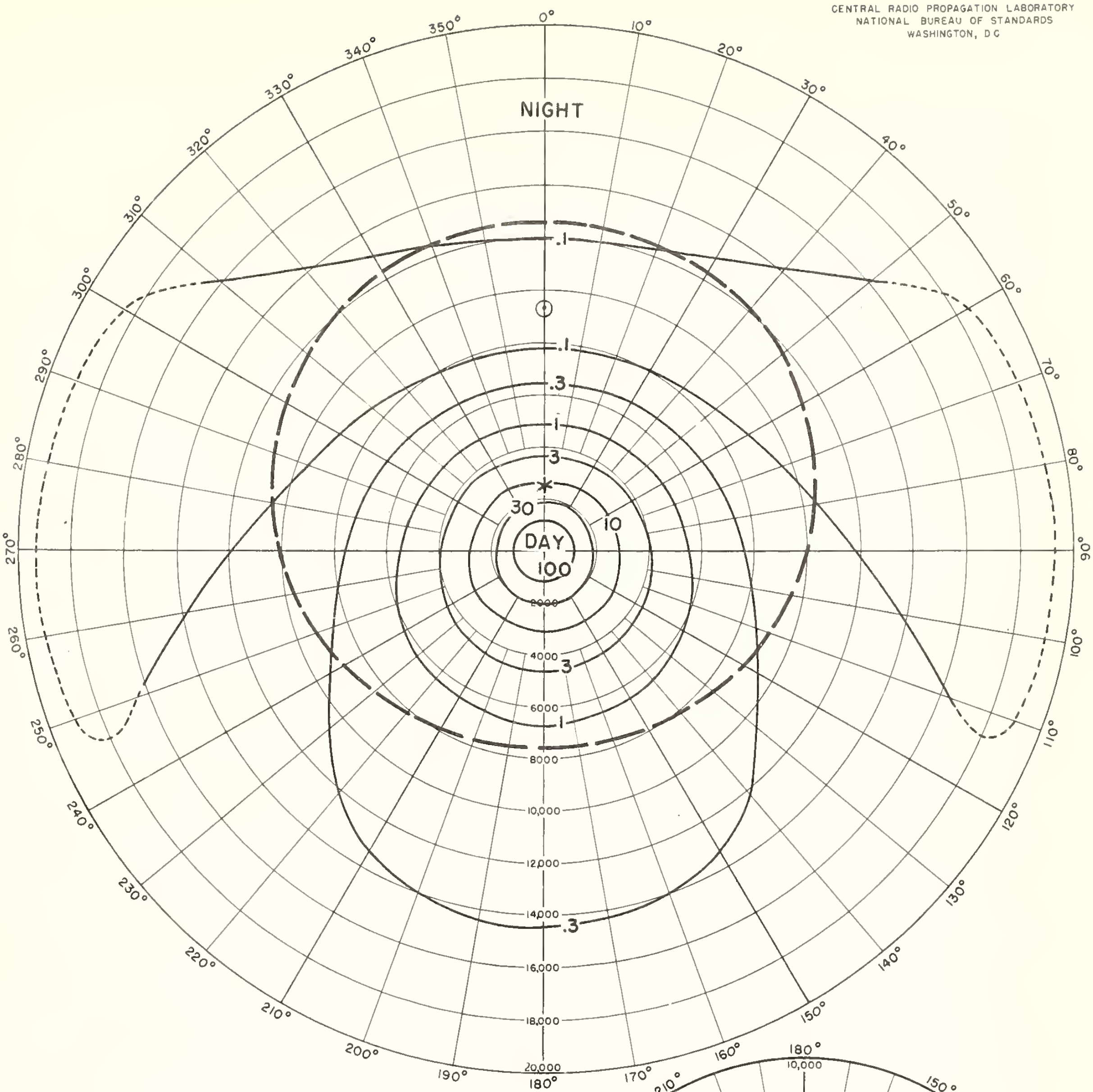
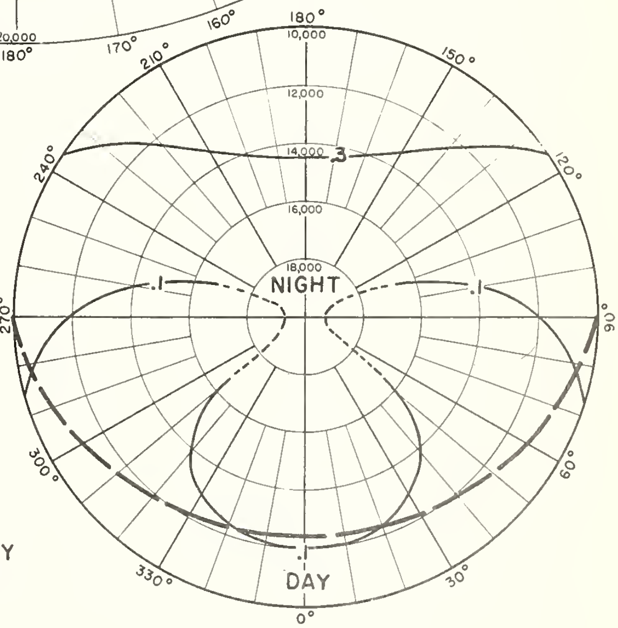



Fig. 23
FIELD INTENSITY, μV/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE, 2500 km (22°30')
SUNSPOT MAXIMUM

✱ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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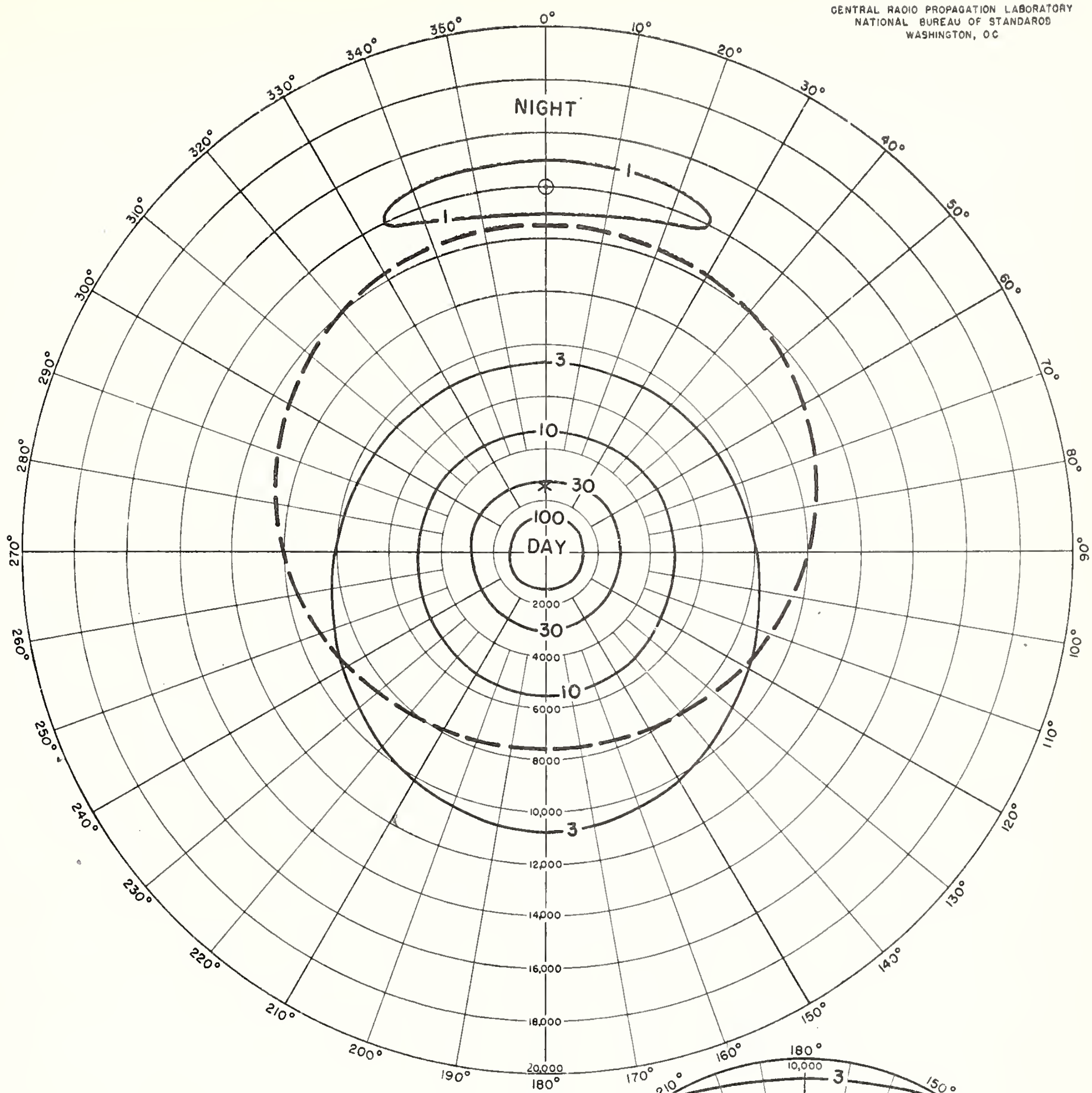
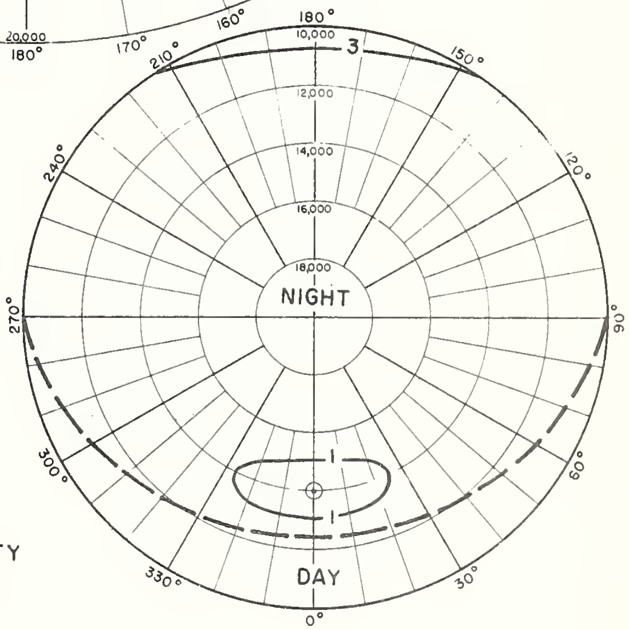



Fig. 24
FIELD INTENSITY, μV/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 2500 km (22°30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

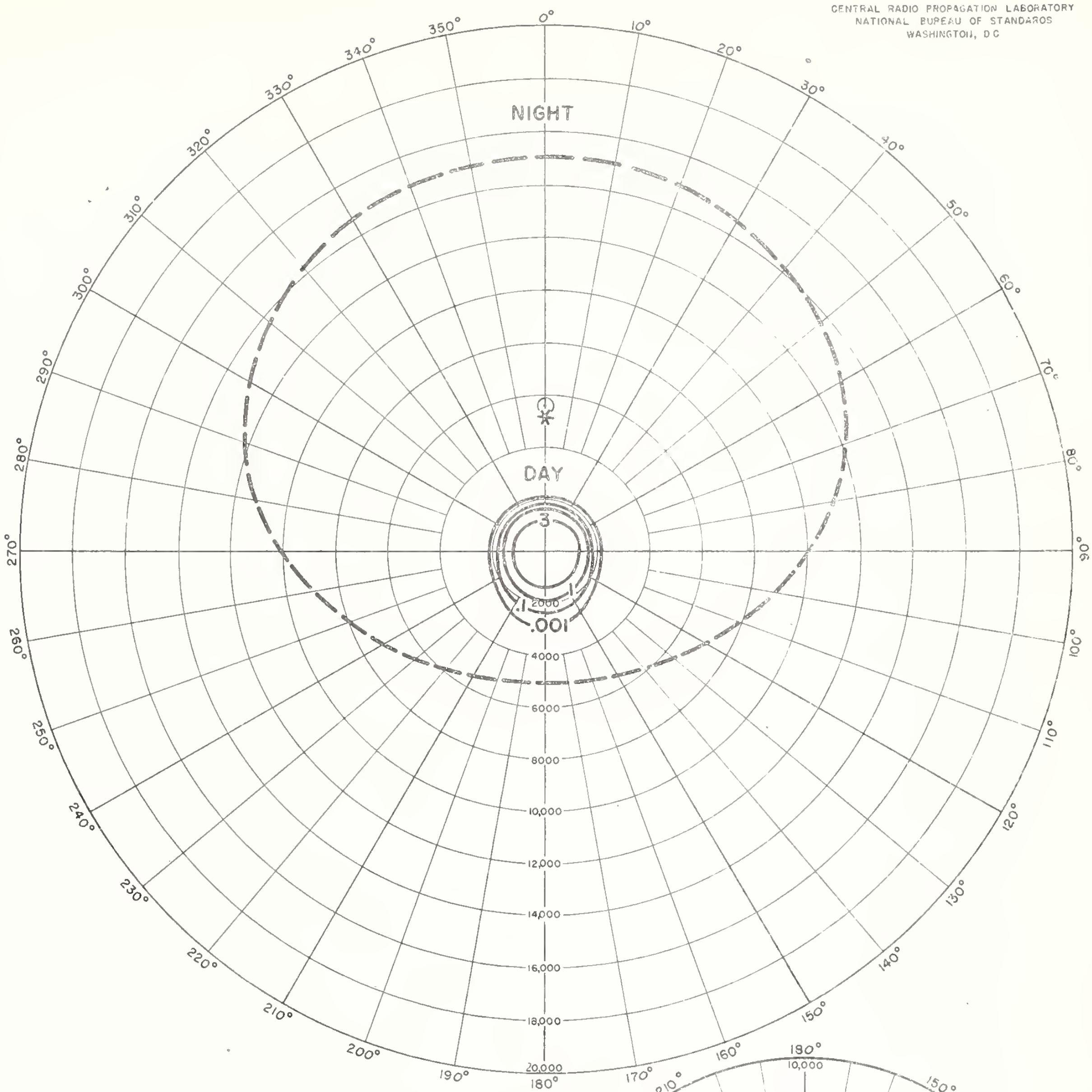
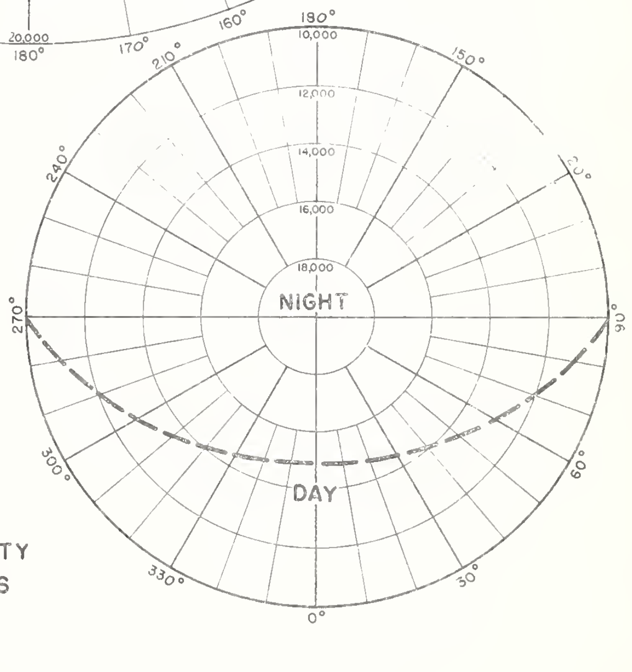



Fig. 25
FIELD INTENSITY, µv/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 5000 km (45°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

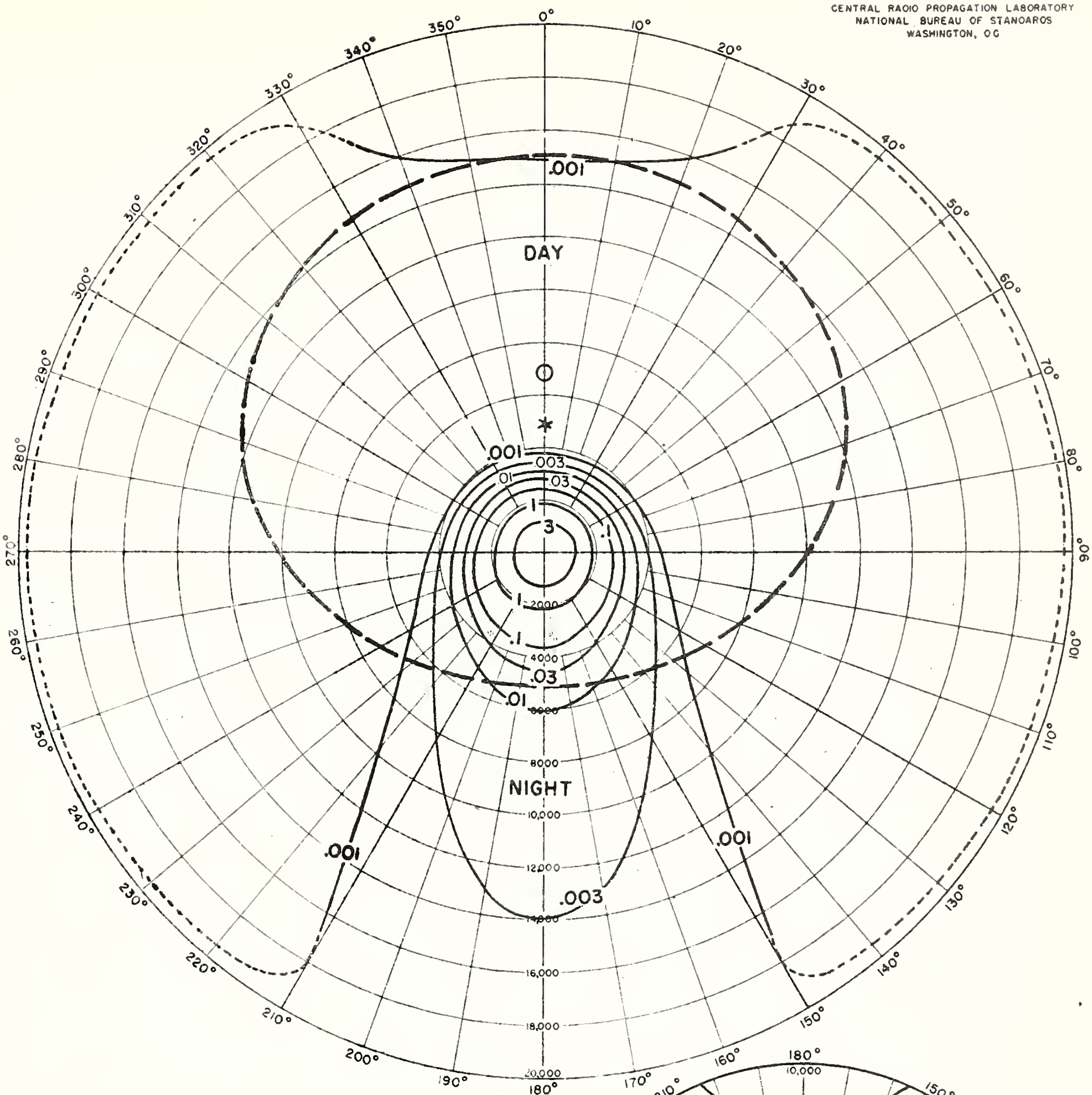
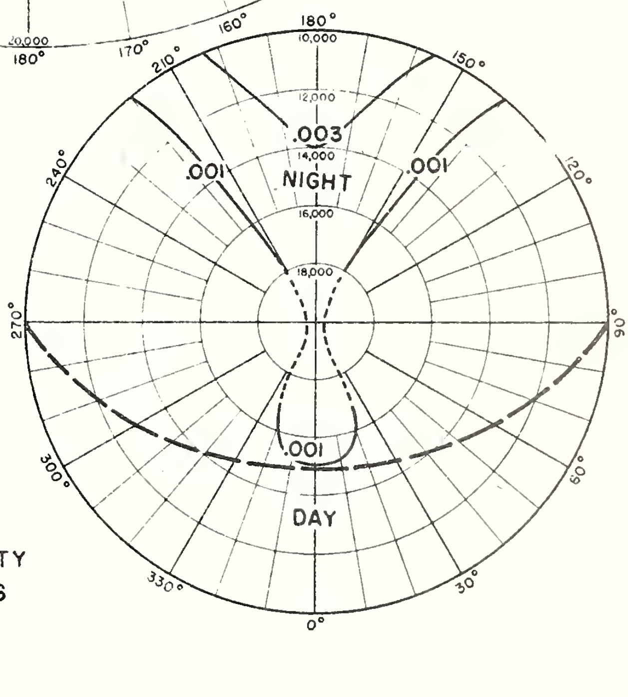



Fig. 26
FIELD INTENSITY, μV/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 5000 km (45°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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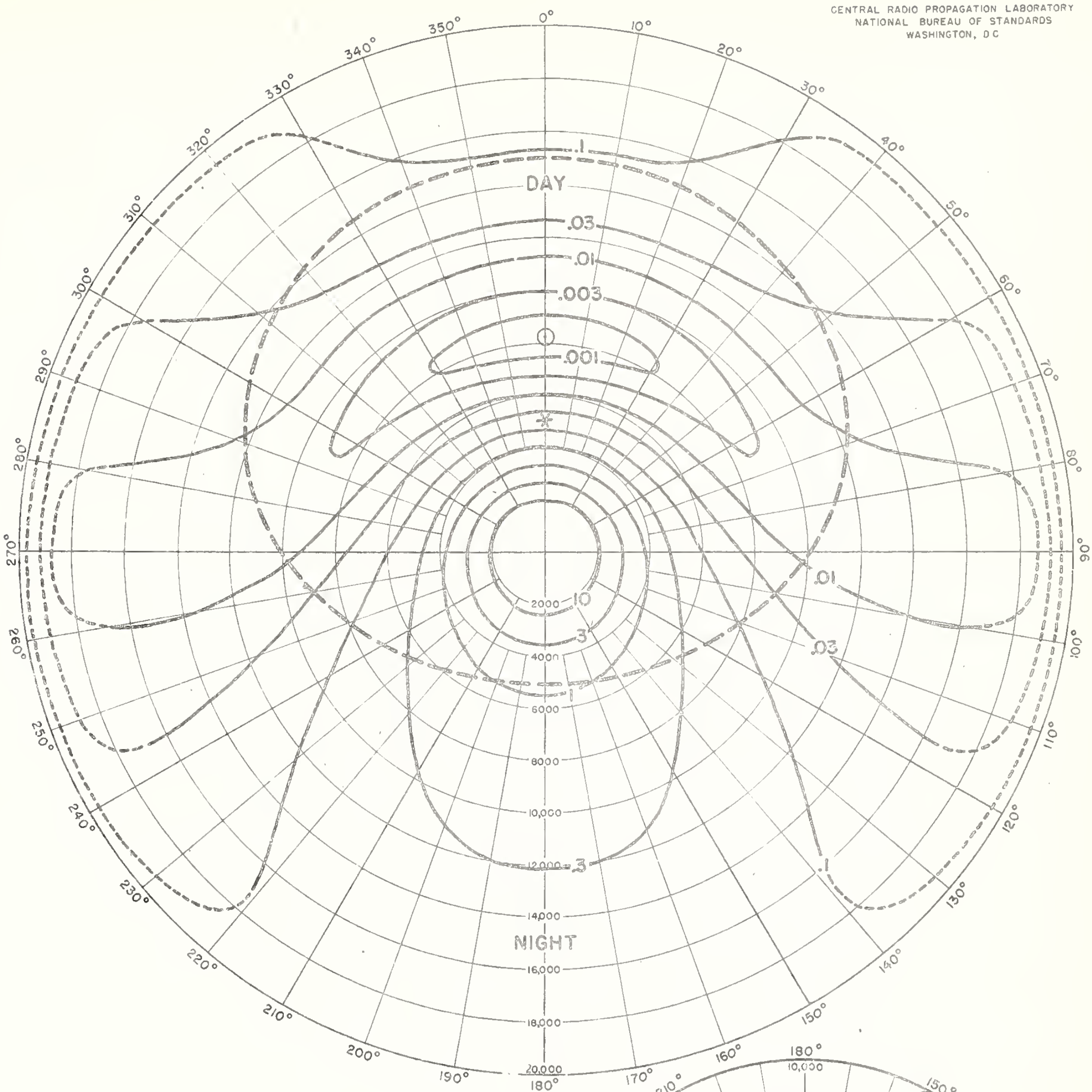
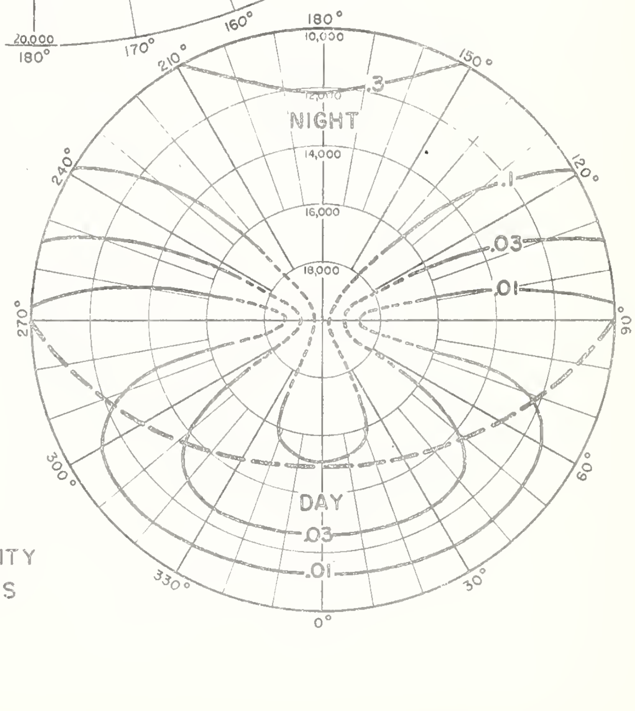



Fig. 27
FIELD INTENSITY, μv/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE 5000 km (45°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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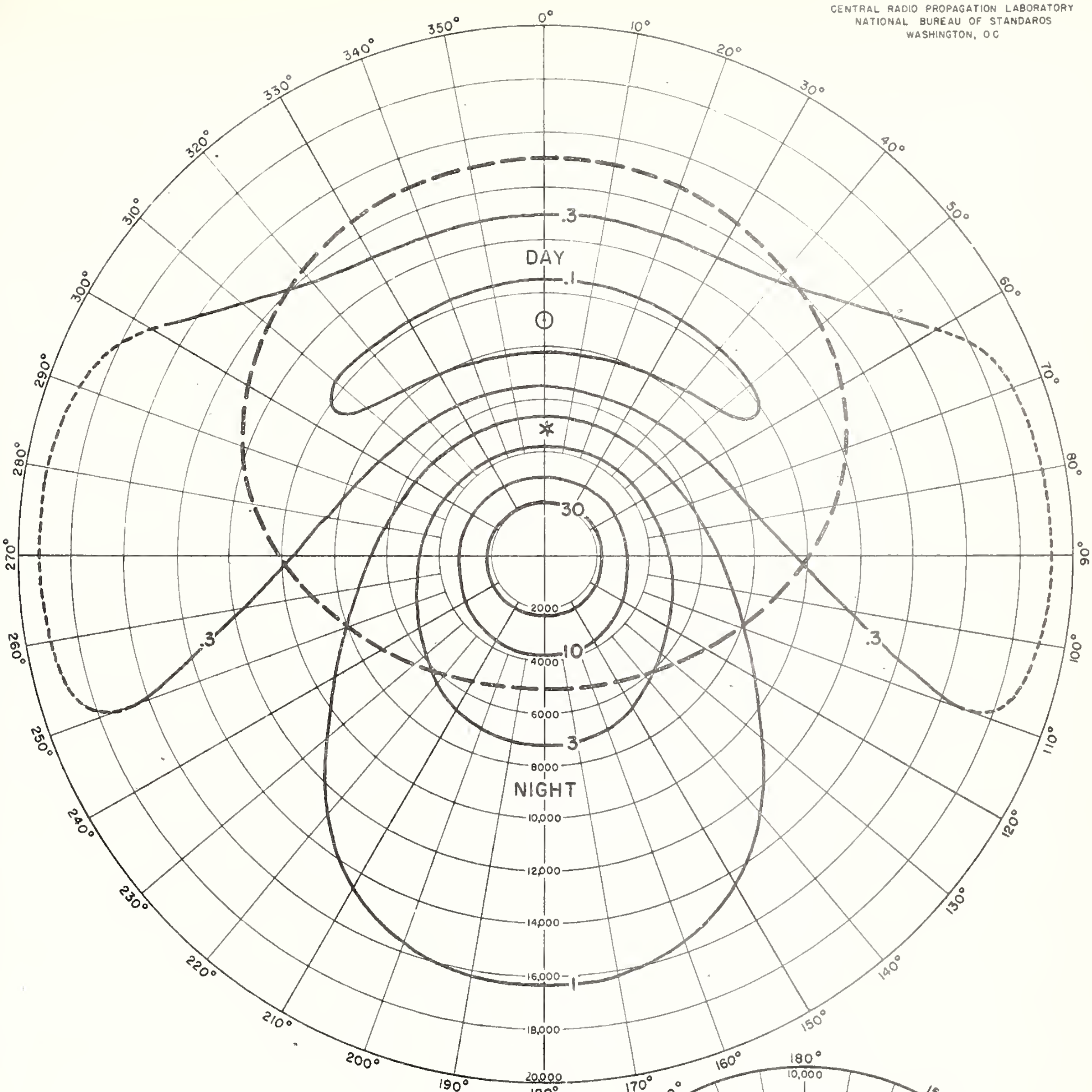
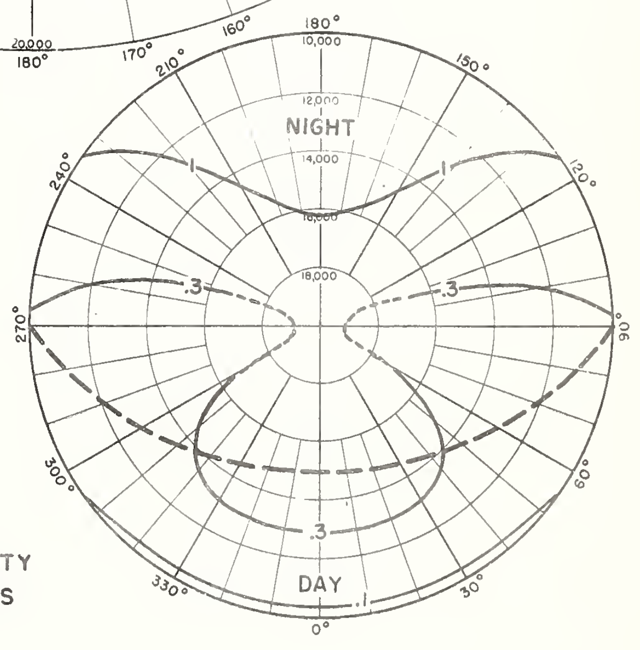



Fig. 28
FIELD INTENSITY, μv/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE, 5000 km (45°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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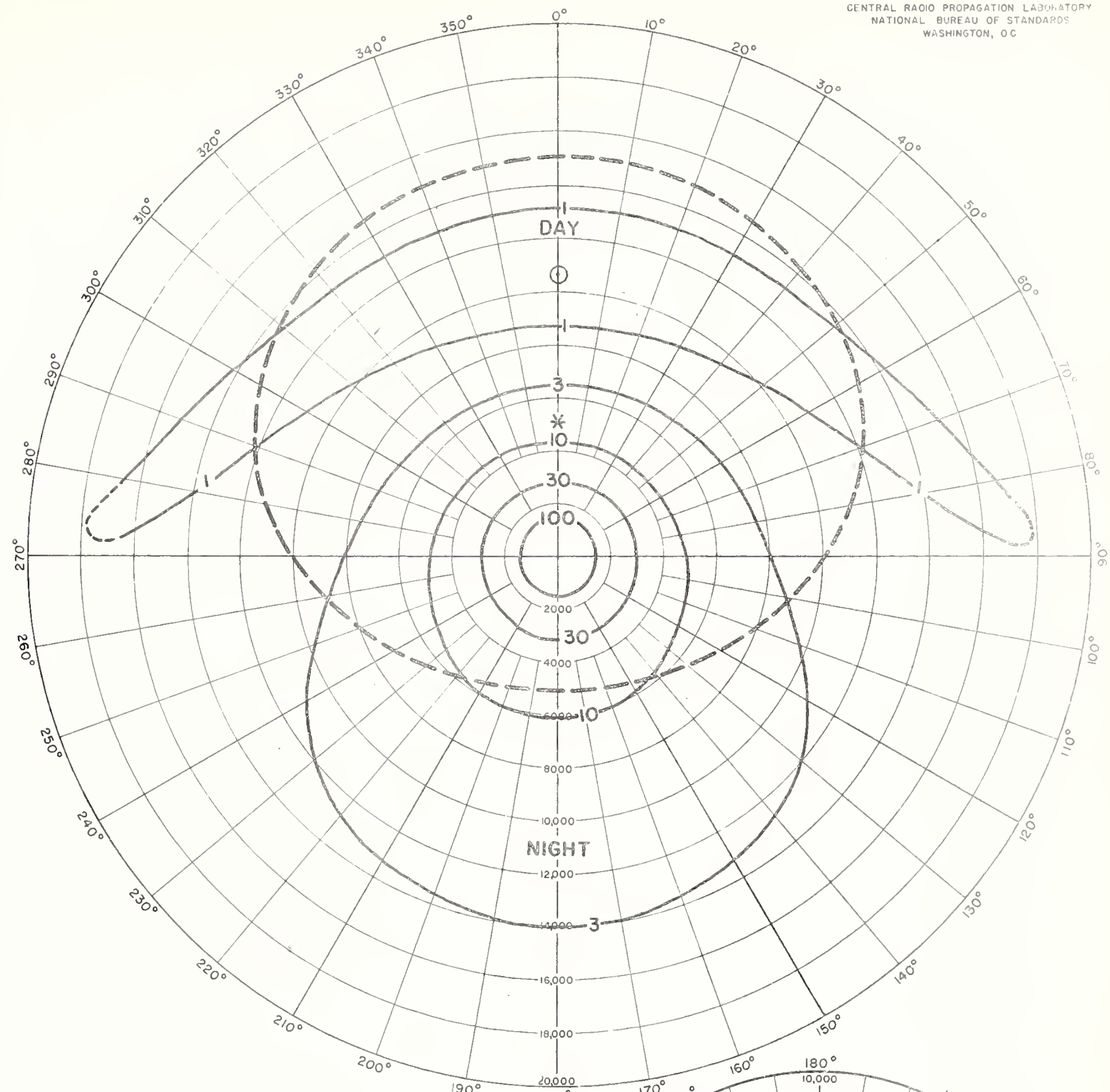
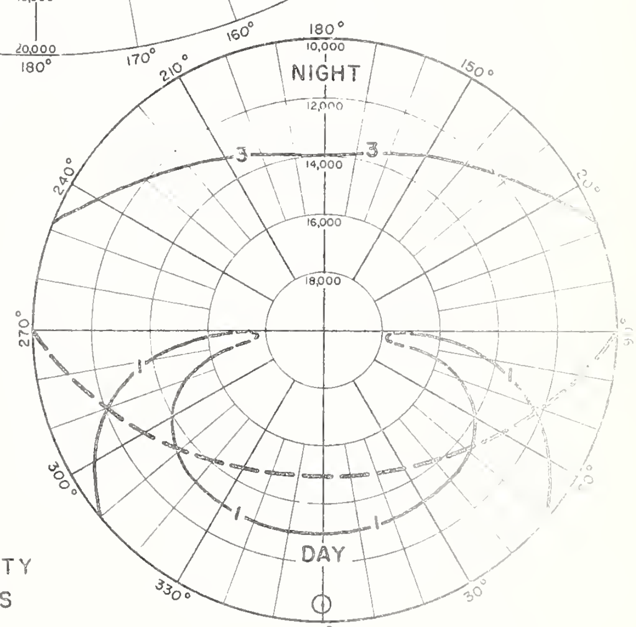



Fig. 29
FIELD INTENSITY, μv/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE, 5000 km (45°)
SUNSPOT MINIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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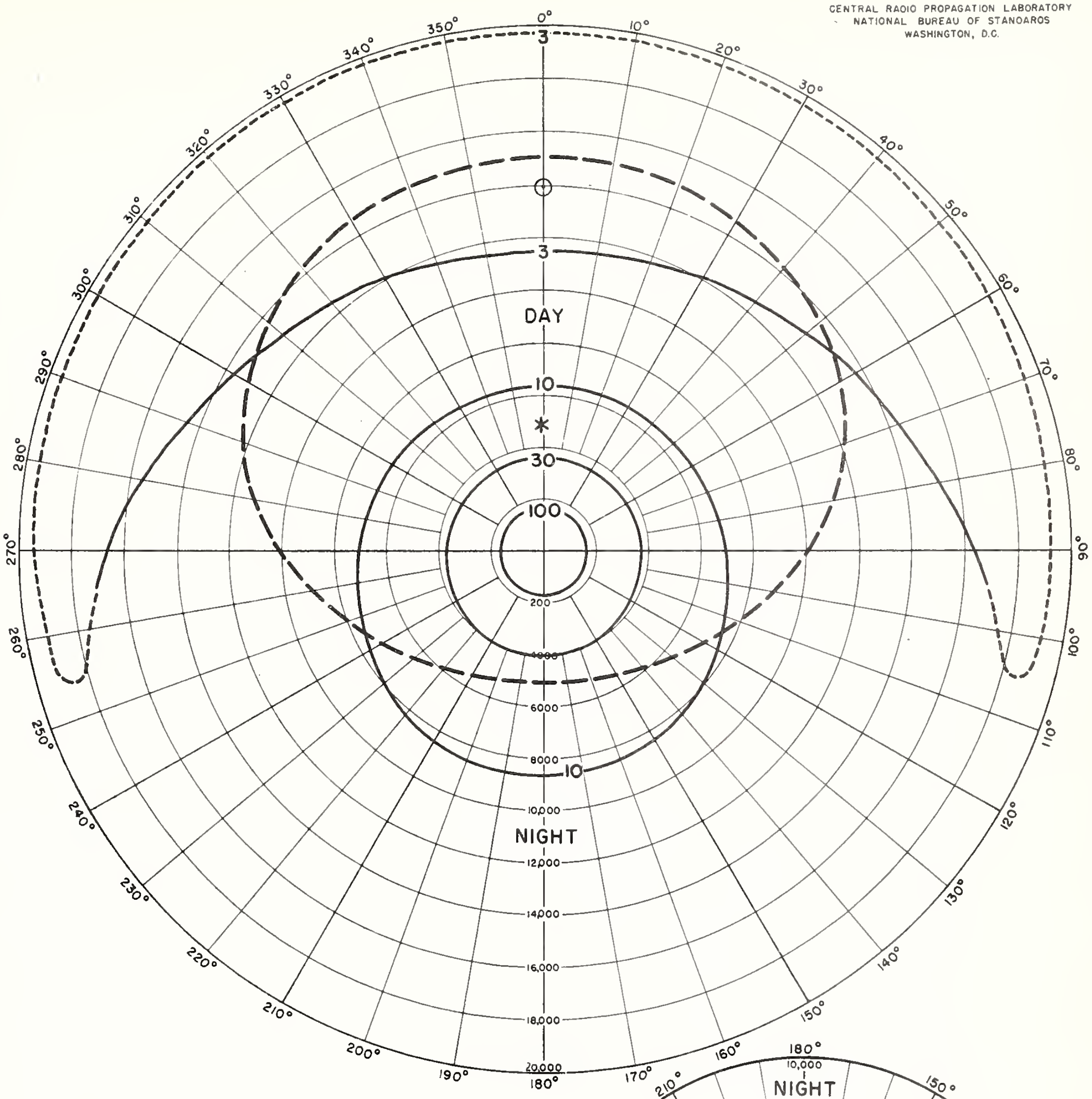
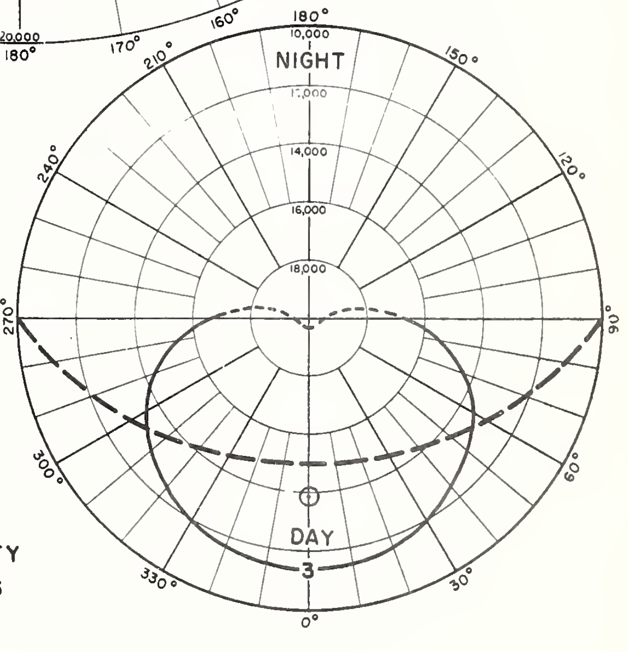



Fig. 30
FIELD INTENSITY, µv/m, I KW, 25 Mc
SUBSOLAR DISTANCE, 5000 km (45°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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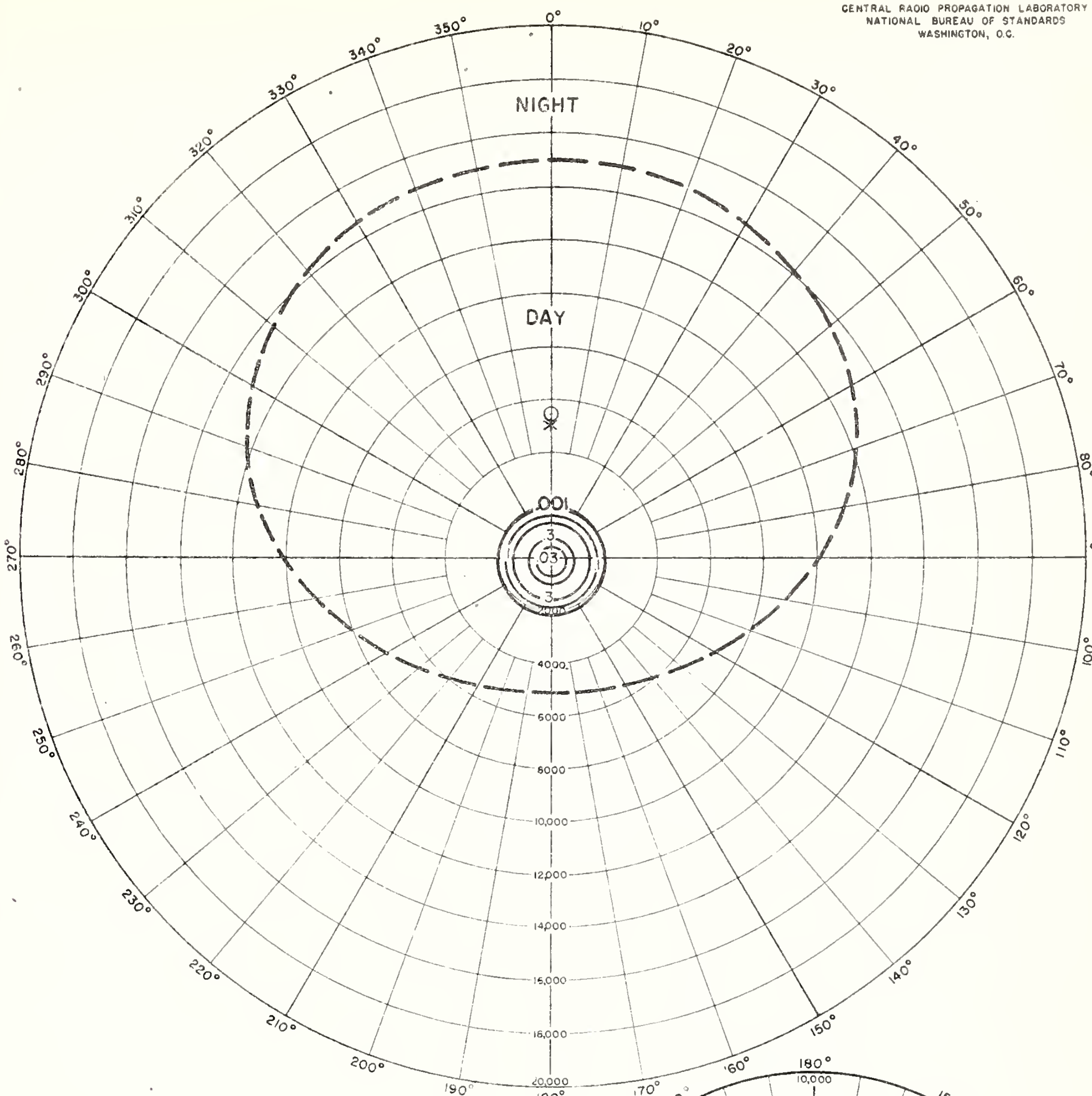
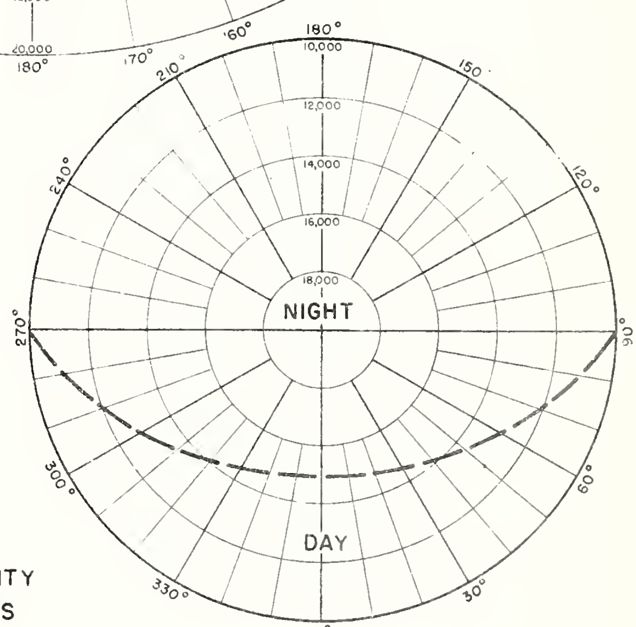



Fig. 31
FIELD INTENSITY, μV/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 5000 km (45°)
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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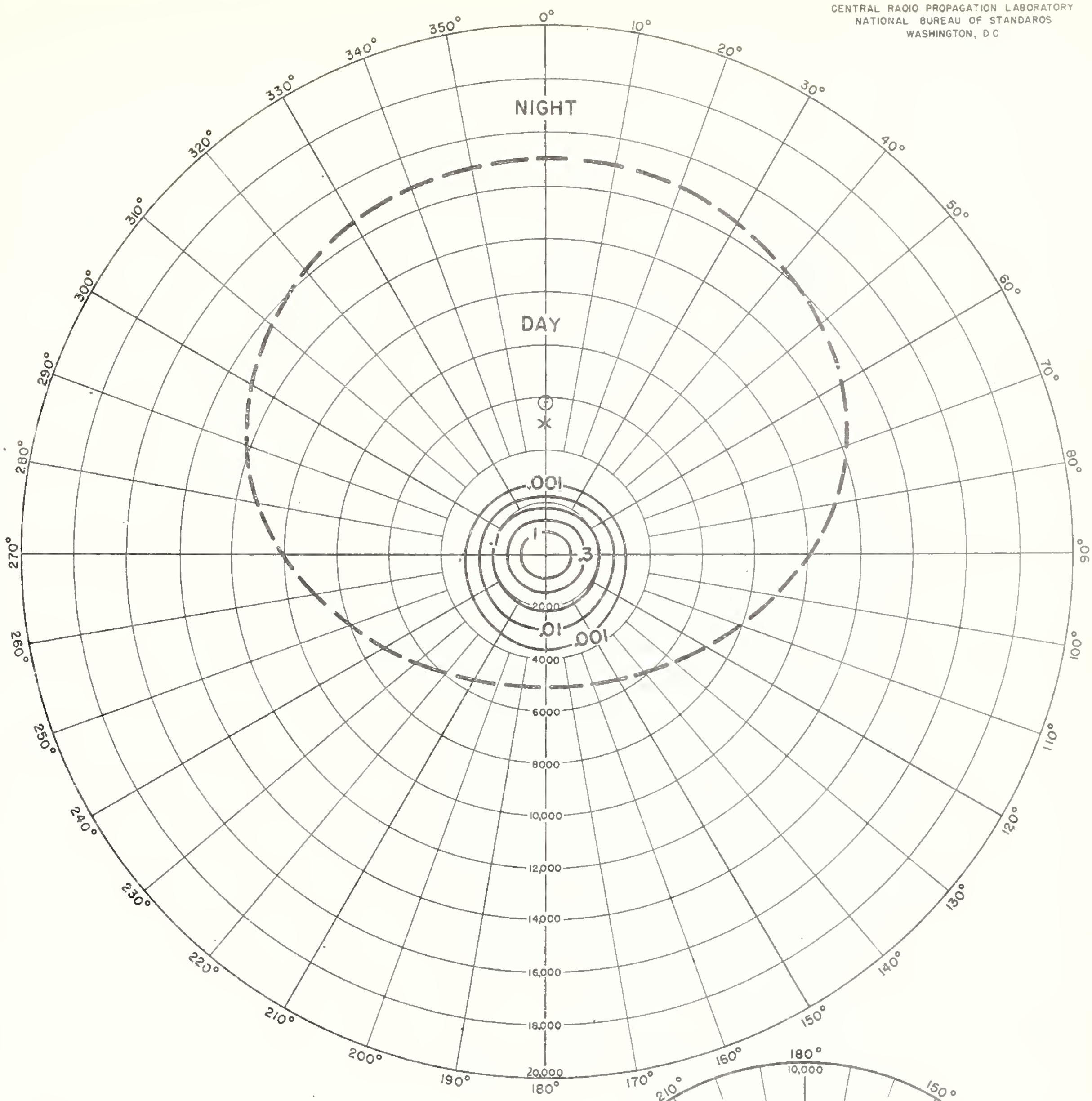
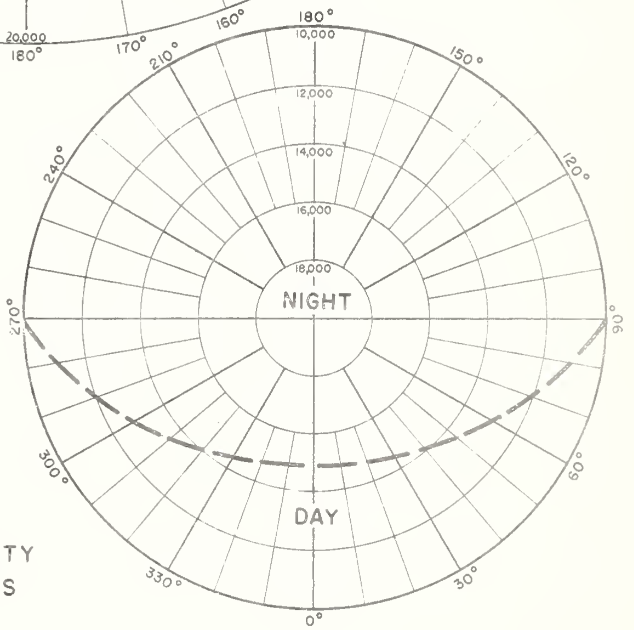



Fig. 32
FIELD INTENSITY, μv/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 5000 km (45°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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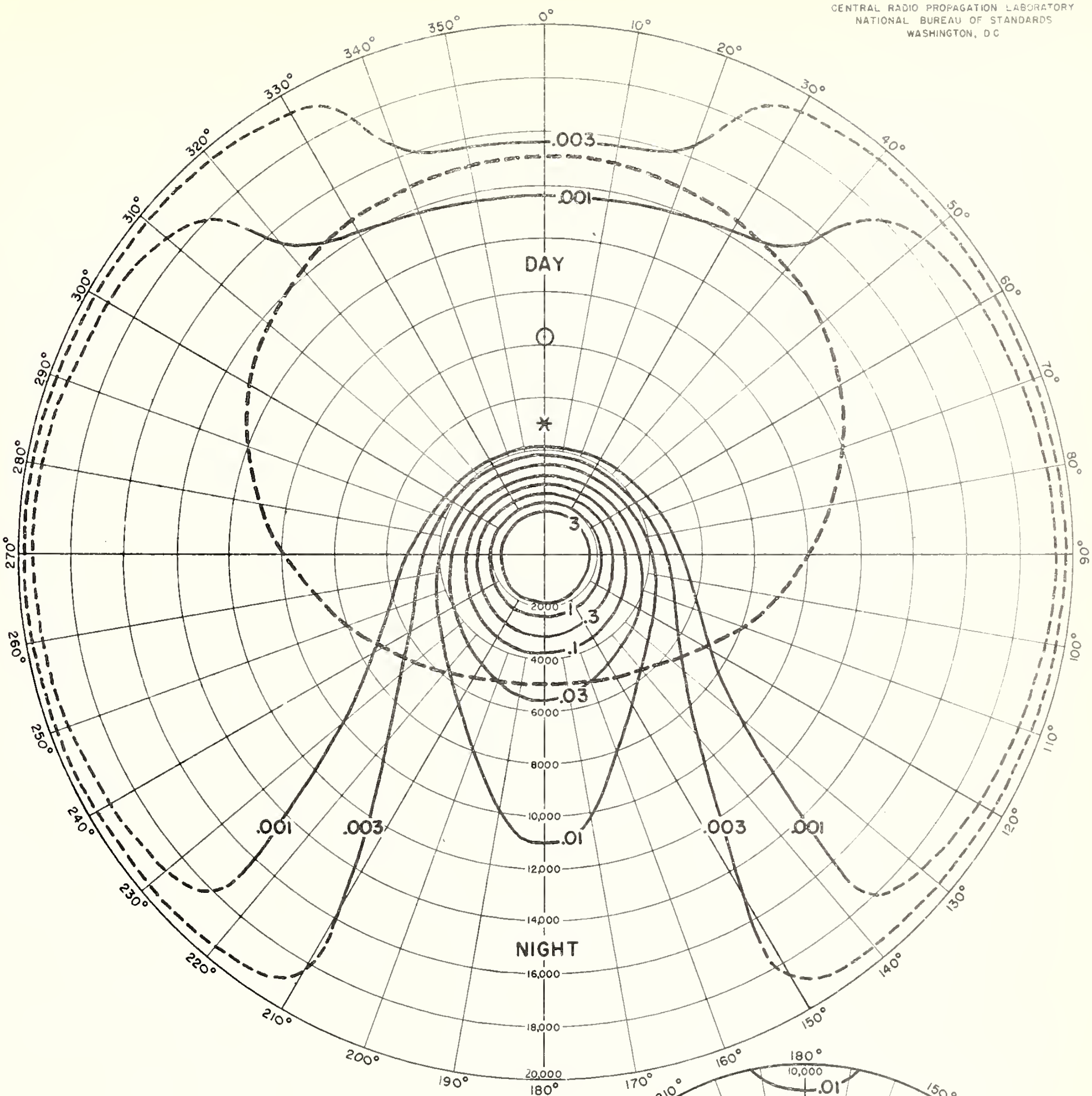
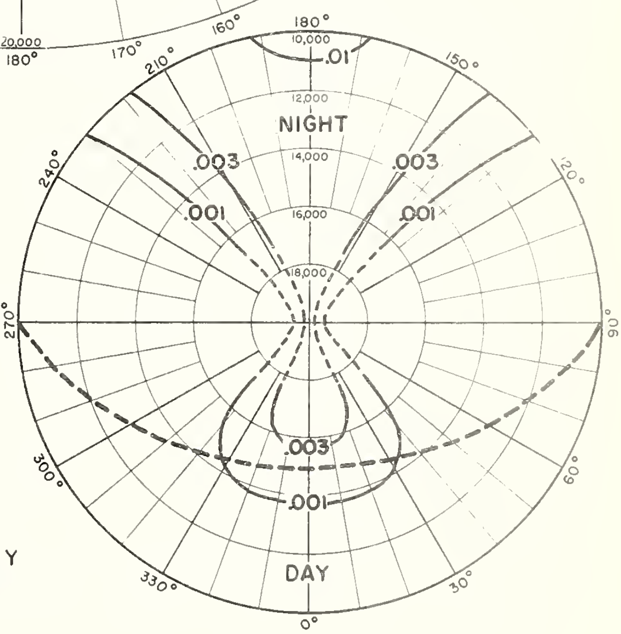



Fig. 33
FIELD INTENSITY, μv/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE 5000 km (45°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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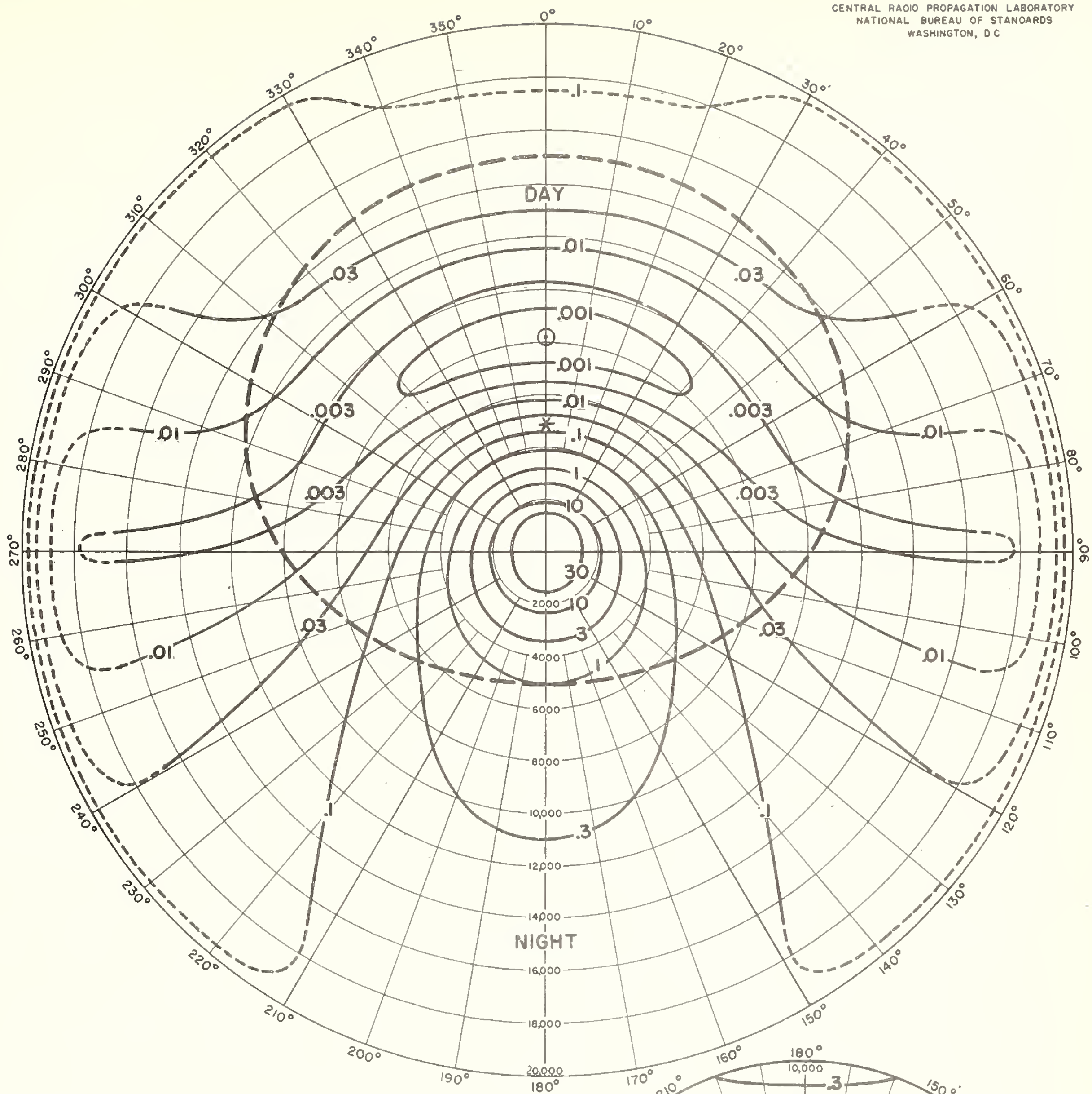
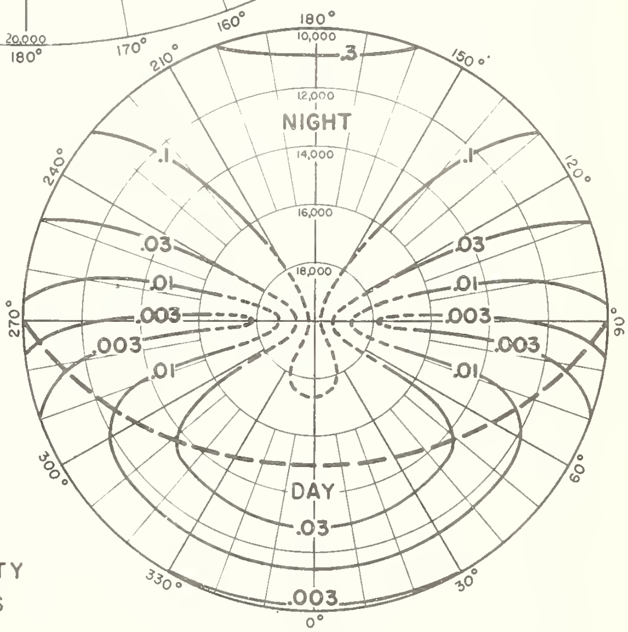



Fig. 34
FIELD INTENSITY, μV/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE 5000 km (45°)
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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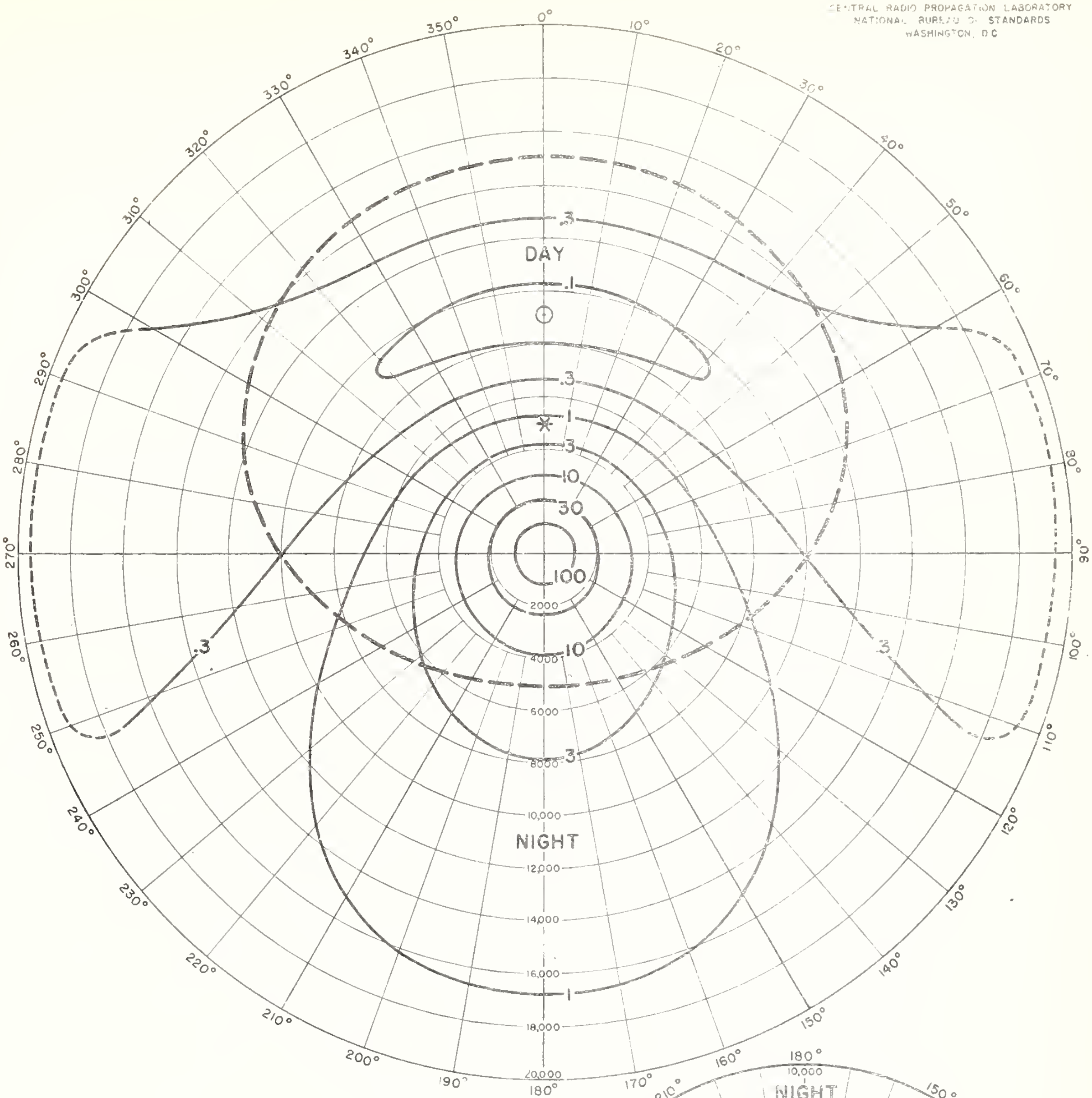
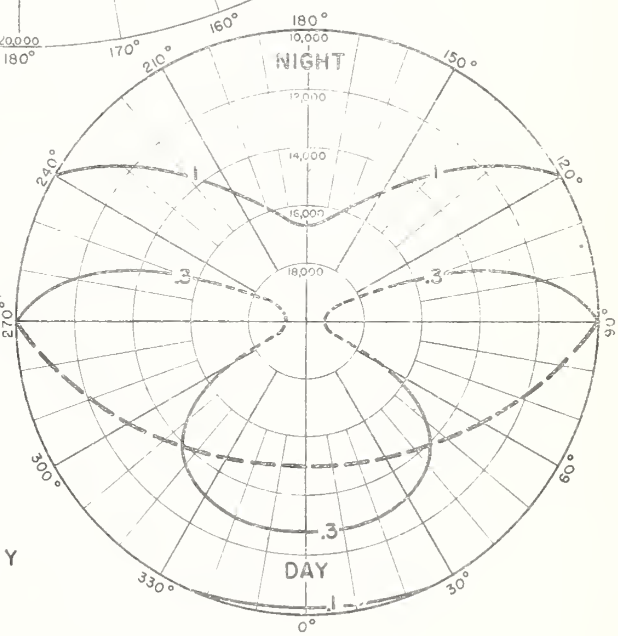



Fig. 35
FIELD INTENSITY, μV/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE 5000 km (45°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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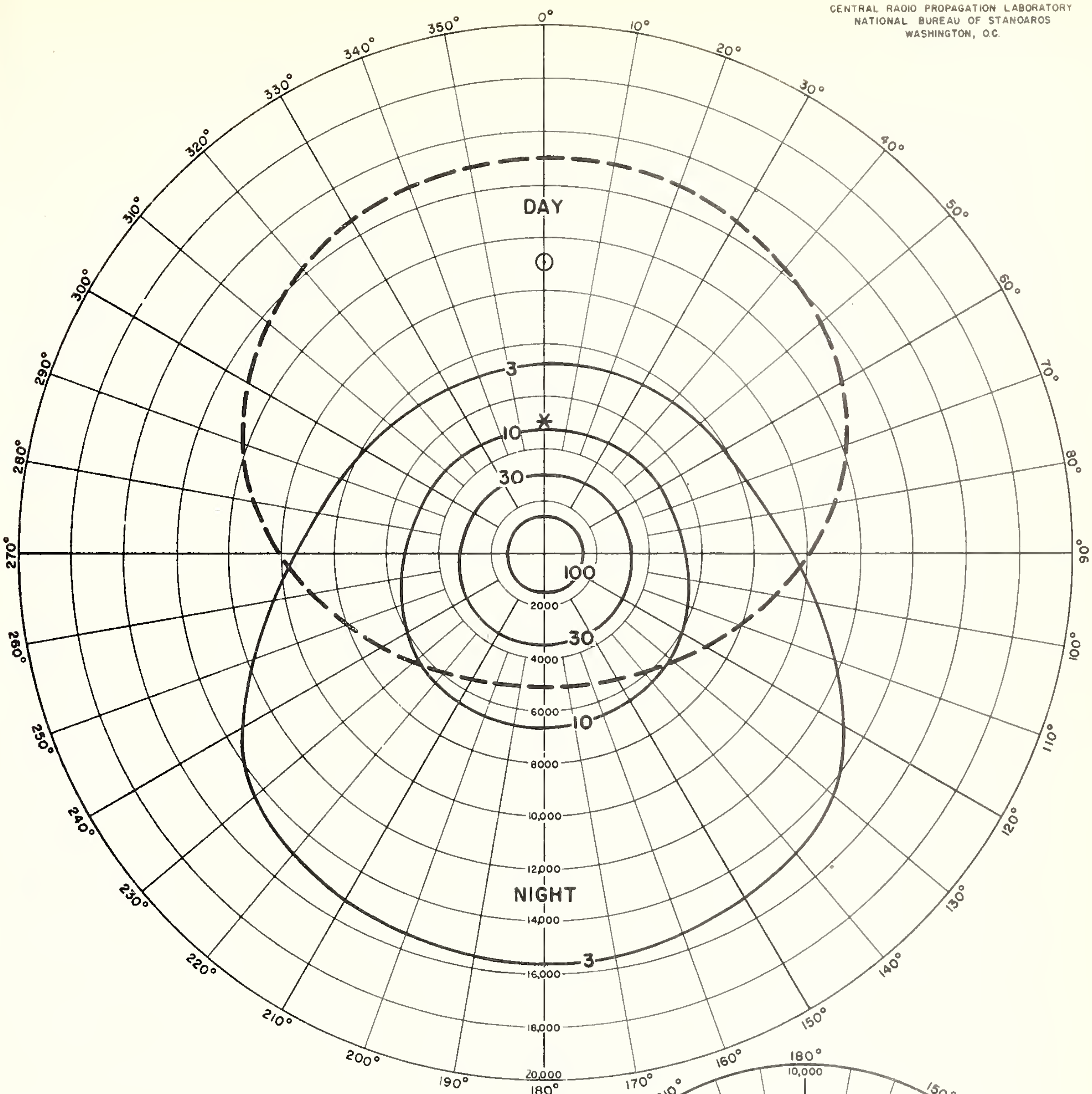
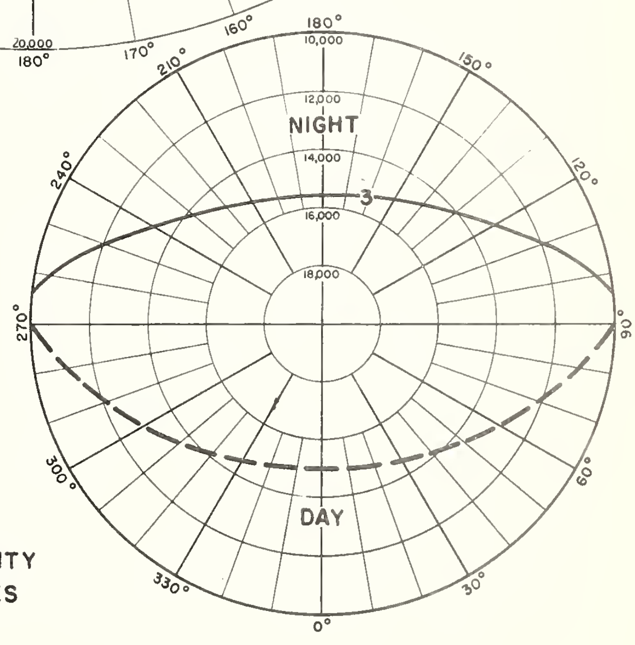



Fig. 36
FIELD INTENSITY, μV/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE 5000 km (45°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

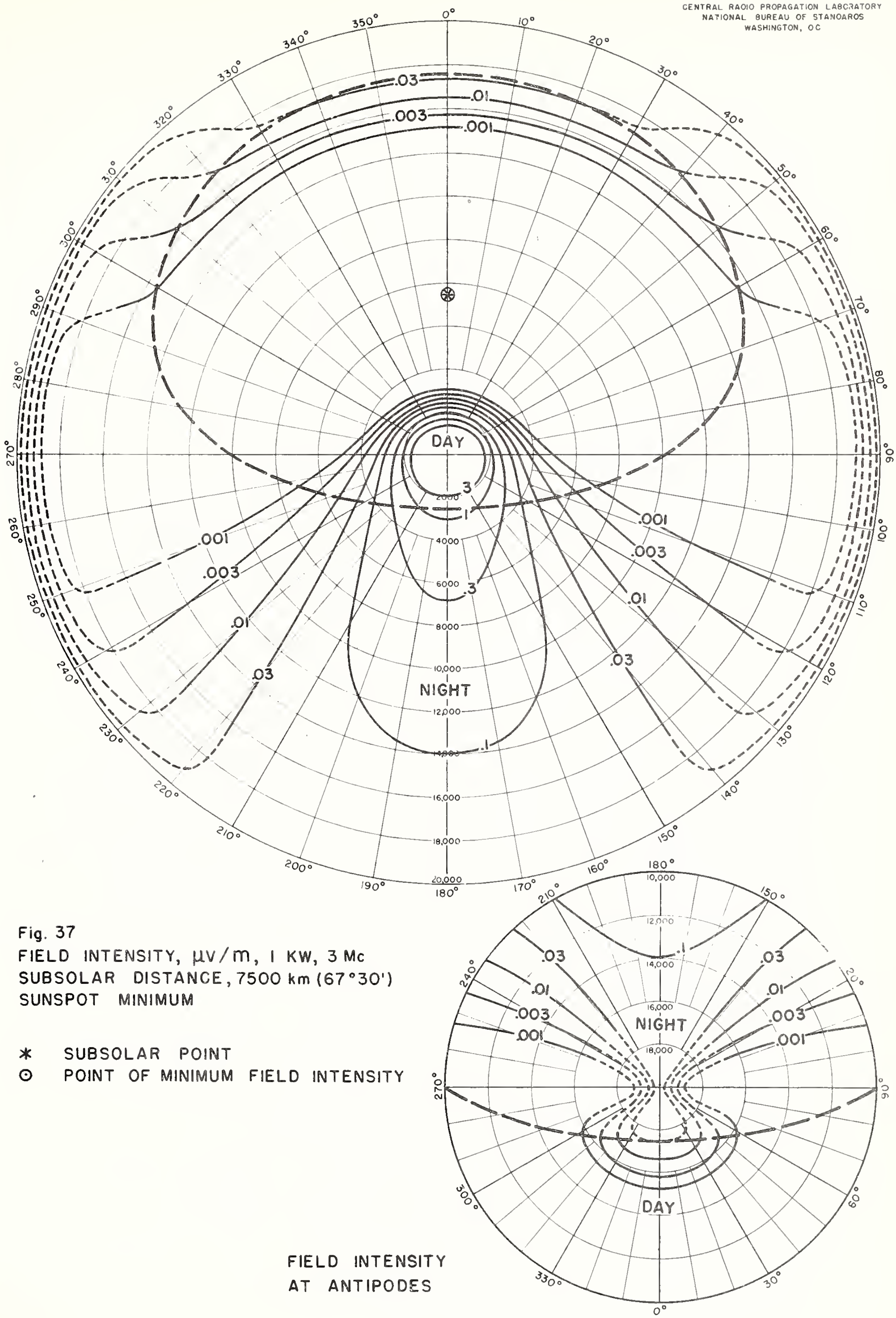



Fig. 37
FIELD INTENSITY, μv/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 7500 km (67°30')
SUNSPOT MINIMUM

✱ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

FIELD INTENSITY
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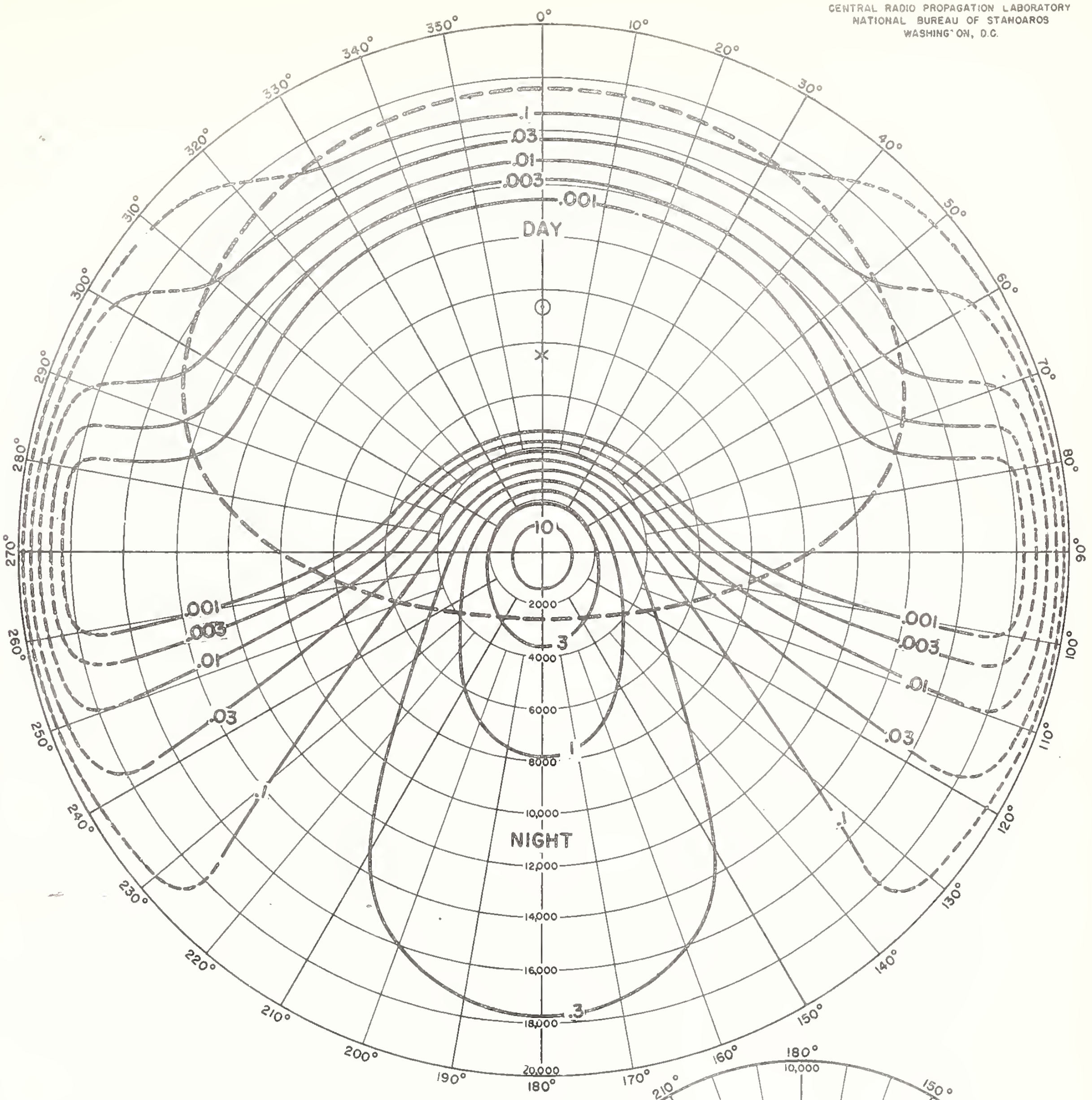
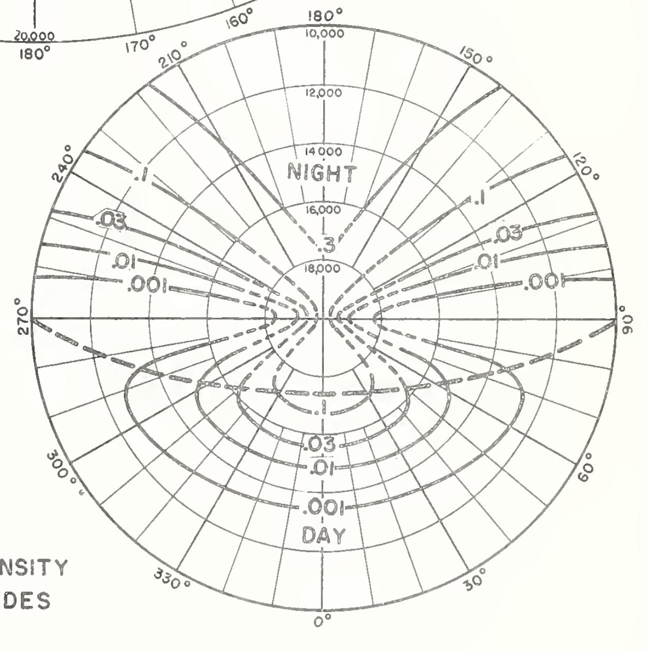



Fig. 38
FIELD INTENSITY, µV/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 7500 km (67°30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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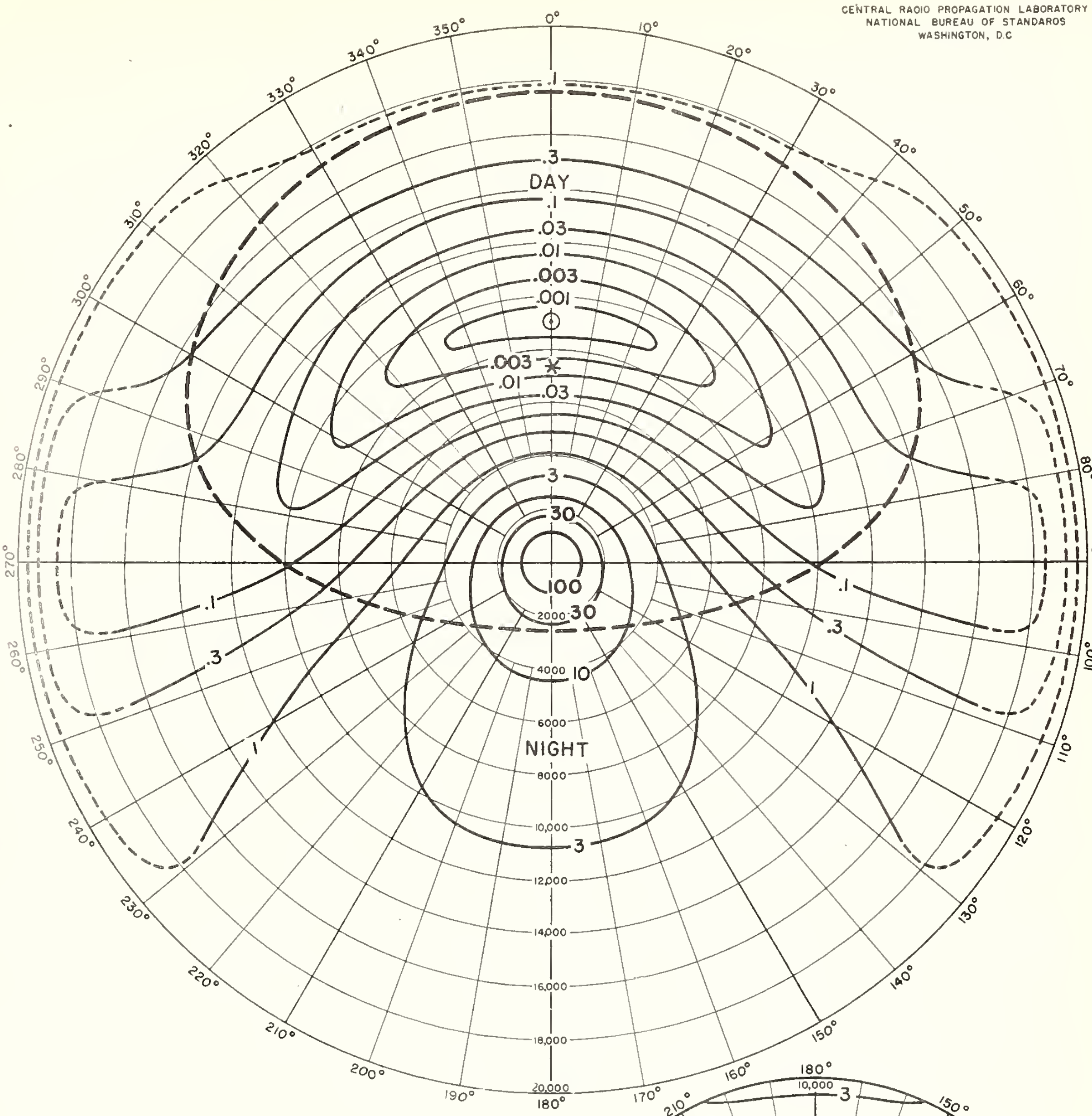
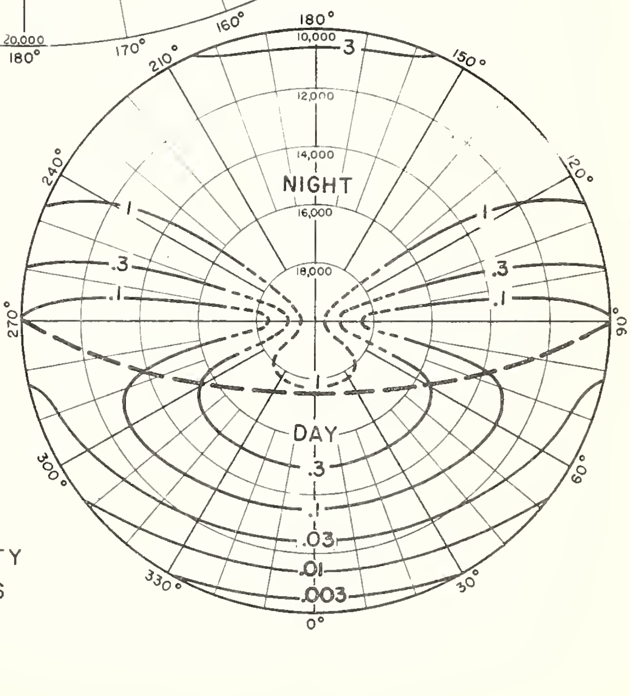



Fig. 39
FIELD INTENSITY, μv/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE 7500 km (67° 30')
SUNSPOT MINIMUM

⁎ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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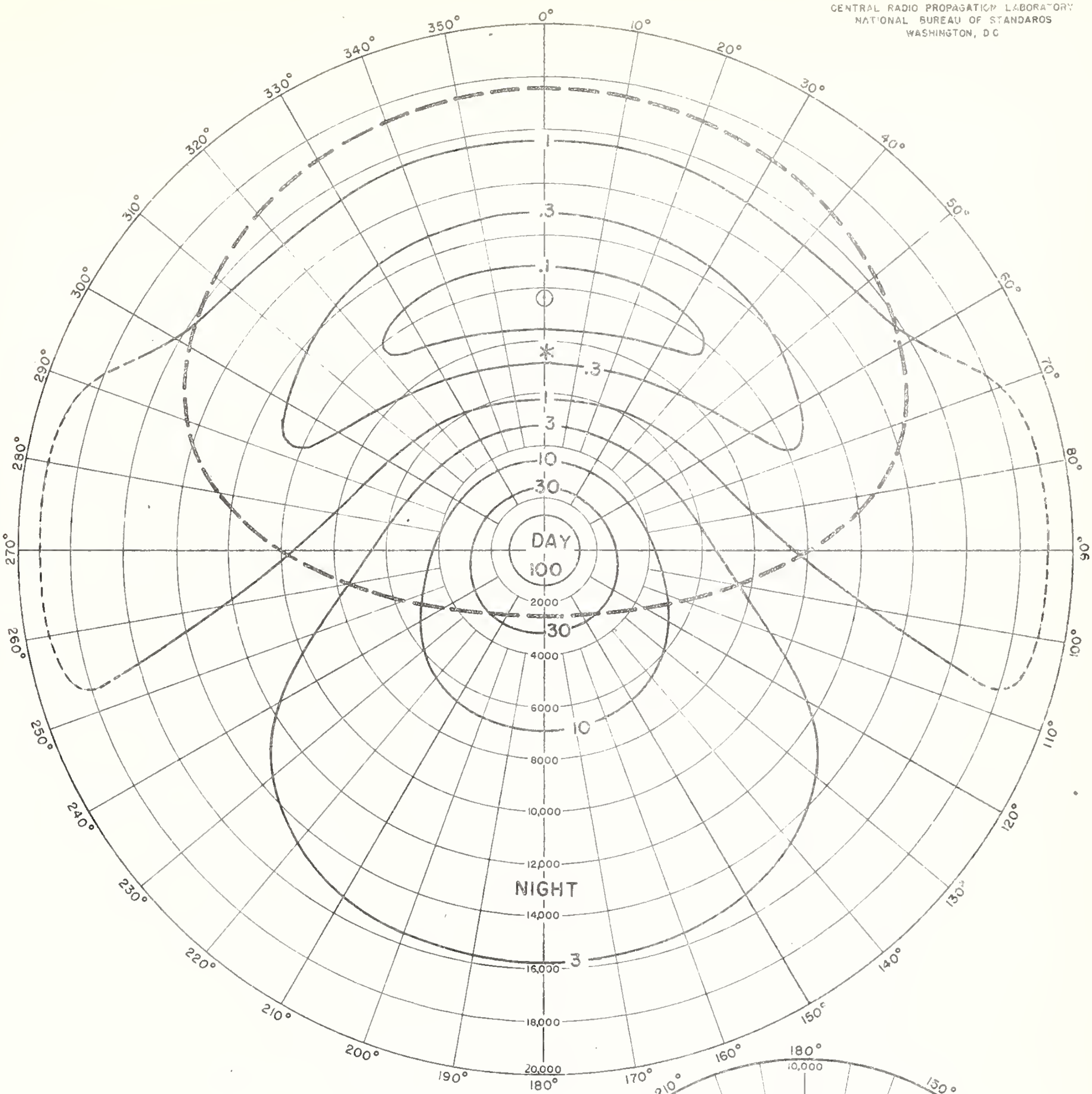
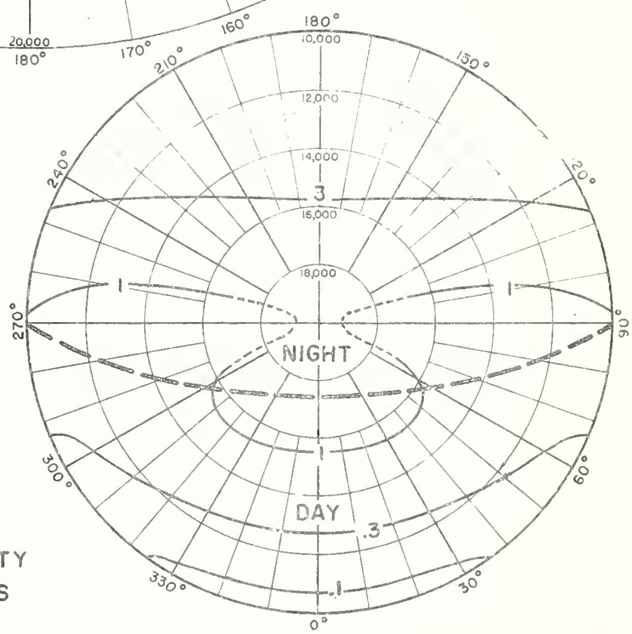



Fig. 40
FIELD INTENSITY, μv/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE, 7500 km (67° 30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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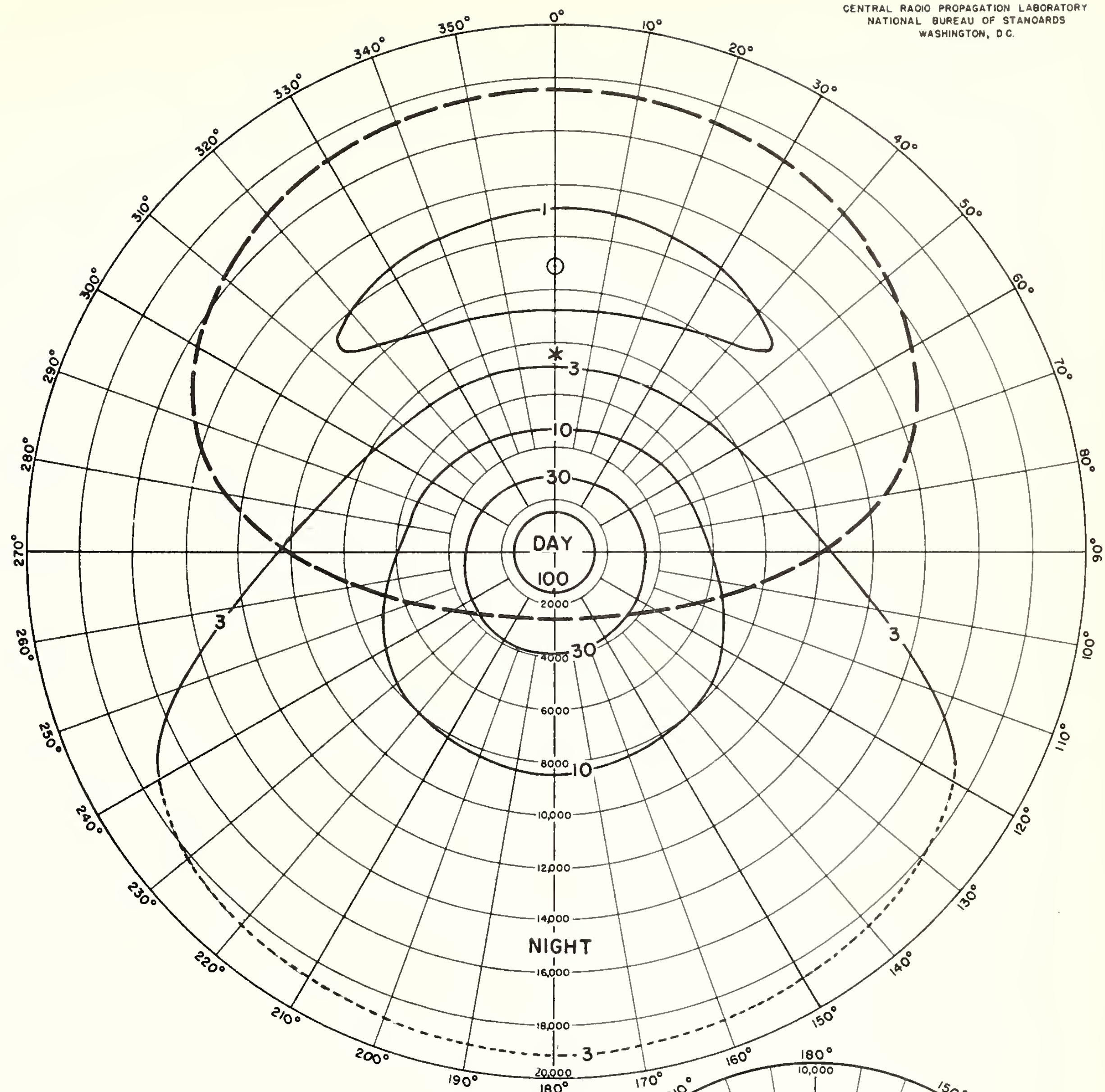
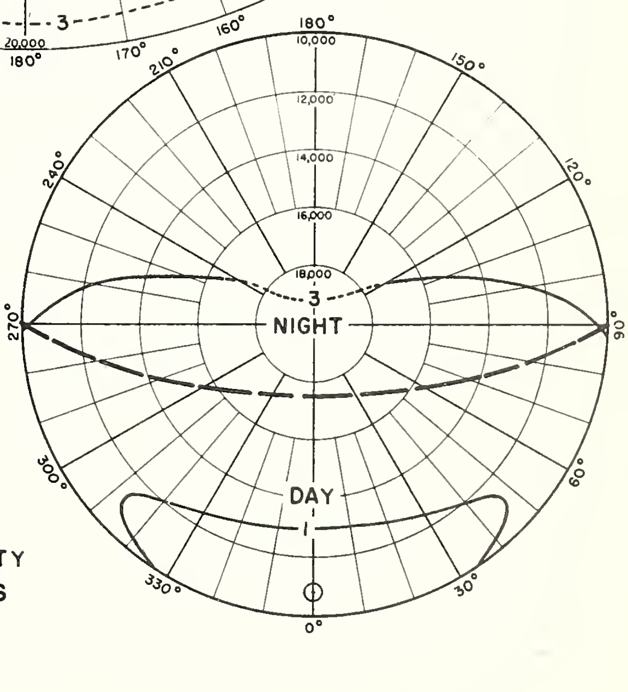



Fig. 41
FIELD INTENSITY, µv/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE, 7500 km (67° 30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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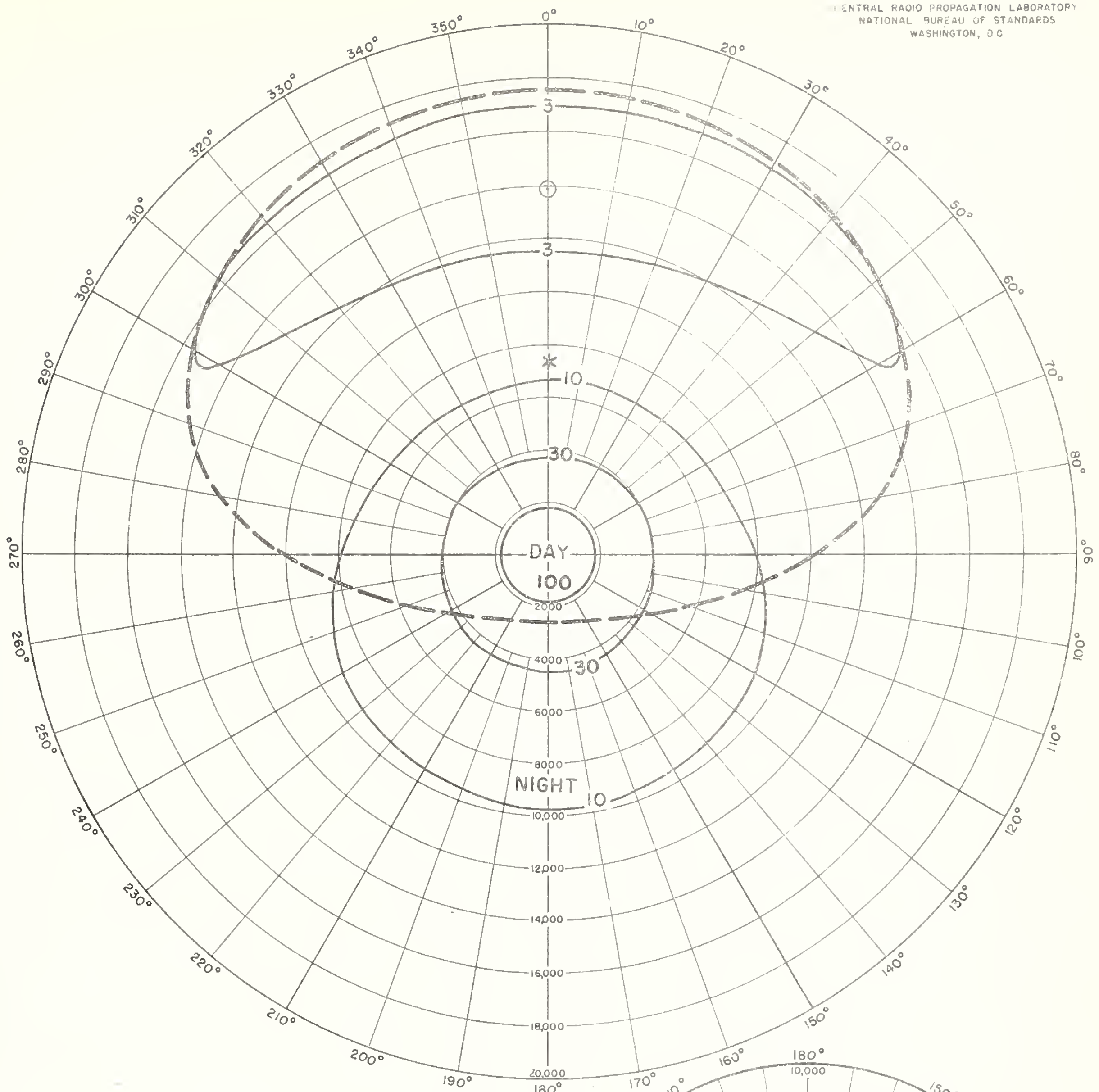
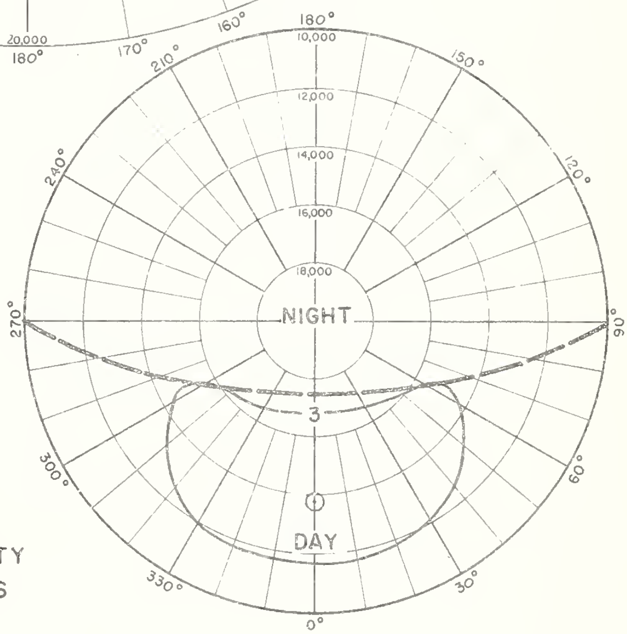



Fig. 42
FIELD INTENSITY, $\mu v/m$, I KW, 25 Mc
SUBSOLAR DISTANCE, 7500 km (67° 30')
SUNSPOT MINIMUM

✳ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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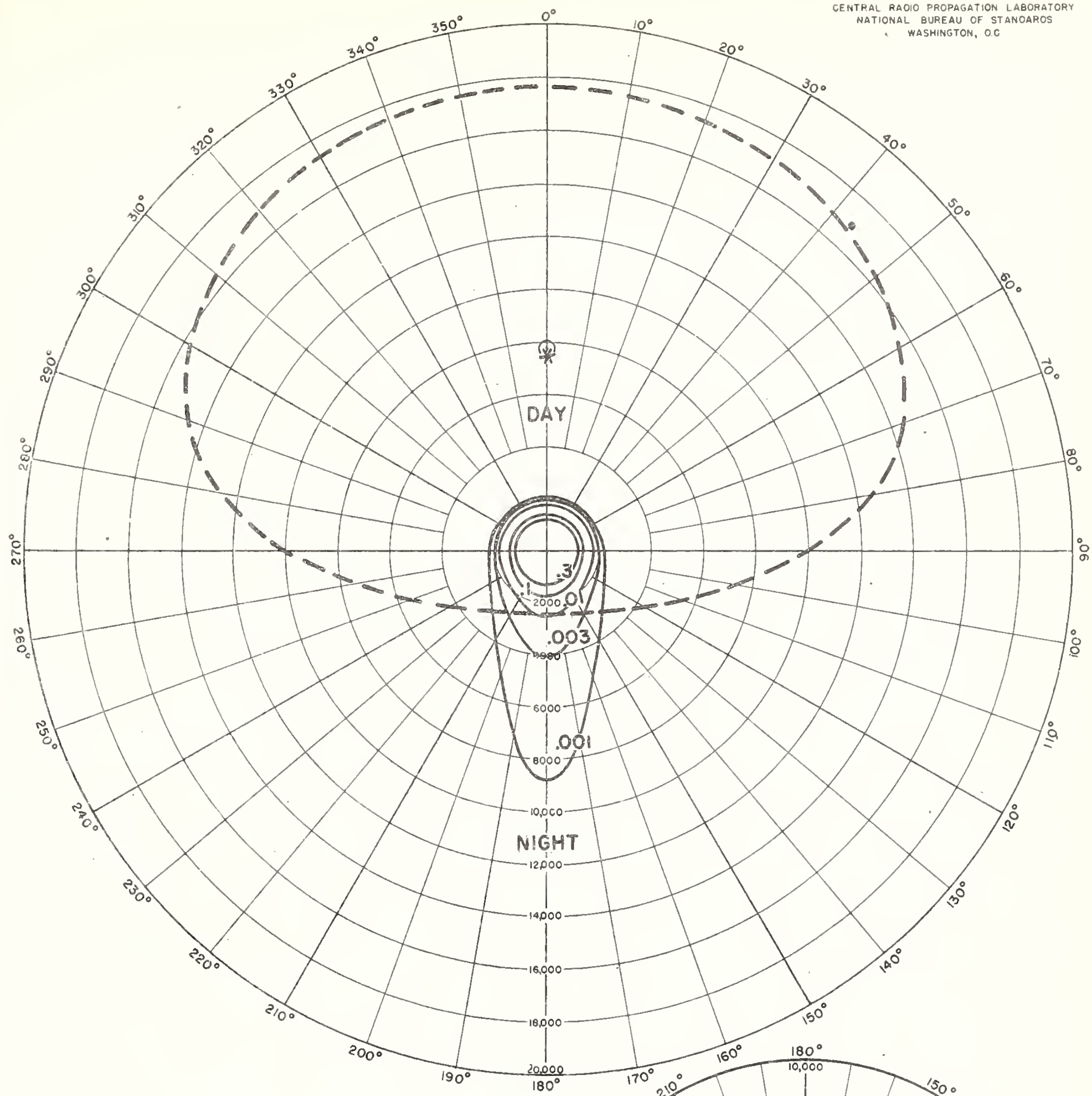
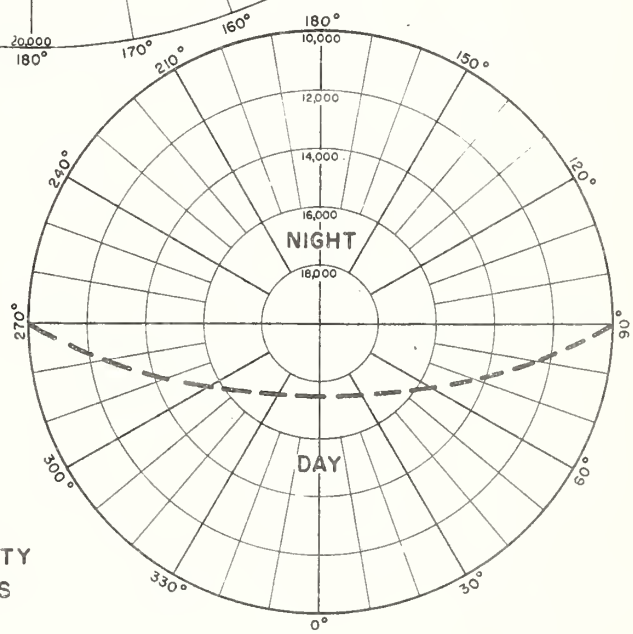



Fig. 43
FIELD INTENSITY, μv/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 7500 km (67°30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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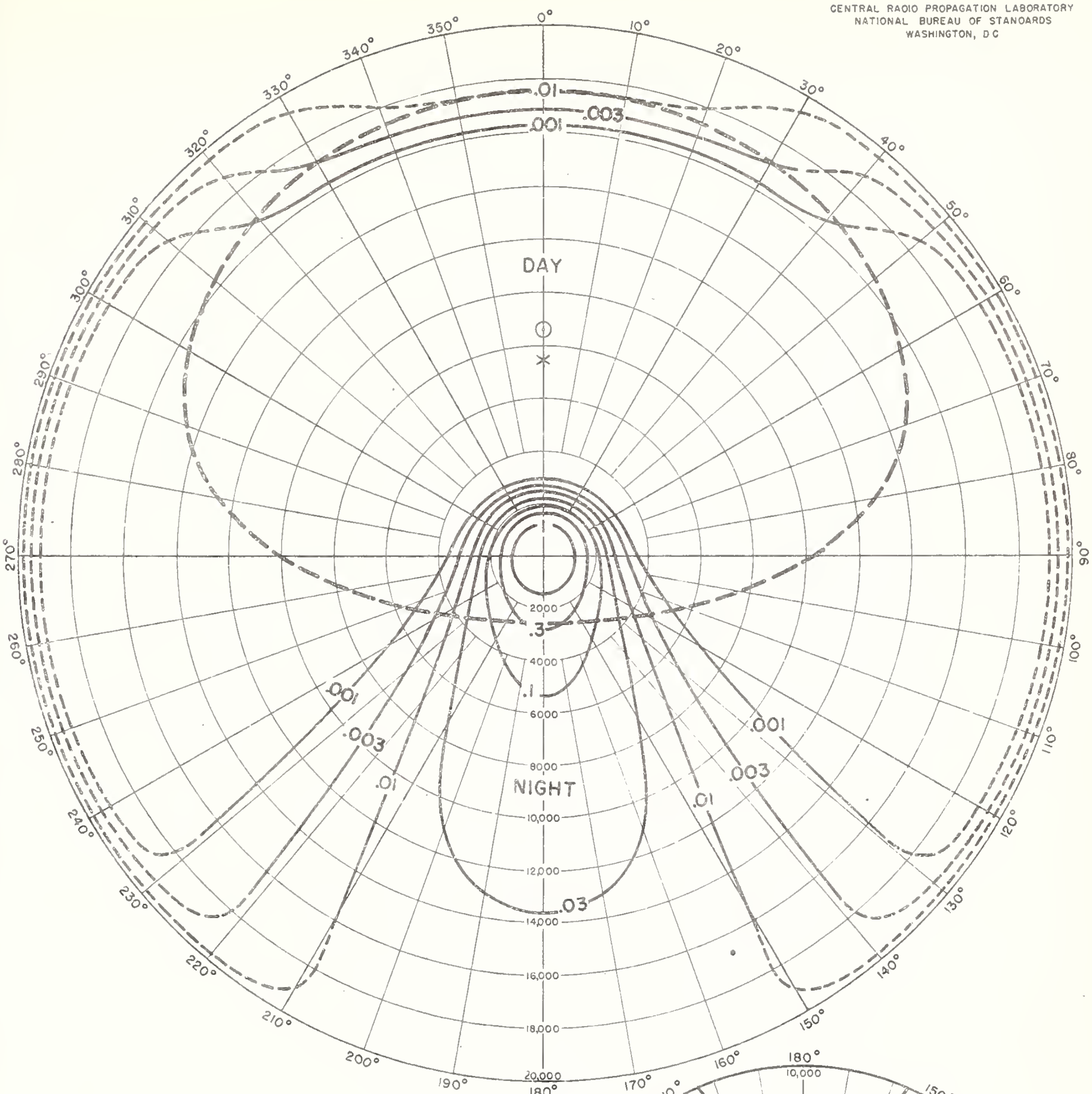
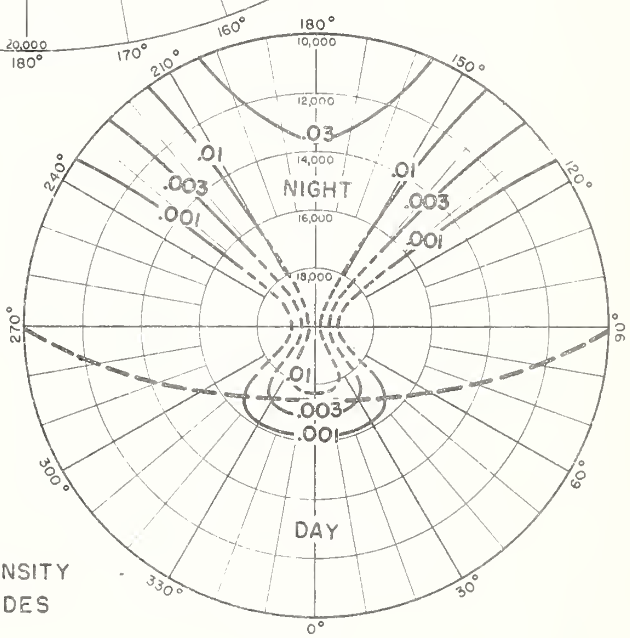



Fig. 44
FIELD INTENSITY, μV/m, I KW, 5 Mc
SUBSOLAR DISTANCE, 7500km (67°30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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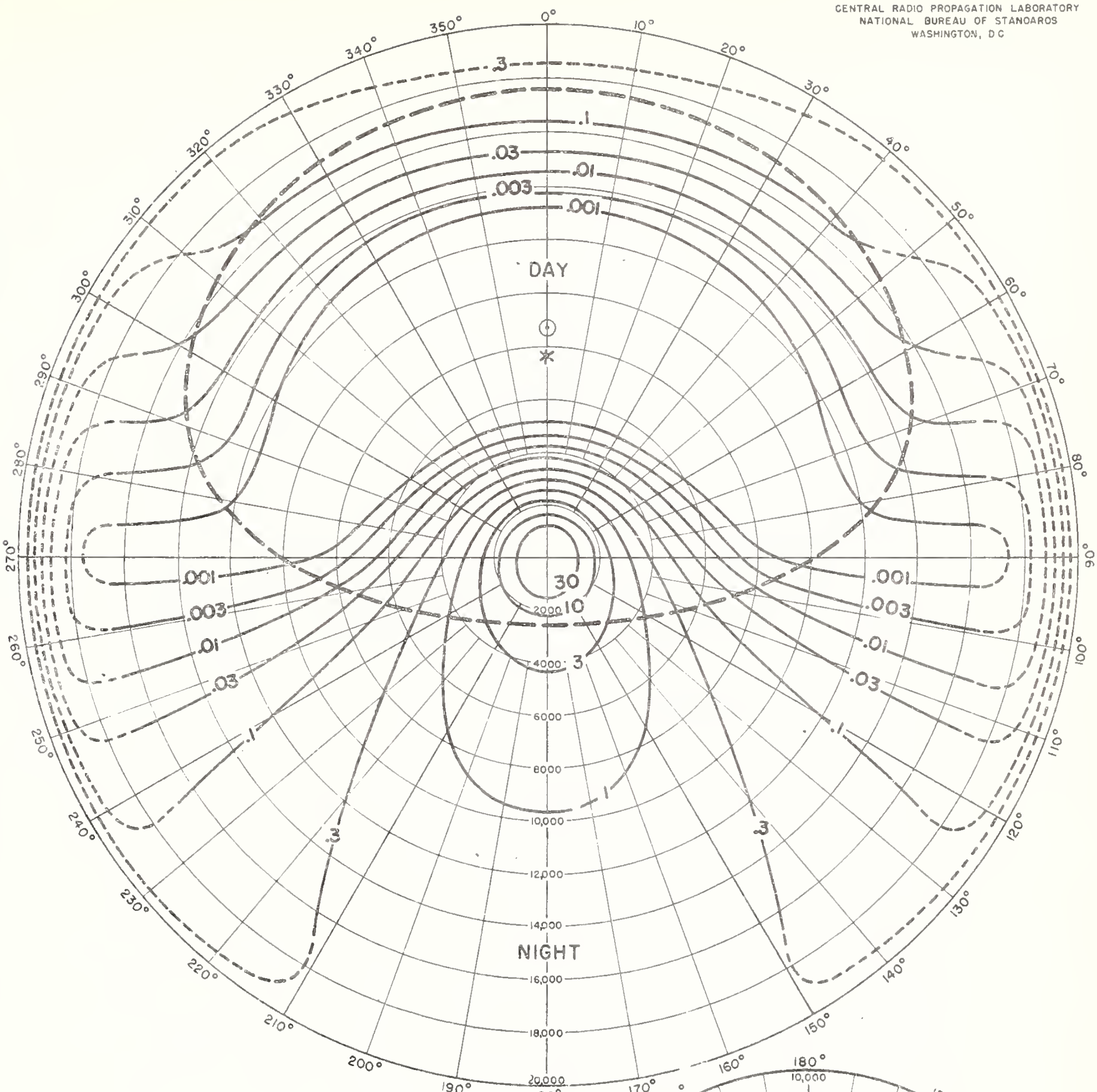
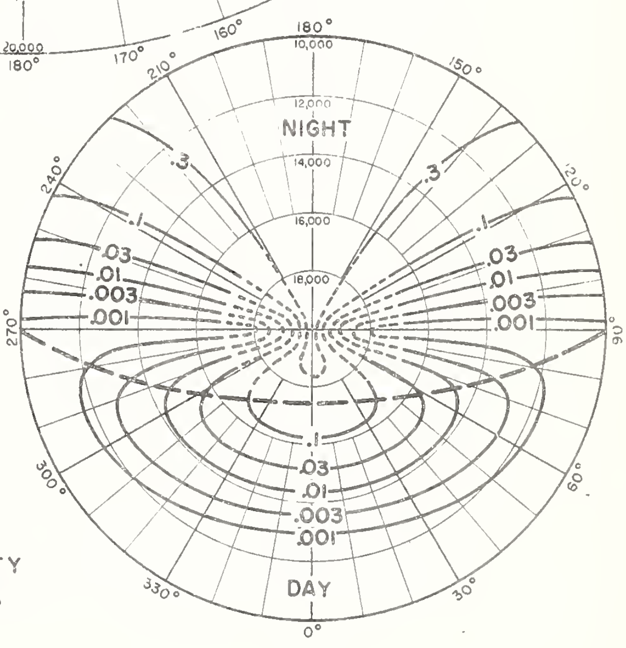



Fig. 45
FIELD INTENSITY, μv/m, I KW, 7 Mc
SUBSOLAR DISTANCE, 7500 km (67° 30')
SUNSPOT MAXIMUM

✻ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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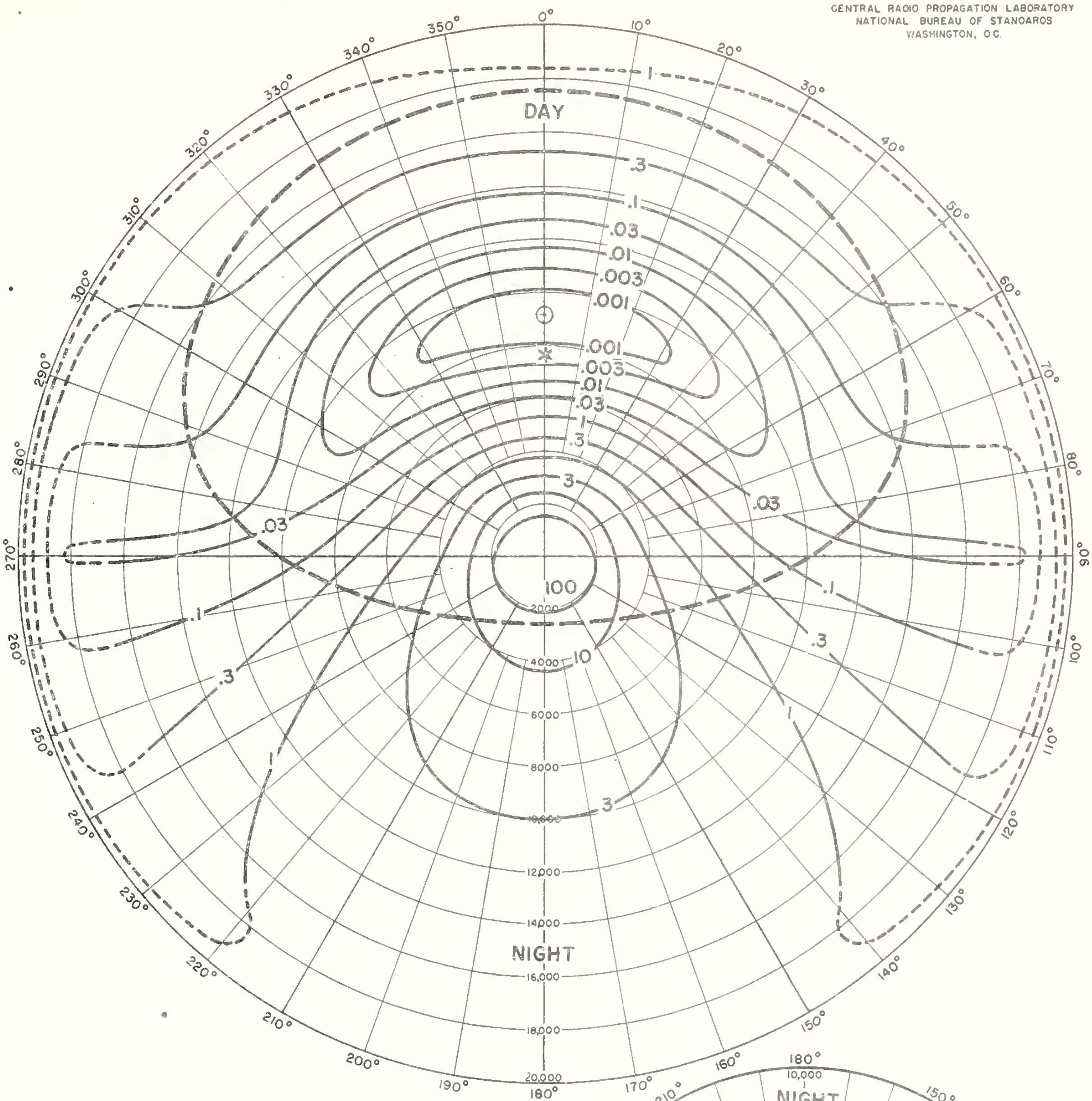
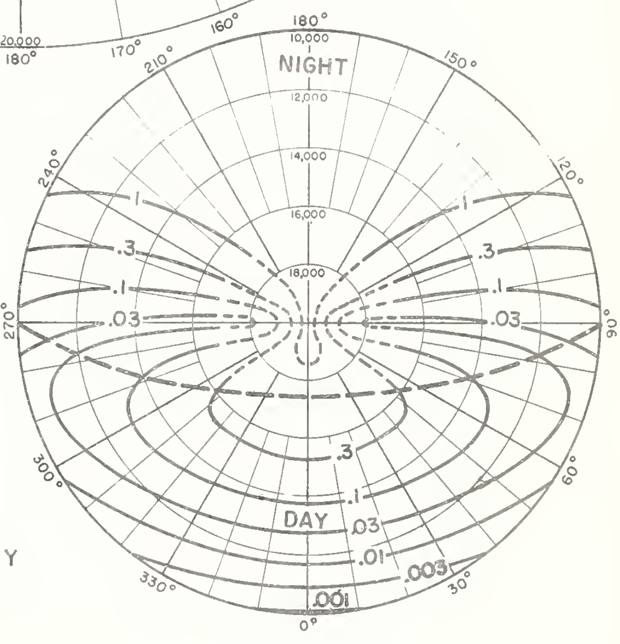



Fig. 46
FIELD INTENSITY, μV/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE 7500 km (67° 30')
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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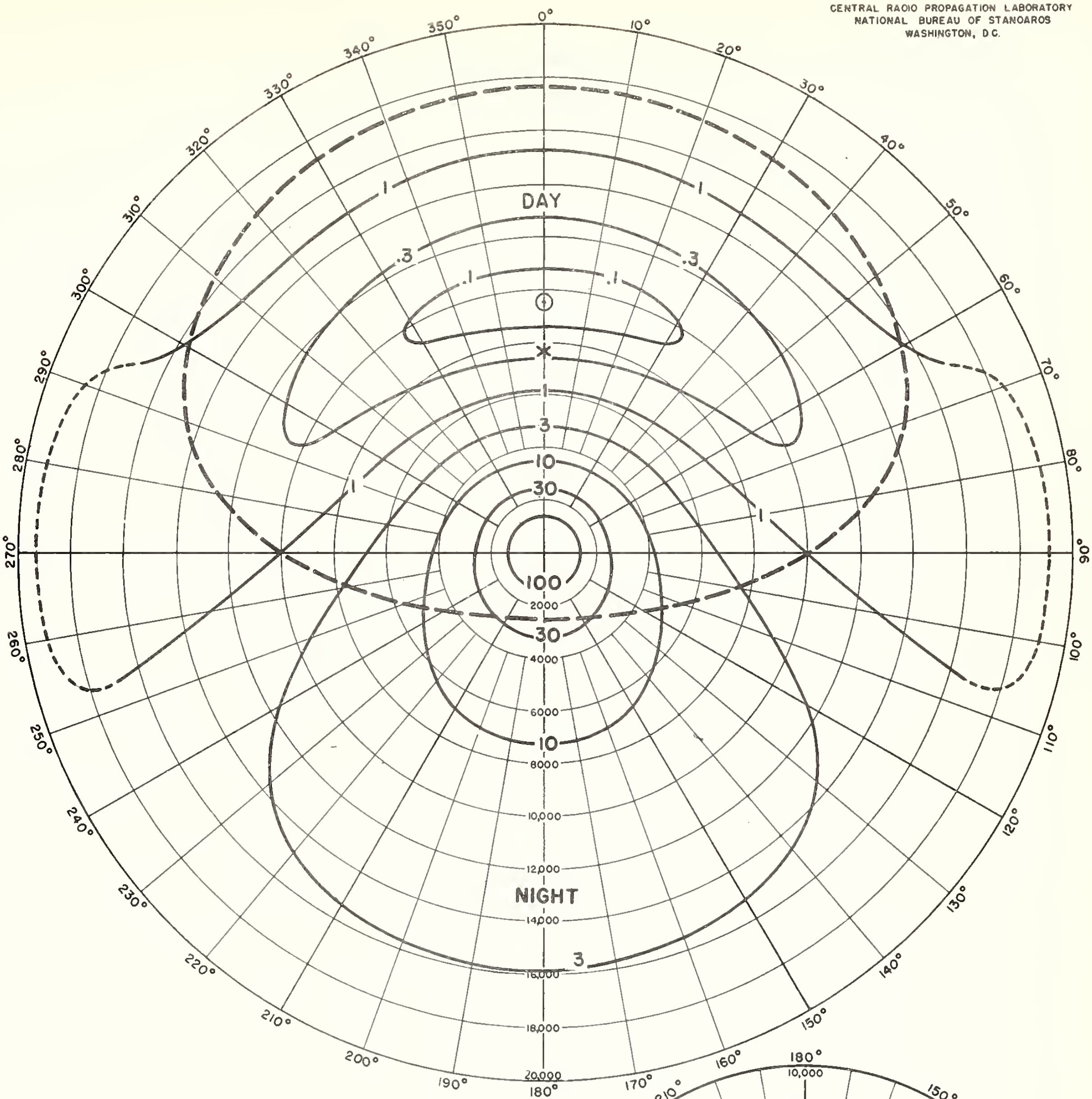
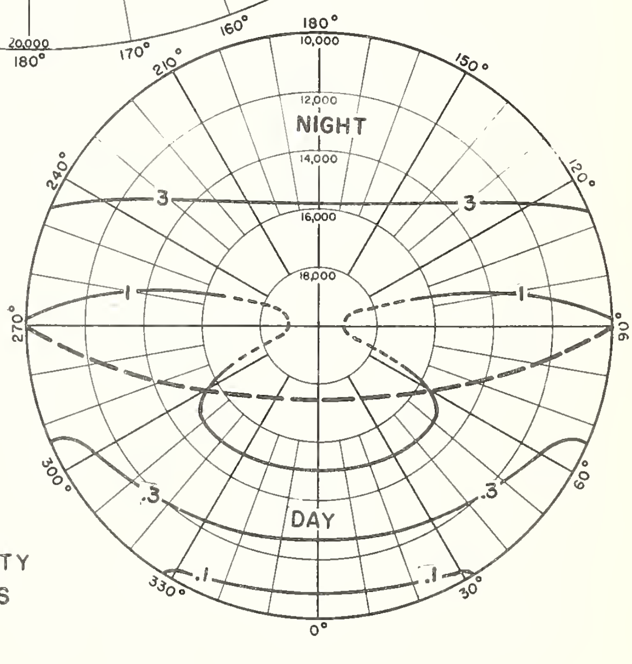



Fig. 47
FIELD INTENSITY, µv/m, I KW, 15 Mc
SUBSOLAR DISTANCE 7500 km (67° 30')
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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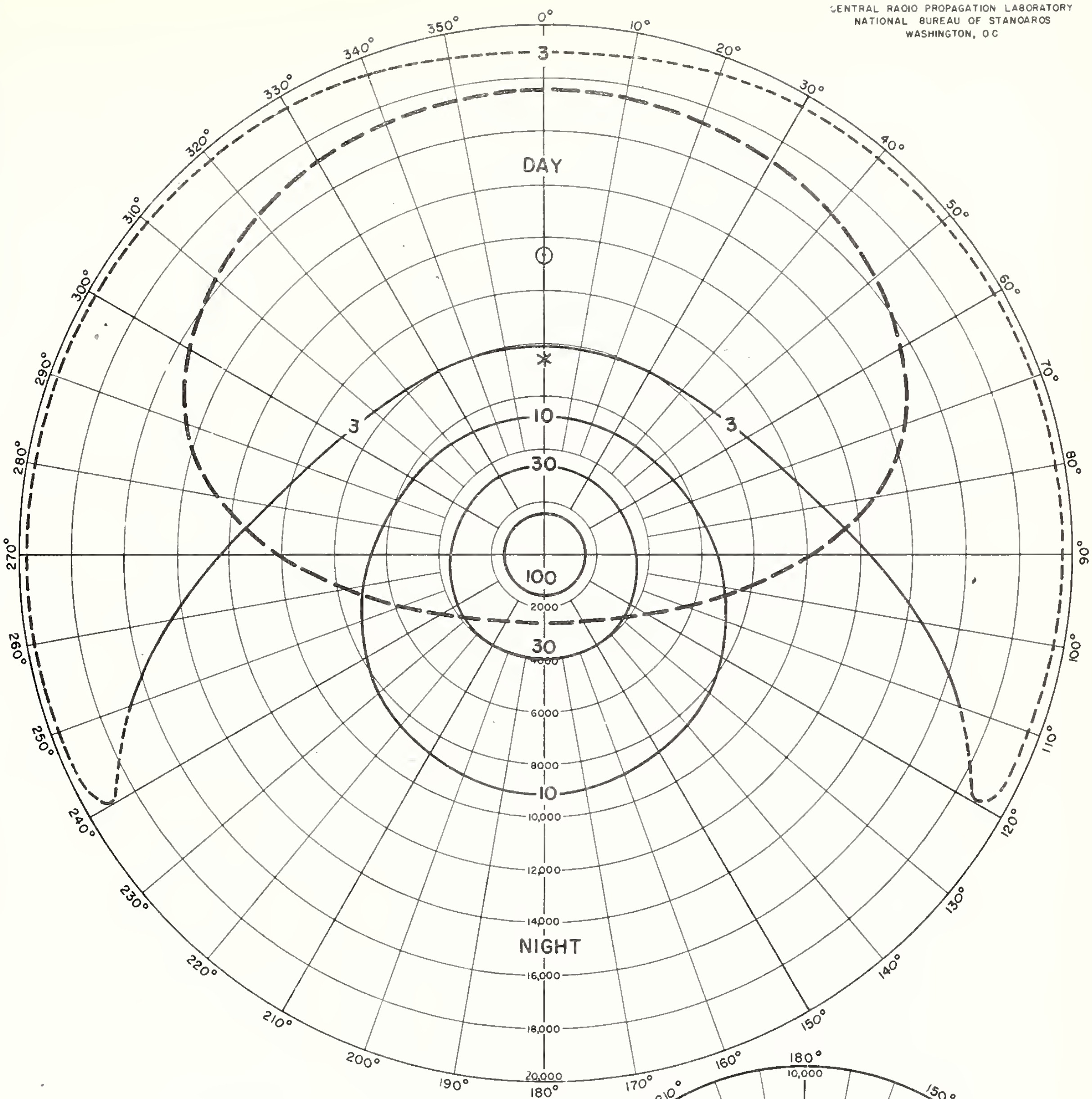
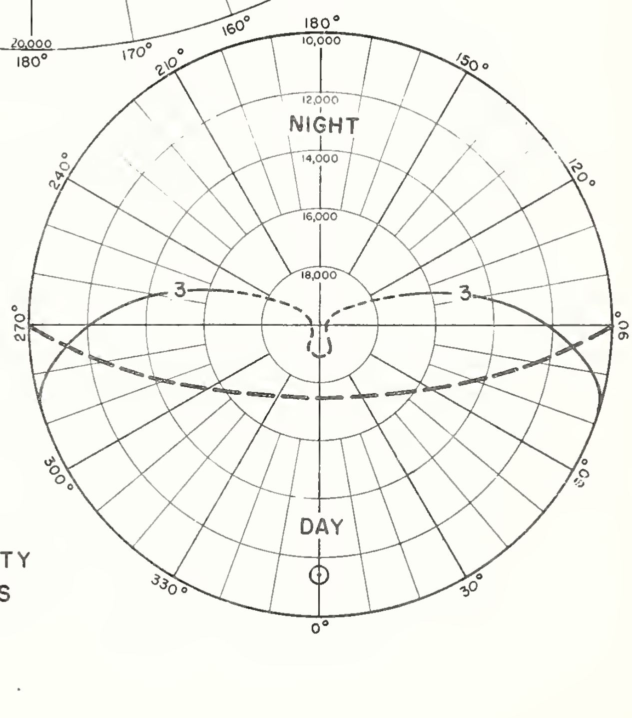



Fig. 48
FIELD INTENSITY, μv/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 7500 km (67° 30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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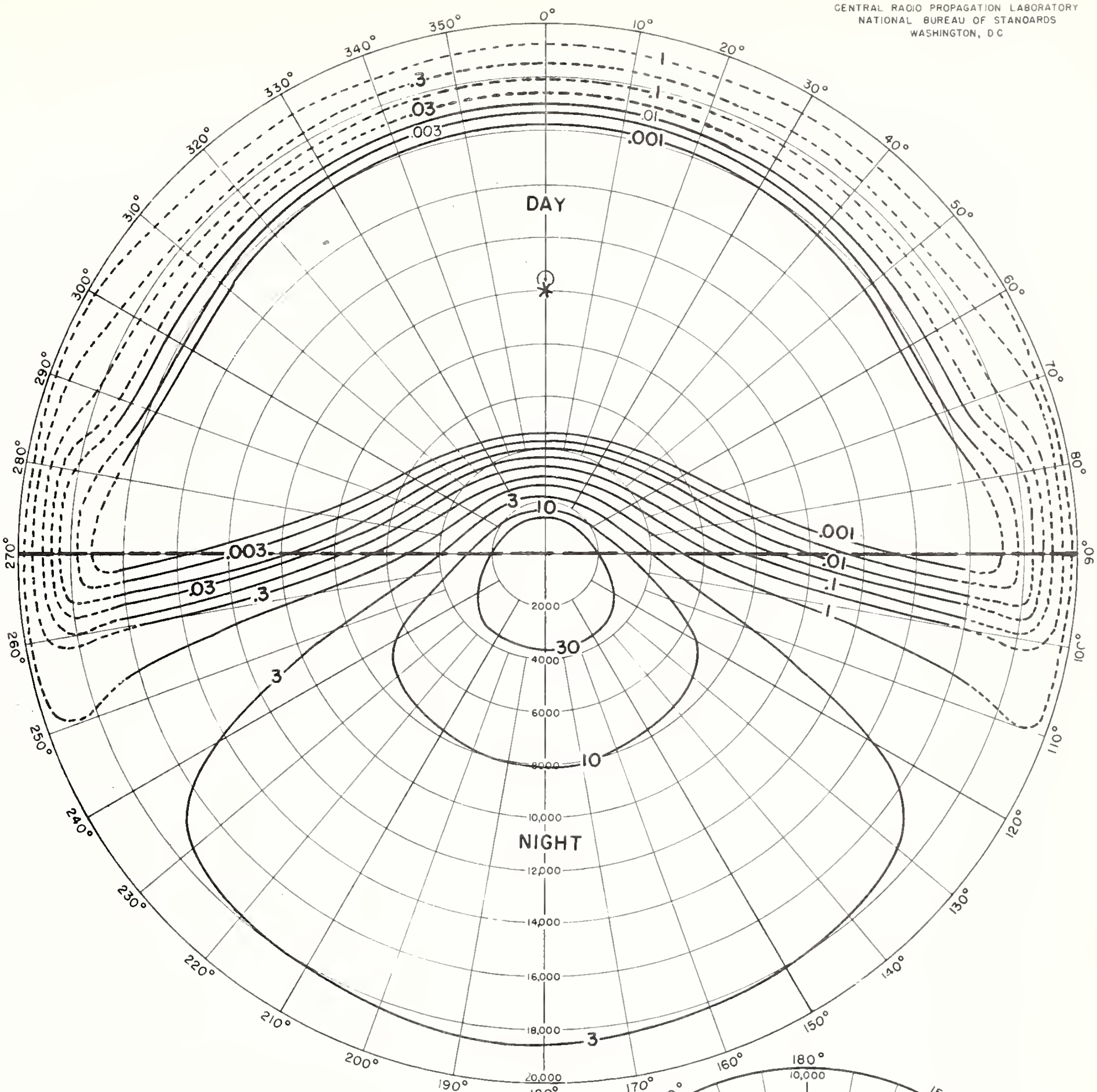
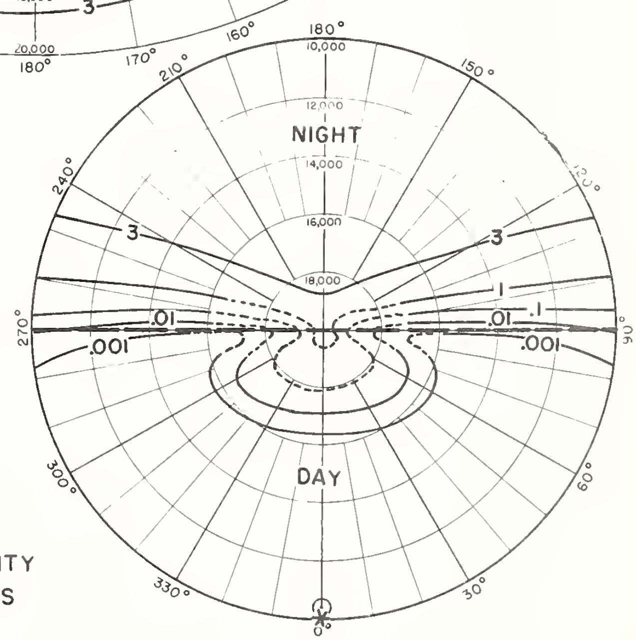



Fig. 49
FIELD INTENSITY, μv/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 10,000 km (90°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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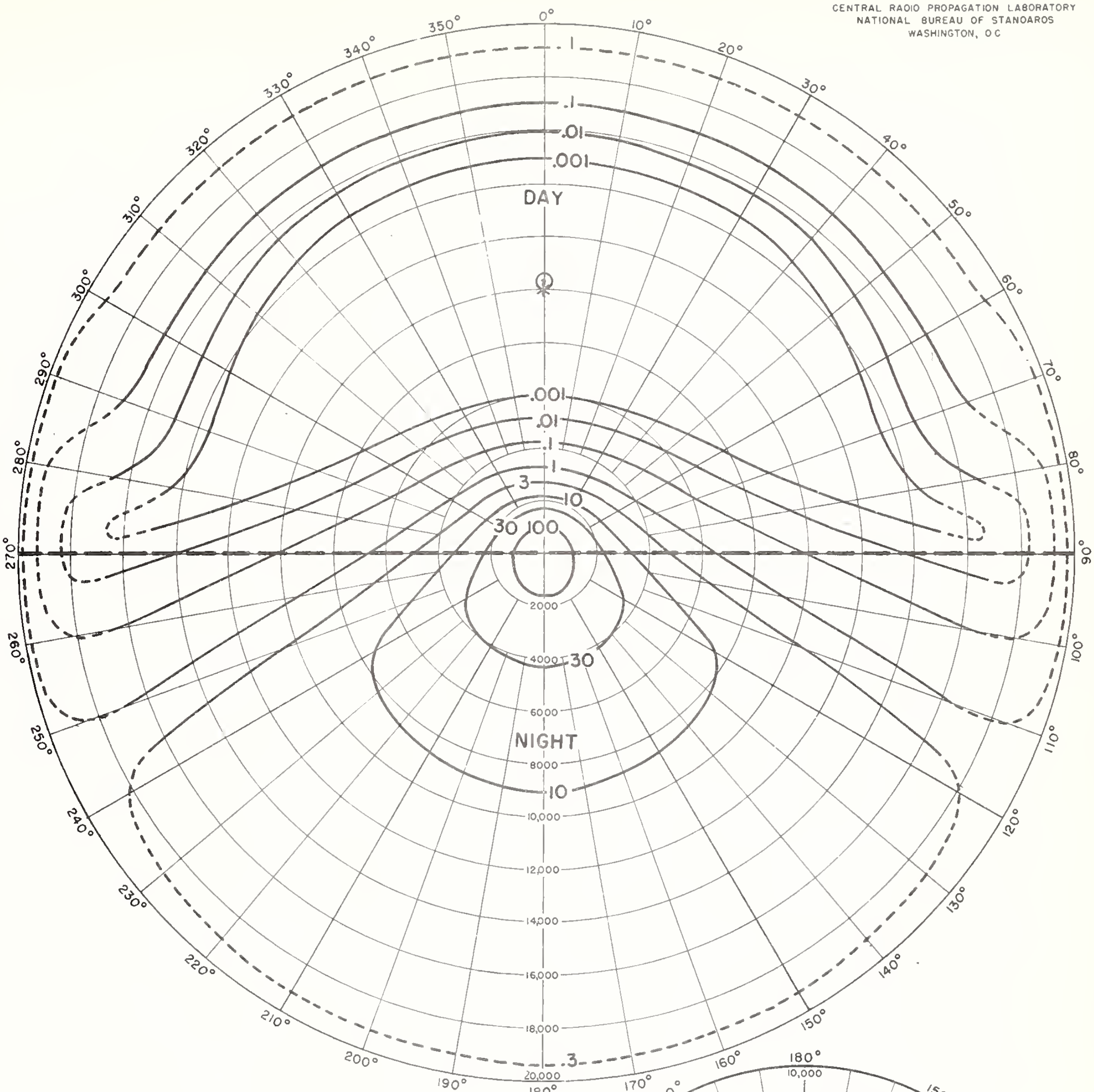
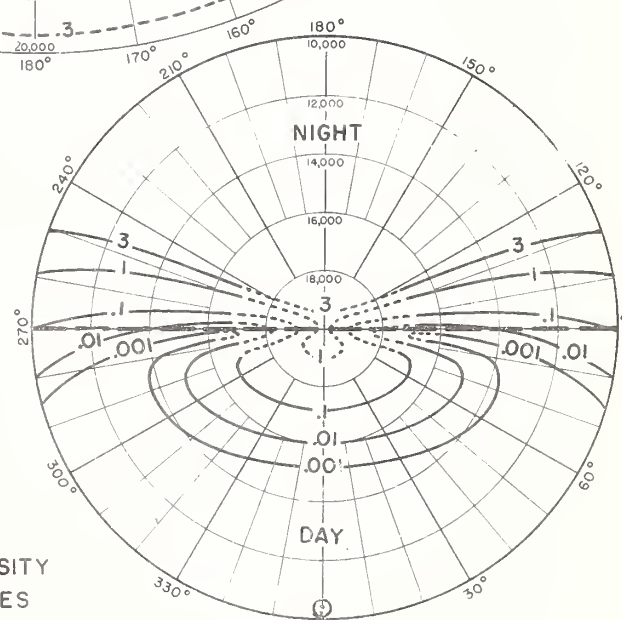



Fig. 50
FIELD INTENSITY, µv/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 10,000 km (90°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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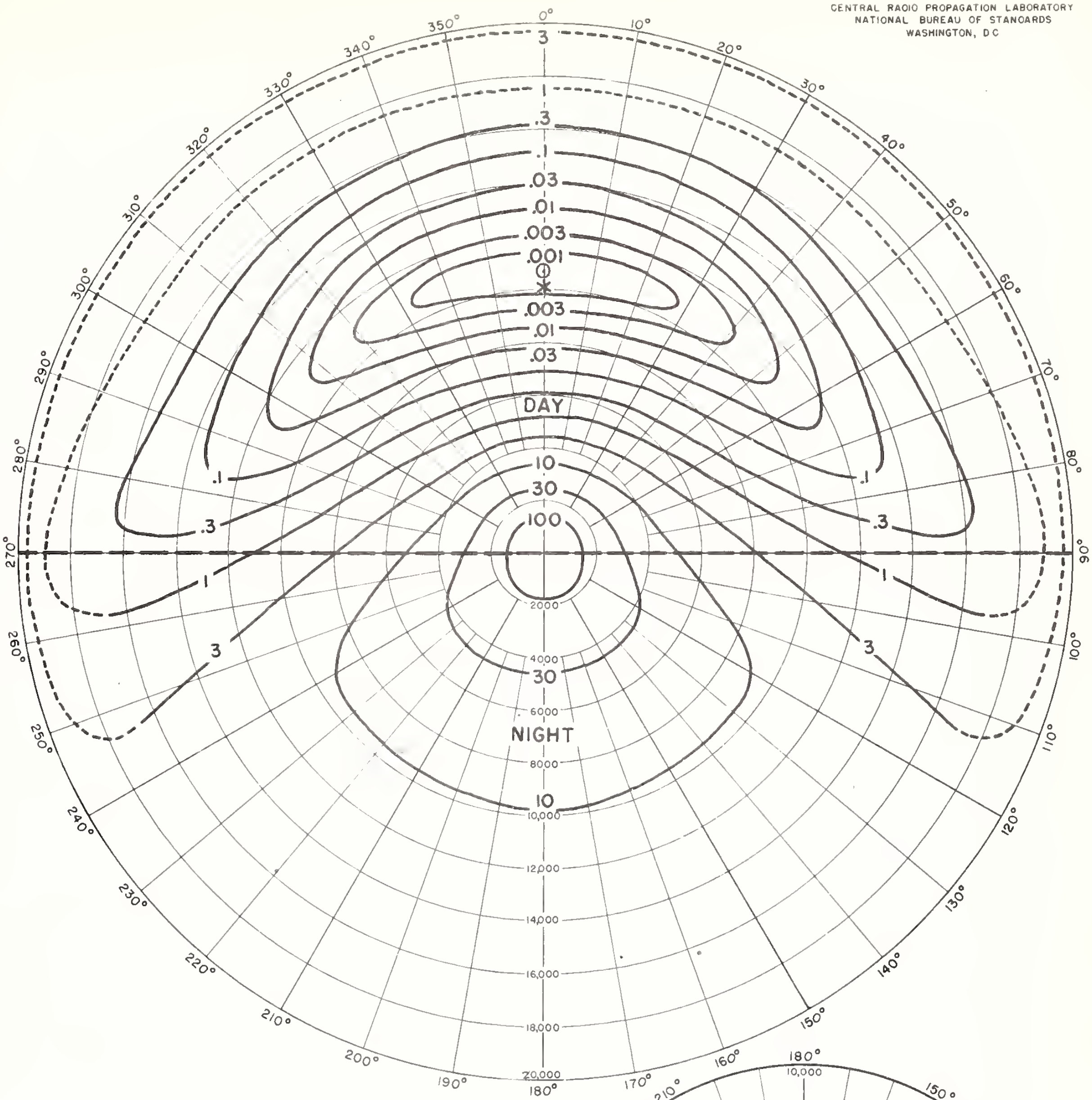
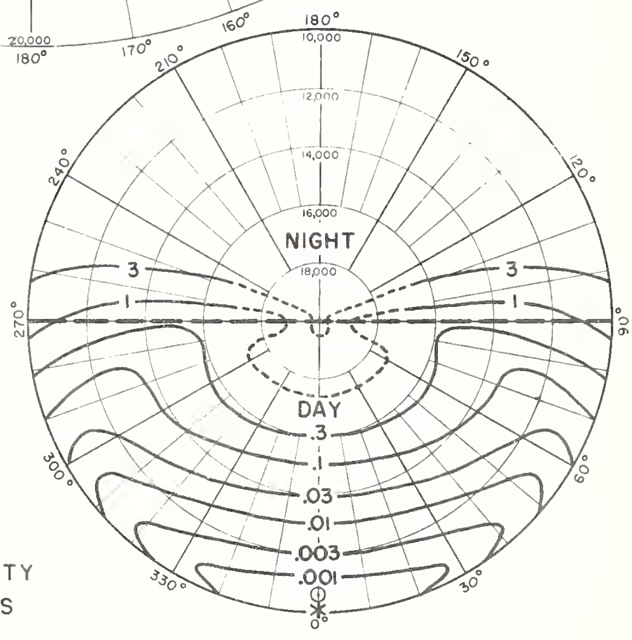



Fig. 51
FIELD INTENSITY, μV/m, I KW, 7 Mc
SUBSOLAR DISTANCE 10,000 km (90°)
SUNSPOT MINIMUM

✱ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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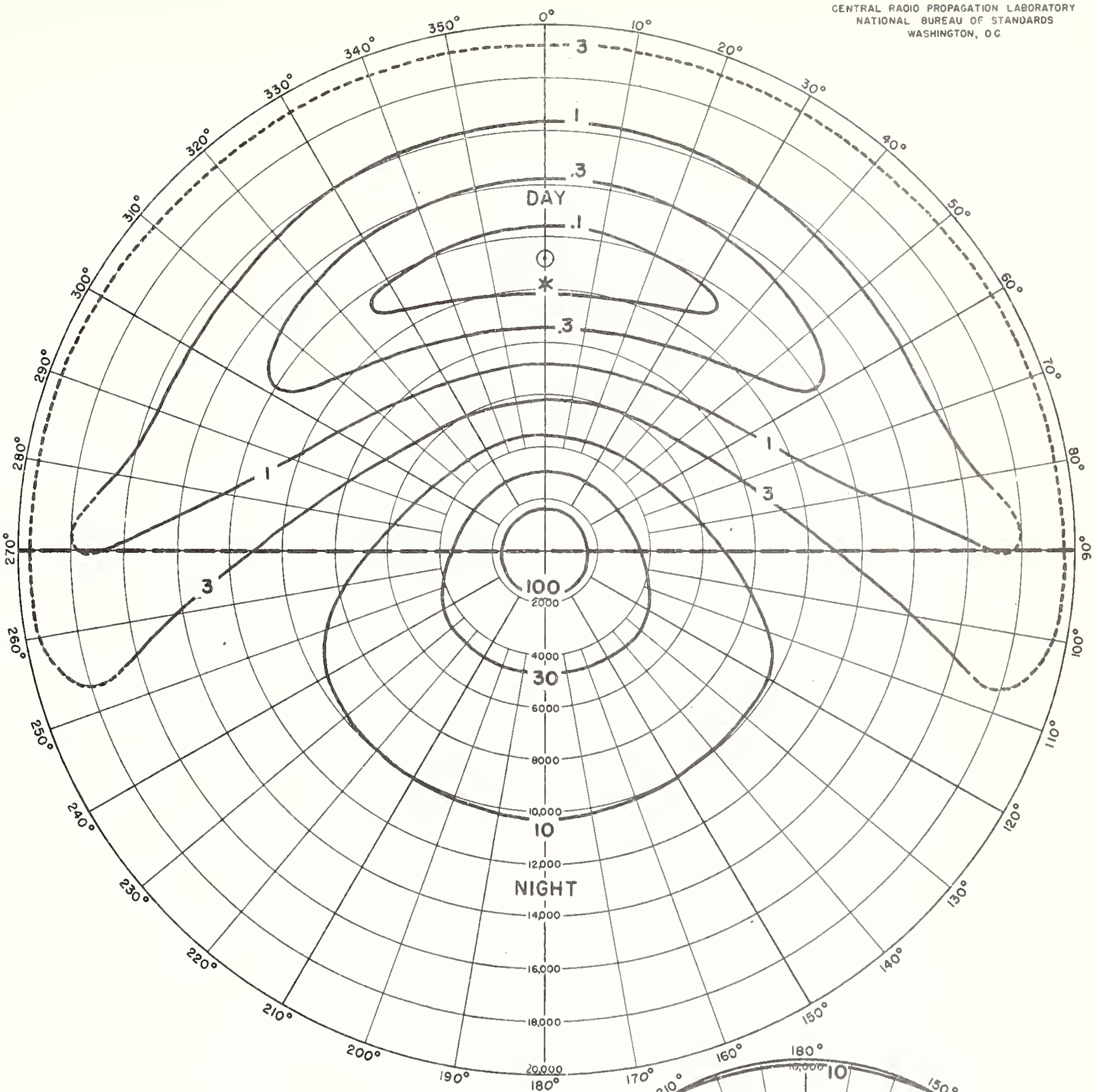
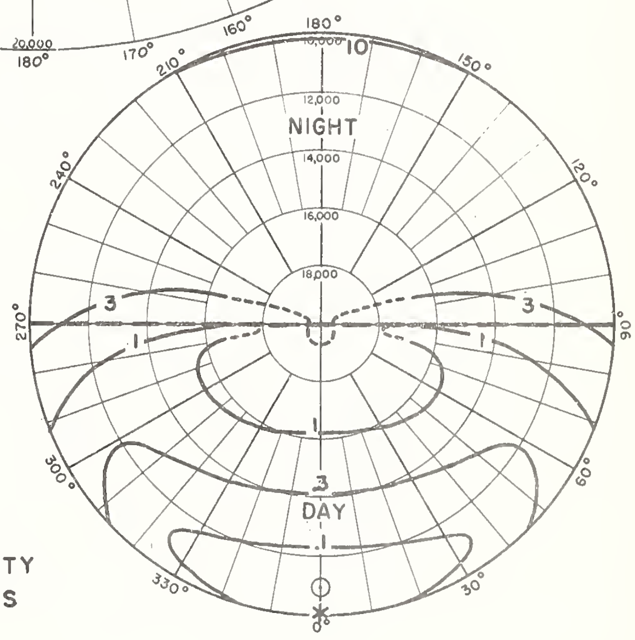



Fig. 52
FIELD INTENSITY, μV/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE, 10,000 km (90°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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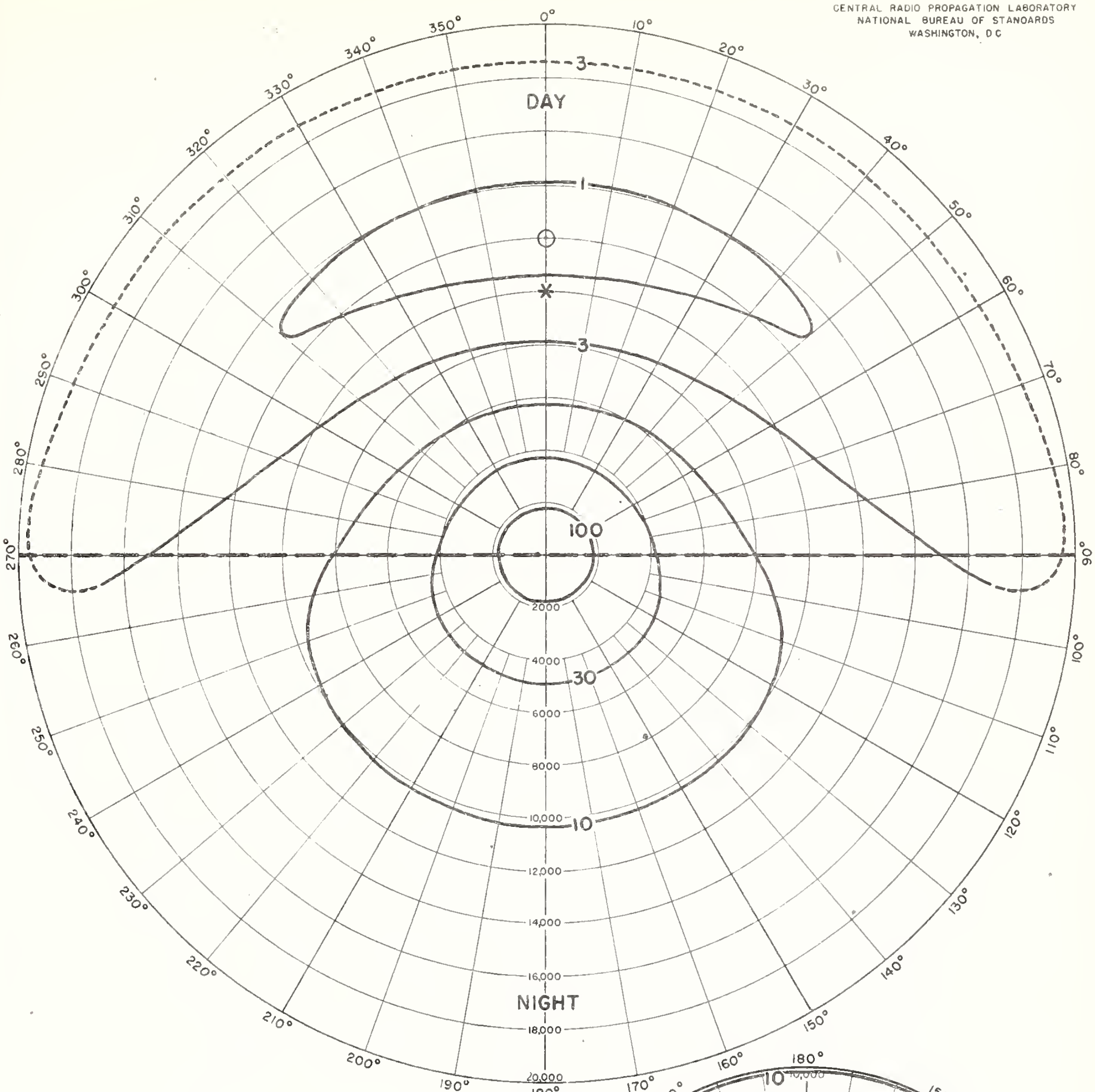
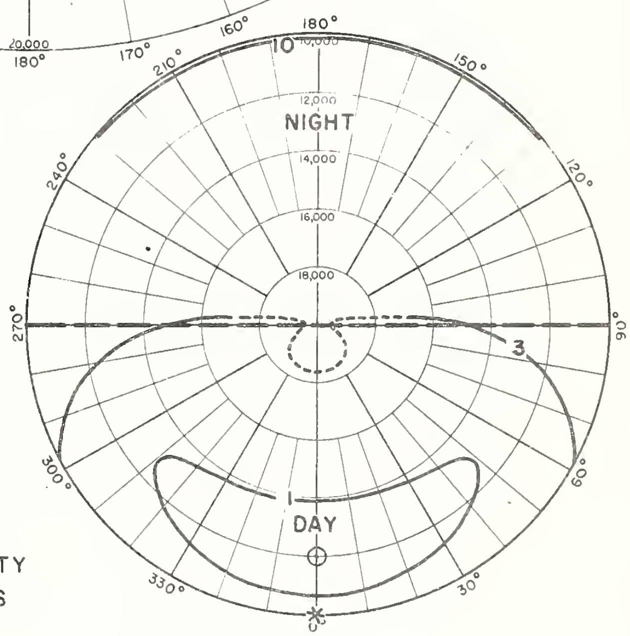



Fig. 53
FIELD INTENSITY, $\mu v/m$, 1 KW, 15 Mc
SUBSOLAR DISTANCE 10,000 km (90°)
SUNSPOT MINIMUM

✱ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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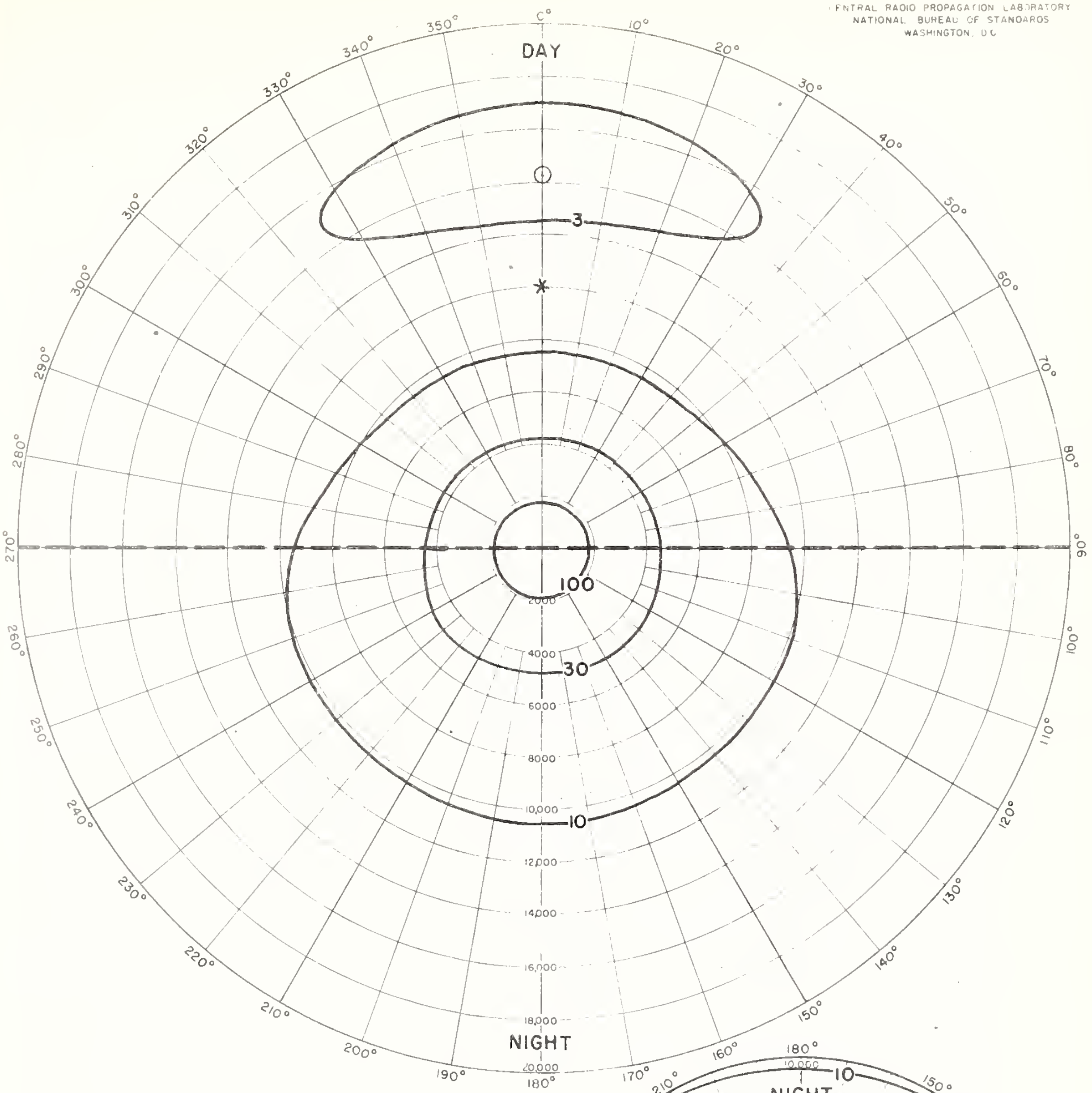
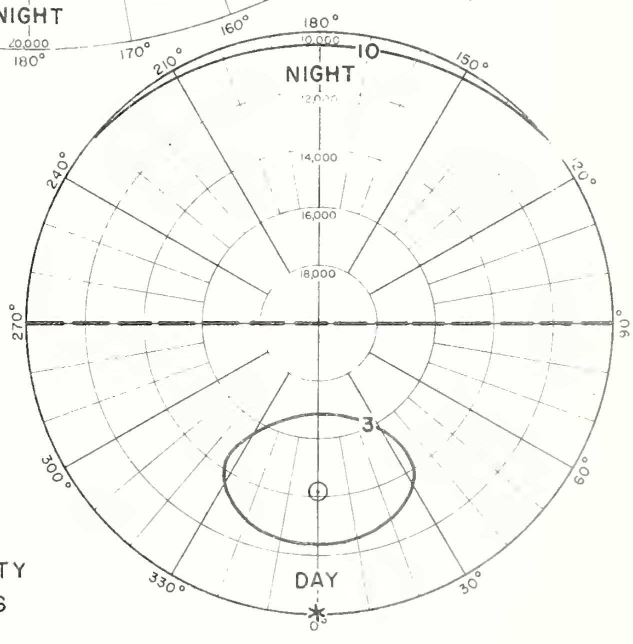



Fig. 54
FIELD INTENSITY, µV/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE 10,000 km (90°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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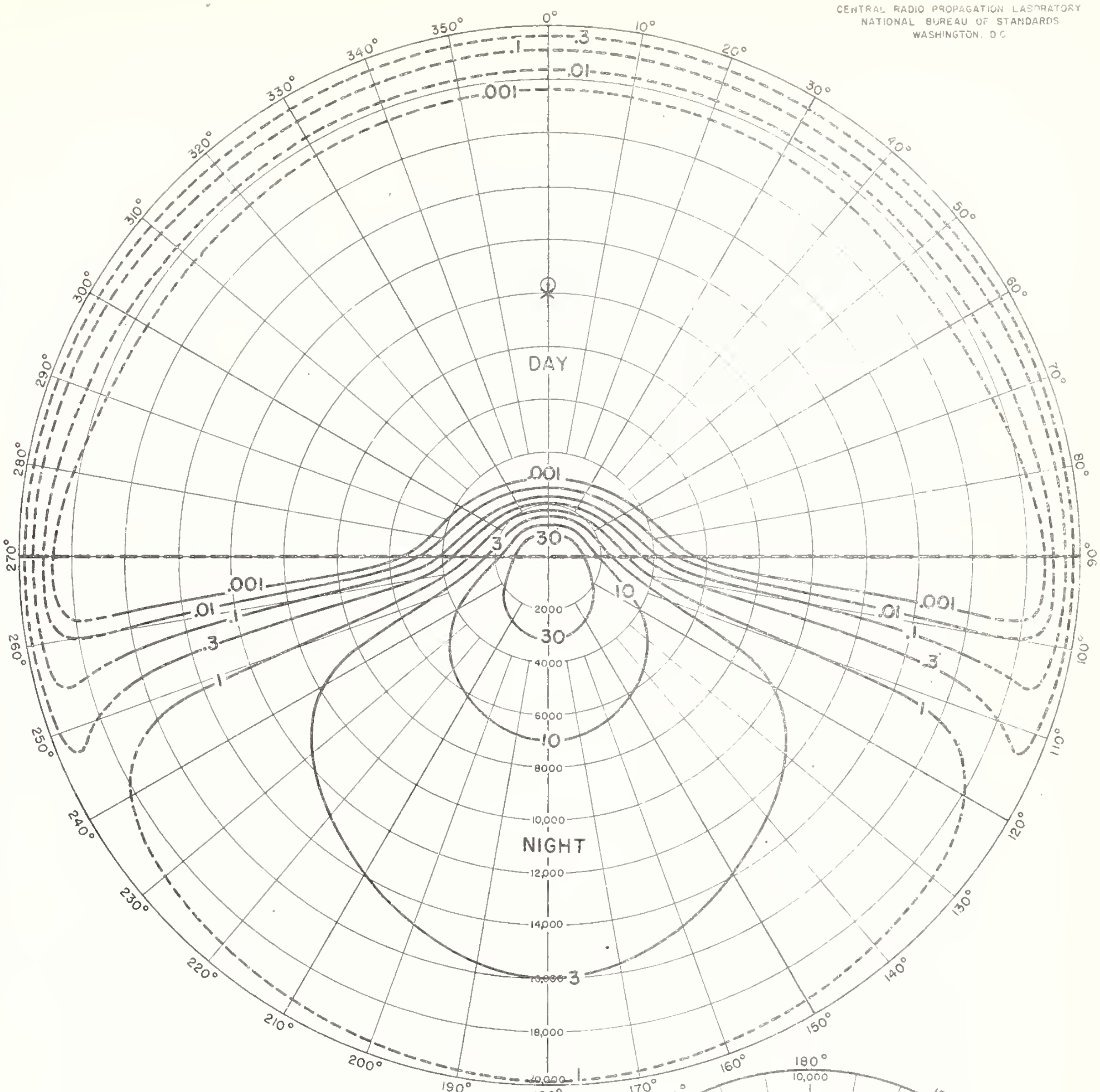
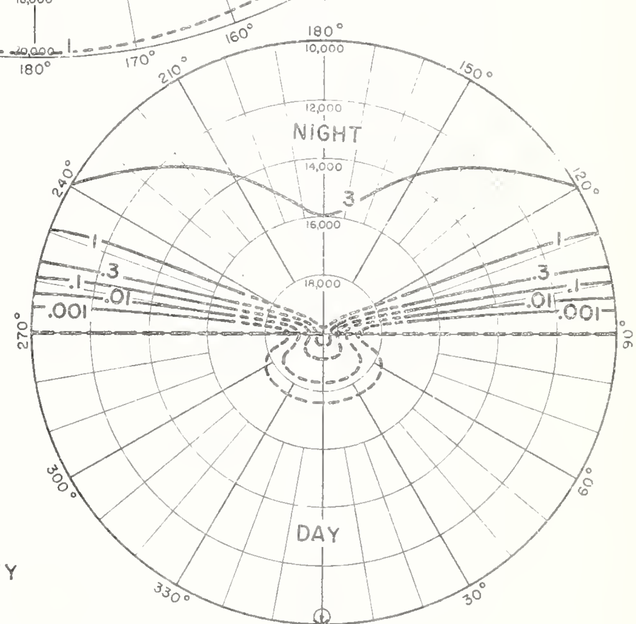



Fig. 55
FIELD INTENSITY, µv/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 10,000km (90°)
SUNSPOT MAXIMUM

✻ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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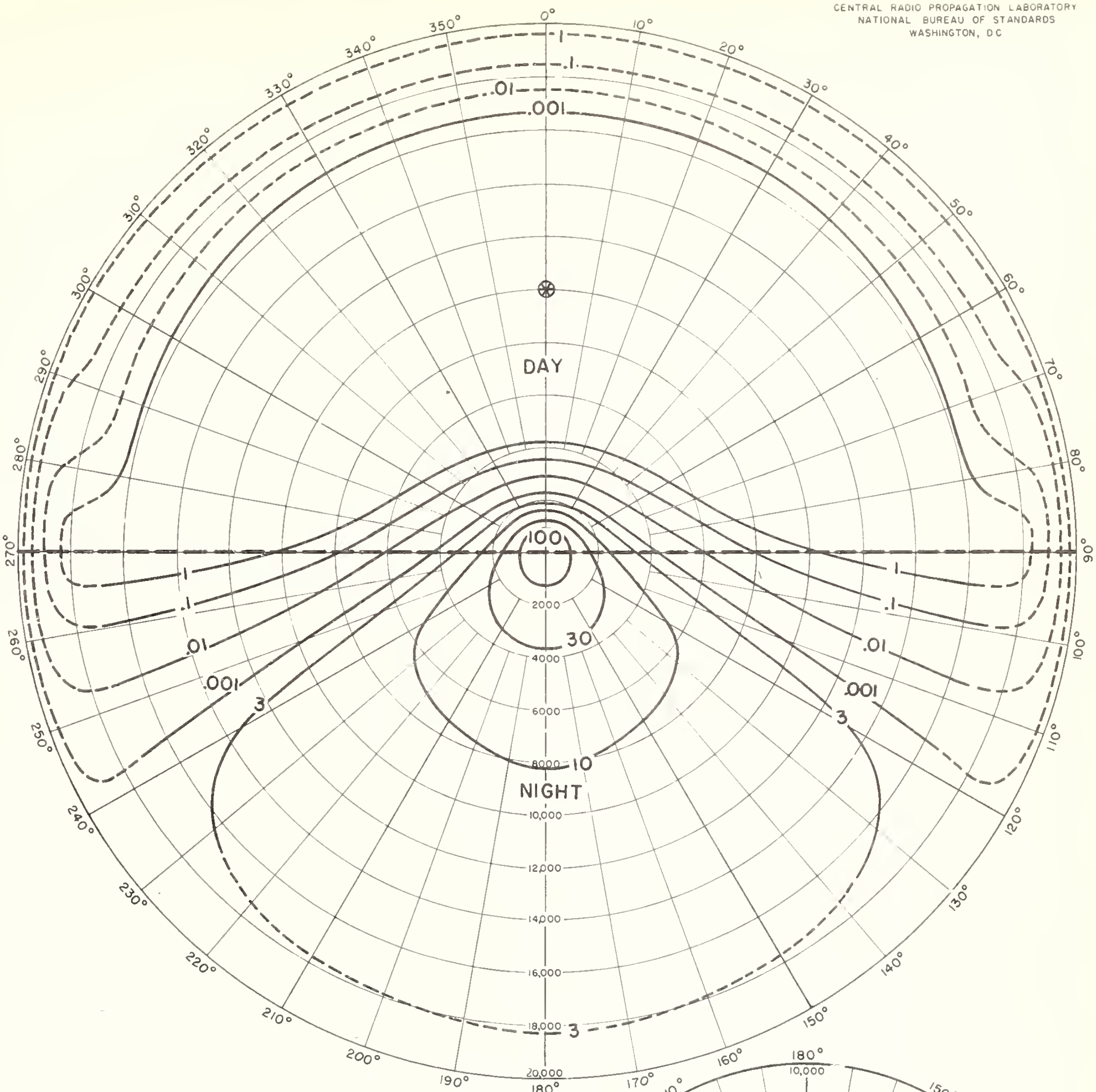


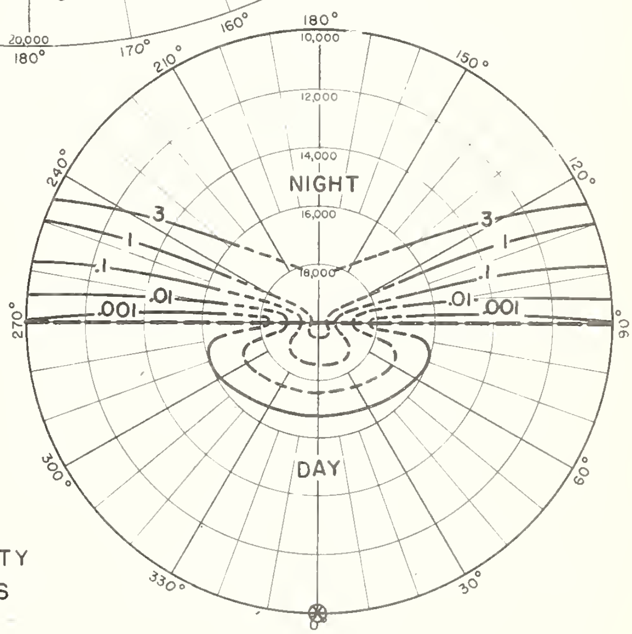


Fig. 56
FIELD INTENSITY, μv/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 10,000 km (90°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

FIELD INTENSITY
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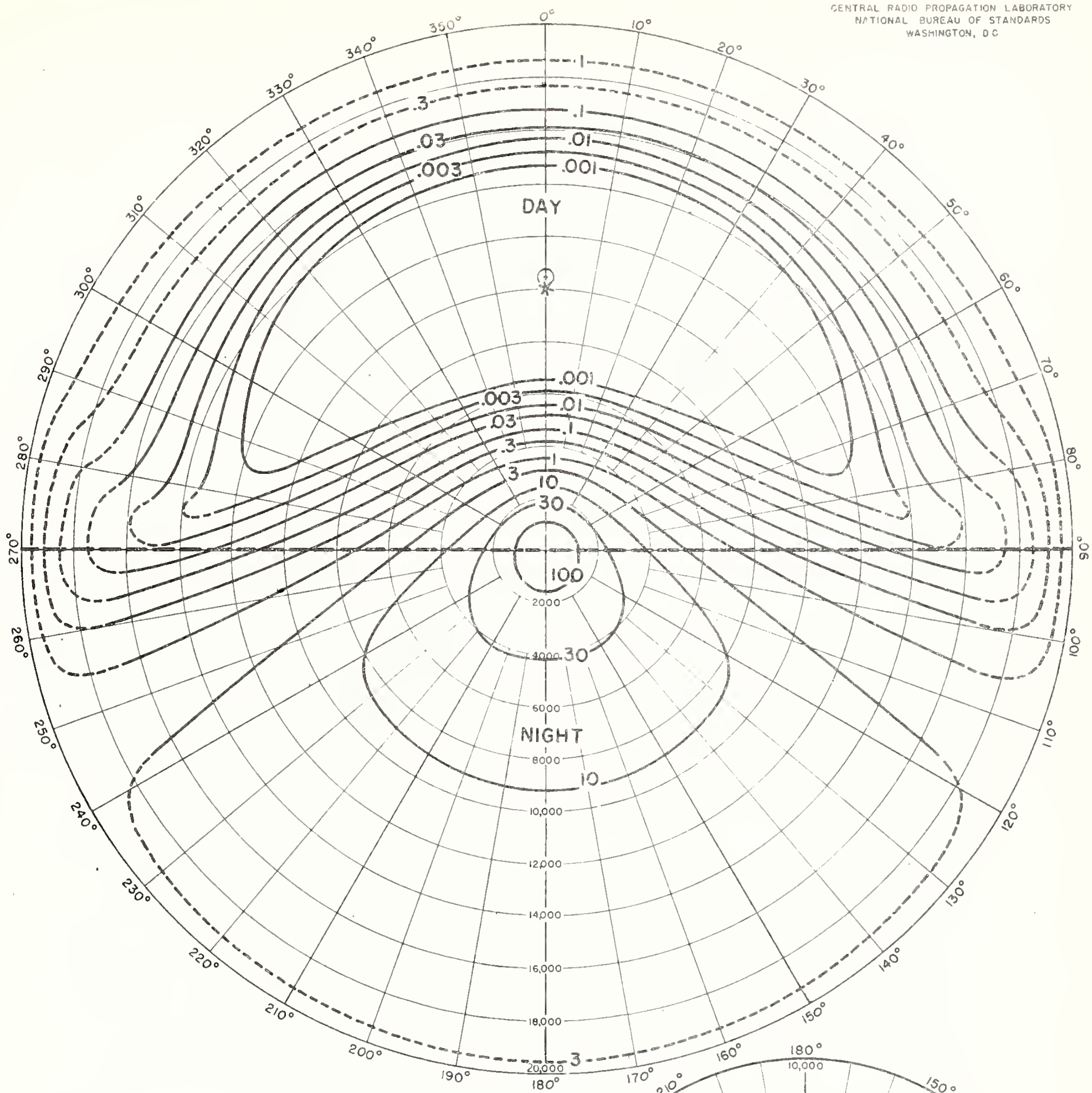
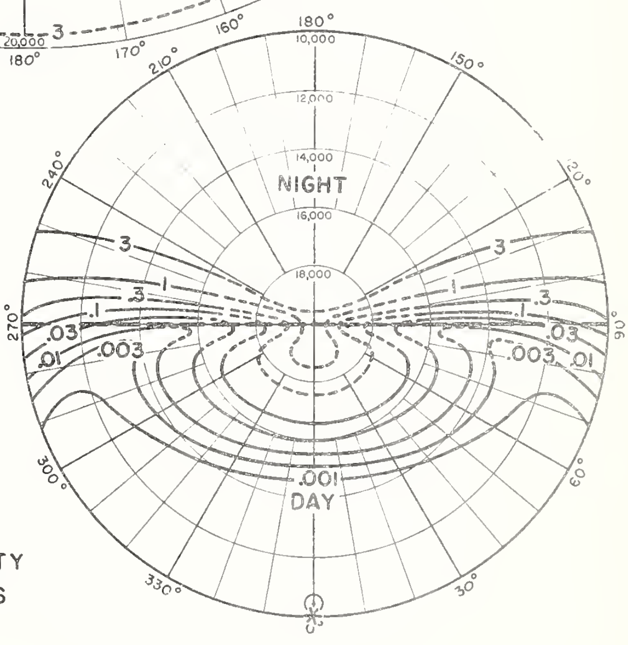



Fig. 57
FIELD INTENSITY, μV/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 10,000 km (90°)
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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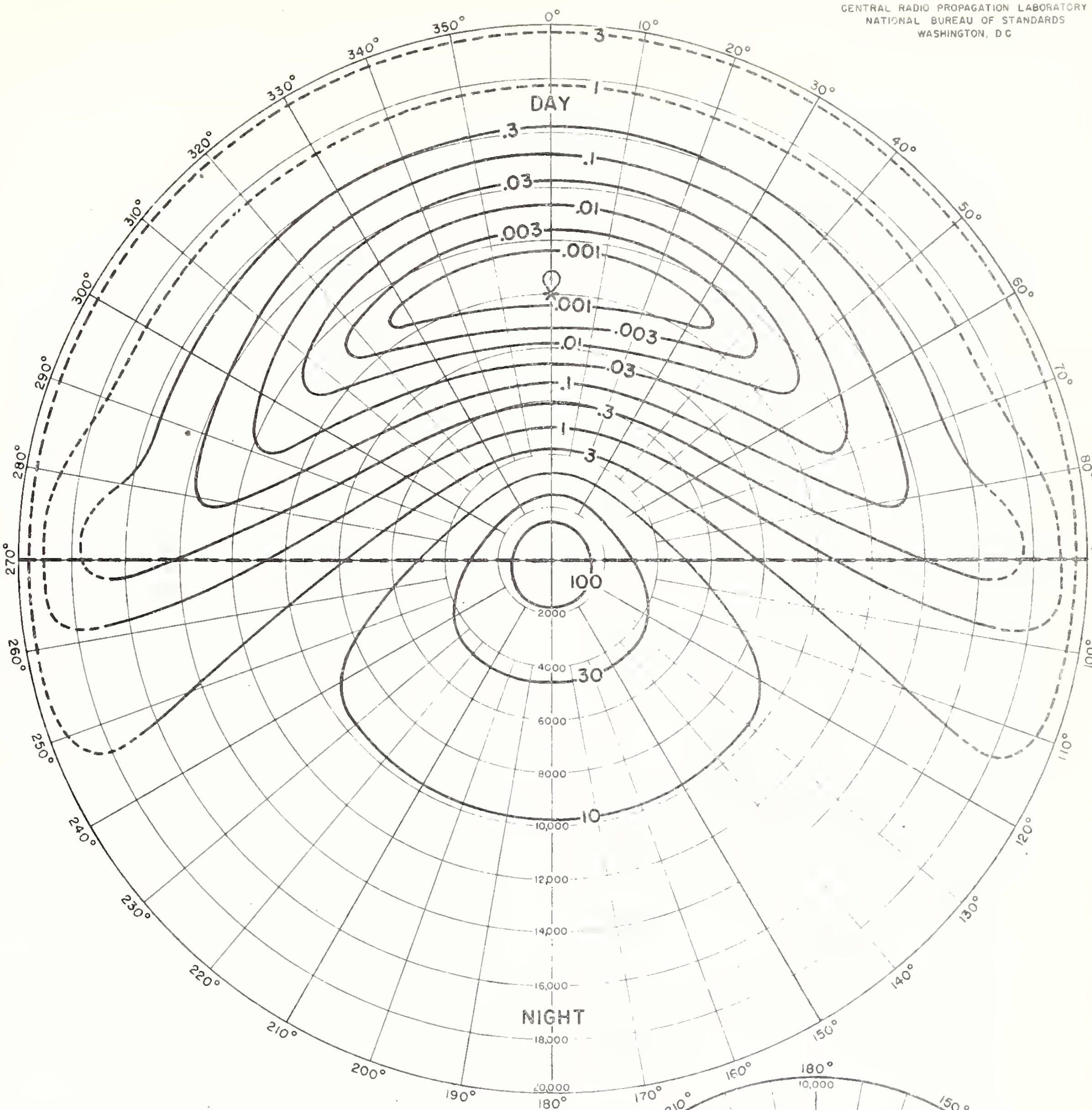
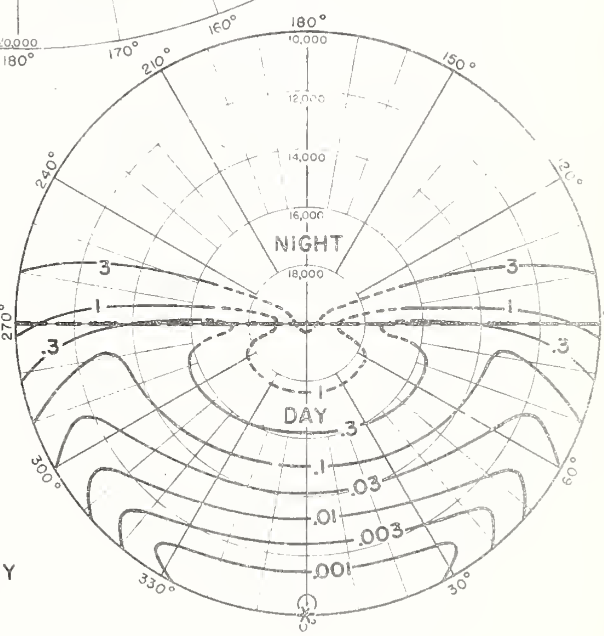



Fig. 58
FIELD INTENSITY, μV/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE 10,000 km (90°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

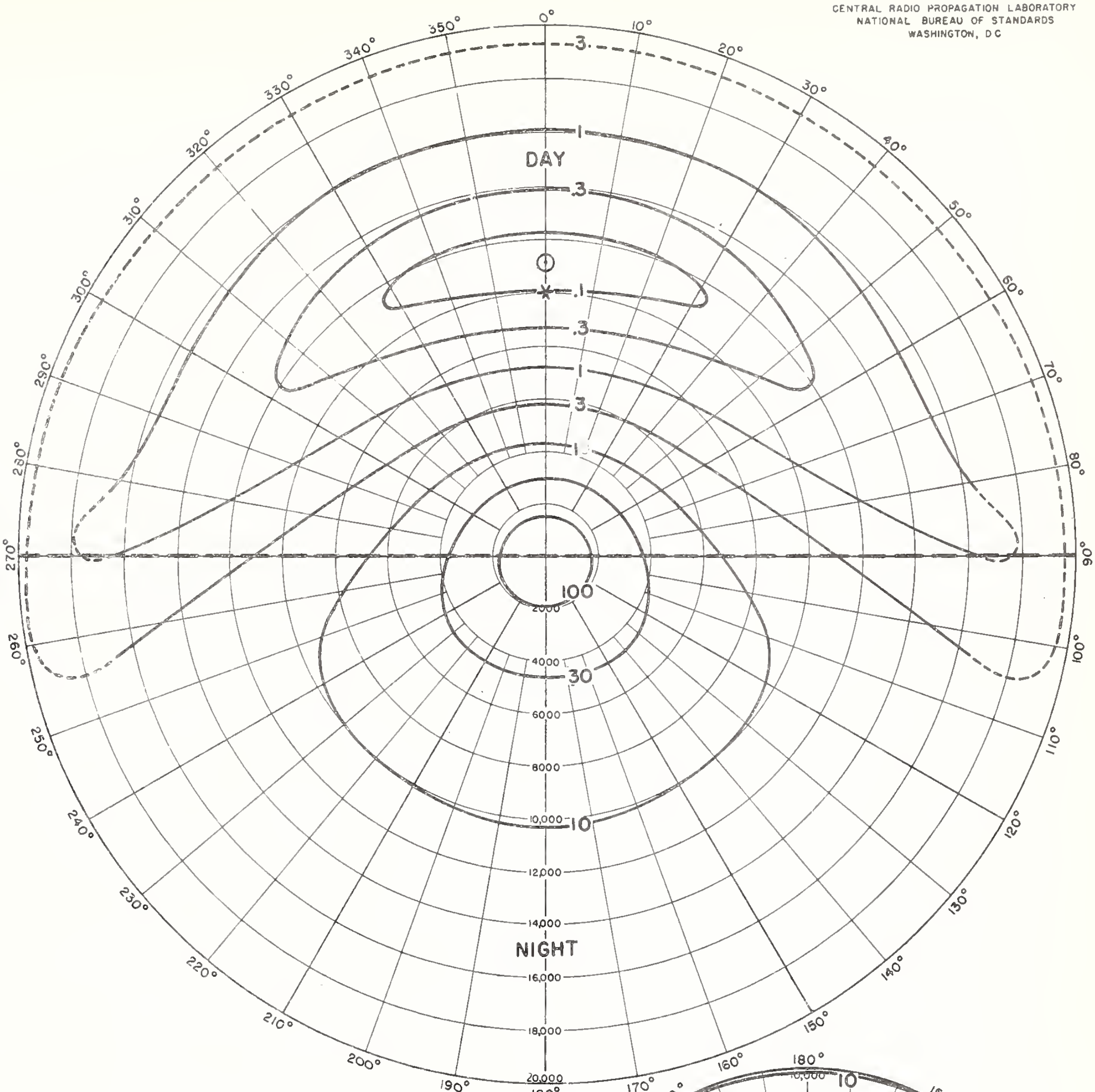
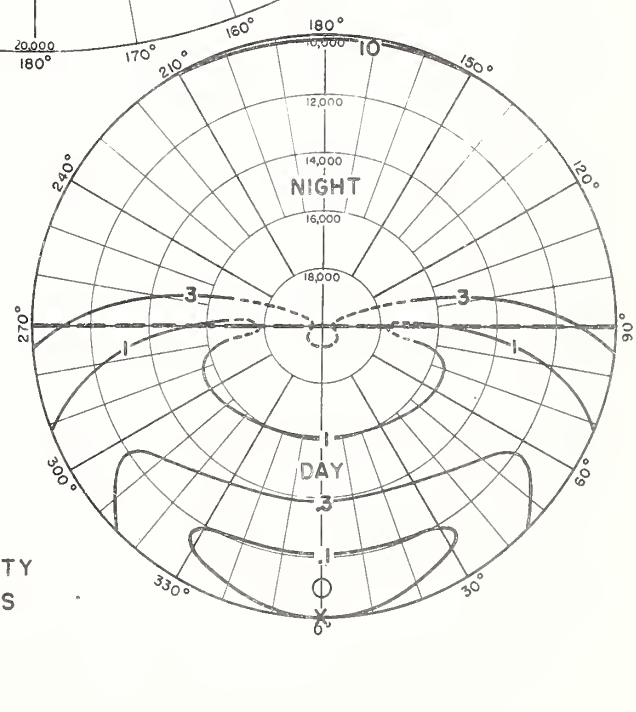



Fig. 59
FIELD INTENSITY, μV/m, I KW, 15 Mc
SUBSOLAR DISTANCE 10,000 km (90°)
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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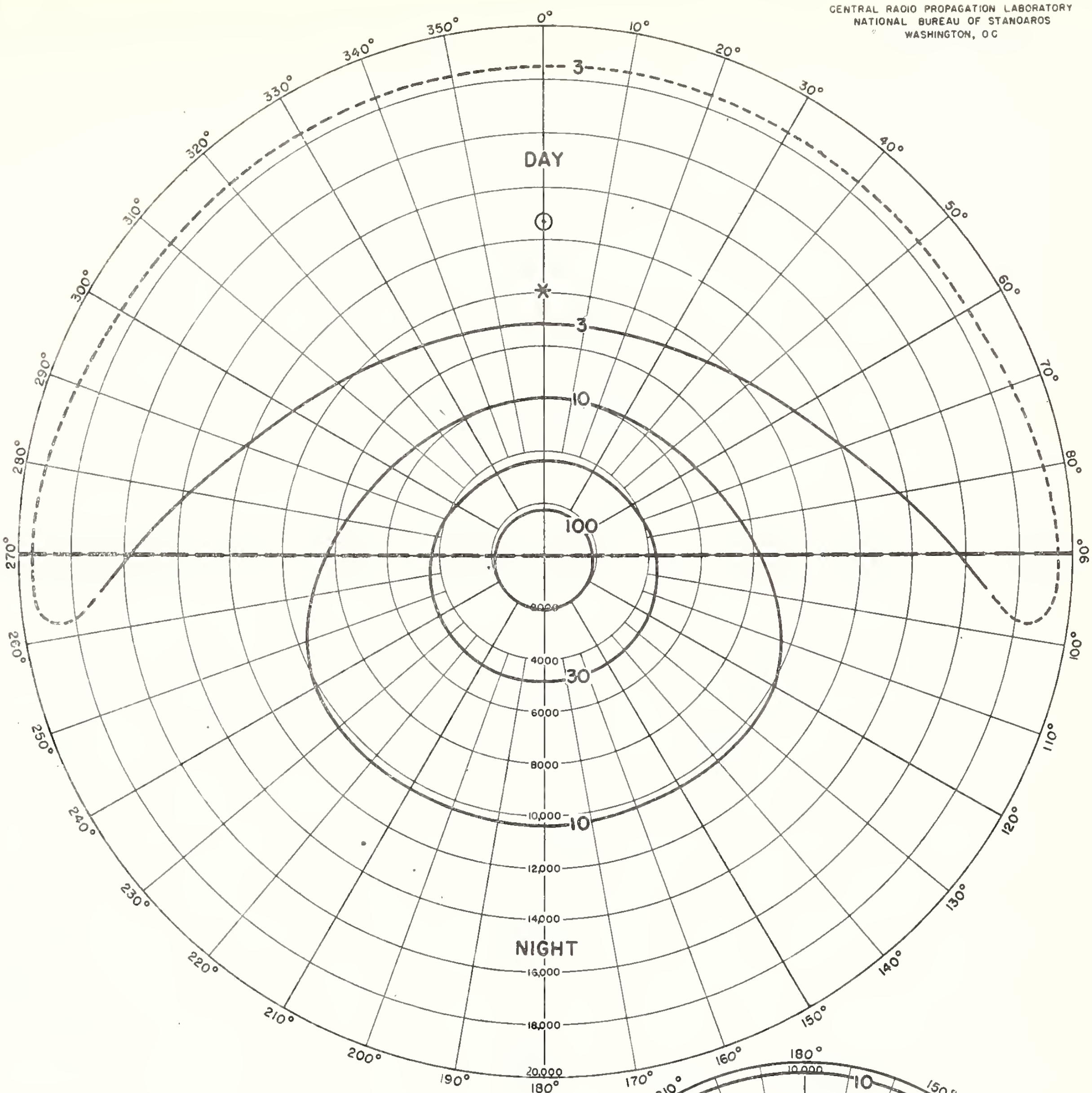
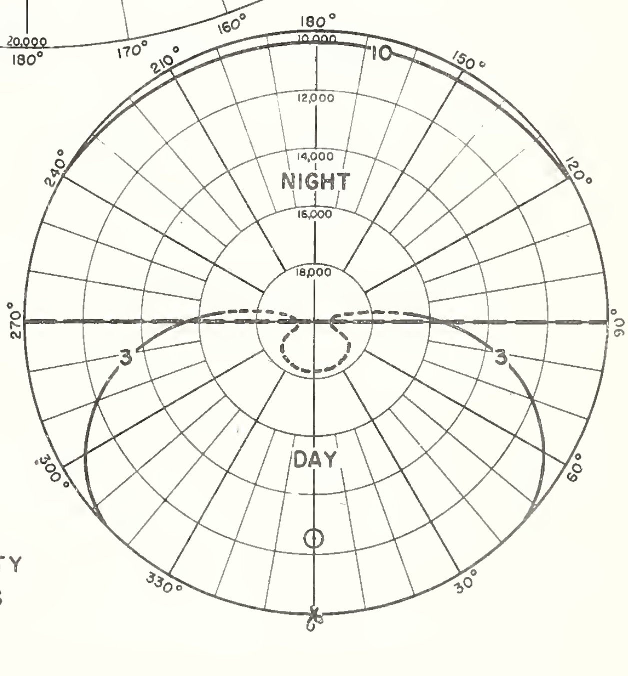



Fig. 60
FIELD INTENSITY, μV/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE 10,000 km (90°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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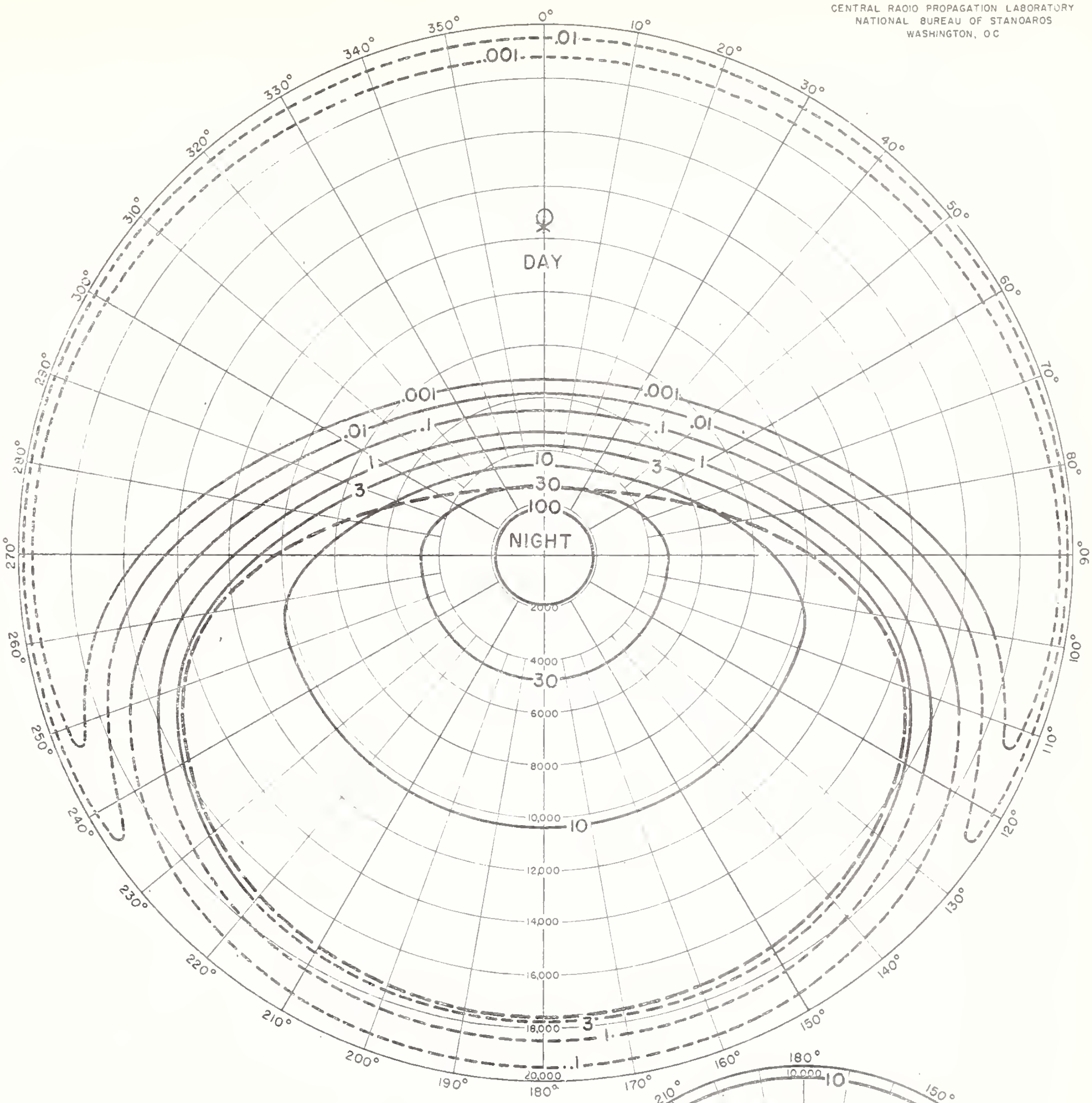
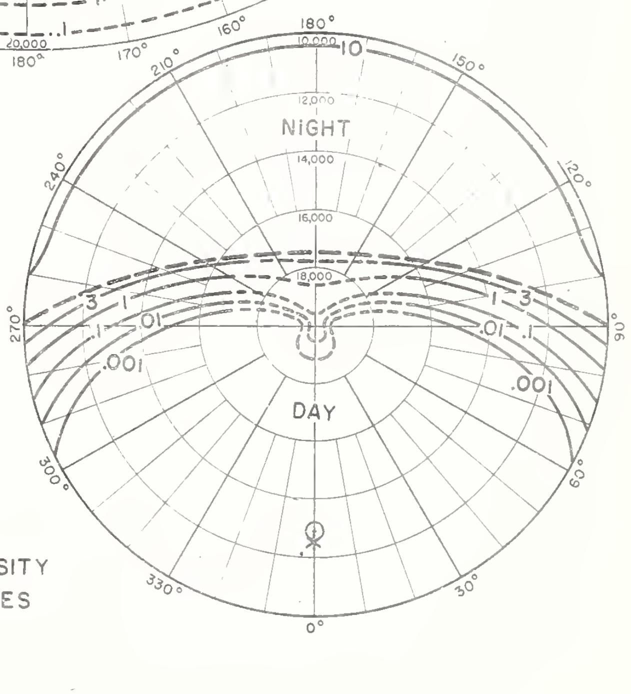



Fig. 61
FIELD INTENSITY, μV/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 12,500 km (112°30')
SUNSPOT MINIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

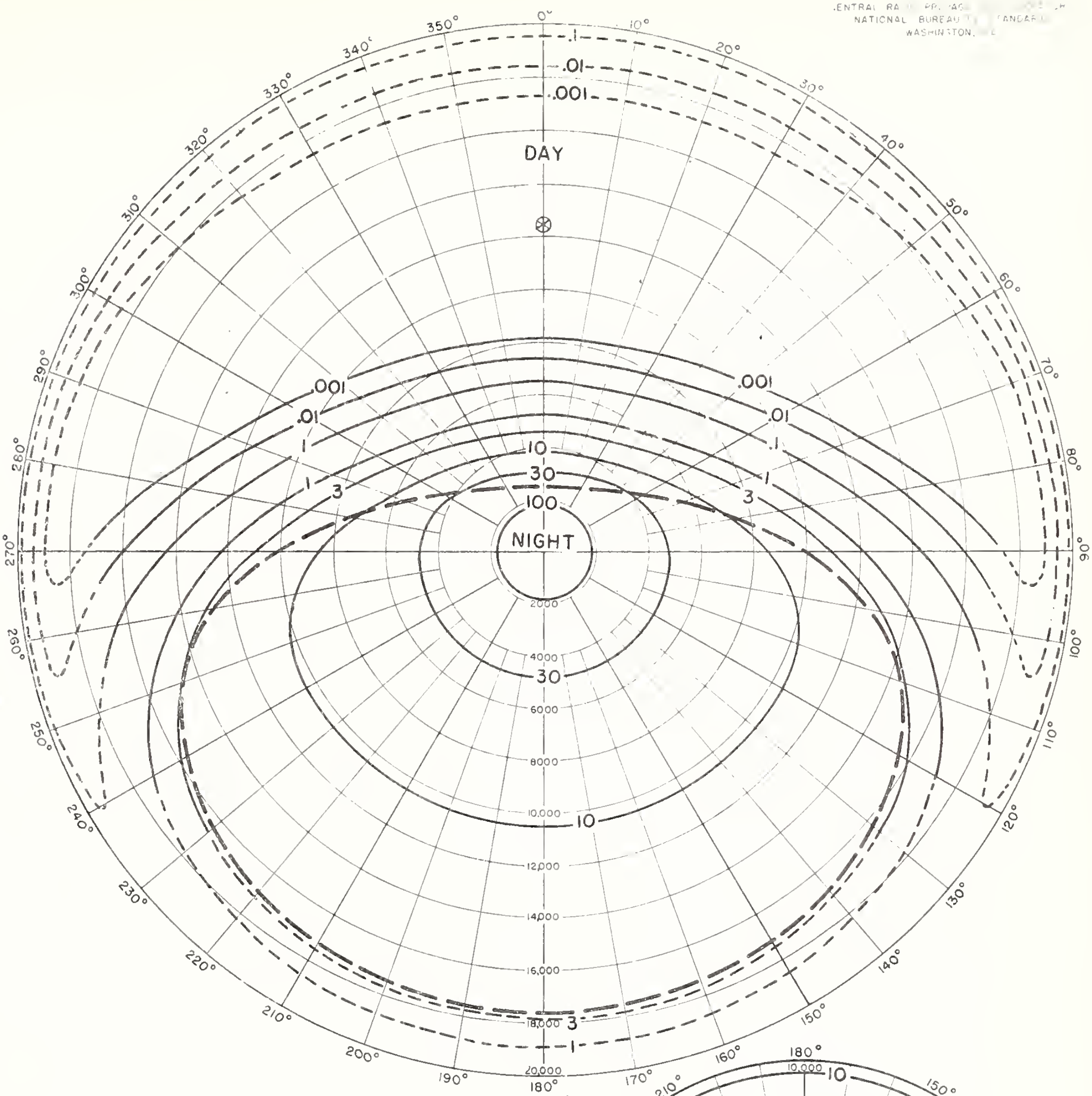
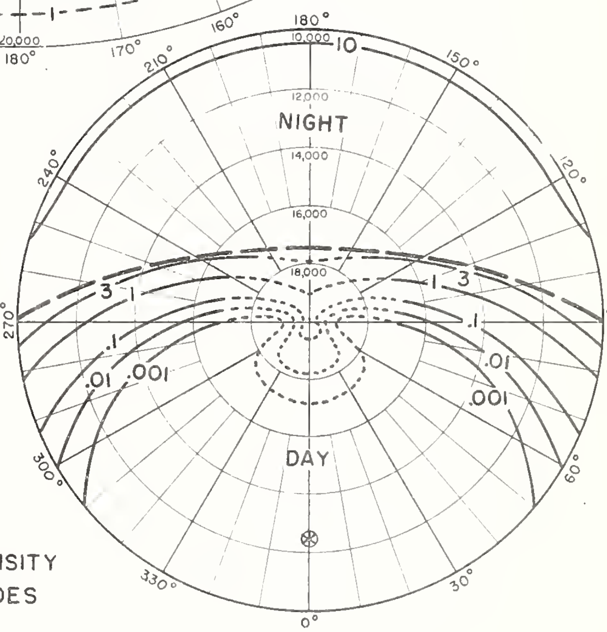



Fig. 62
FIELD INTENSITY, µv/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 12,500 km (112° 30')
SUNSPOT MINIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

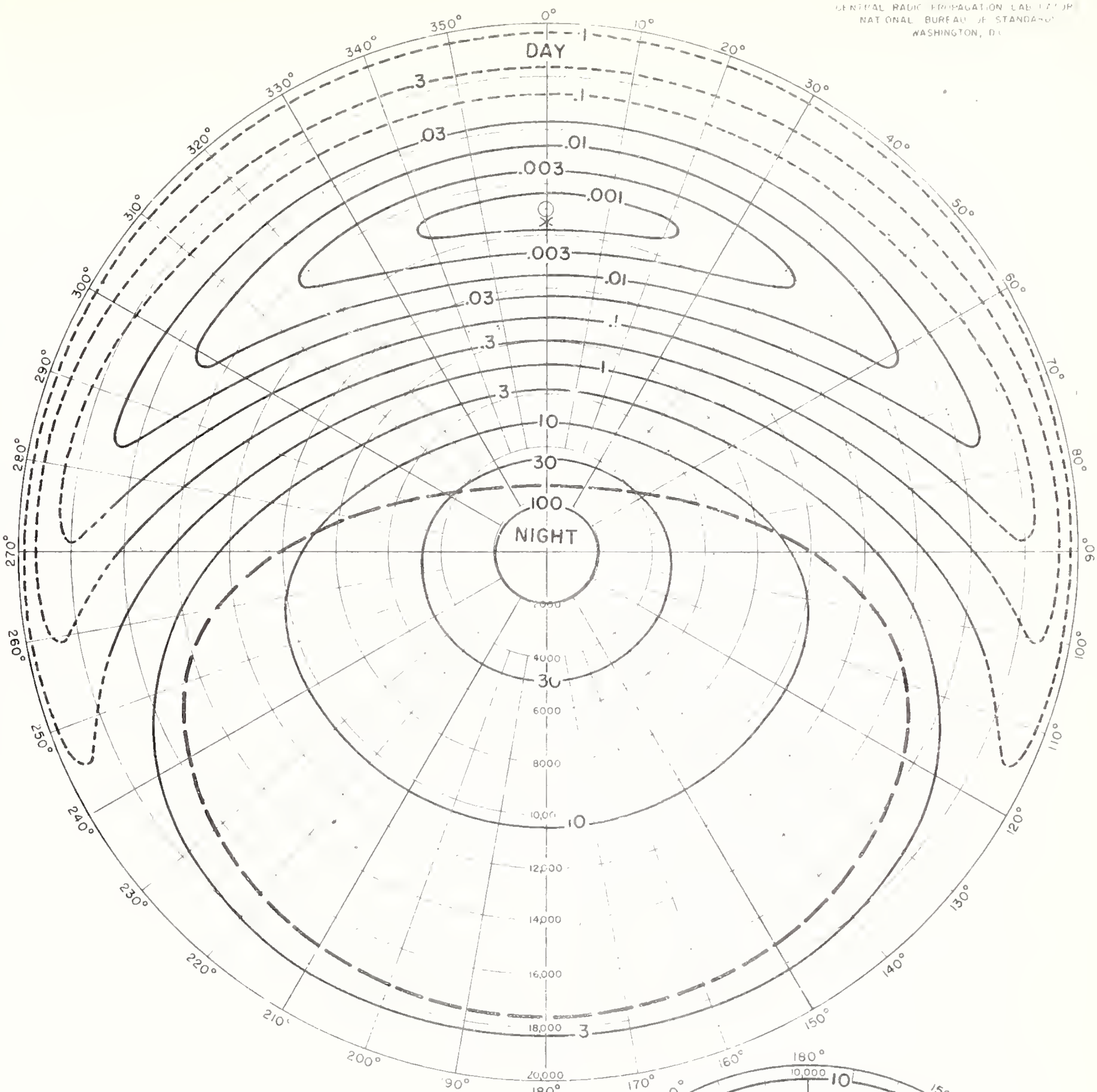
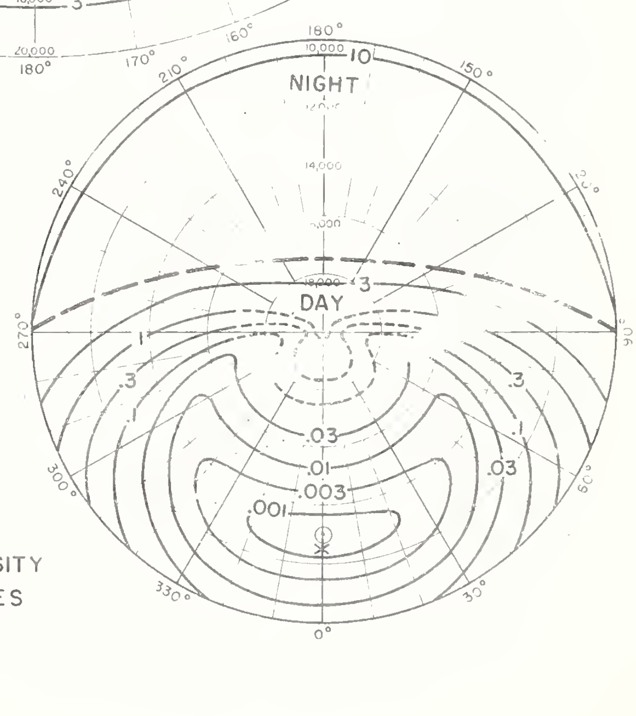



Fig. 63
FIELD INTENSITY, μv/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 12,500 km (112° 30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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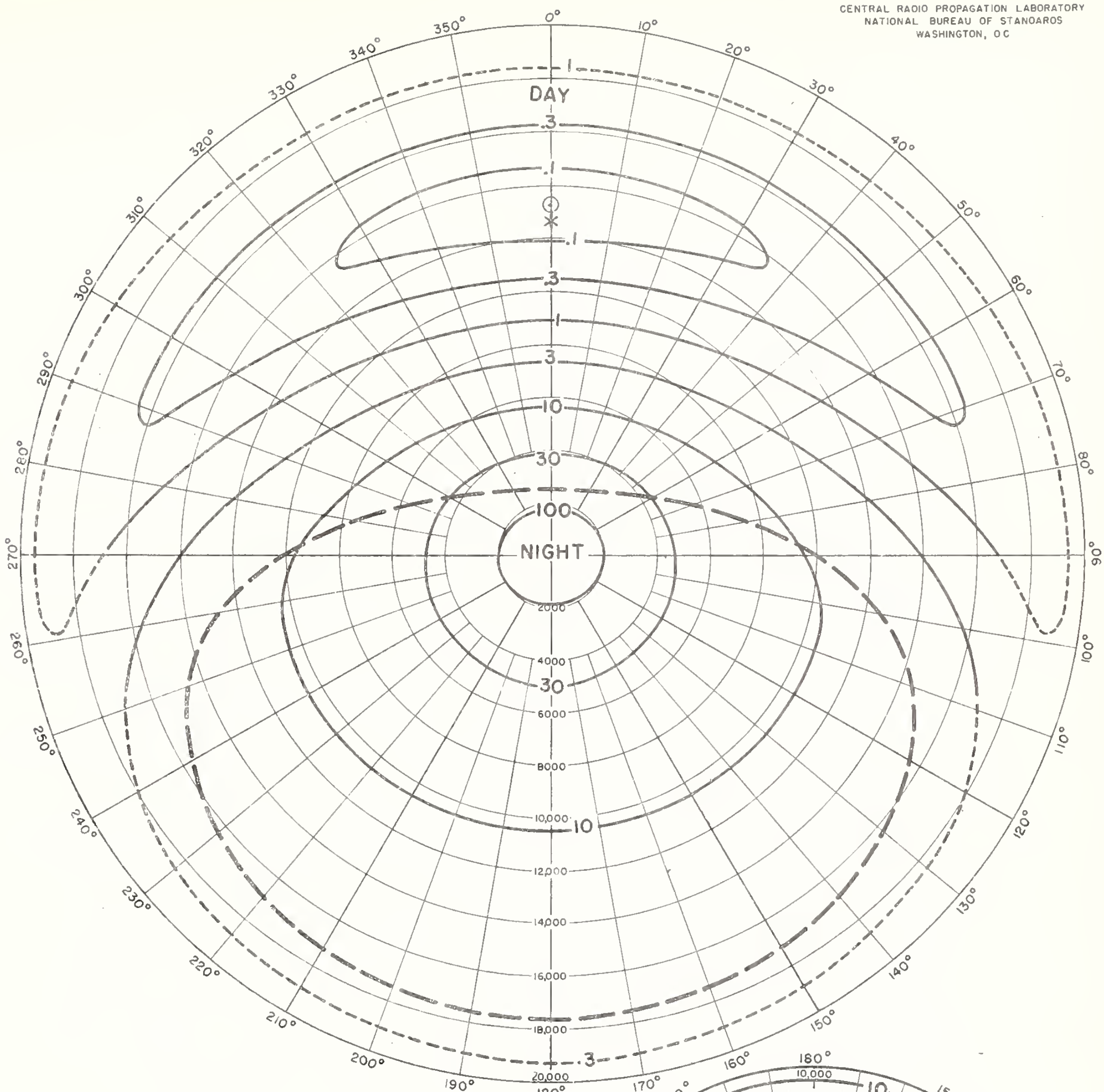
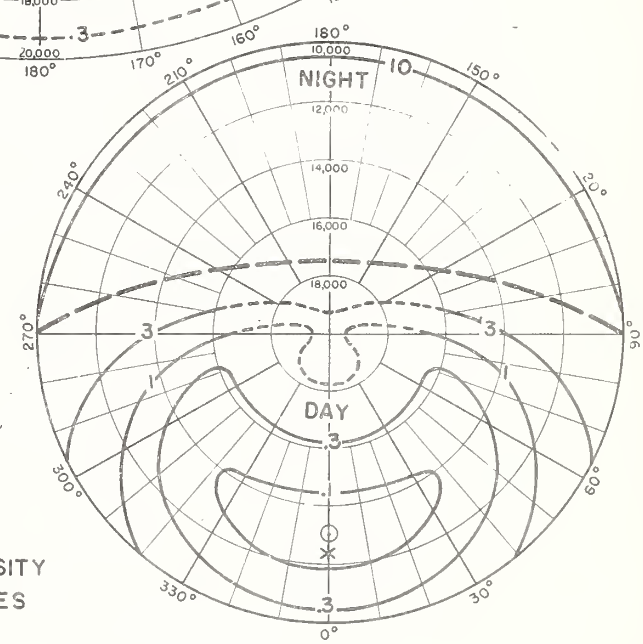



Fig. 64
FIELD INTENSITY, µV/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE, 12 500 km (112°30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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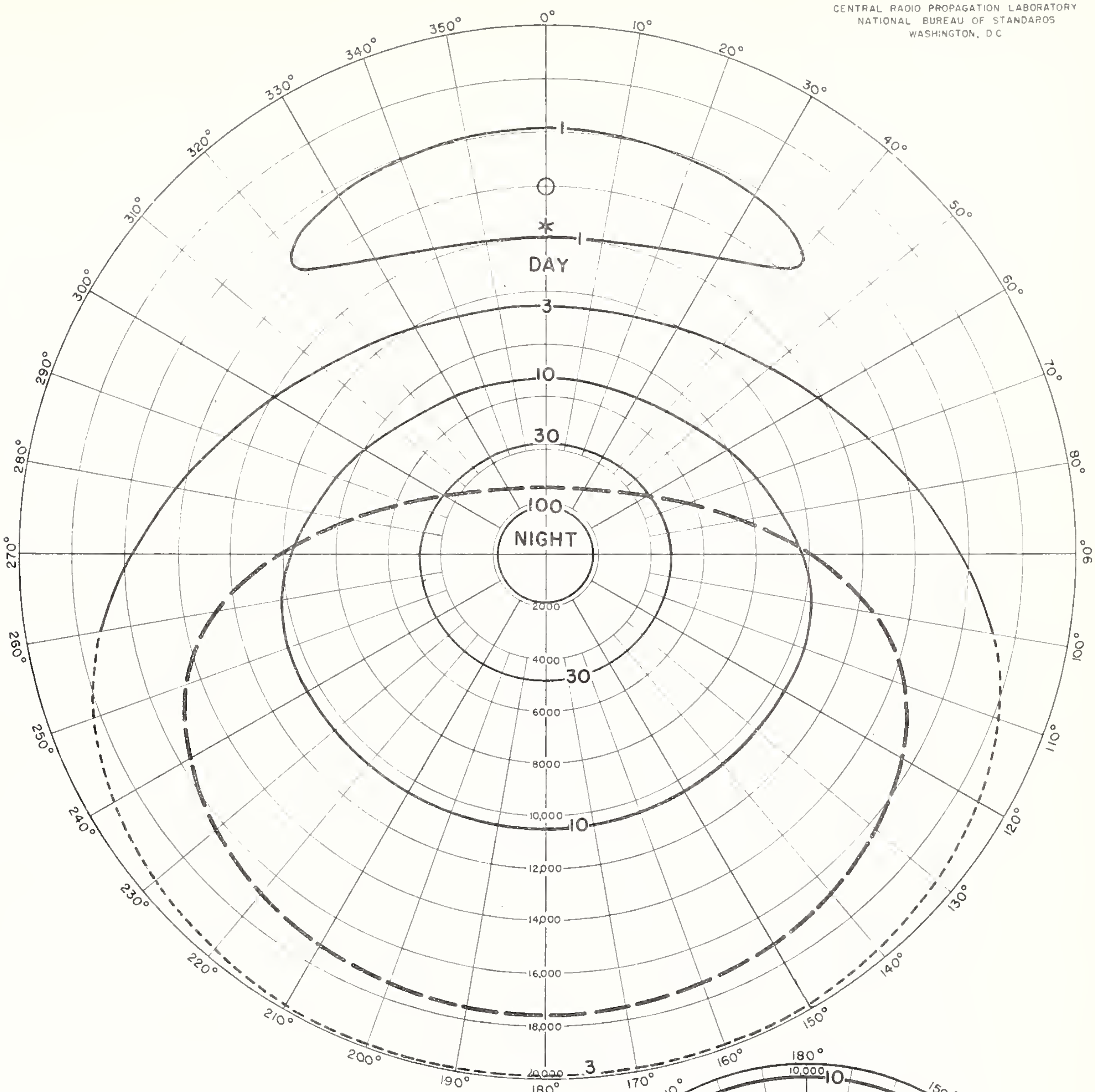
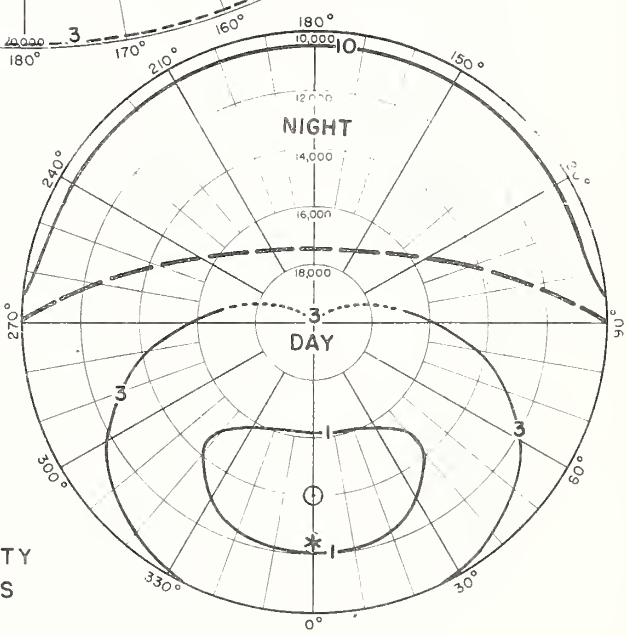



Fig. 65
FIELD INTENSITY, $\mu$V/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE, 12,500 km (112°30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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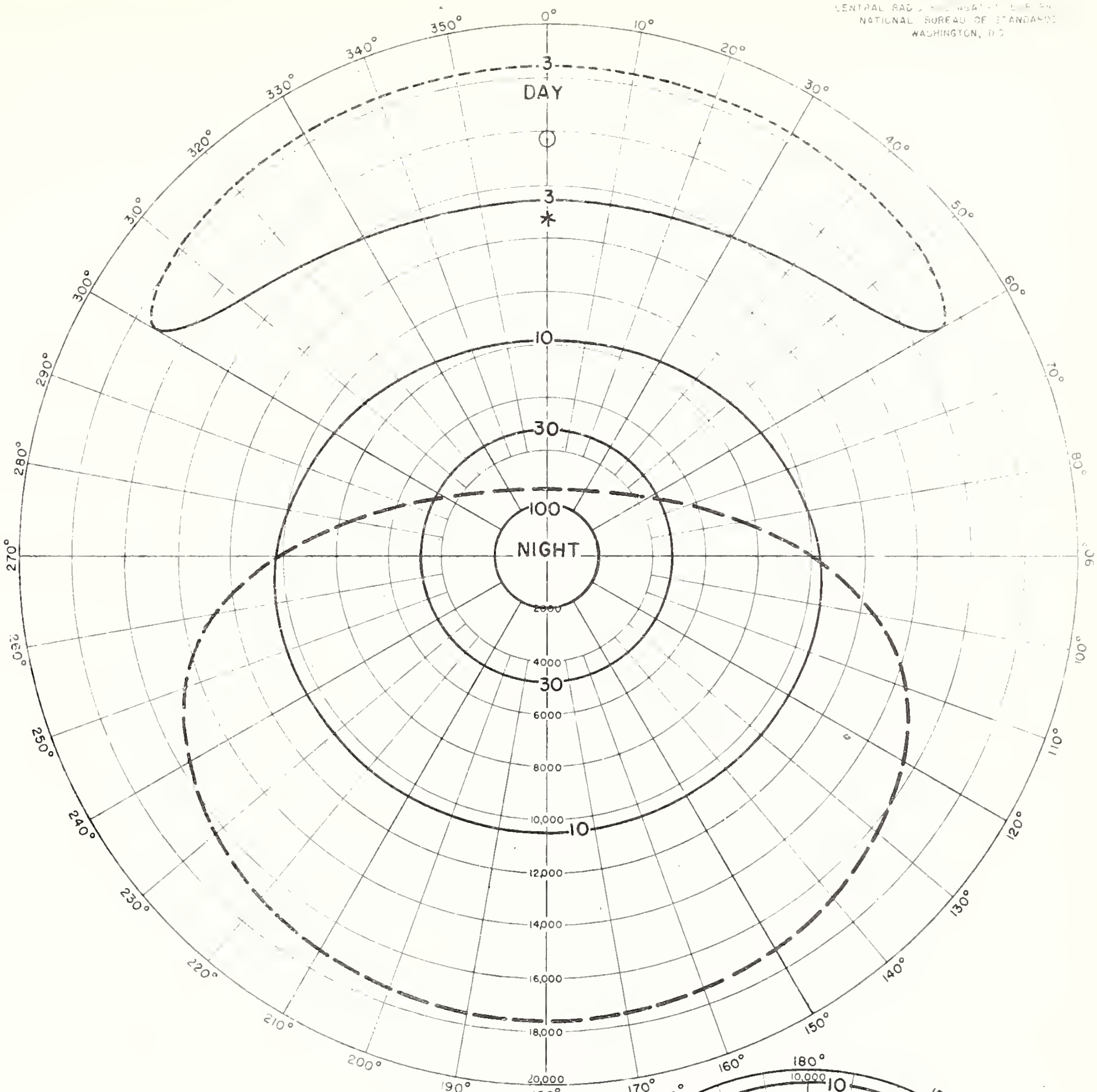
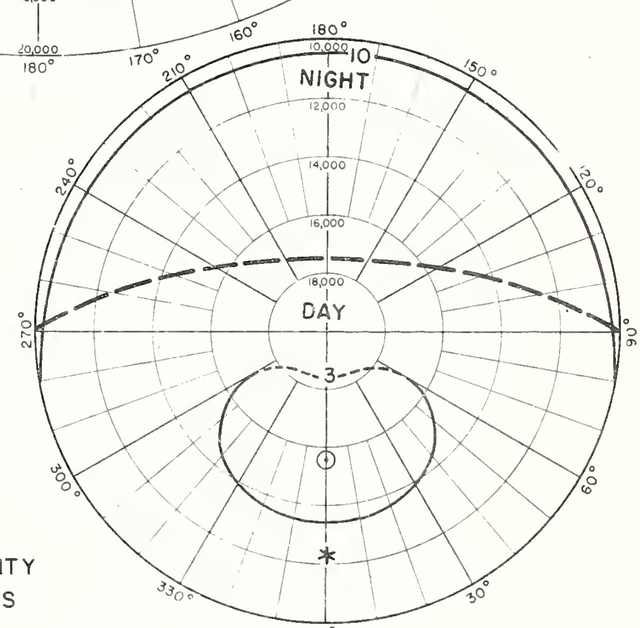



Fig. 66
FIELD INTENSITY, μv/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 12,500 km (112°30')
SUNSPOT MINIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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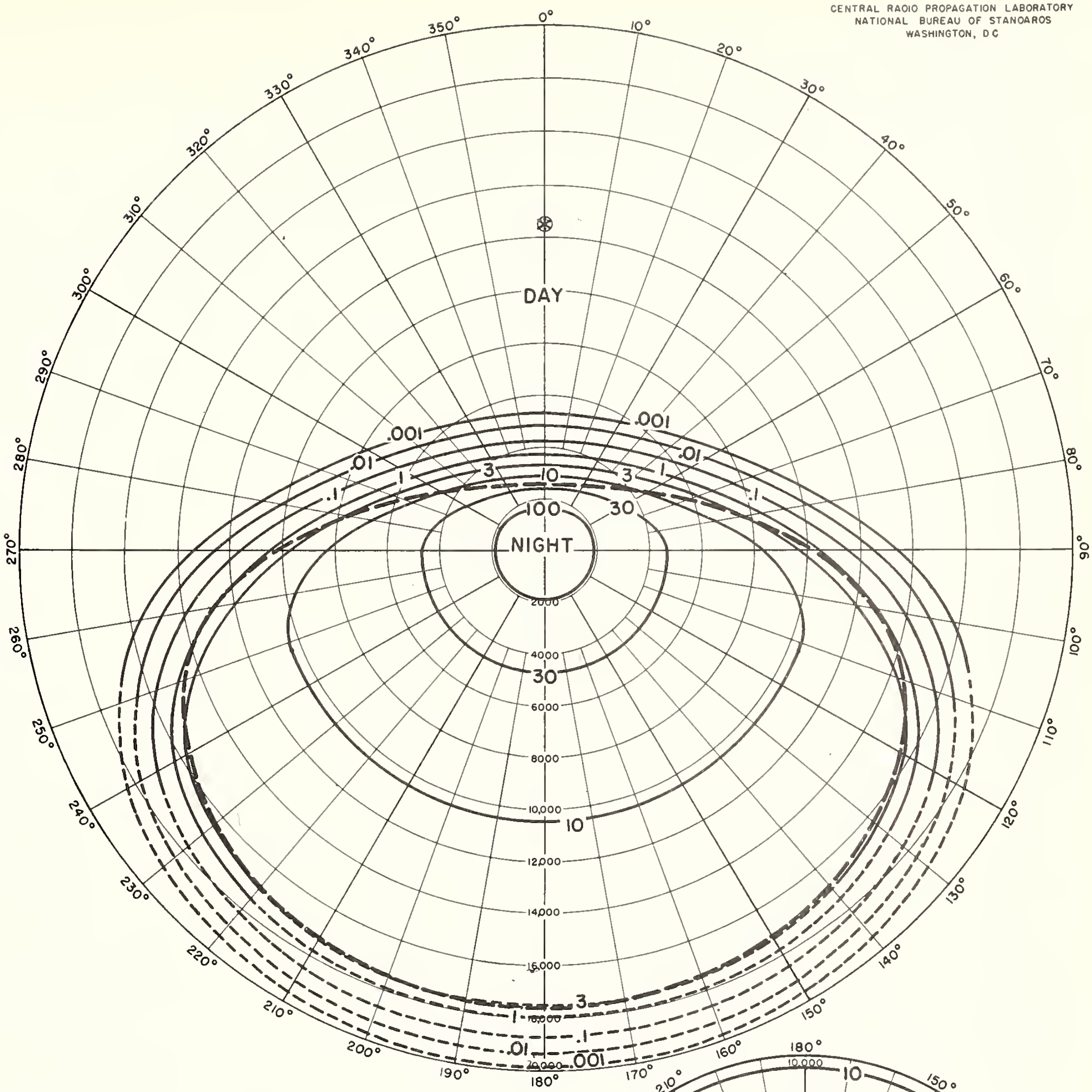
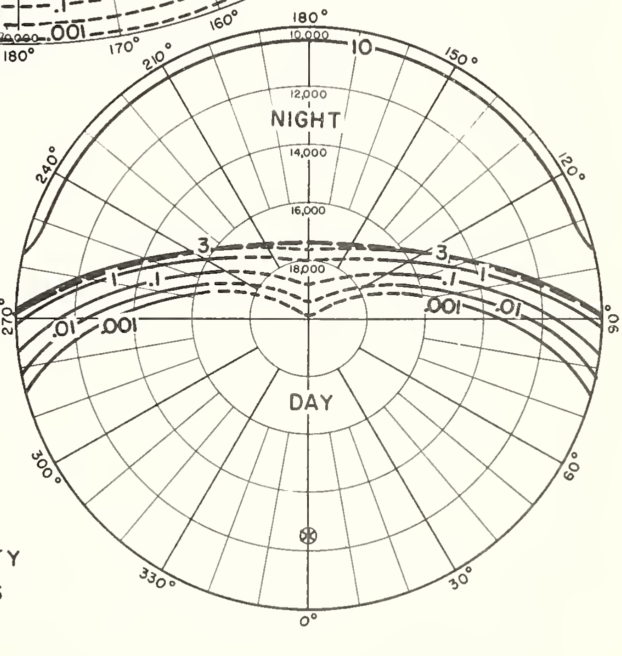



Fig. 67
FIELD INTENSITY, µv/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 12,500 km (112°30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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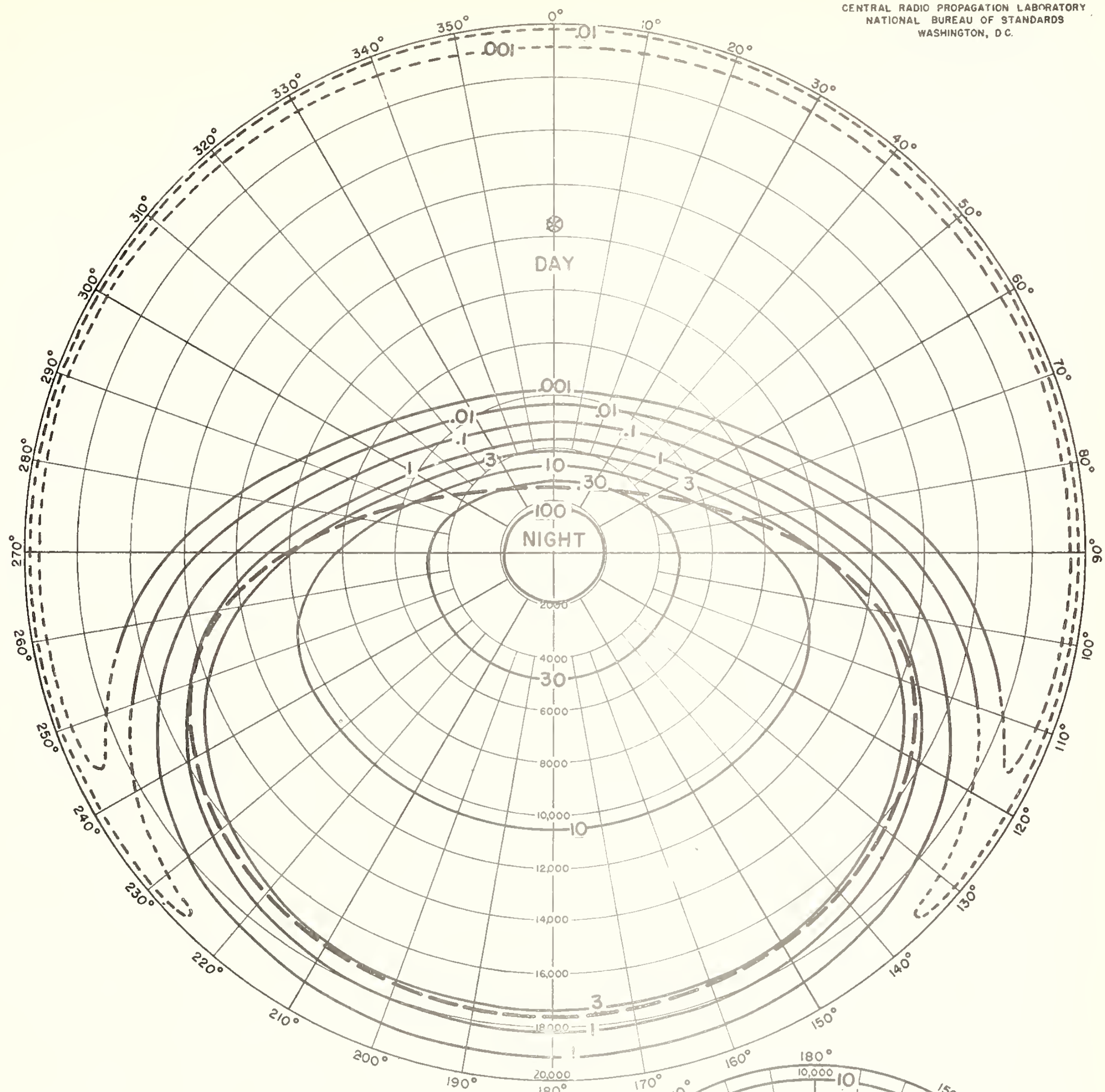
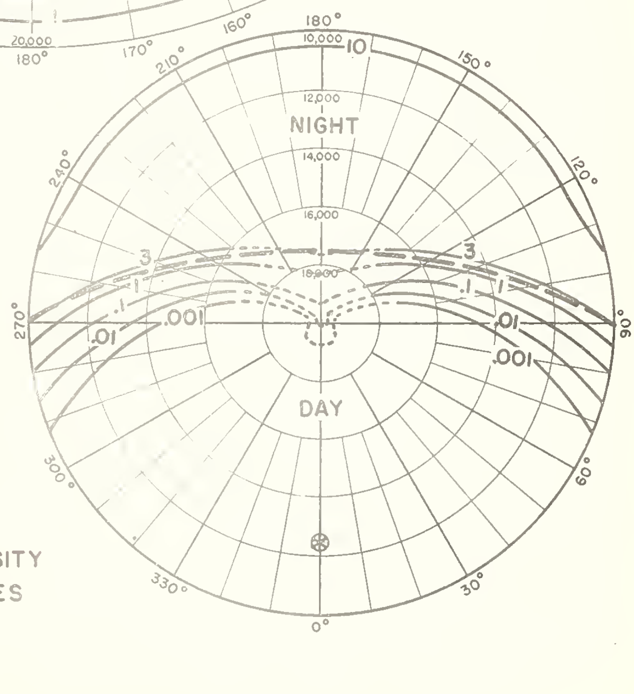



Fig. 68
FIELD INTENSITY, $\mu$v/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 12,500km(112°30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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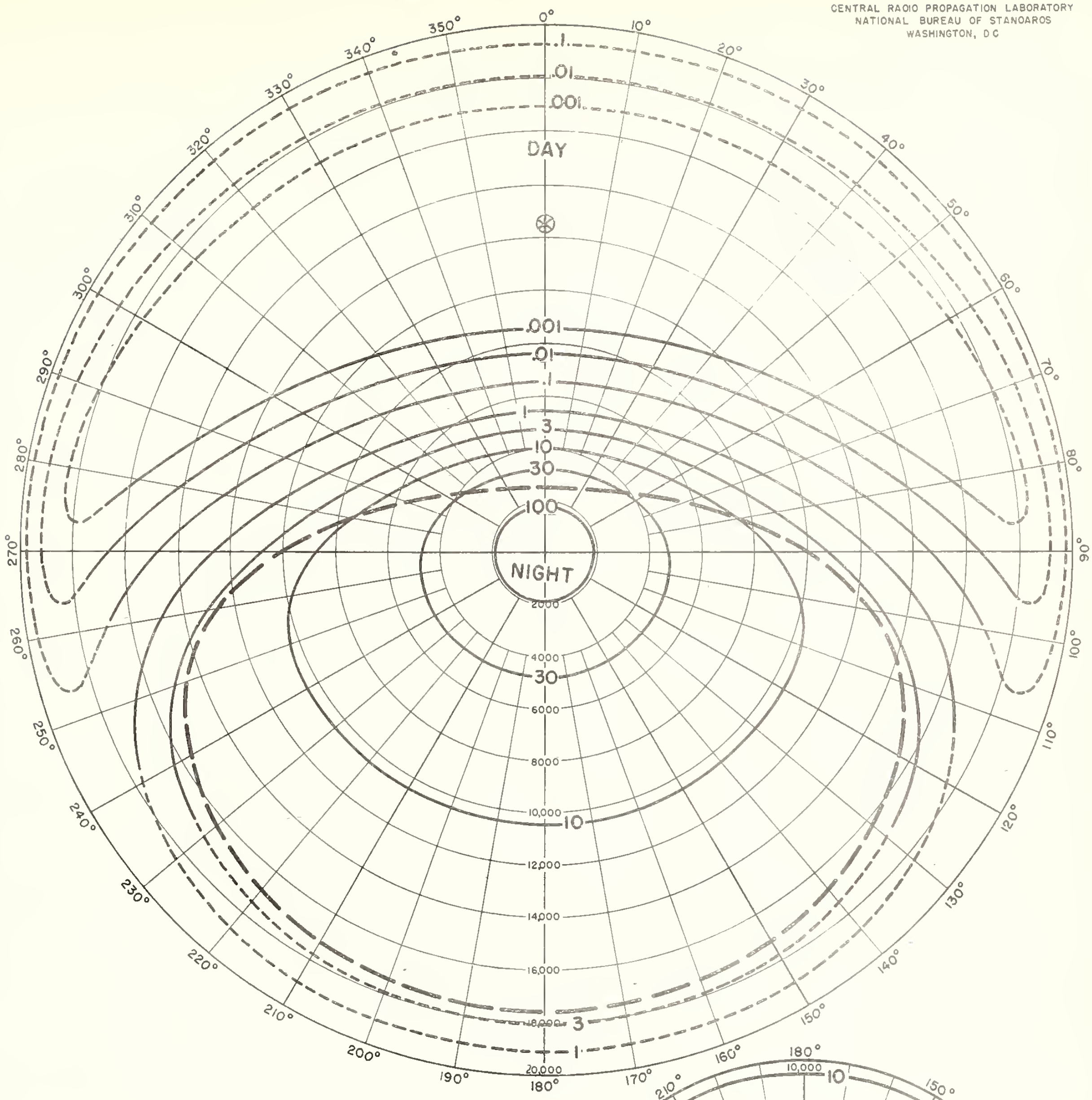
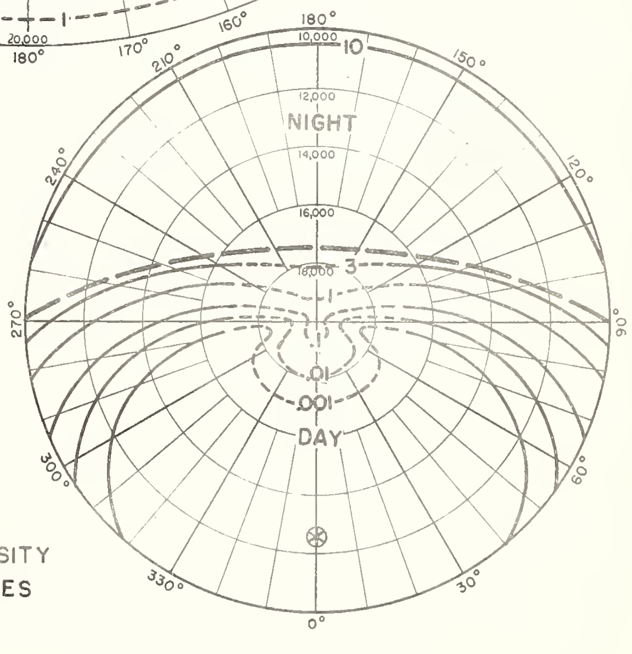


Fig. 69
FIELD INTENSITY, µv/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 12,500 km (112°30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY



FIELD INTENSITY
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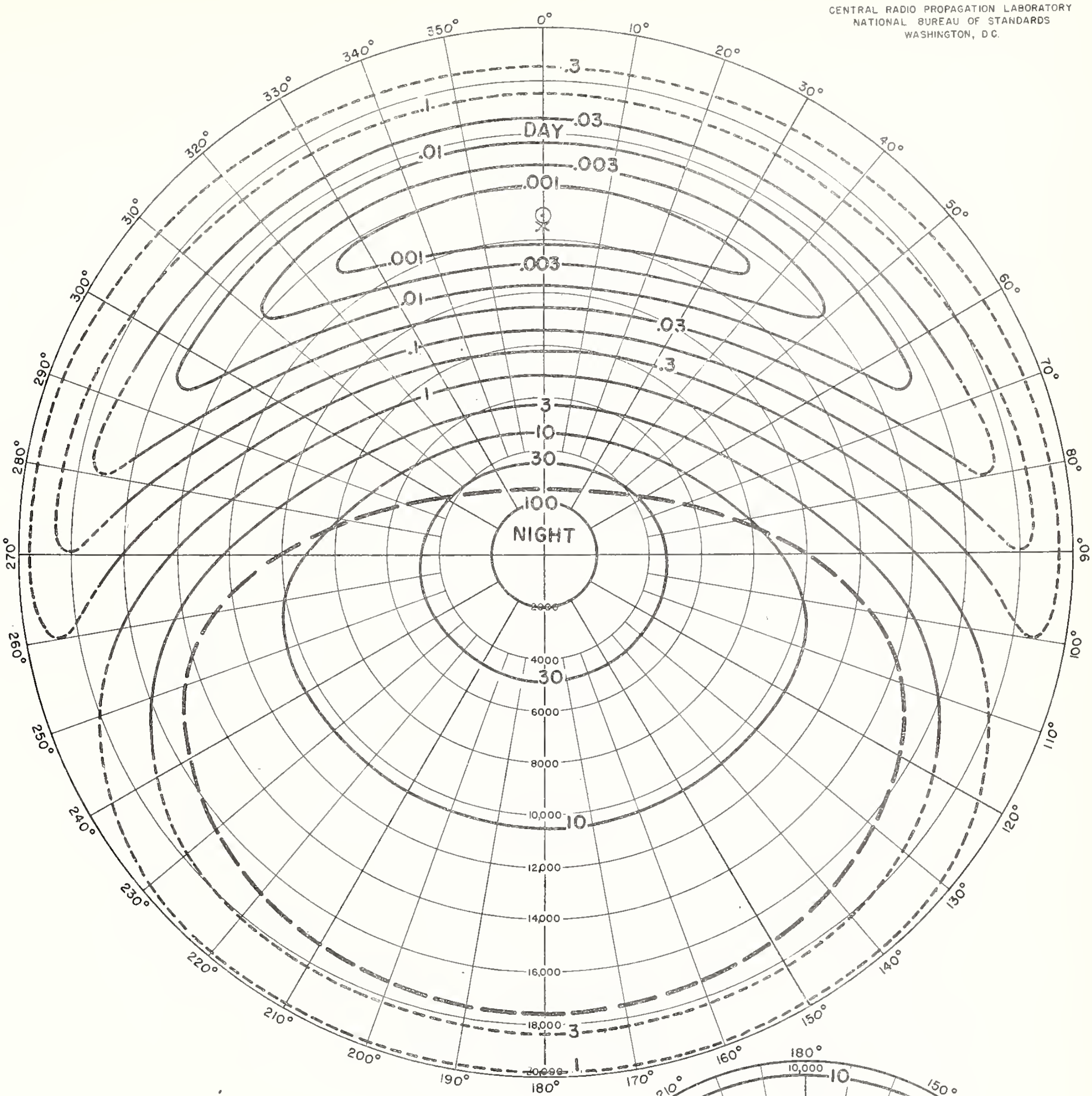
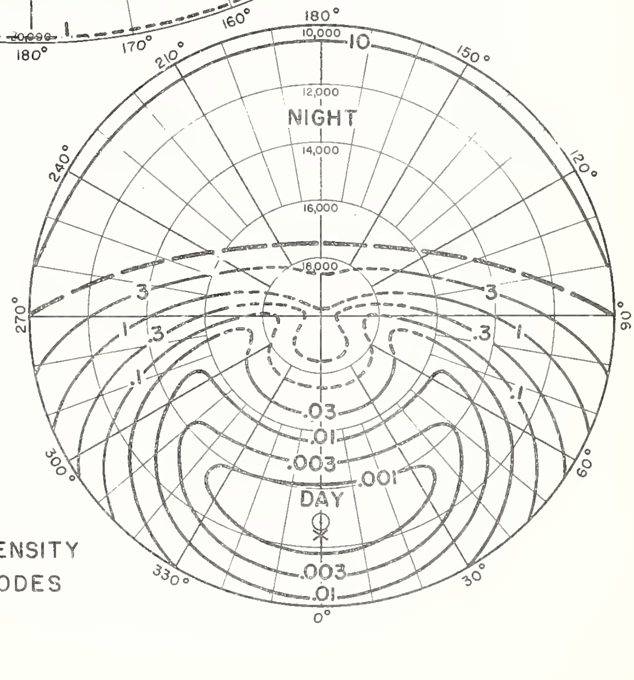



Fig. 70
FIELD INTENSITY, μV/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE, 12500 km (112°30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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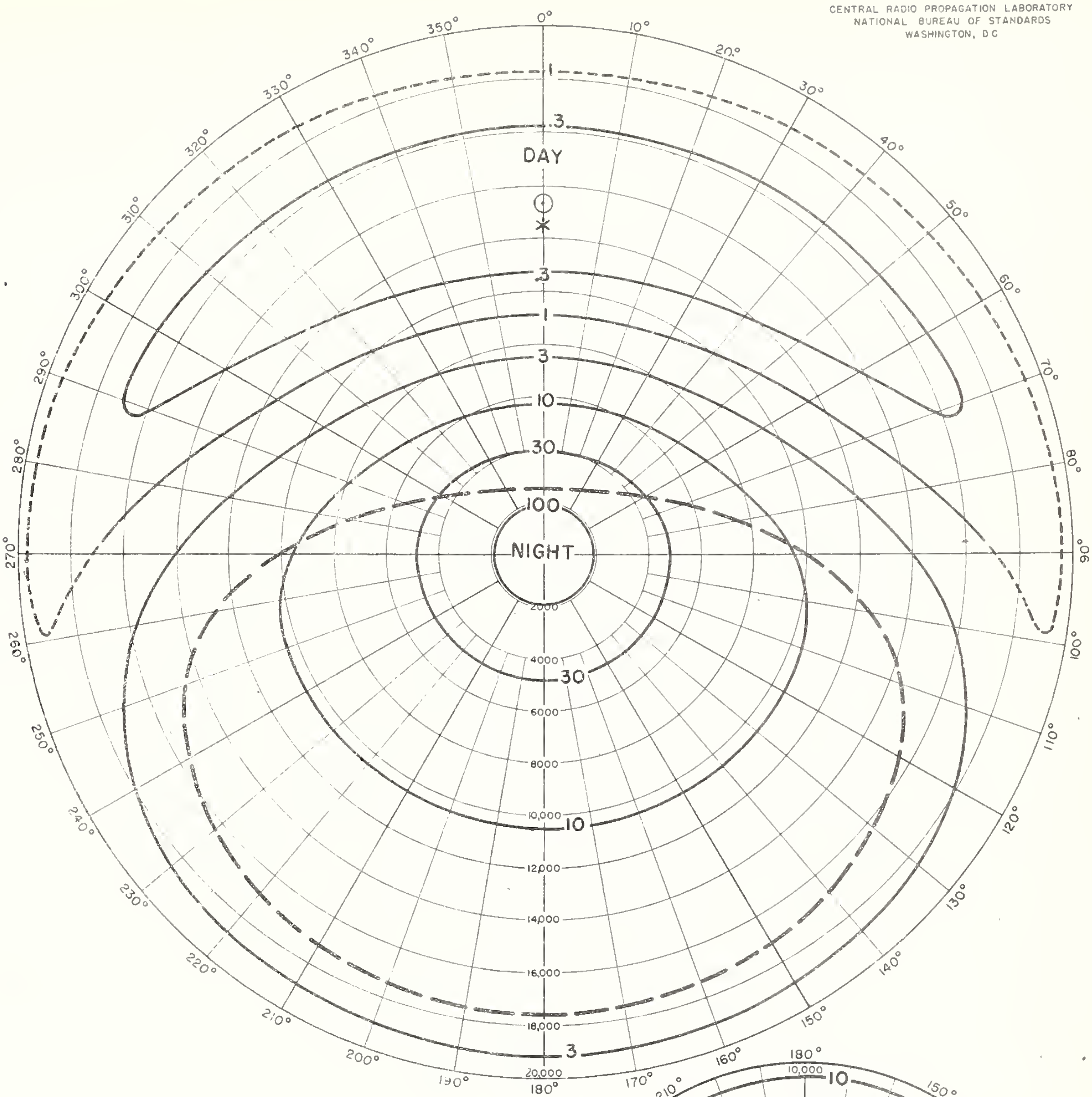
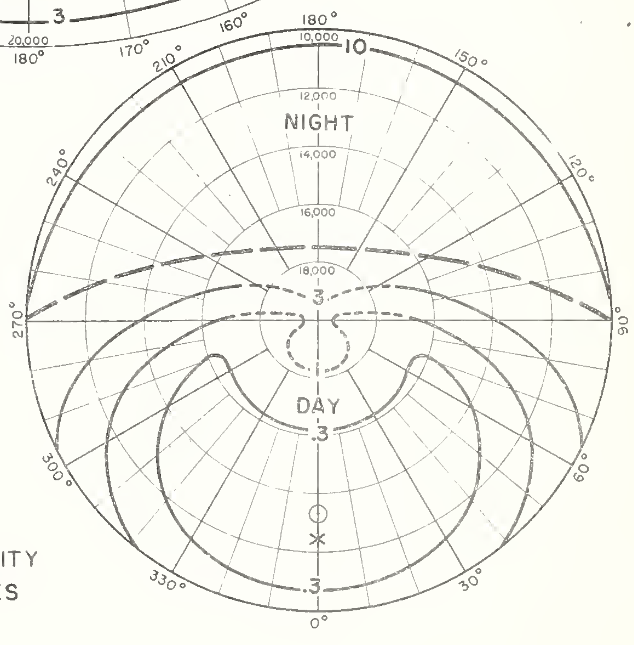



Fig. 71
FIELD INTENSITY, μV/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE, 12,500 km (112°30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

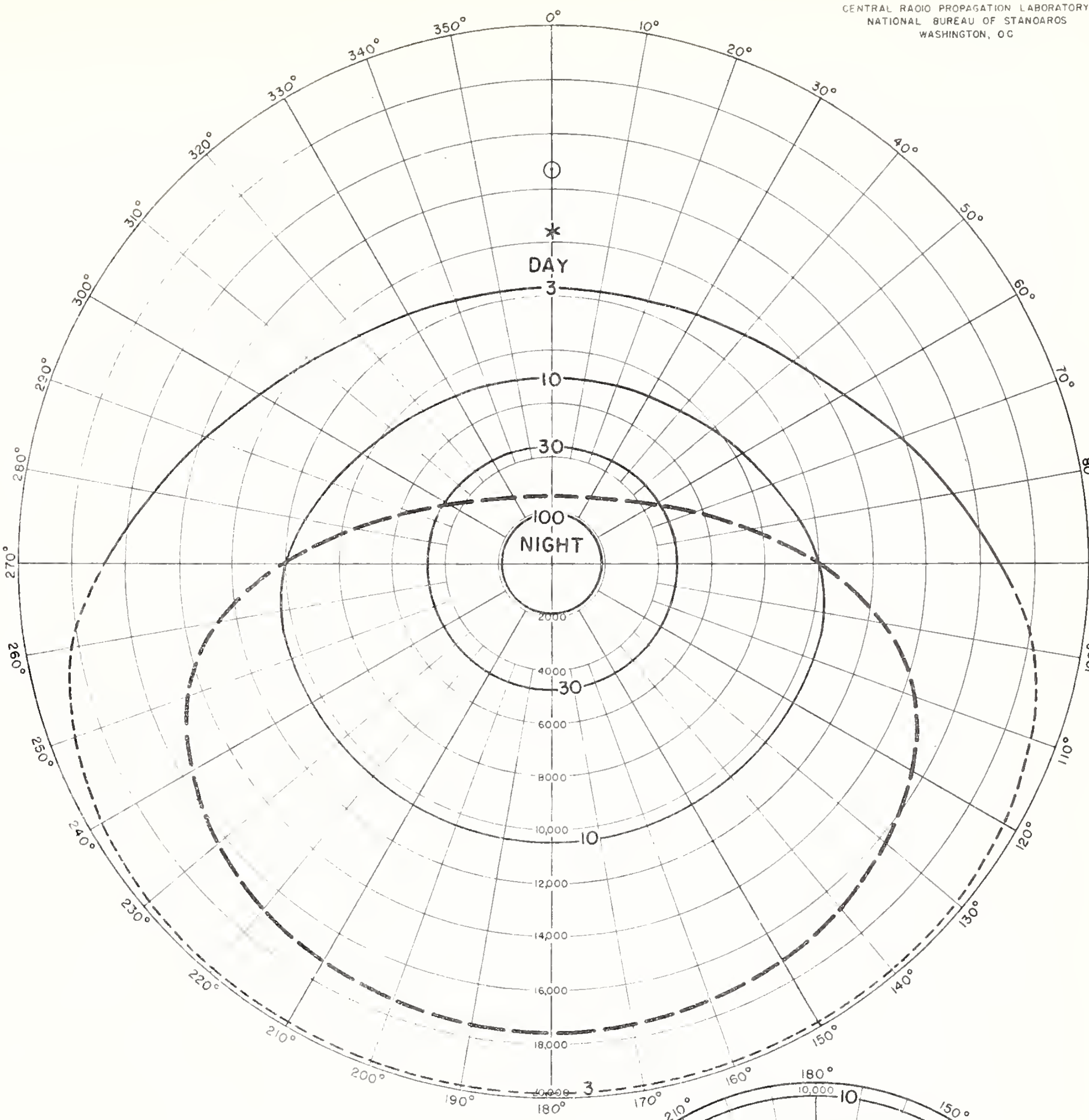
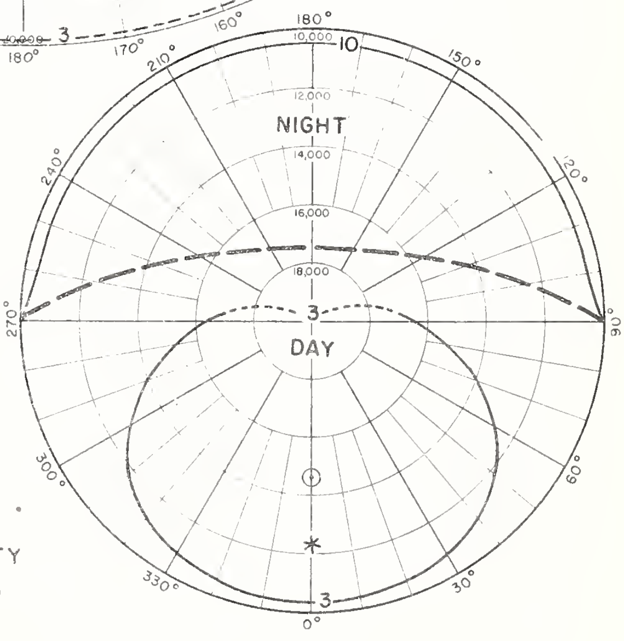



Fig. 72
FIELD INTENSITY, μV/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 12500 km (112°30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

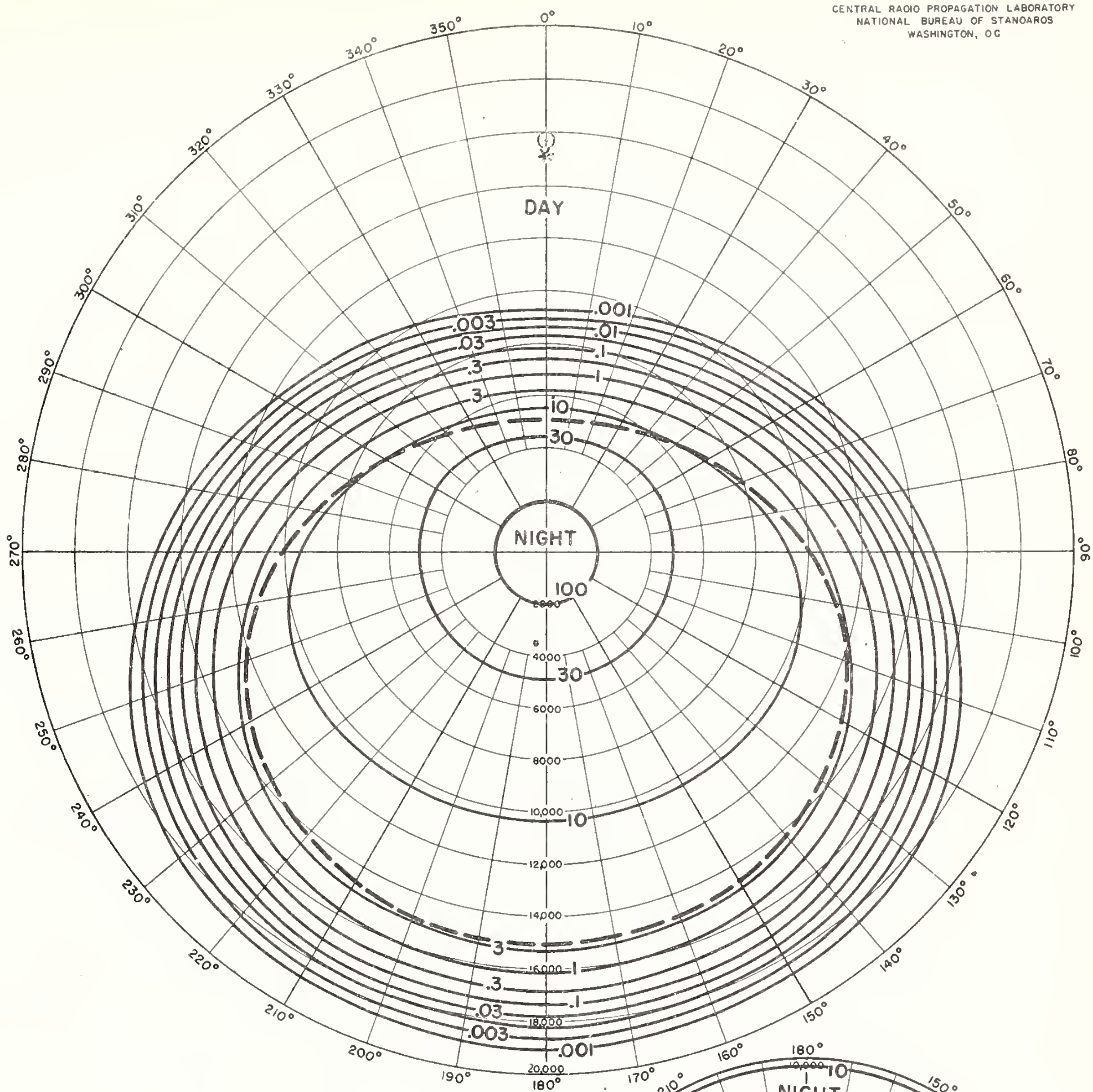
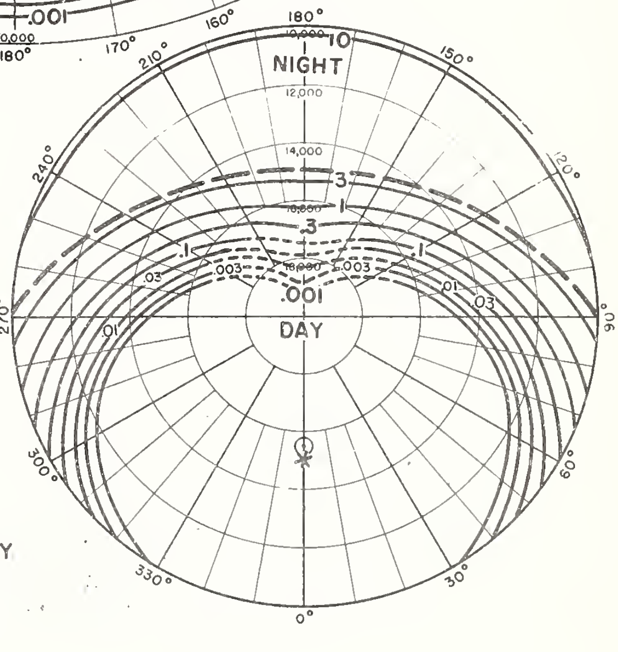



Fig. 73
FIELD INTENSITY, $\mu v/m$, I KW, 3 Mc
SUBSOLAR DISTANCE, 15,000 km (135°)
SUNSPOT MINIMUM

✻ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

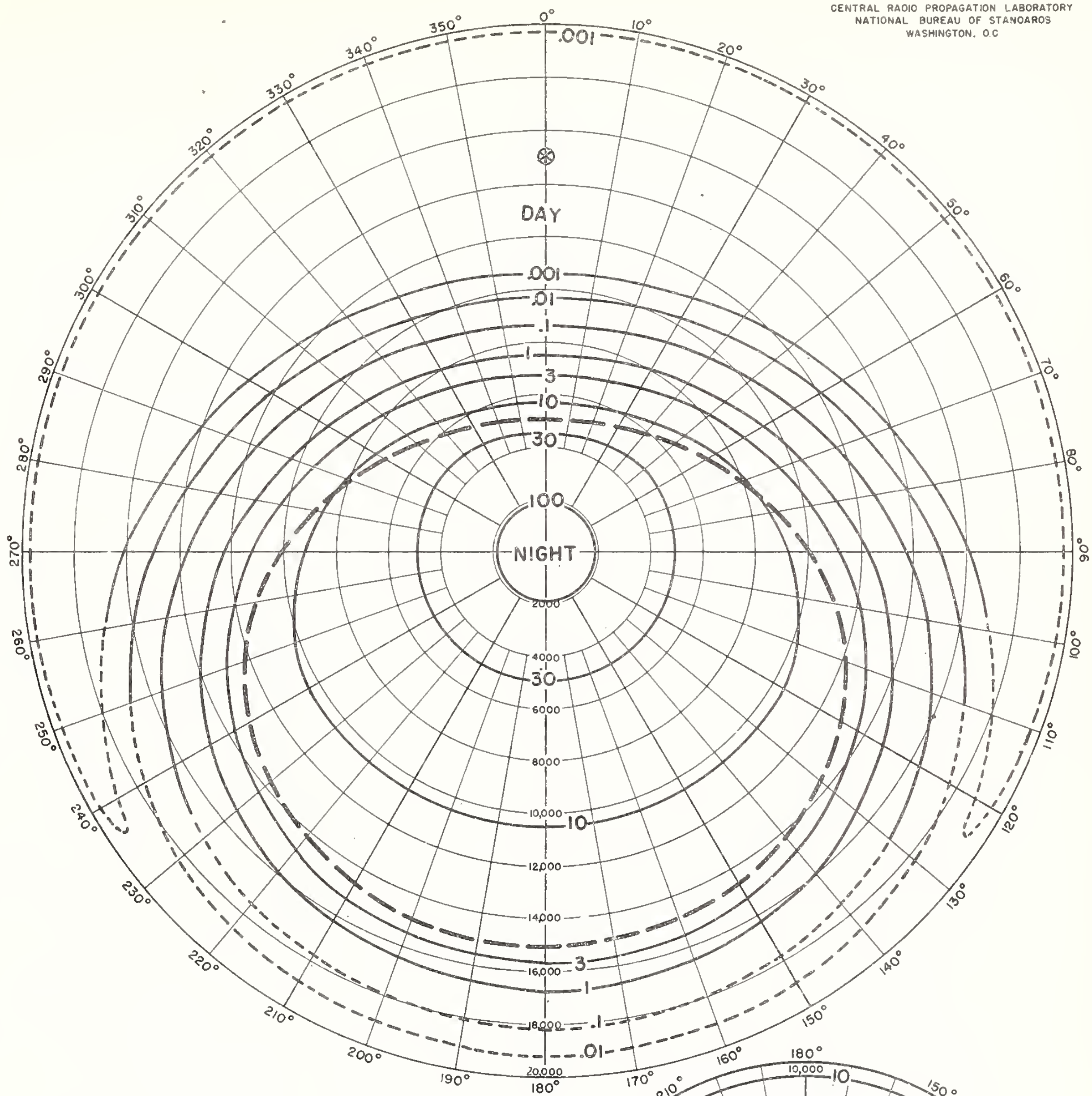
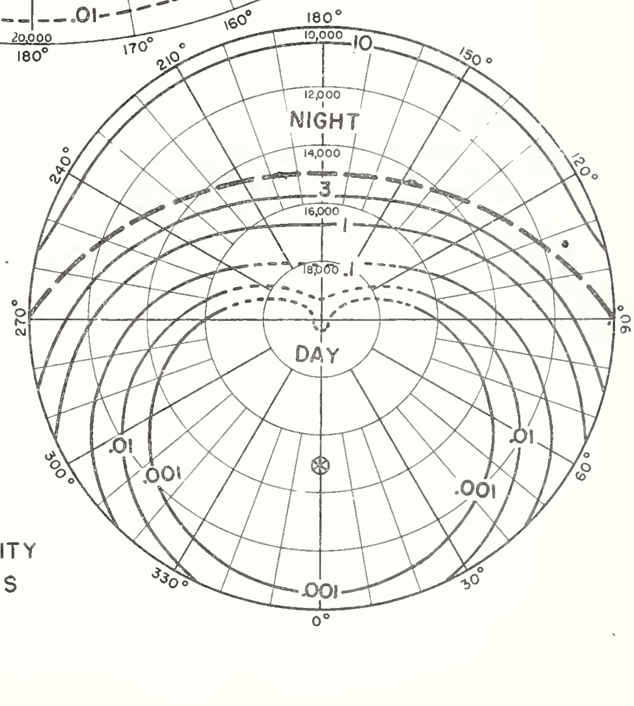



Fig. 74
FIELD INTENSITY, μV/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 15,000 km (135°)
SUNSPOT MINIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

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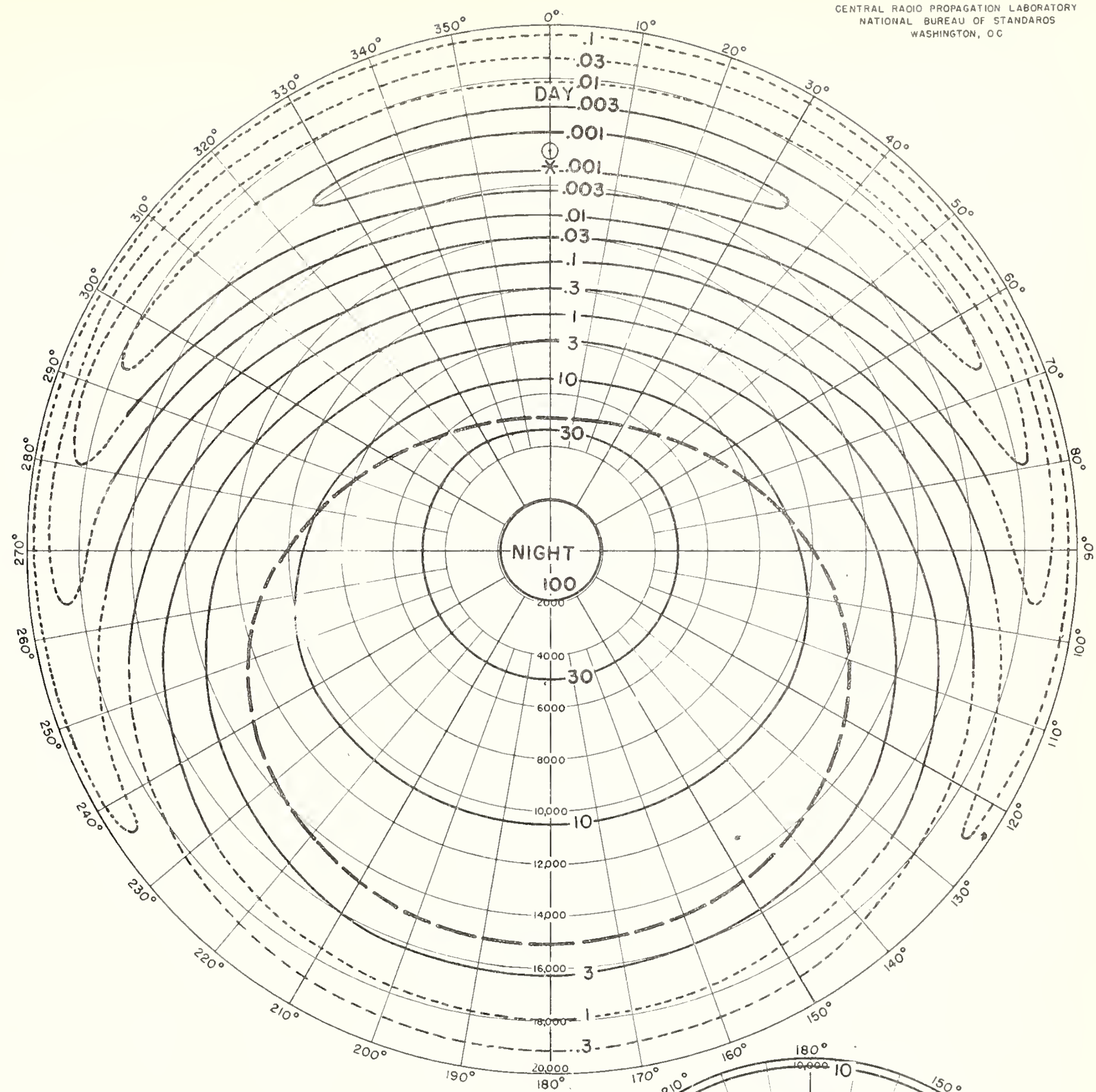
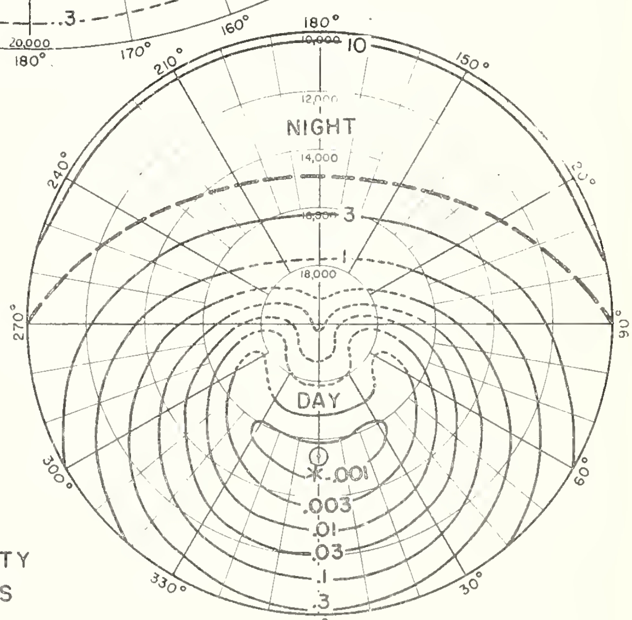



Fig. 75
FIELD INTENSITY, μv/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 15,000 (135°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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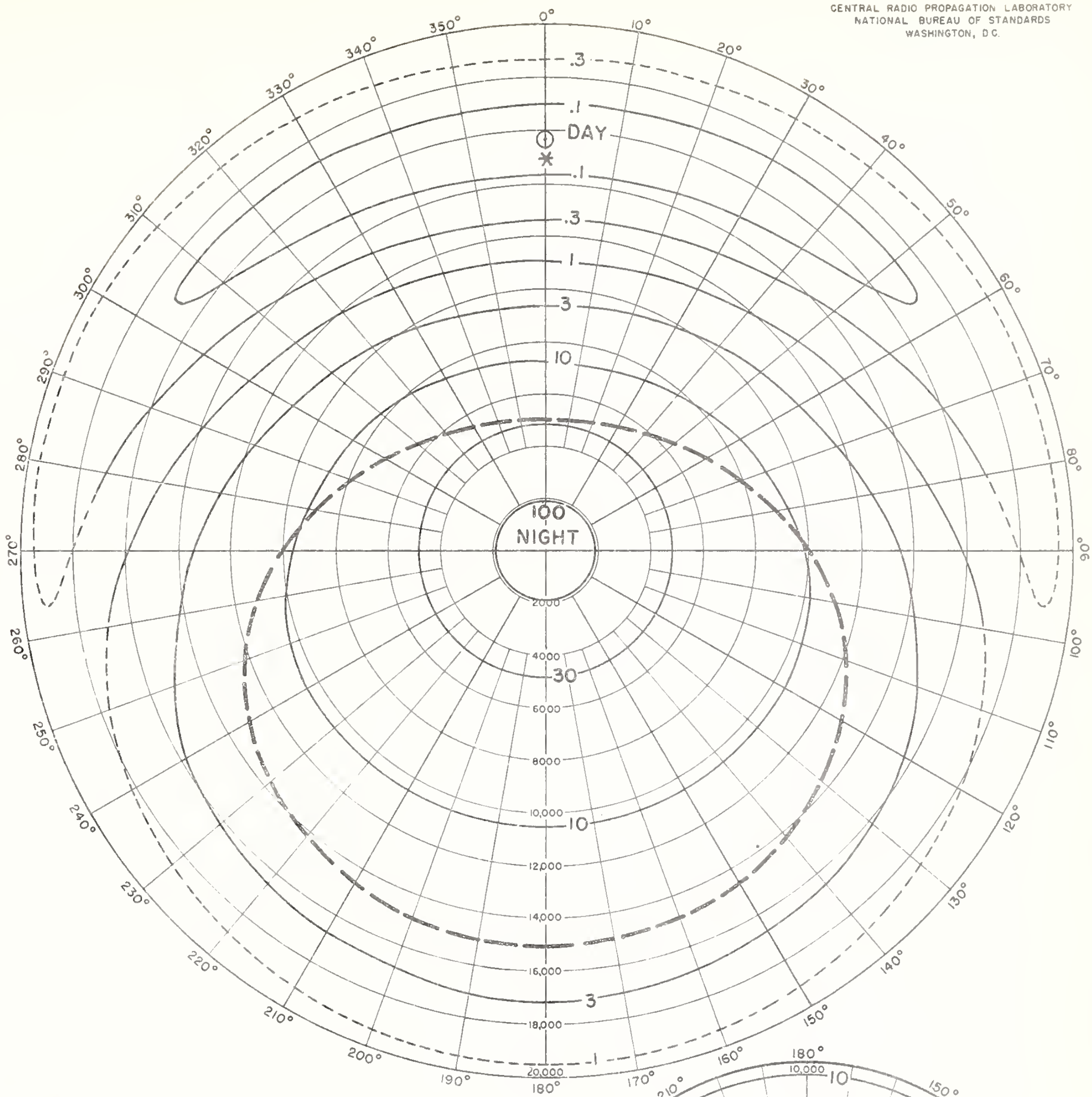
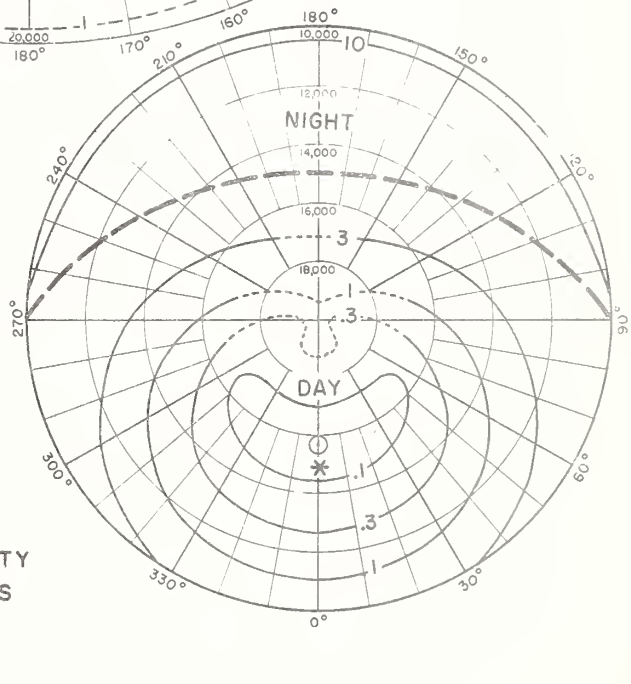



Fig. 76
FIELD INTENSITY, μv/m, I KW, 10 Mc
SUBSOLAR DISTANCE, 15,000 km (135°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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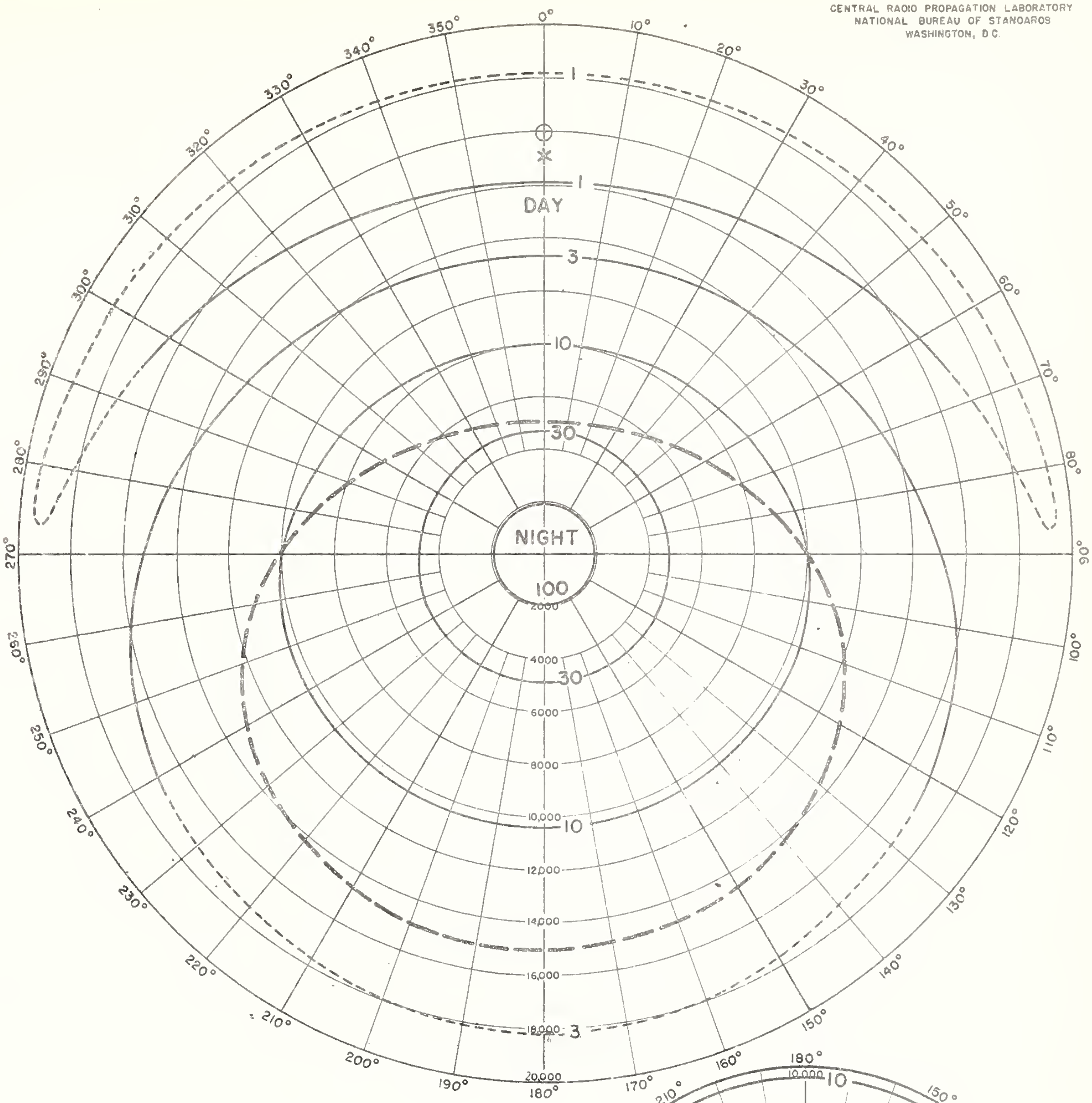
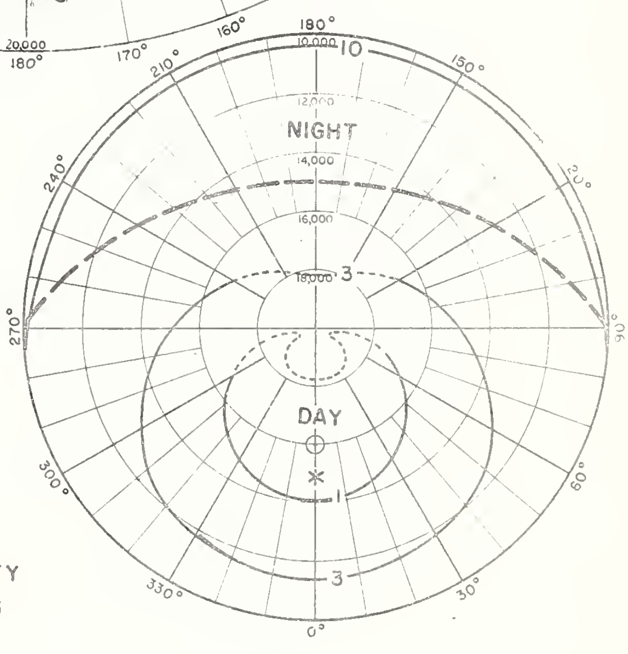



Fig. 77
FIELD INTENSITY, μv/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE, 1500 km (135°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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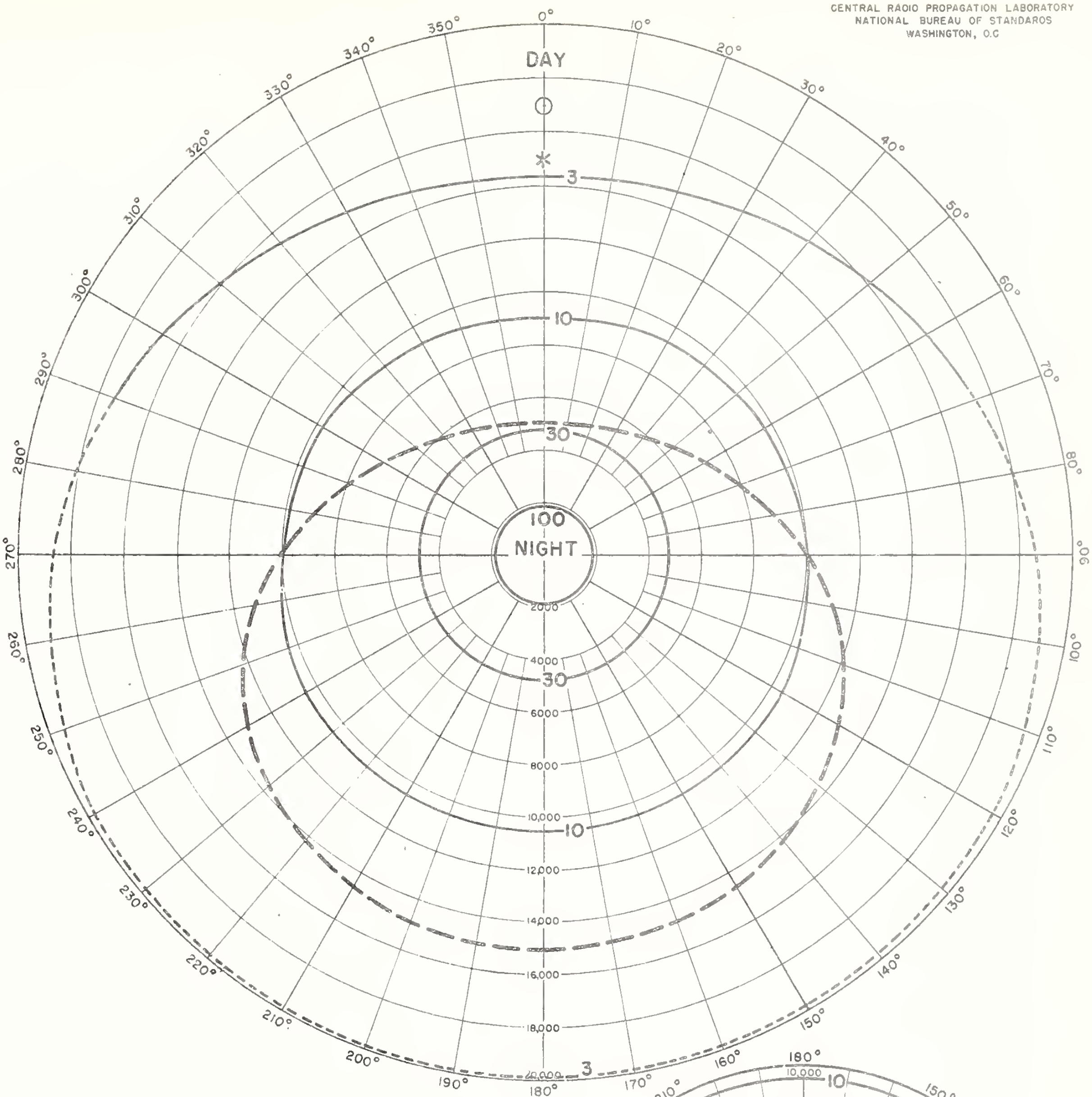
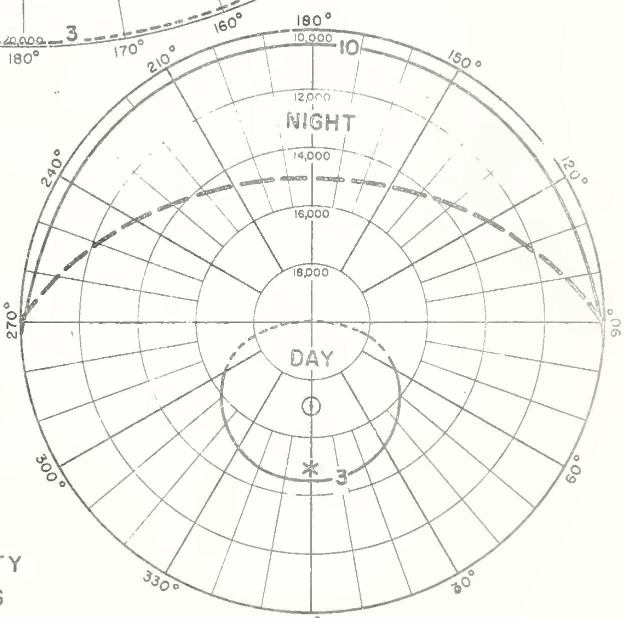



Fig. 78
FIELD INTENSITY, μv/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 15,000 km (135°).
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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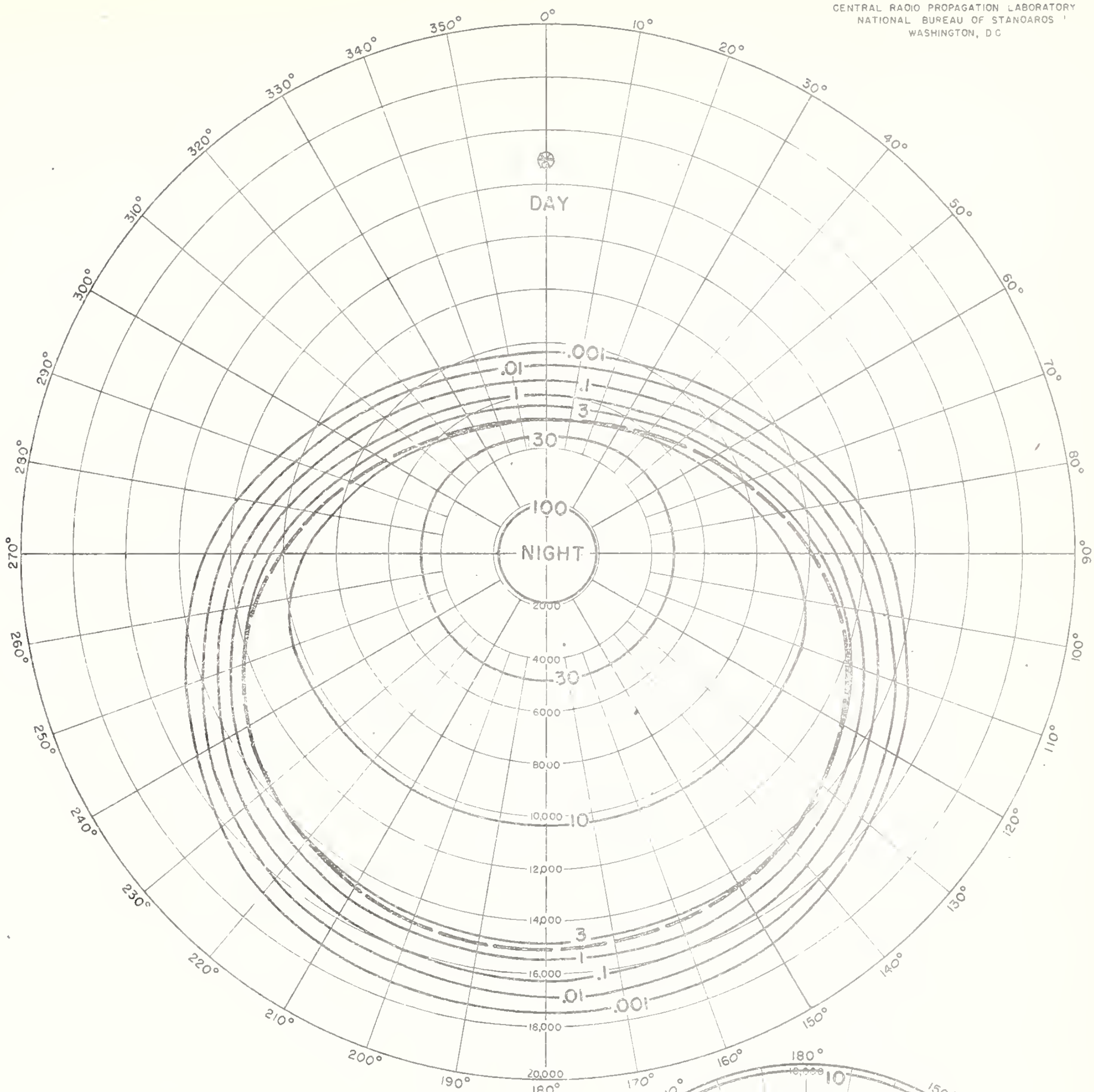
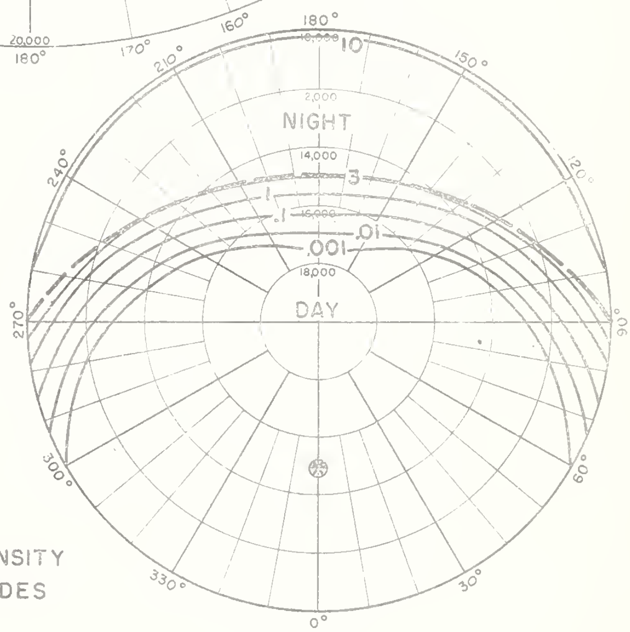



Fig. 79
FIELD INTENSITY, µV/m, 1 KW, 3 Mc.
SUBSOLAR DISTANCE, 15,000 km (135°)
SUNSPOT MAXIMUM

✱ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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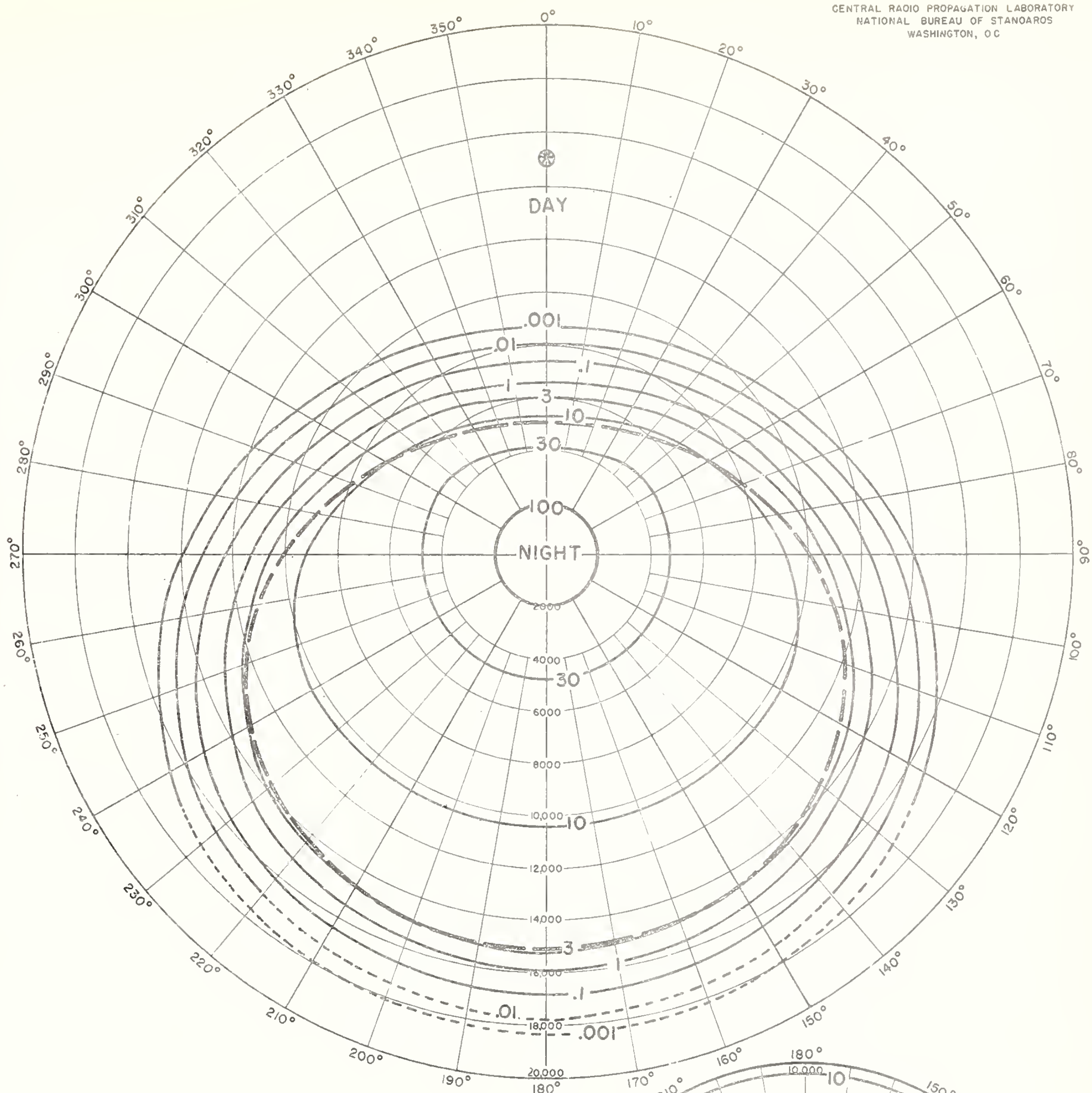
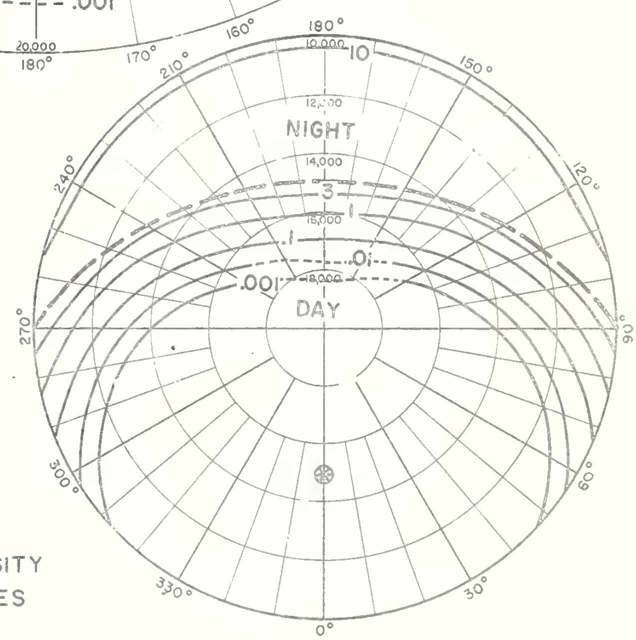



Fig. 80
FIELD INTENSITY, μV/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 15,000 km (135°)
SUNSPOT MAXIMUM

✻ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

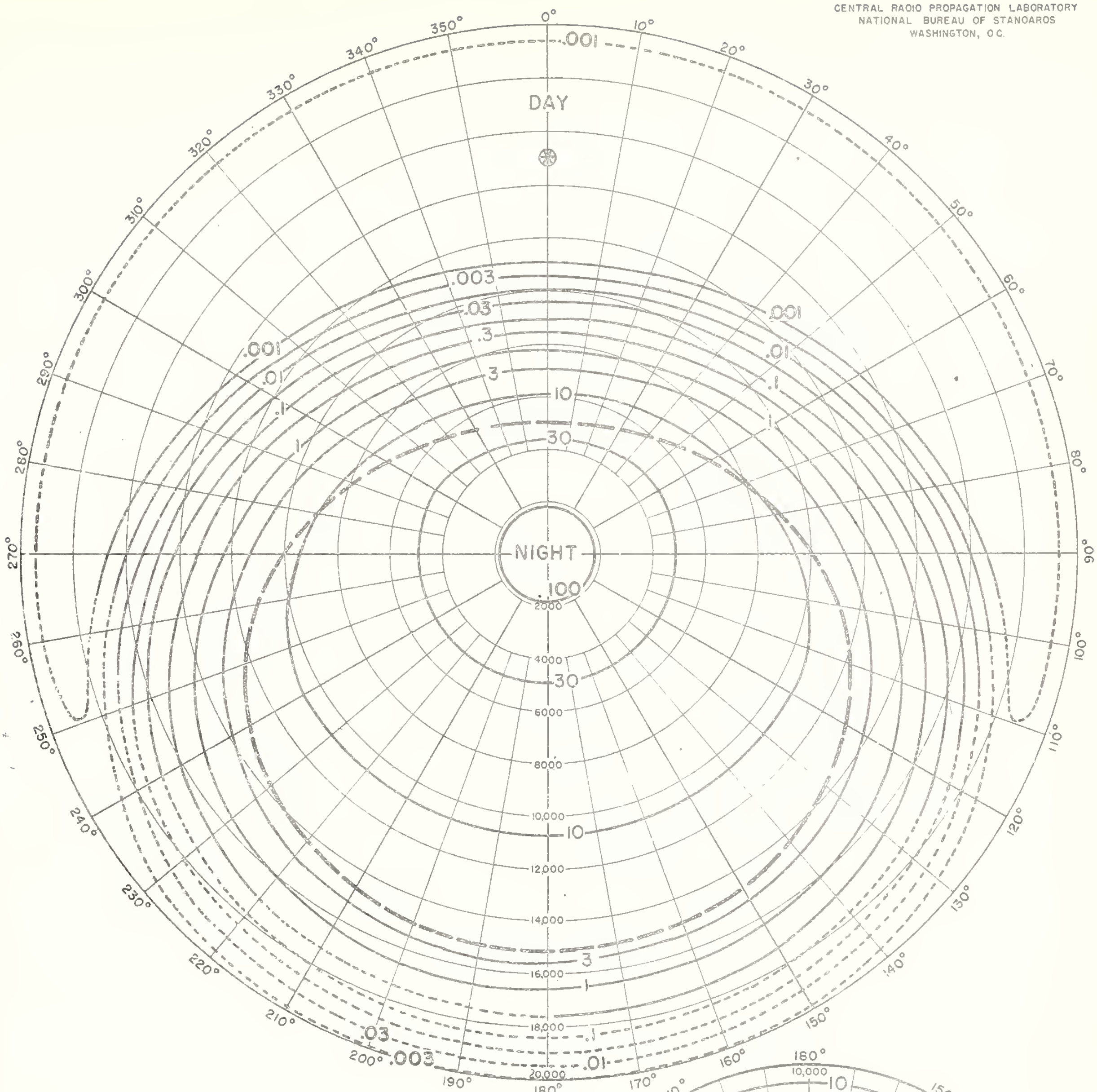
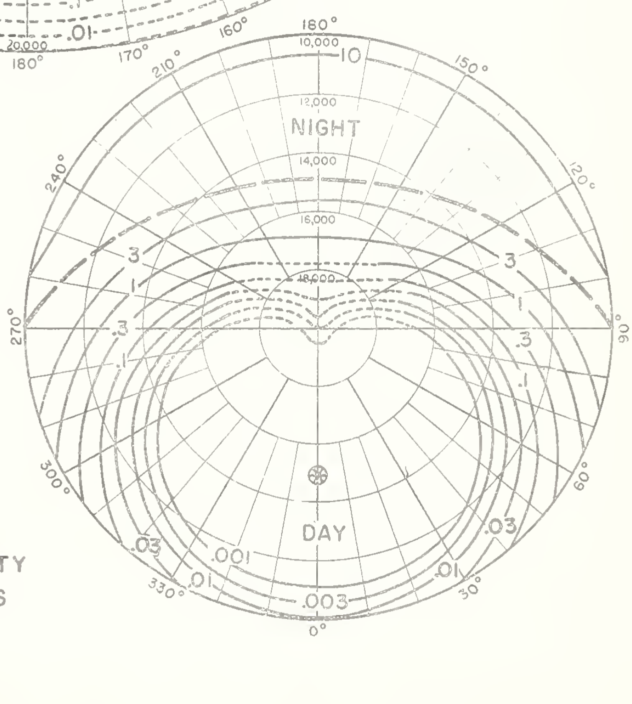



Fig. 81
FIELD INTENSITY, μV/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 15,000 km (135°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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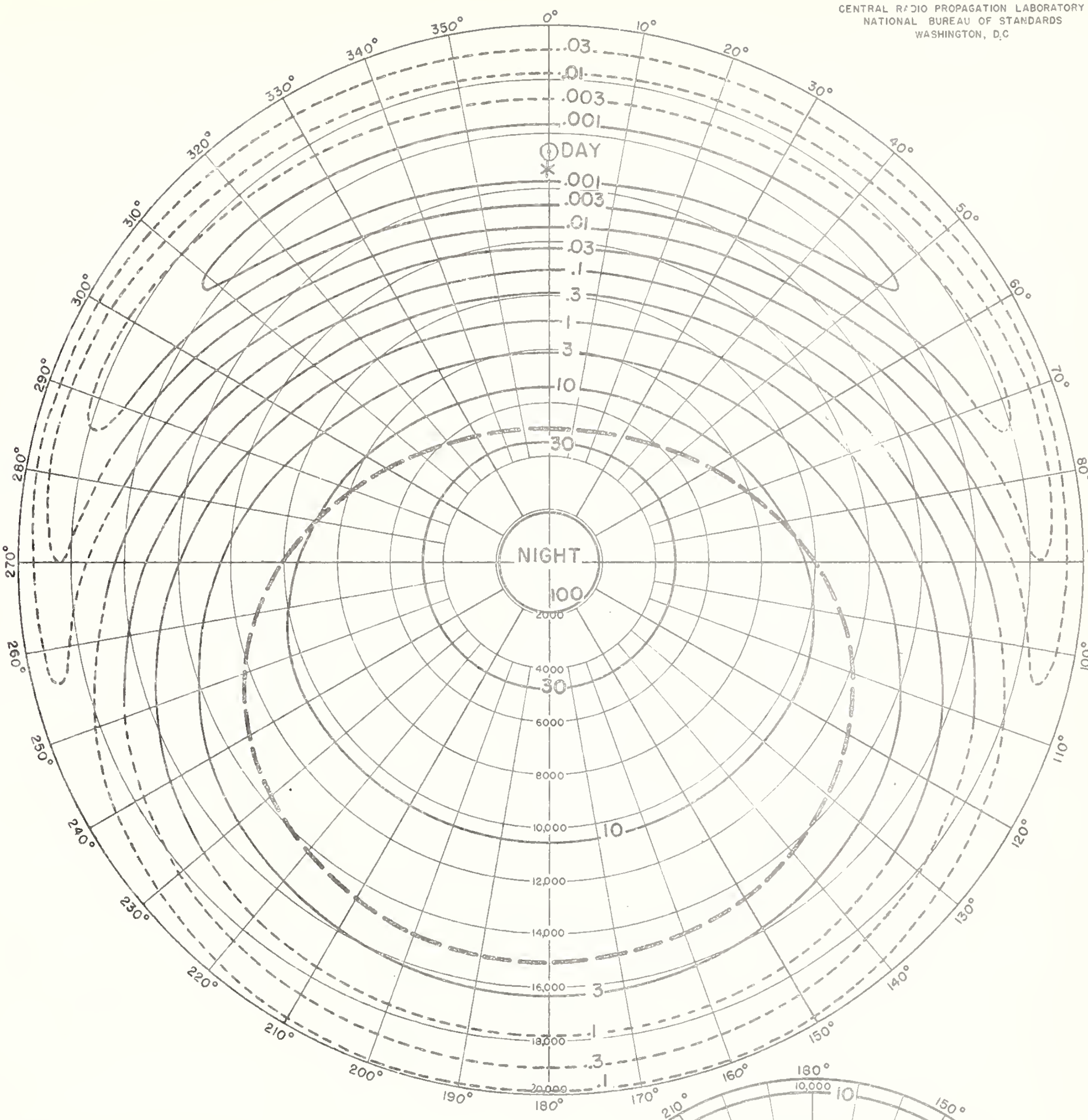
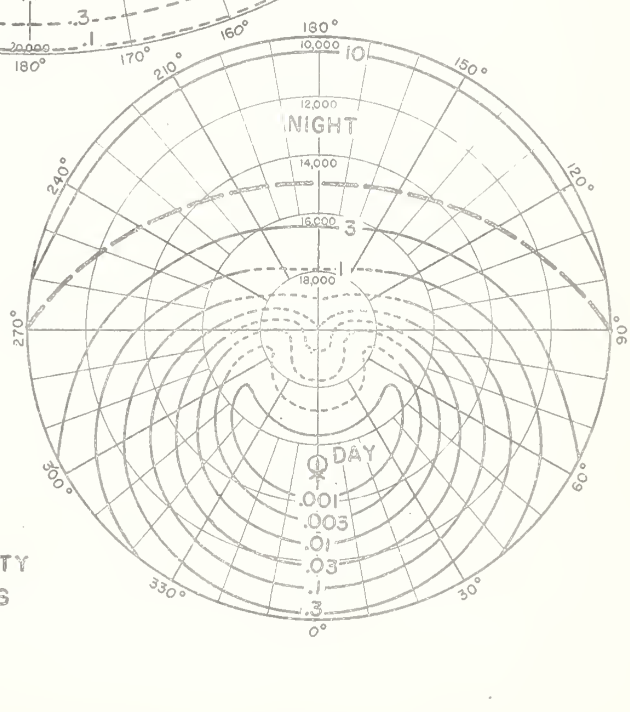



Fig. 82
FIELD INTENSITY, μV/m, I KW, IO Mc
SUBSOLAR DISTANCE, 15,000 km (135°)
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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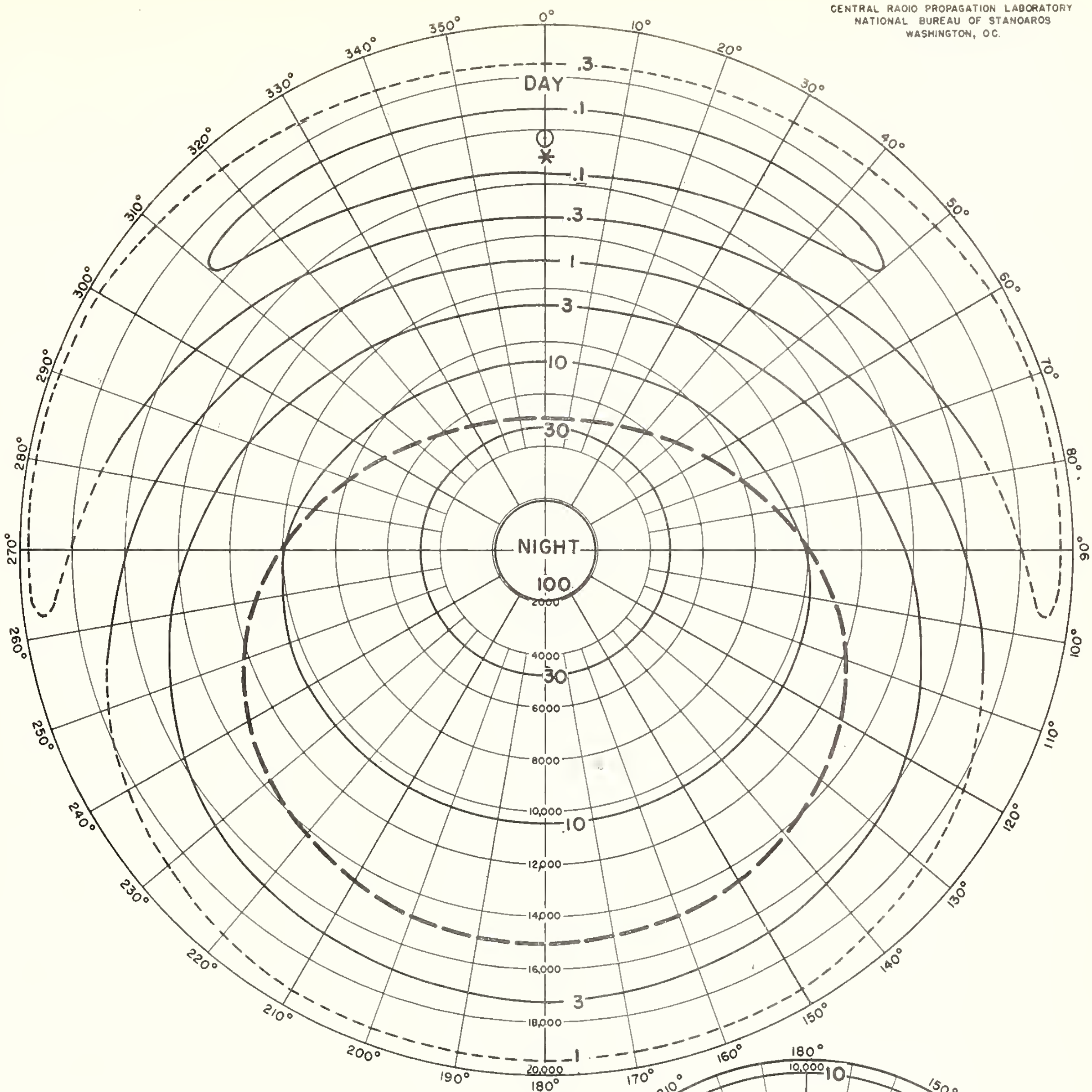
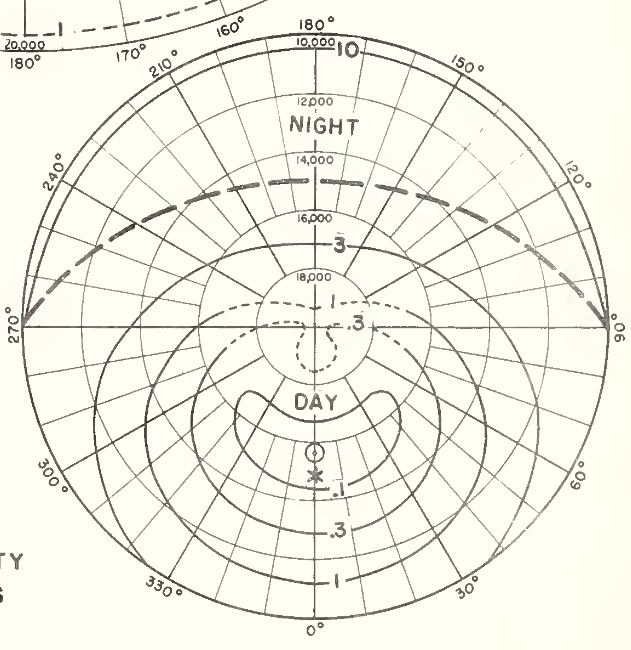



Fig. 83
FIELD INTENSITY, μv/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE, 15,000 km (135°)
SUNSPOT MAXIMUM

✱ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY

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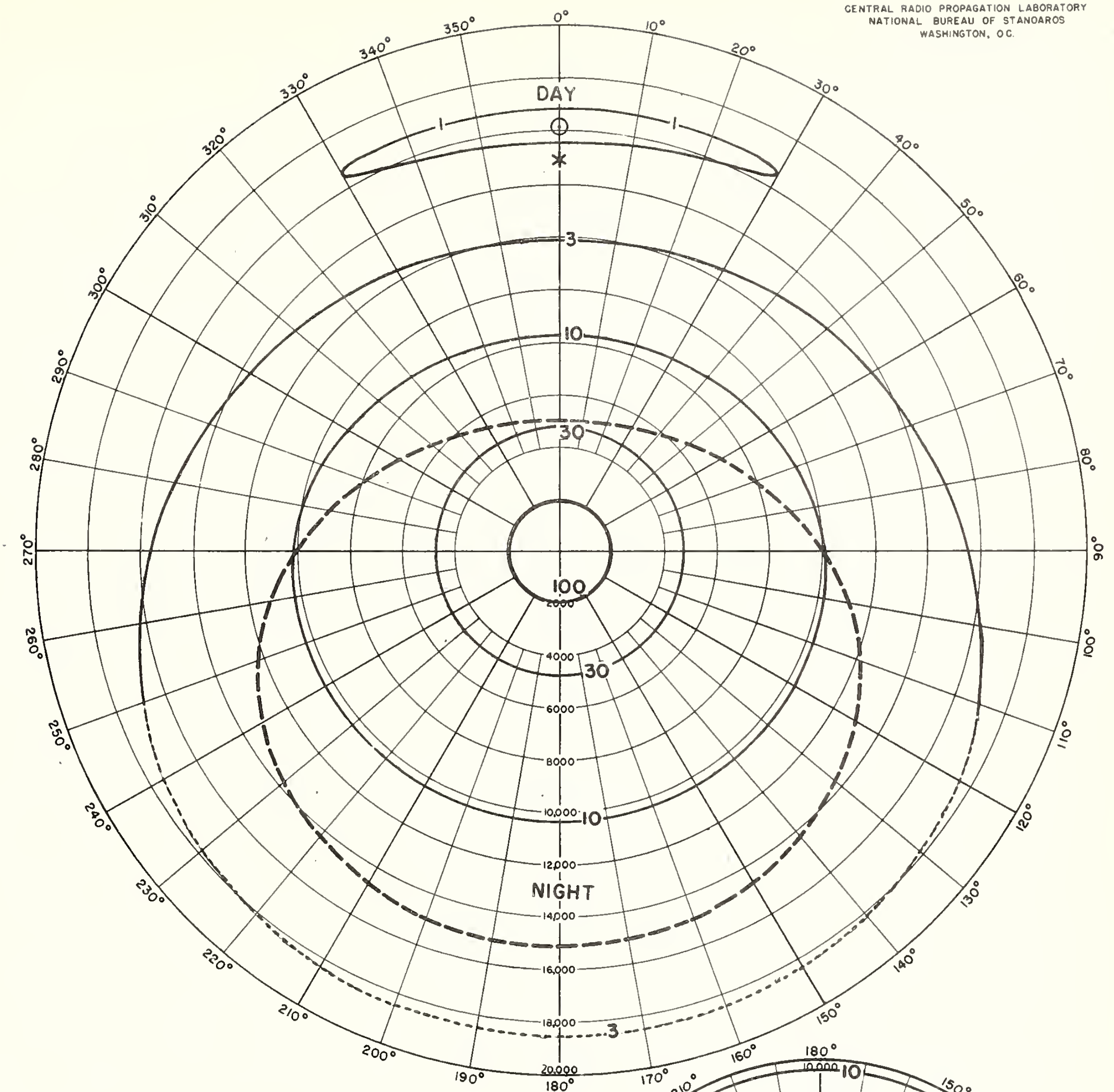
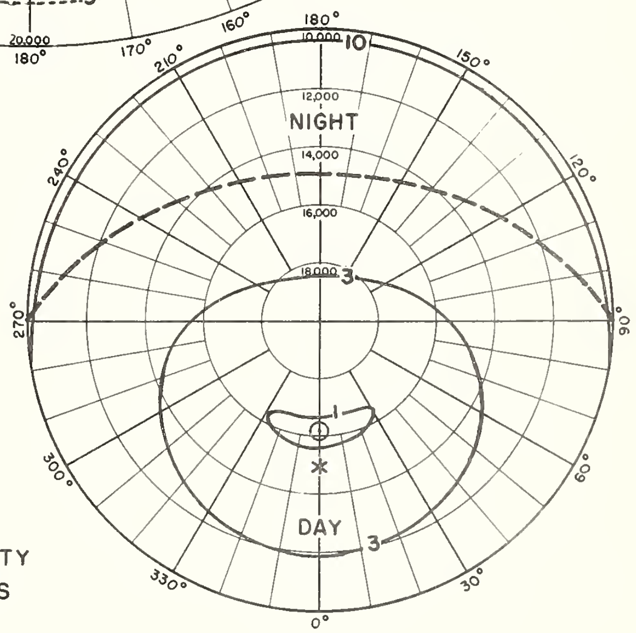



Fig. 84
FIELD INTENSITY, μv/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 15,000 km (135°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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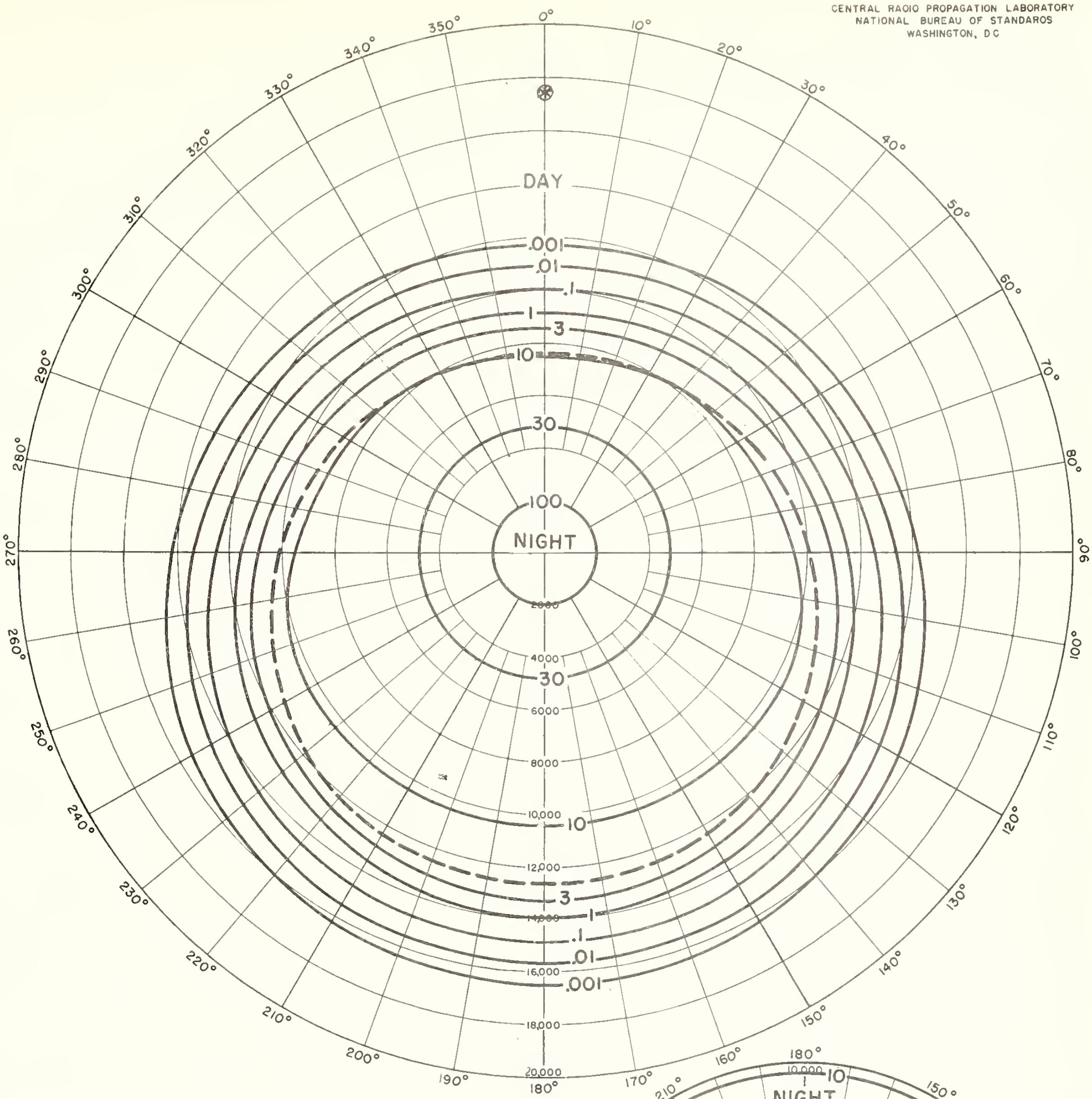
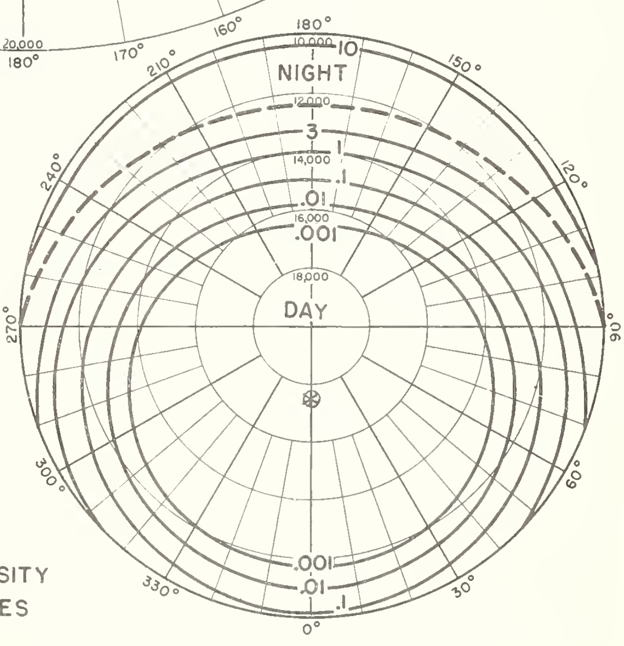



Fig. 85
FIELD INTENSITY, μv/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 17,500km(157° 30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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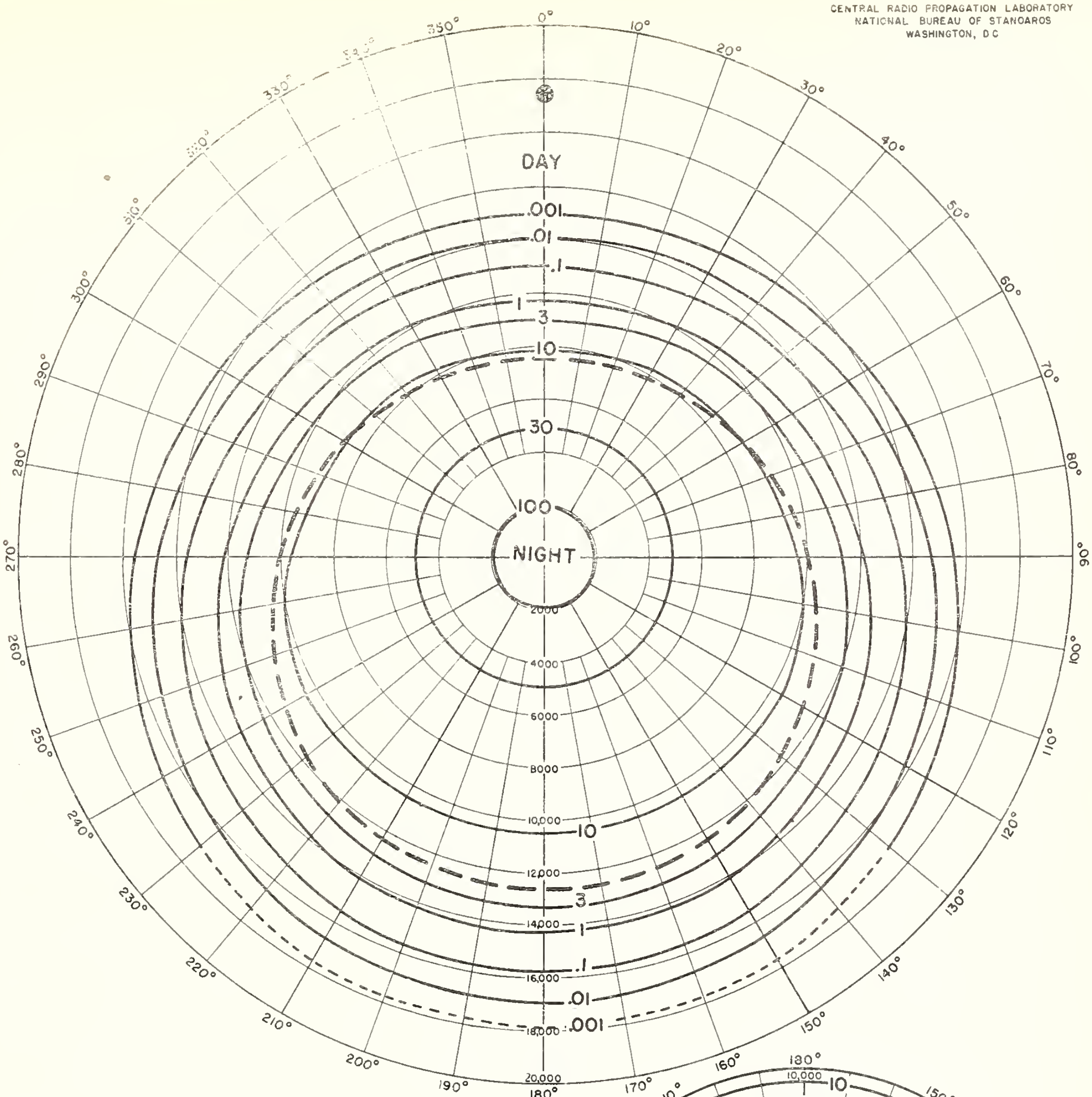
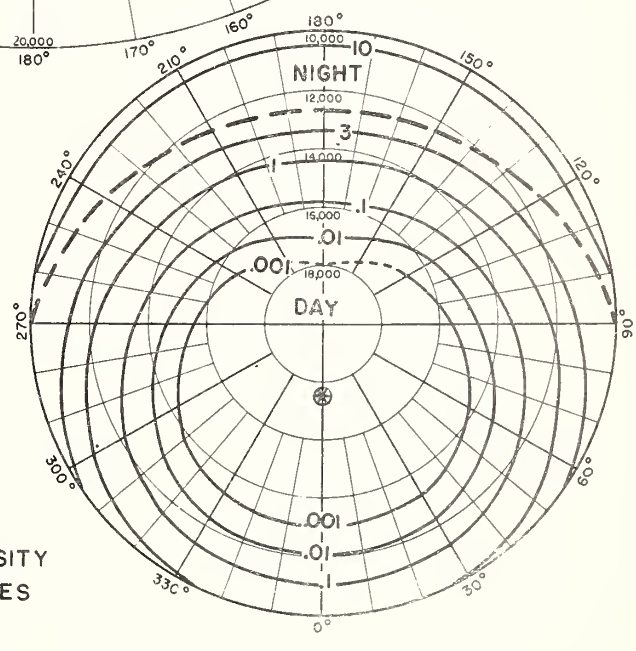



Fig. 86
FIELD INTENSITY, μv/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 17,500 km (157°30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

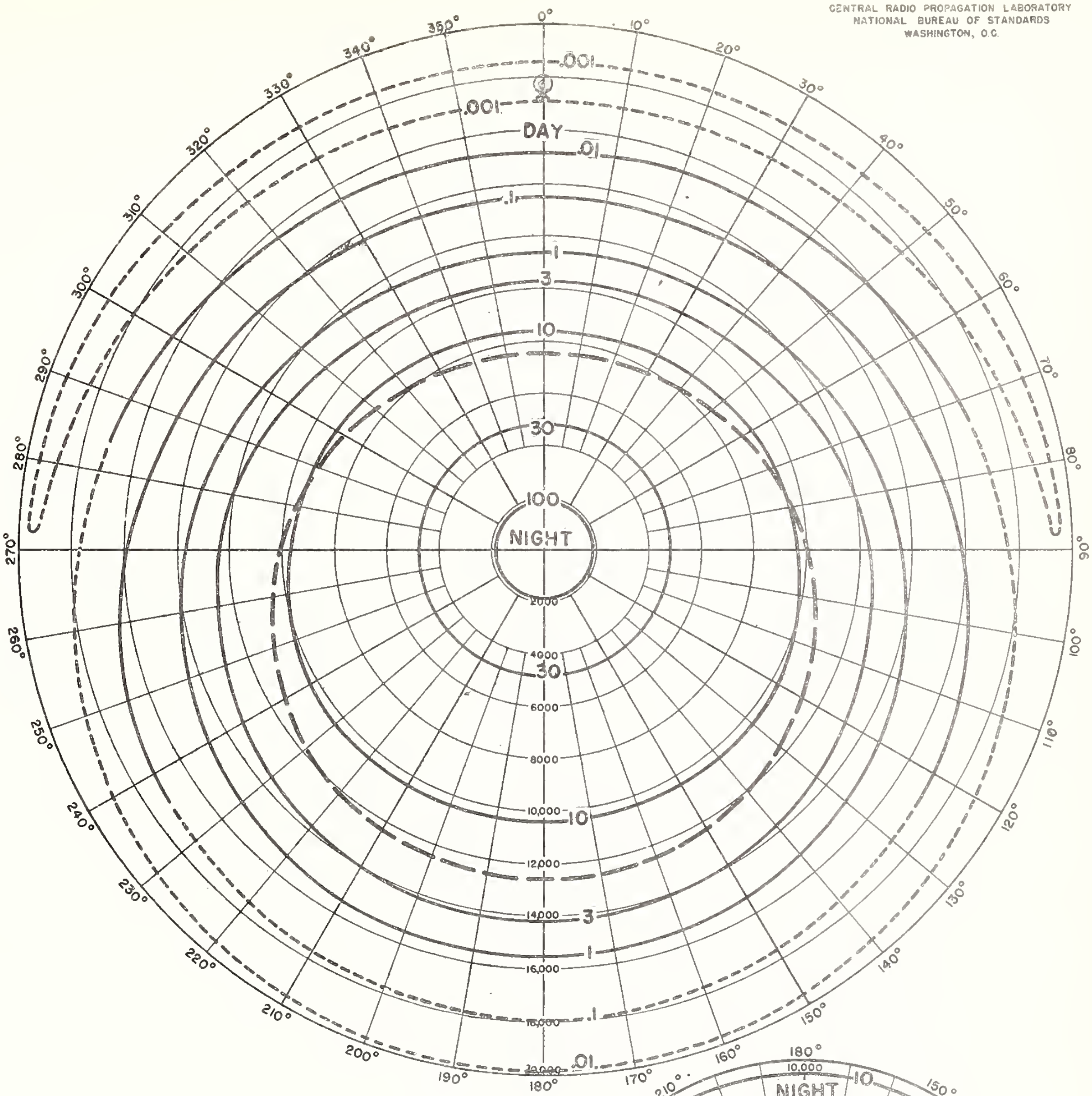
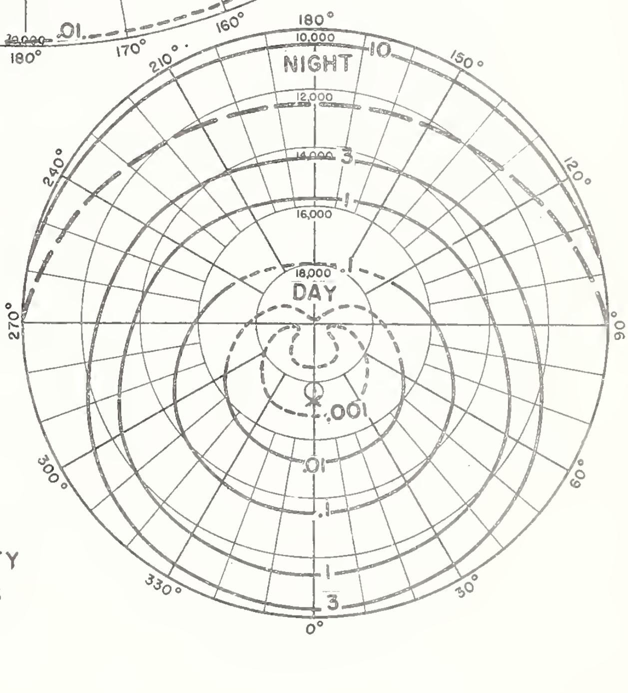



Fig. 87
FIELD INTENSITY, μV/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 17,500 km (157°30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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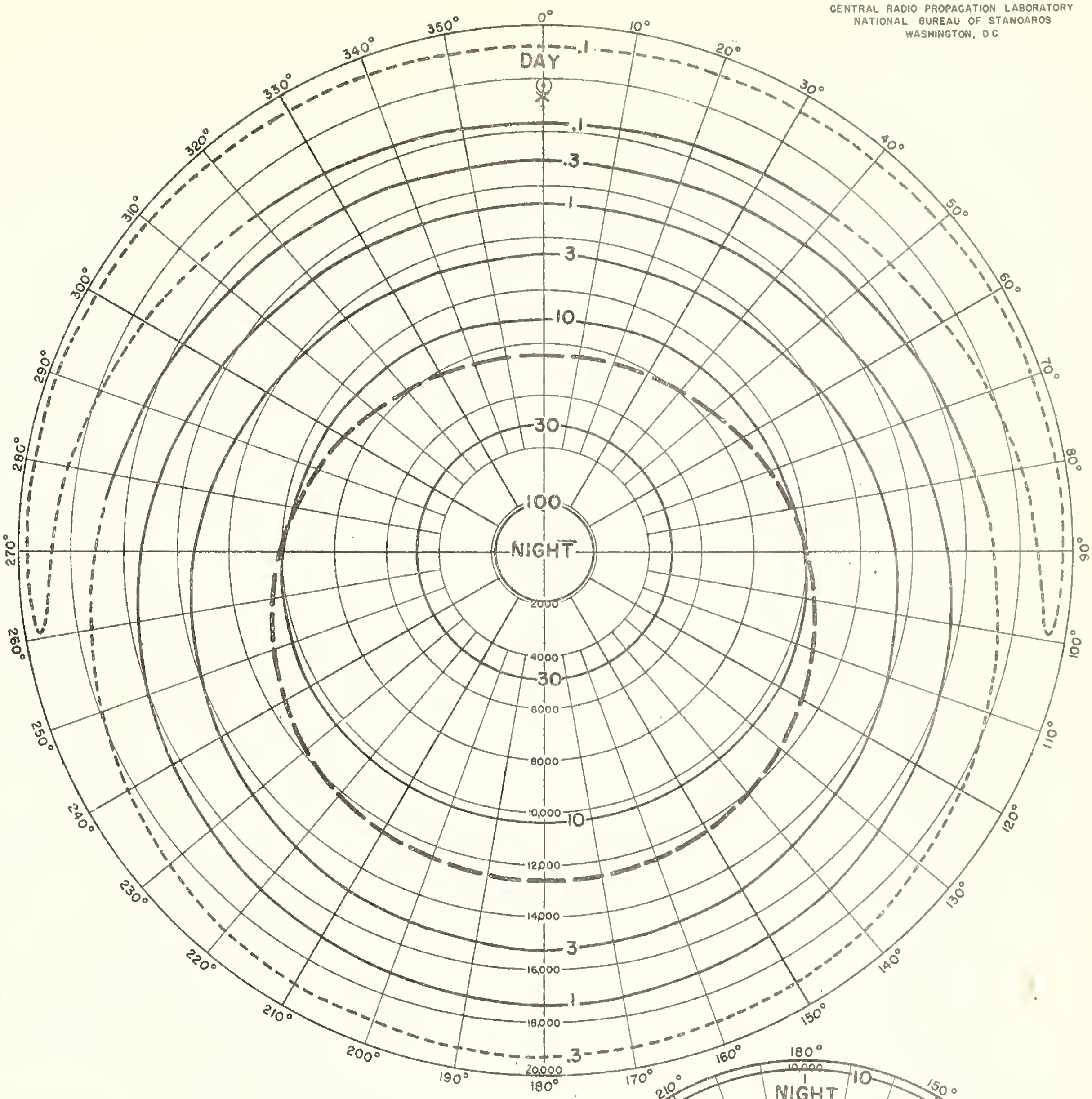
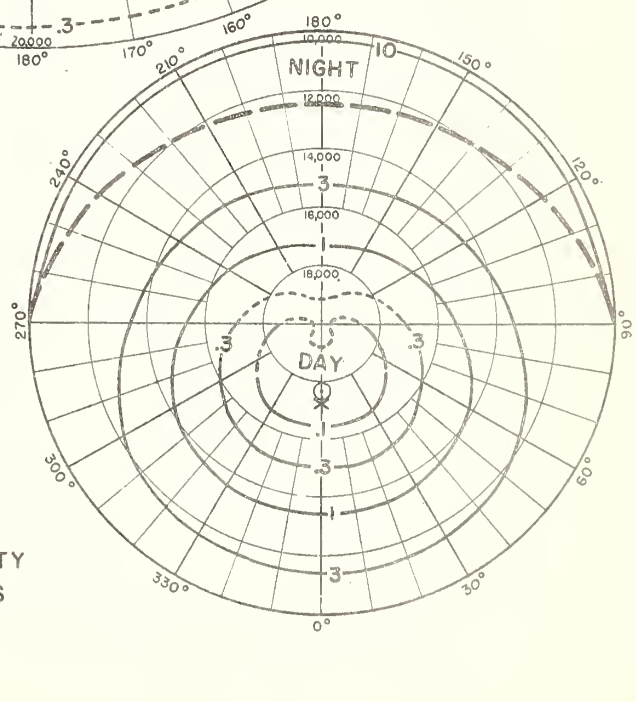



Fig. 88
FIELD INTENSITY, µv/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE, 17,500 km (157° 30')
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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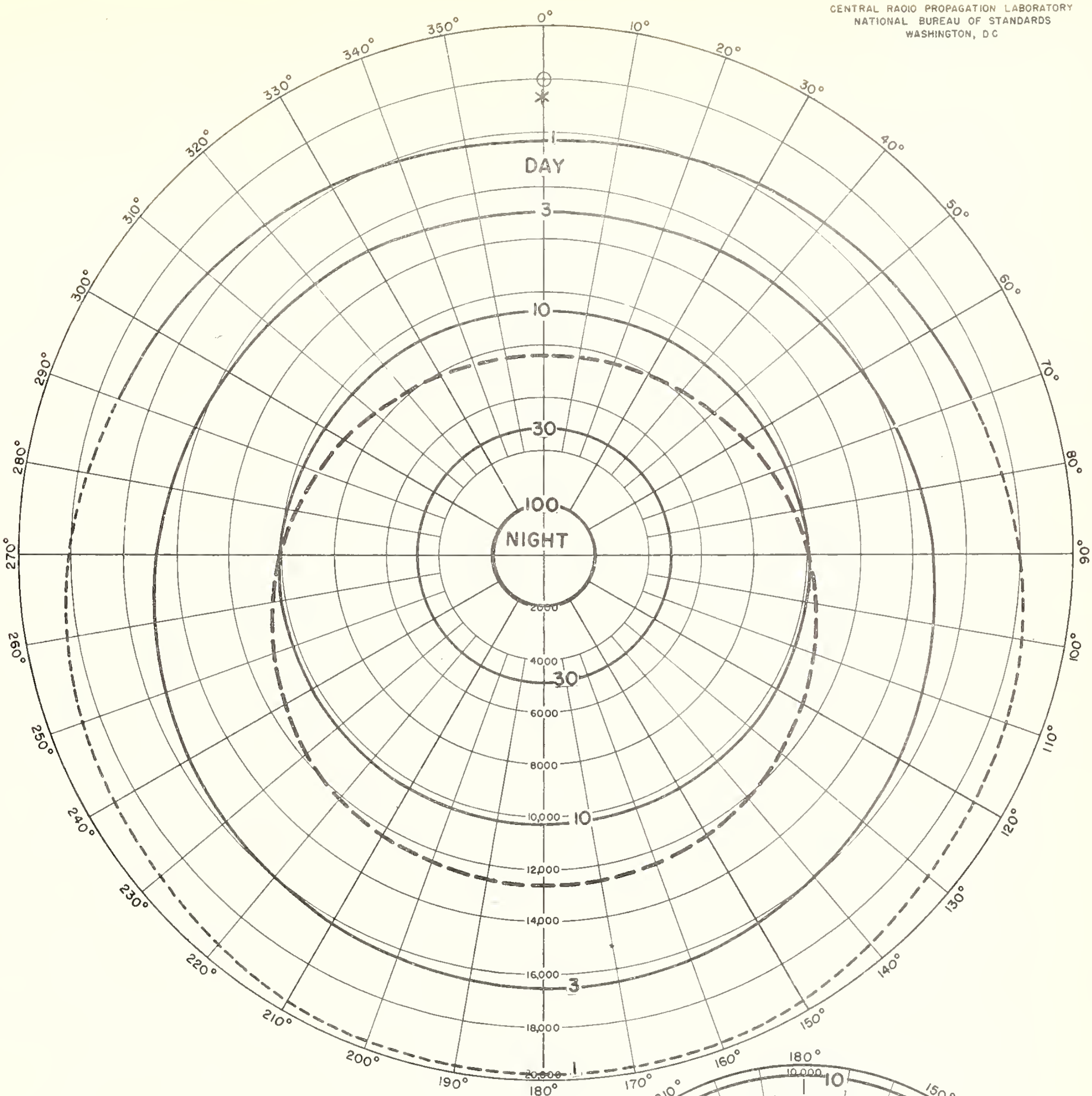
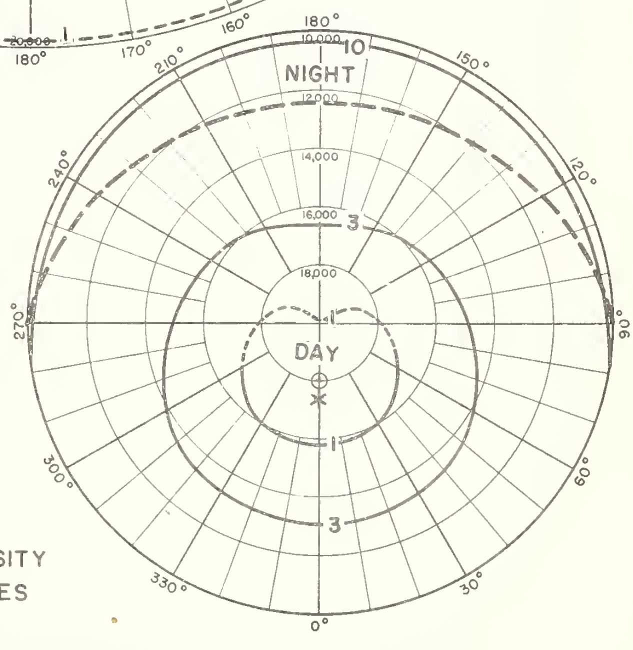



Fig. 89
FIELD INTENSITY, µv/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE, 17, 500km (157° 30')
SUNSPOT MINIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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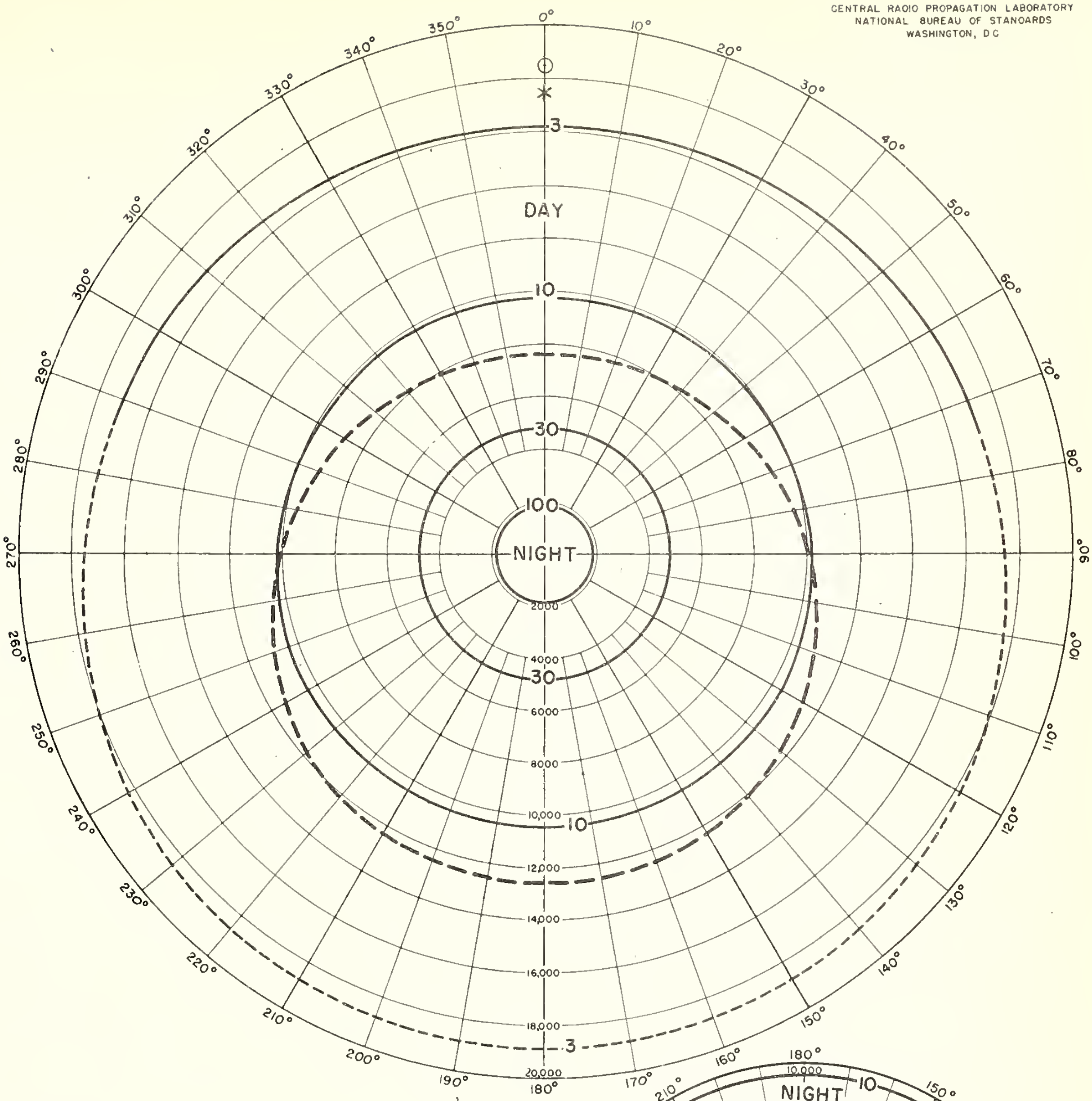
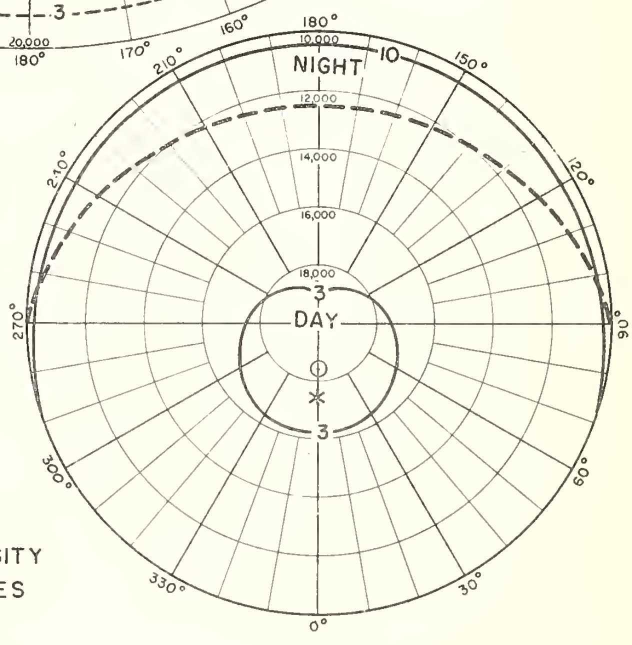



Fig. 90
FIELD INTENSITY, μv/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 17,500 km (157° 30')
SUNSPOT MINIMUM

✱ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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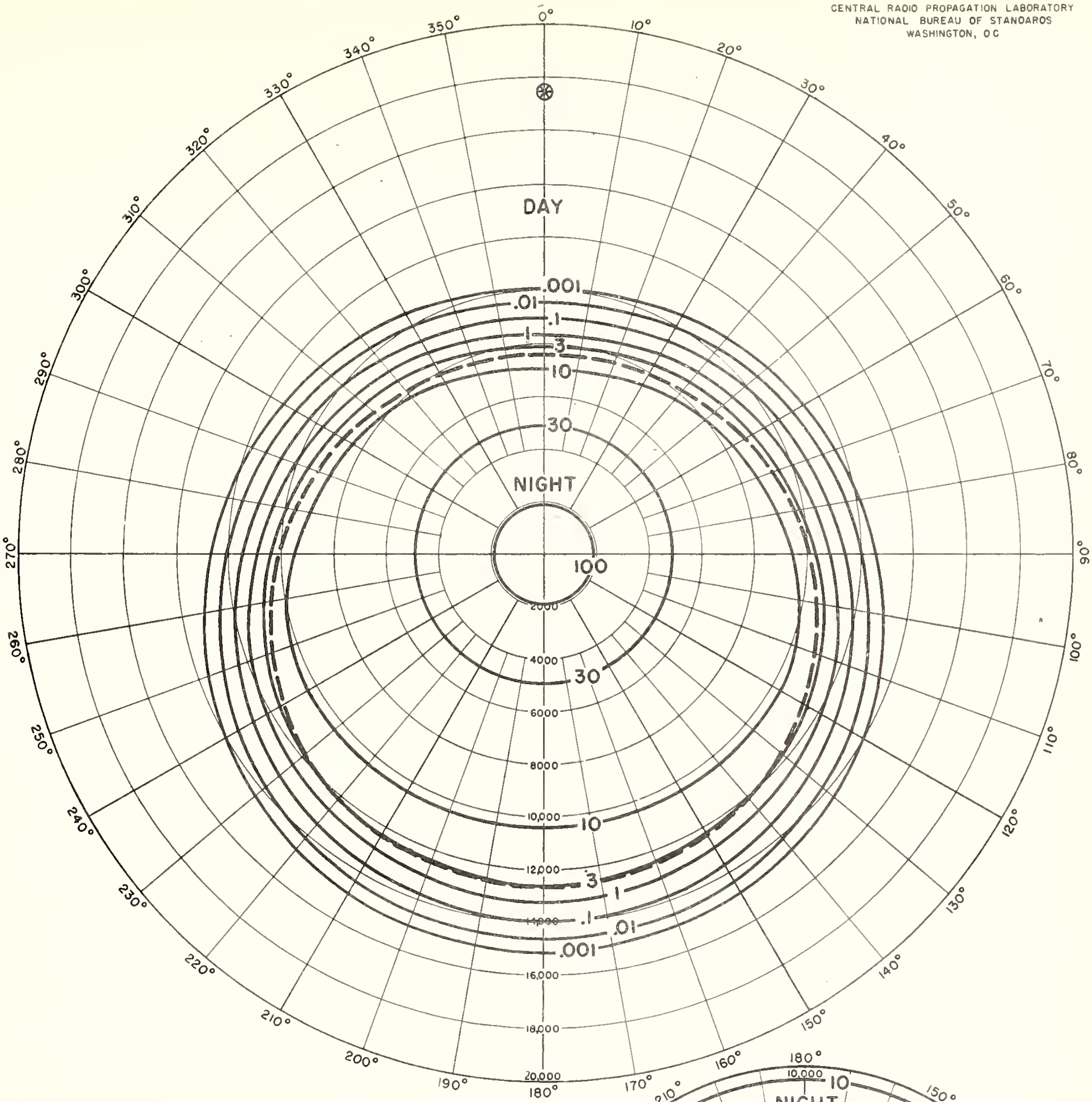
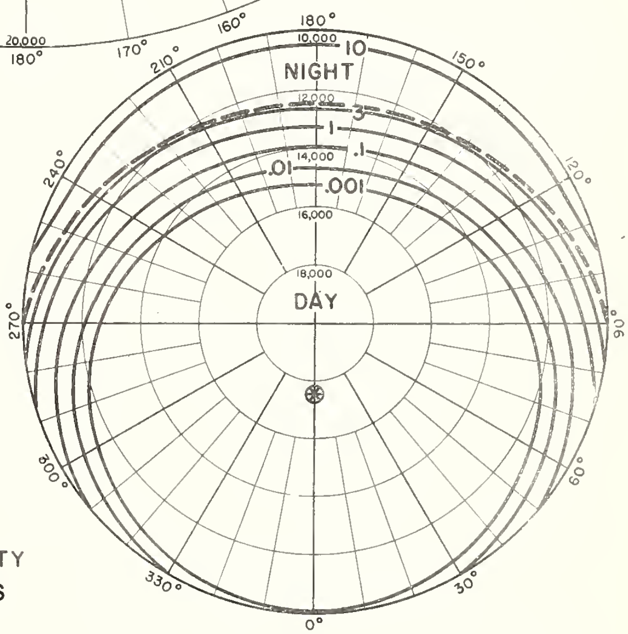



Fig. 91
FIELD INTENSITY, μV/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 17,500 km (157° 30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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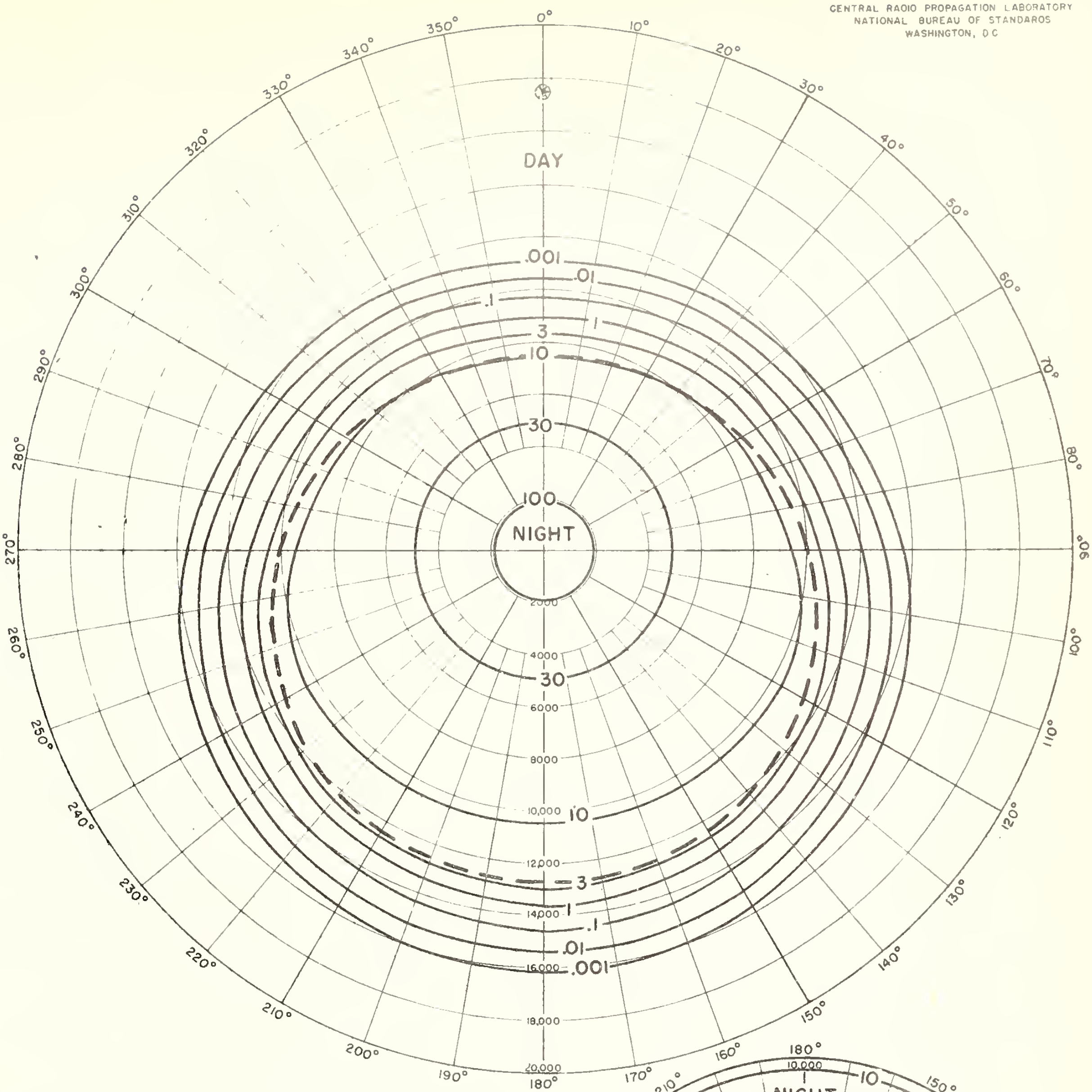
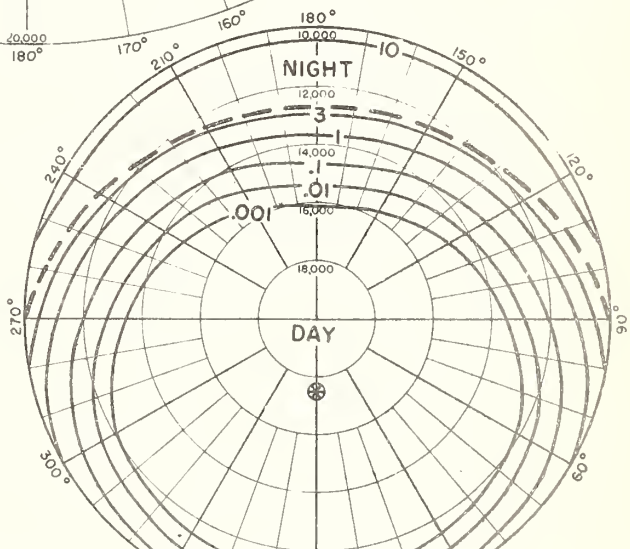



Fig. 92
FIELD INTENSITY, μv/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 17,500 km (157°30')
SUNSPOT MAXIMUM

✱ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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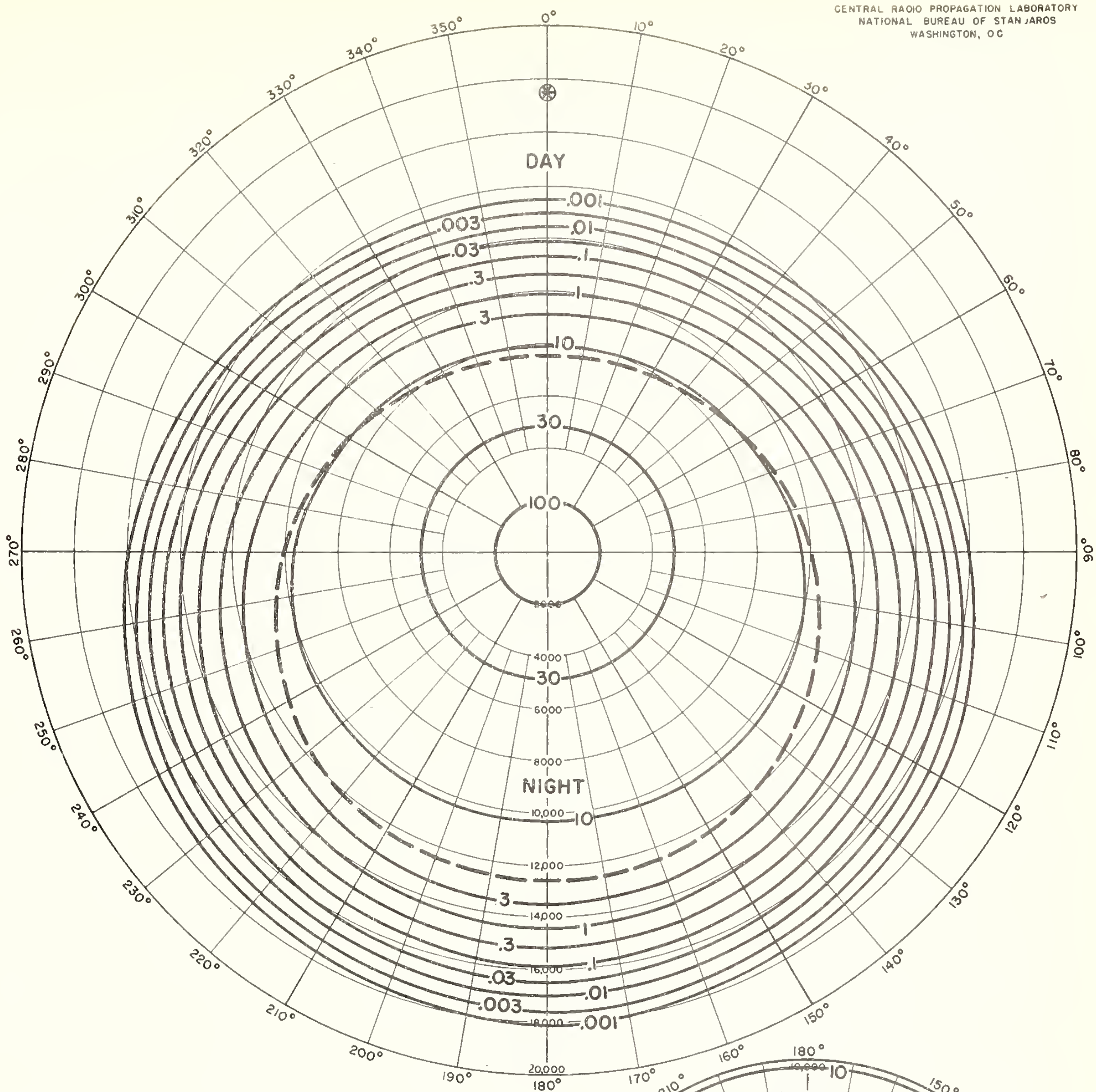
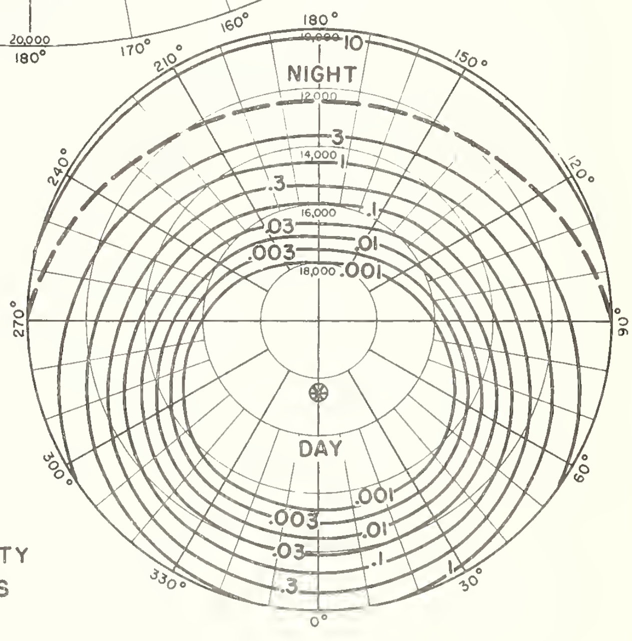



Fig. 93
FIELD INTENSITY, μV/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 17 500 km (157° 30')
SUNSPOT MAXIMUM

✱ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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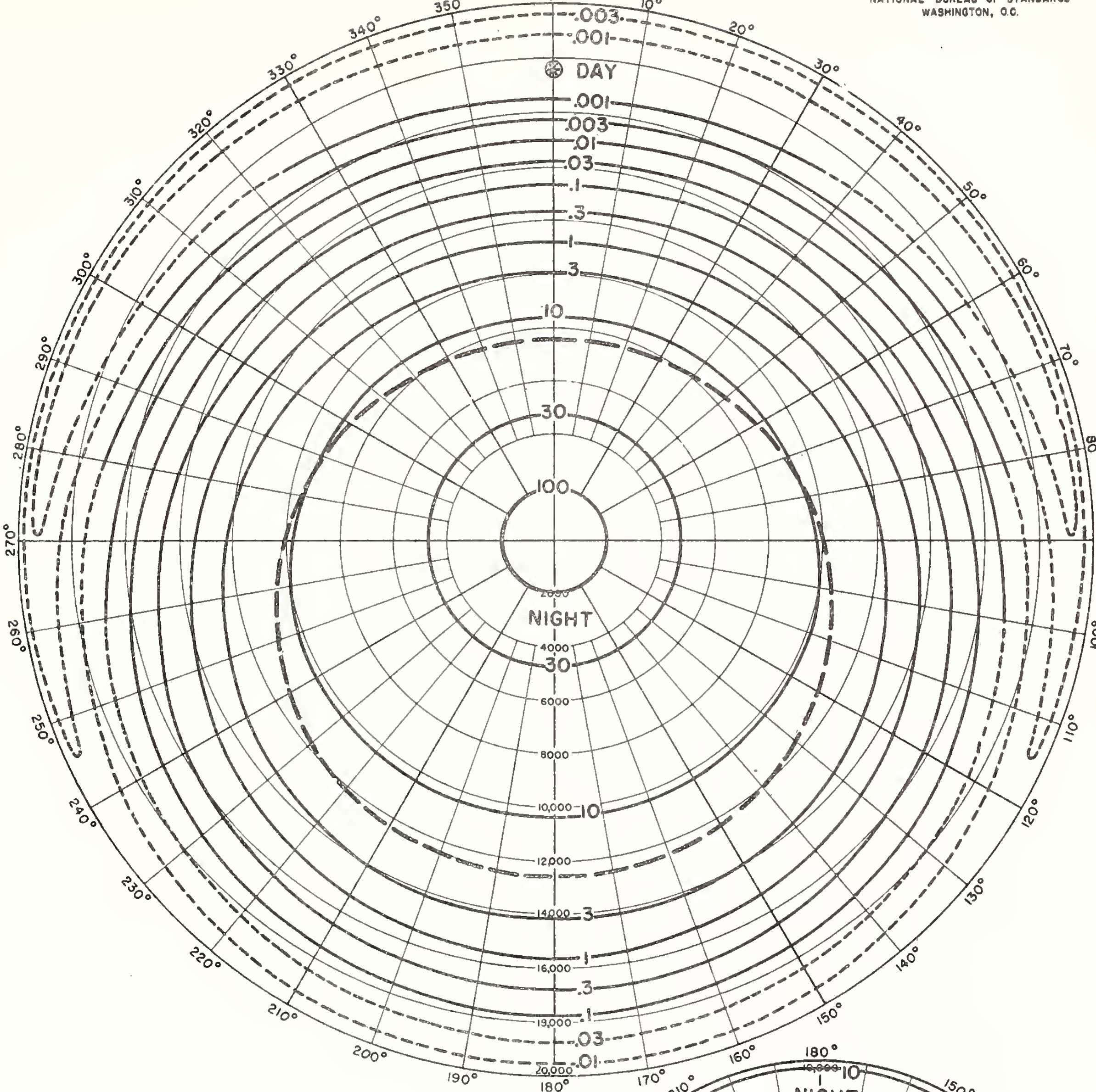
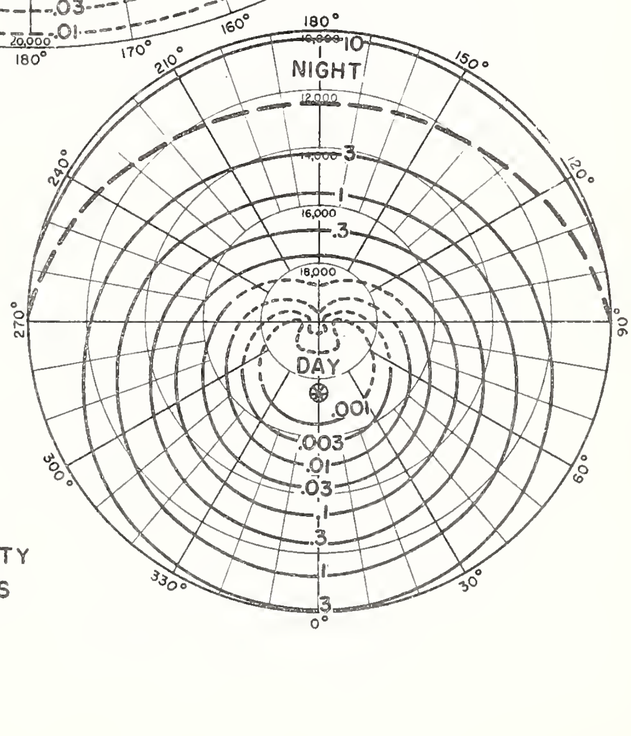



Fig. 94
FIELD INTENSITY, μV/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE, 17,500 km (157°30')
SUNSPOT MAXIMUM

✻ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

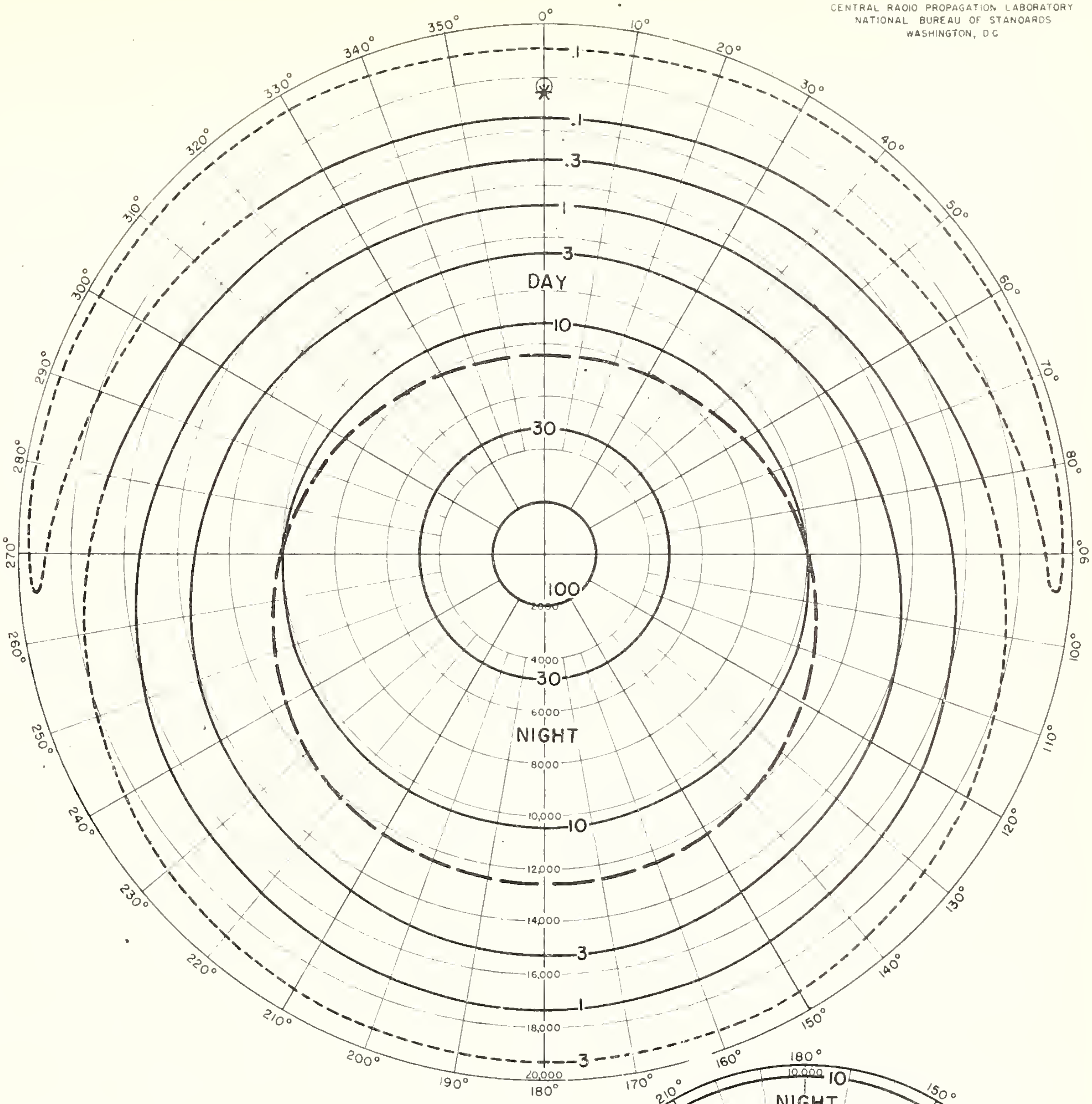
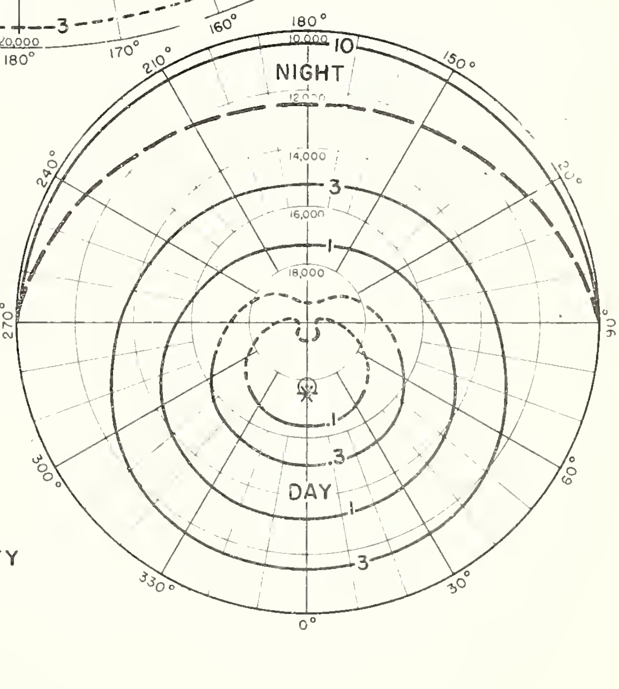



Fig. 95
FIELD INTENSITY, μv/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE, 17,500 km (157° 30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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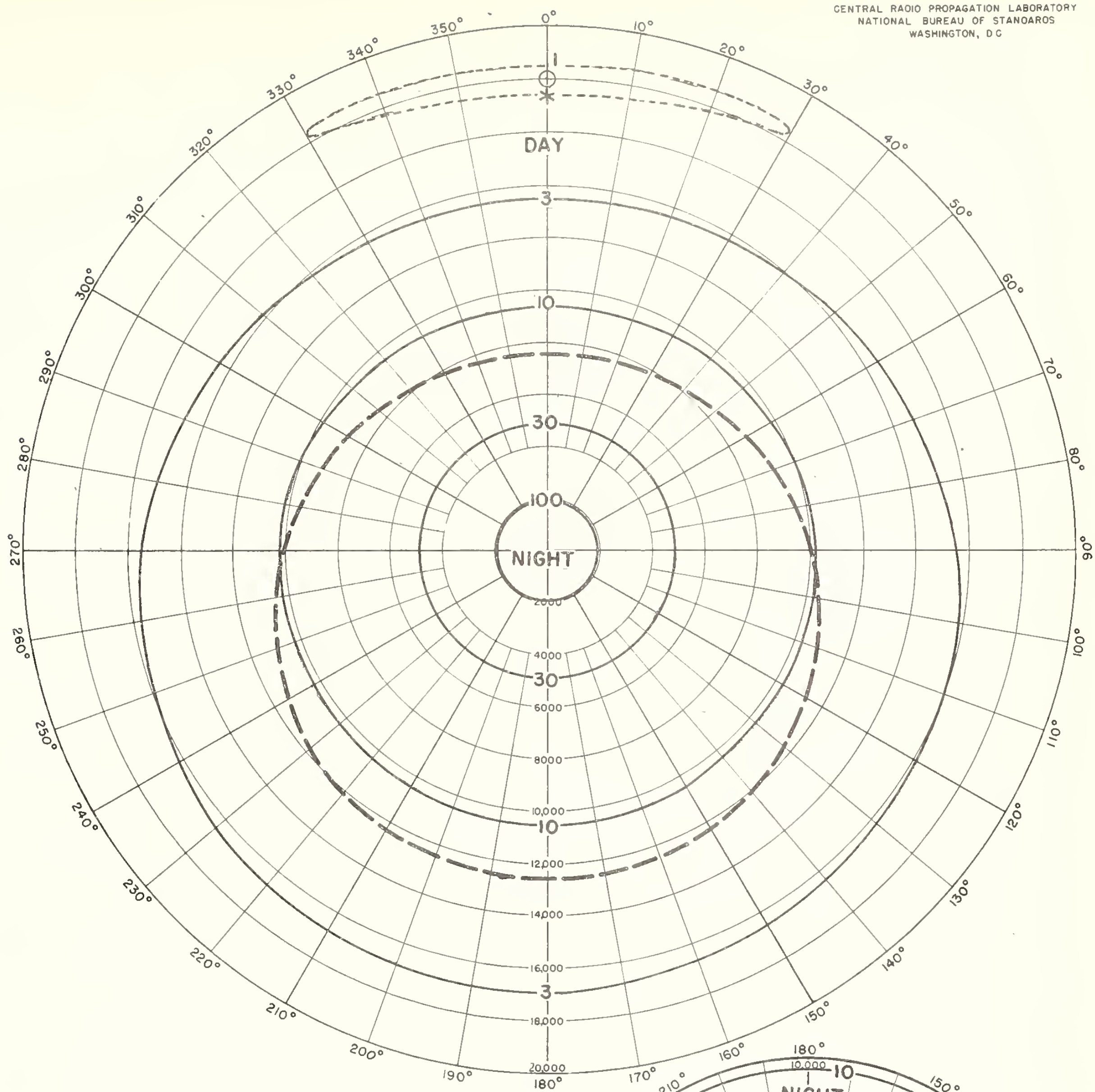
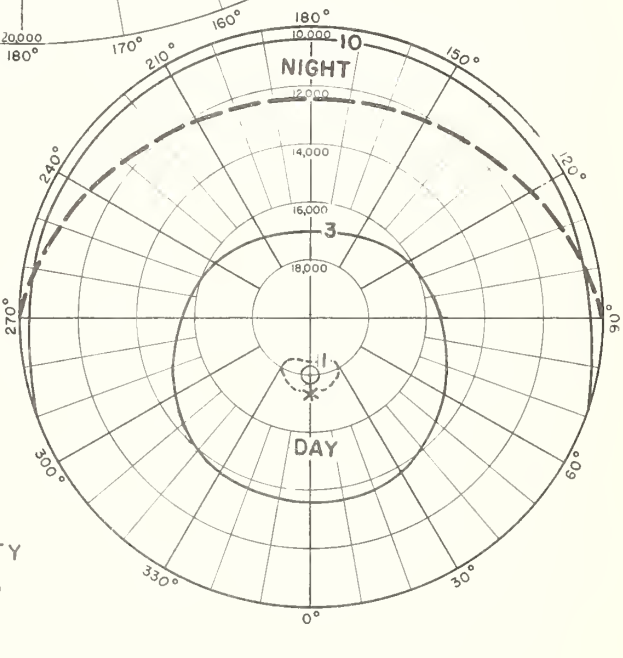



Fig. 96
FIELD INTENSITY, μv/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 17,500 km (157°30')
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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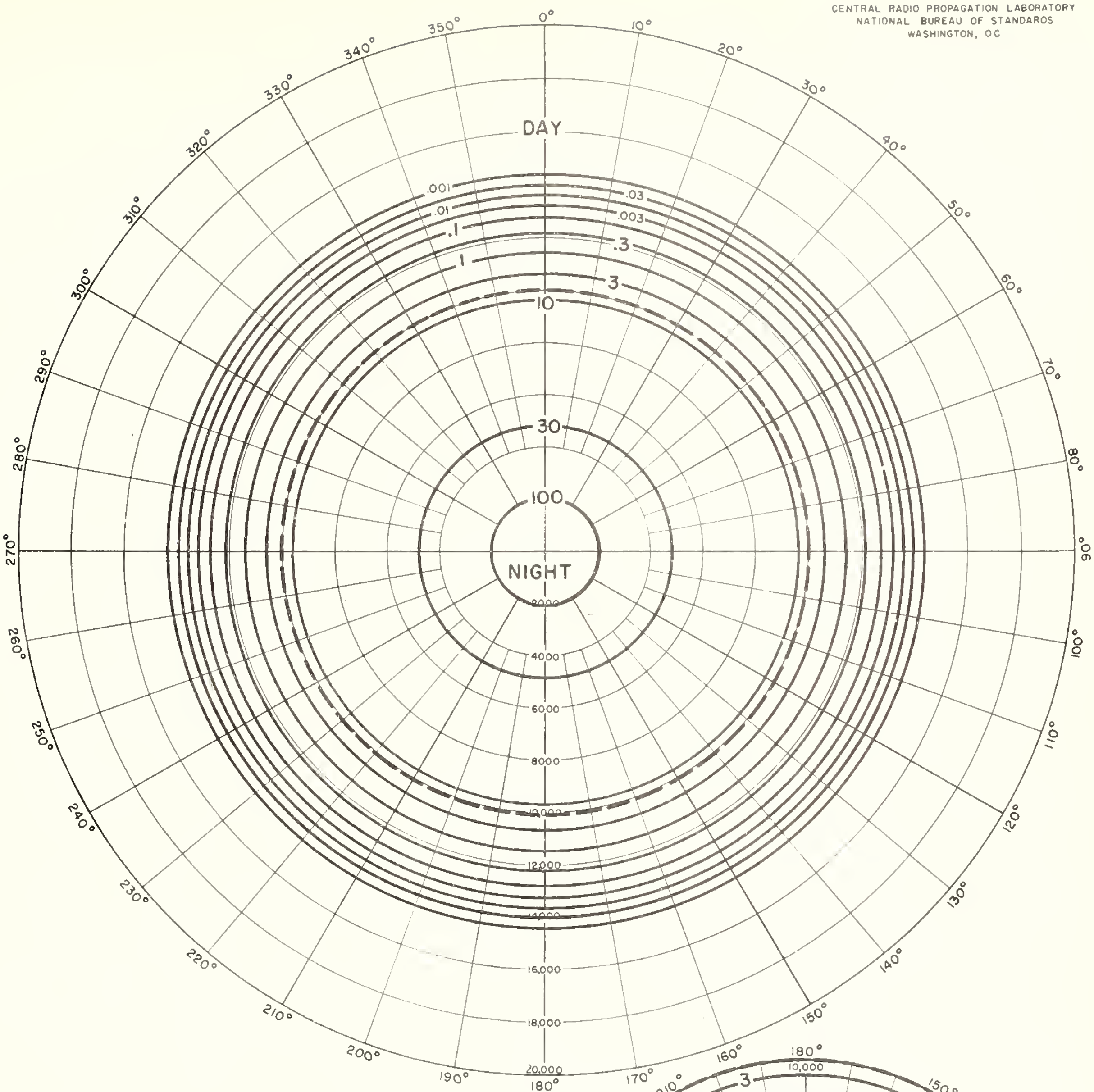
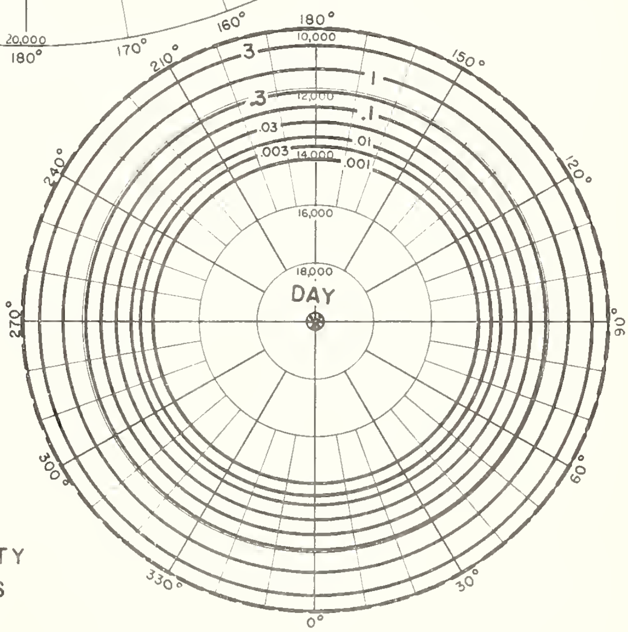



Fig. 97
FIELD INTENSITY, $\mu v/m$, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 20 000 km (180°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

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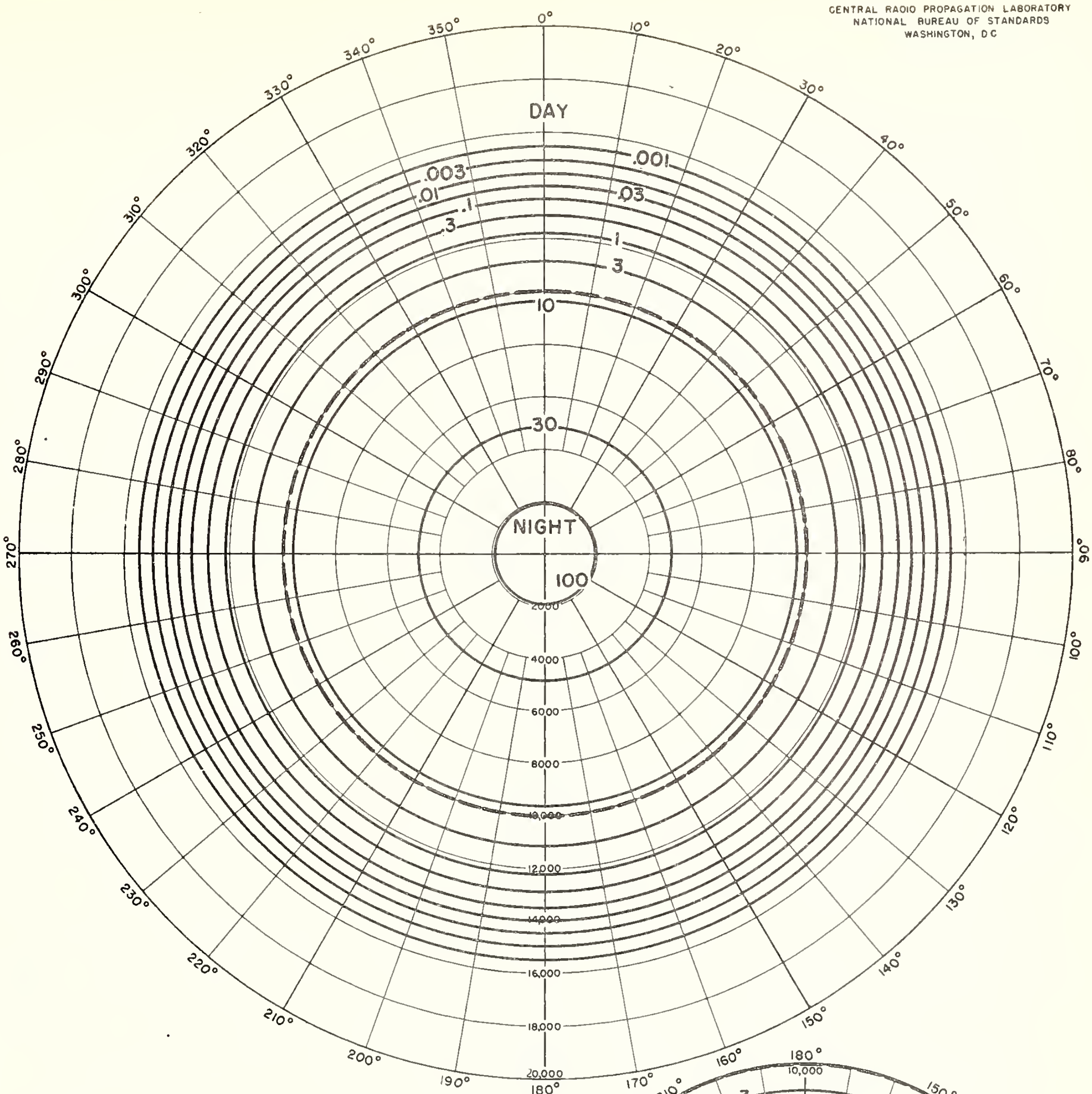
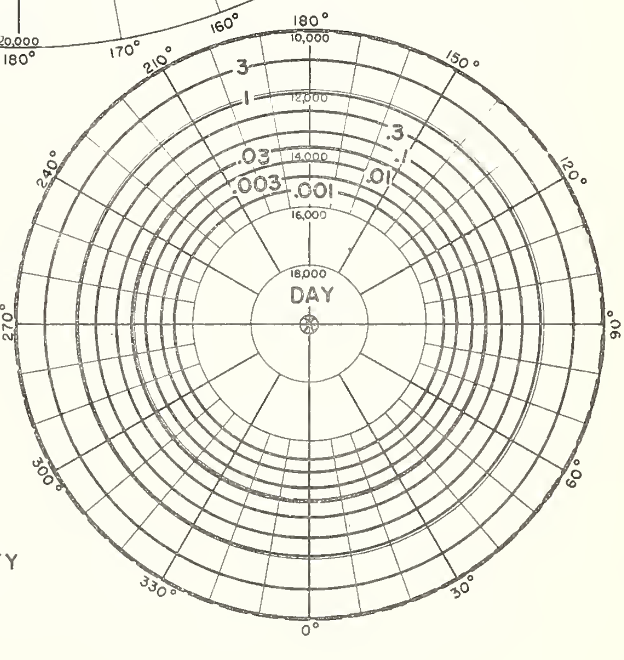



Fig. 98
FIELD INTENSITY, μV/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 20,000 km (180°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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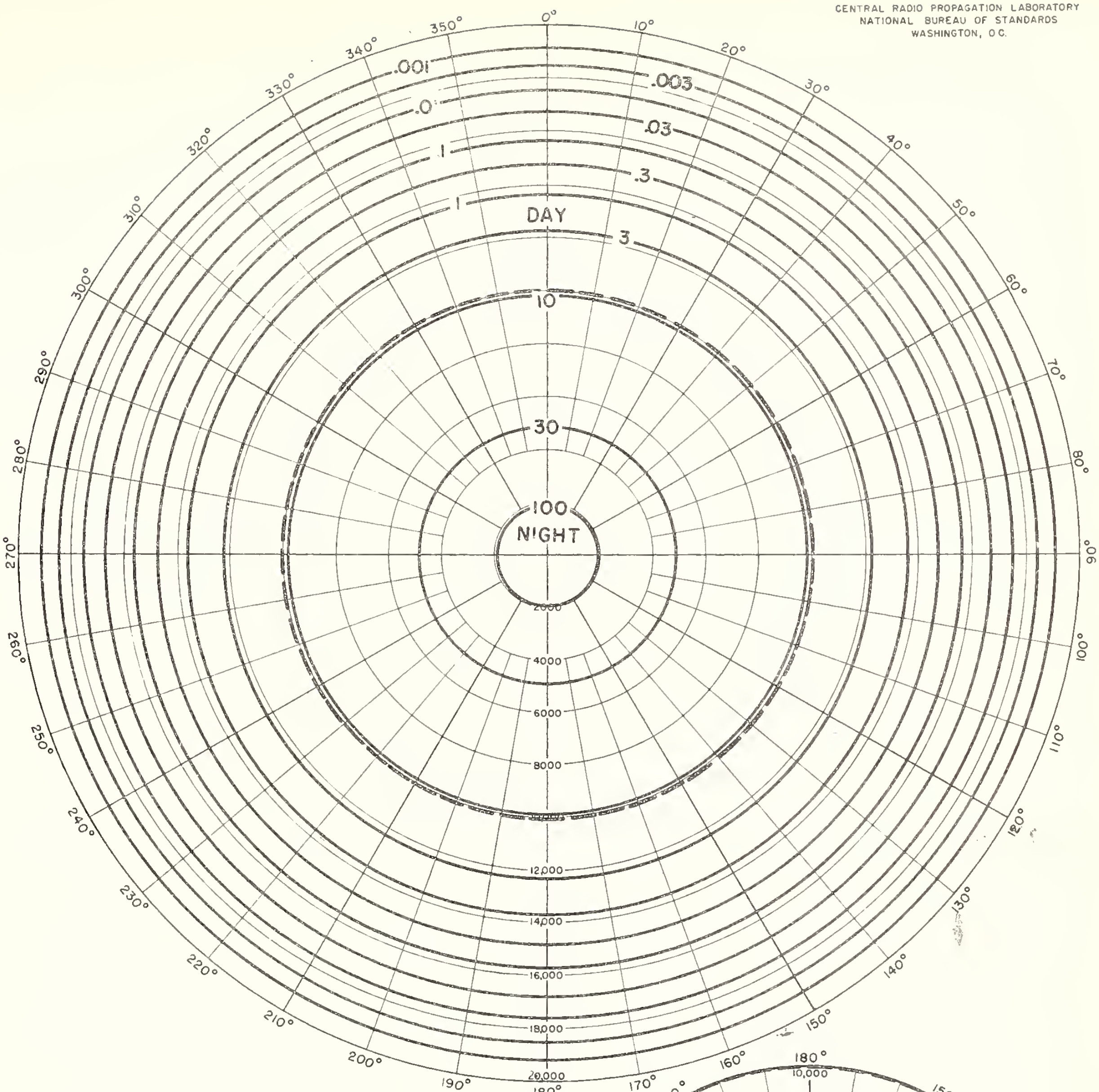
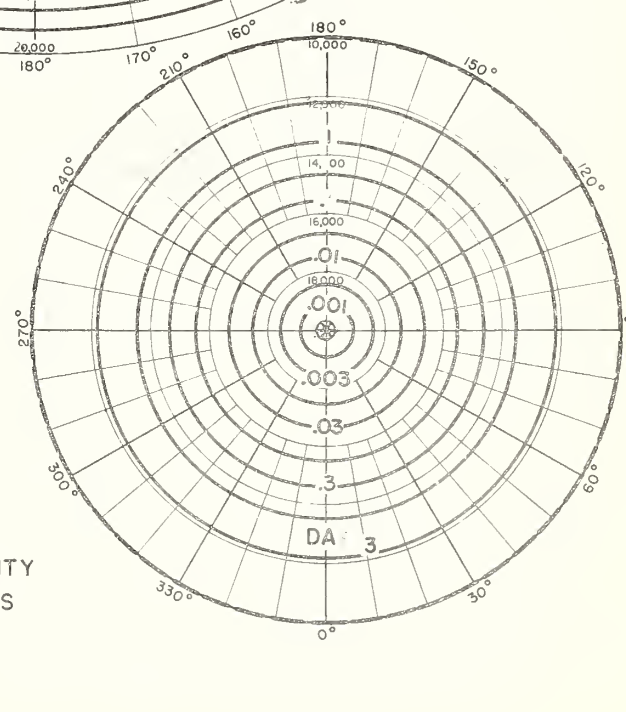



Fig. 99
FIELD INTENSITY, μv/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 20,000 km (180°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY



FIELD INTENSITY
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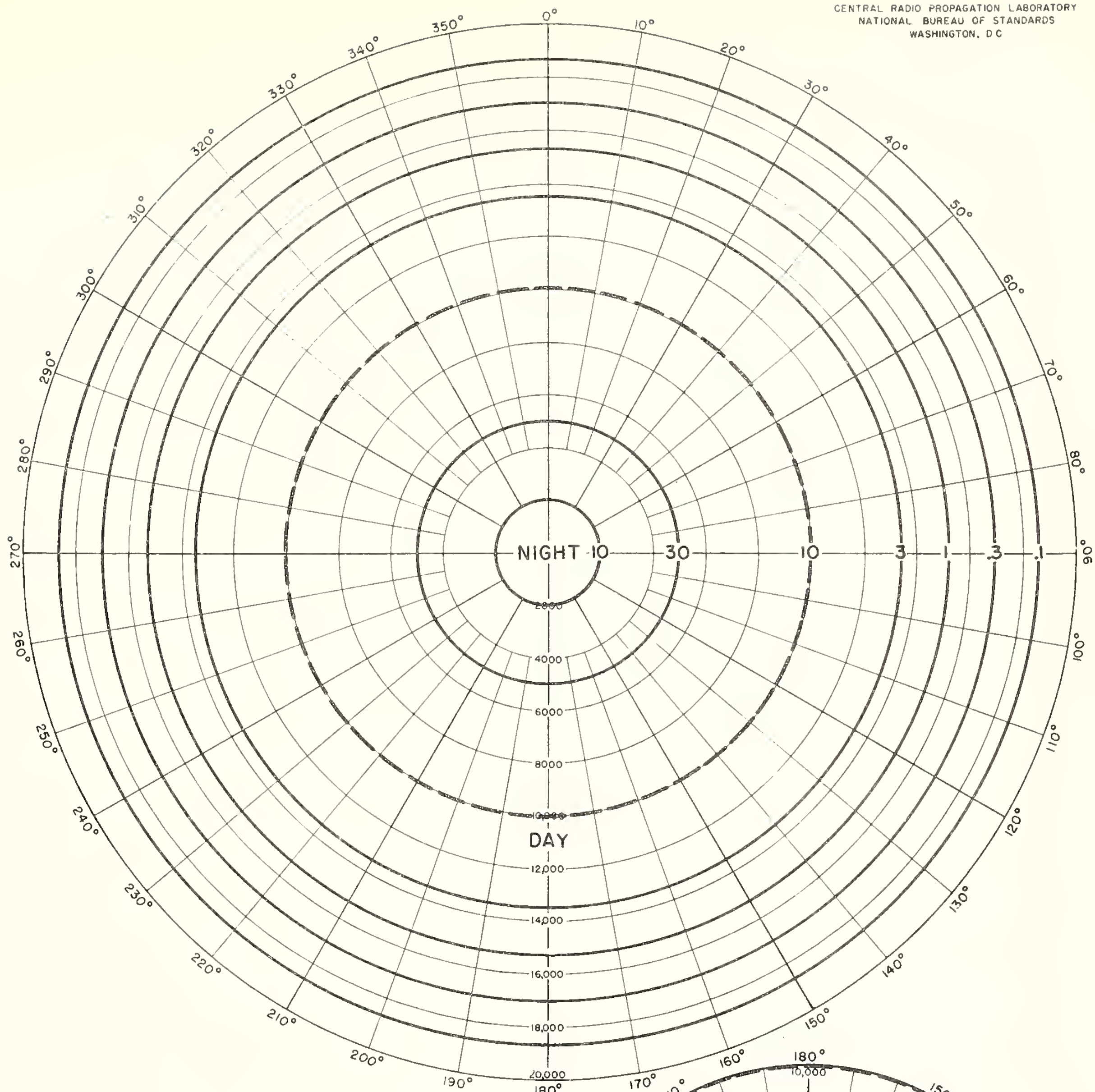
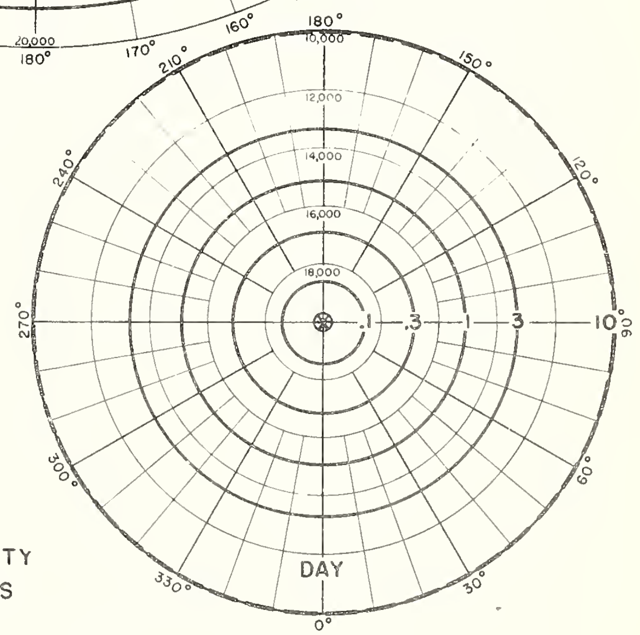



Fig. 100
FIELD INTENSITY, μV/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE 20,000 km (180°)
SUNSPOT MINIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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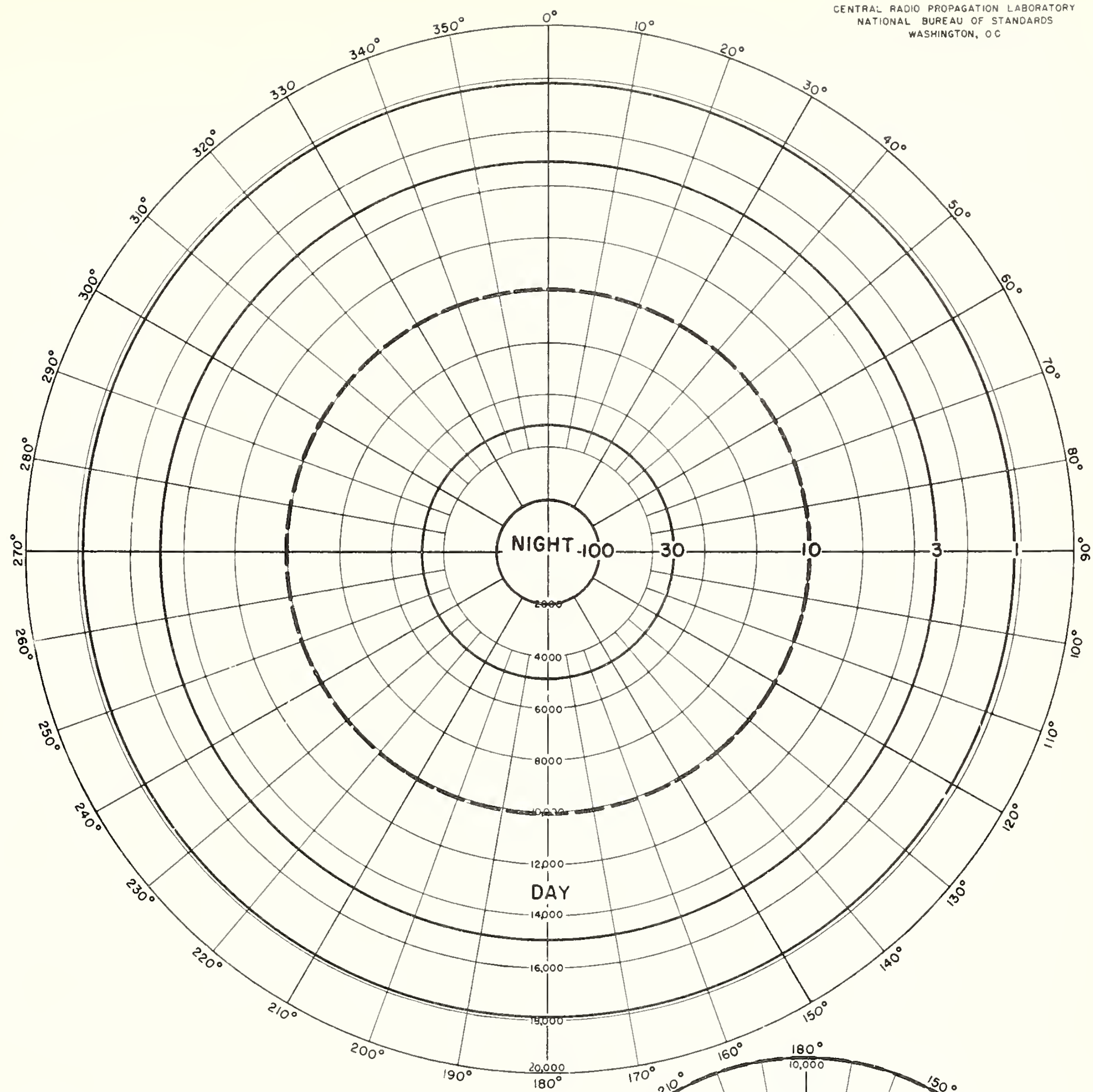
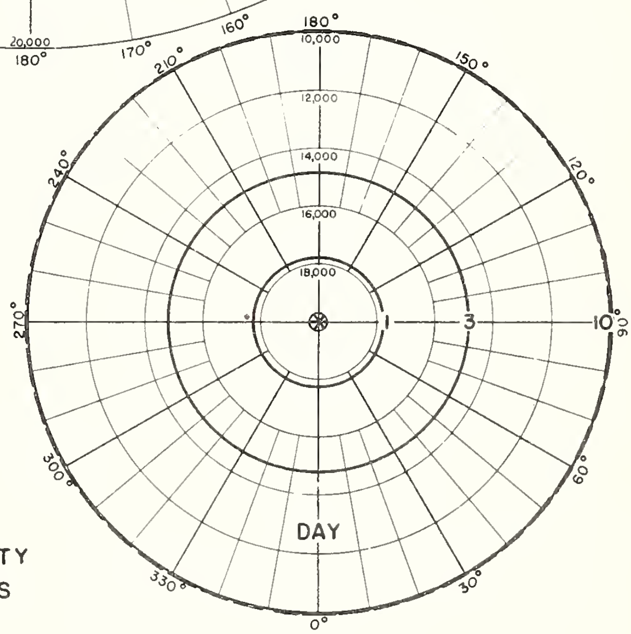



Fig. 101
FIELD INTENSITY, µv/m 1 KW, 15 Mc
SUBSOLAR DISTANCE, 20,000 km (180°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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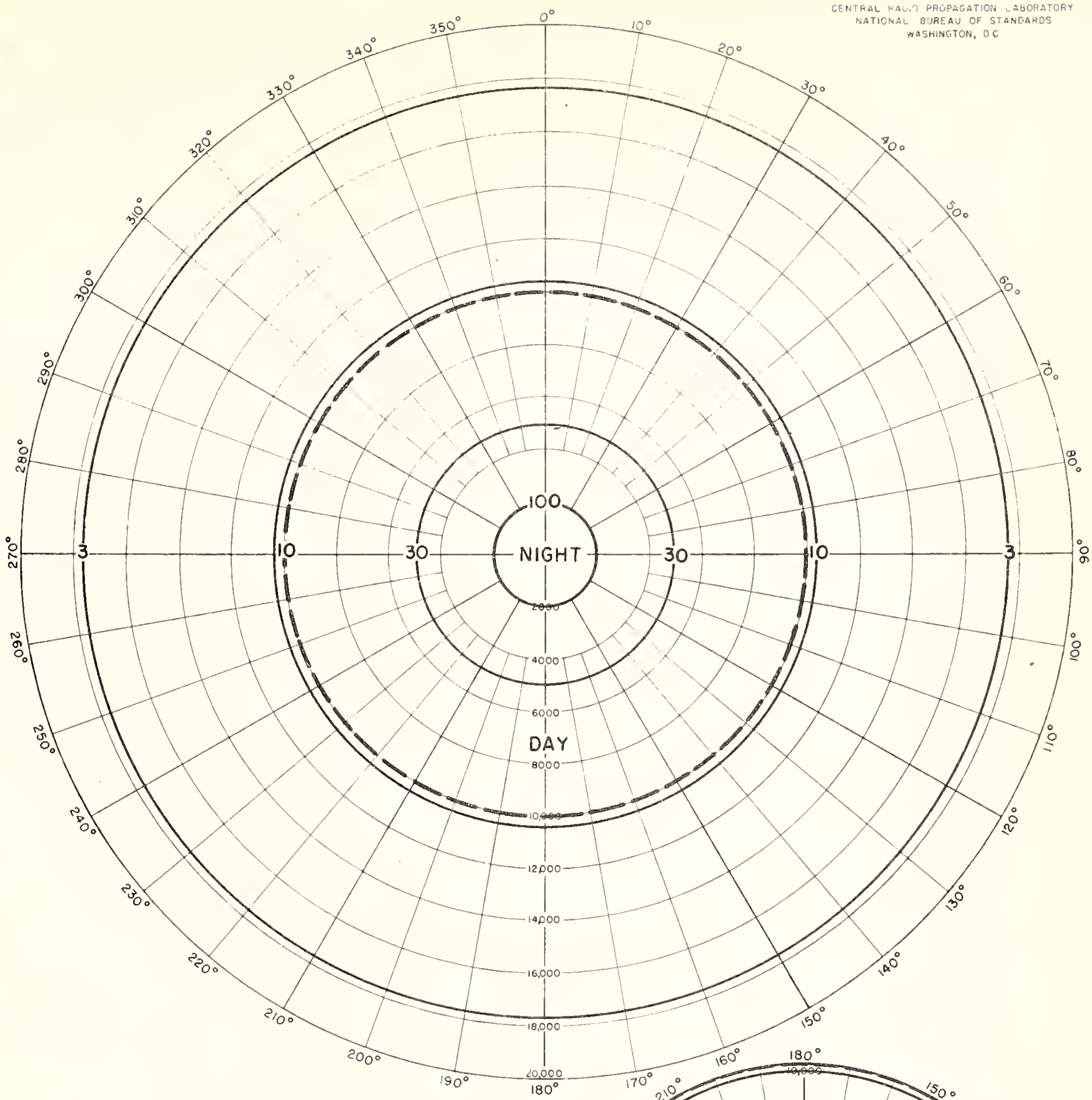
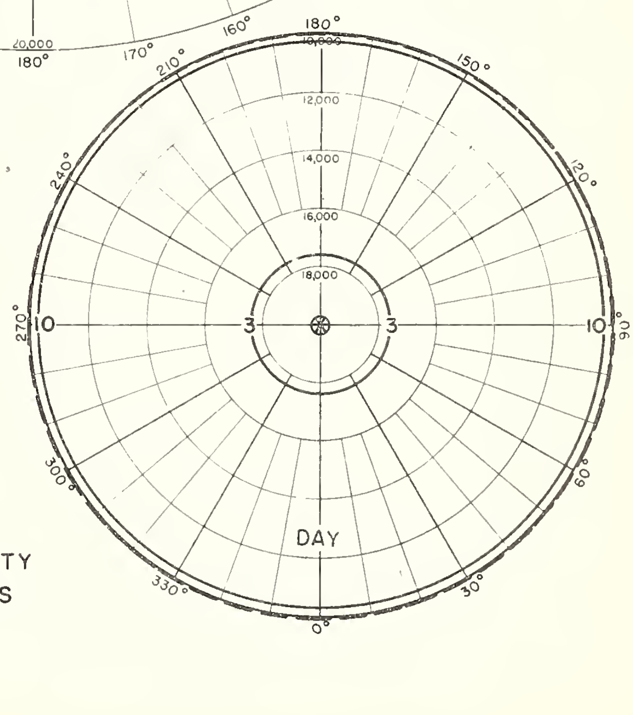



Fig. 102
FIELD INTENSITY, μV/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 20,000 km (180°)
SUNSPOT MINIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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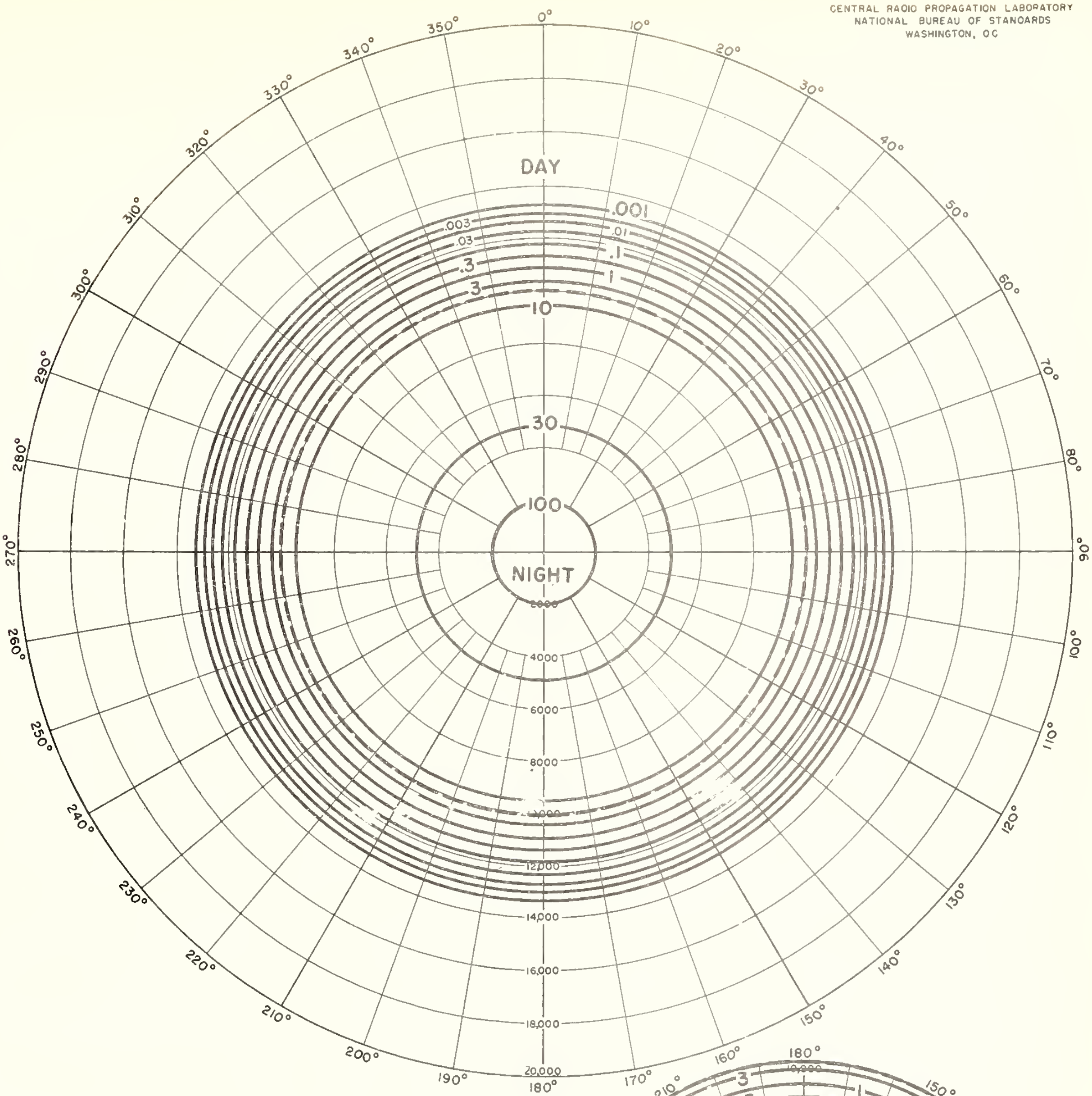
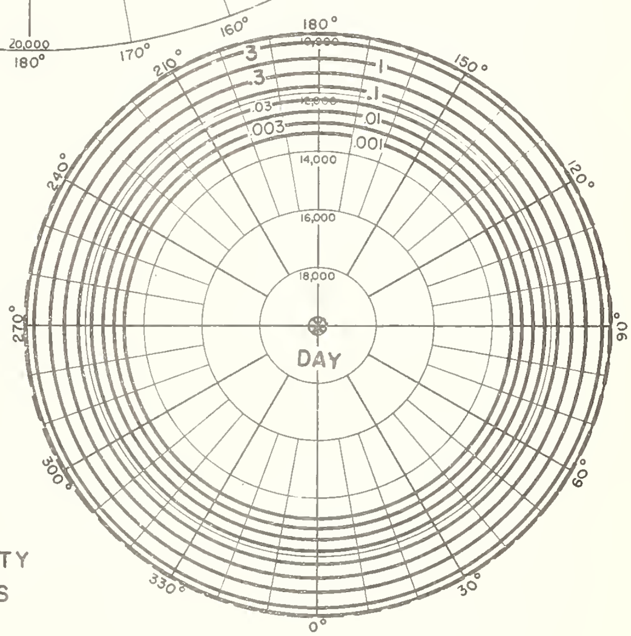



Fig. 103
FIELD INTENSITY, μv/m, 1 KW, 3 Mc
SUBSOLAR DISTANCE, 20,000 km (180°)
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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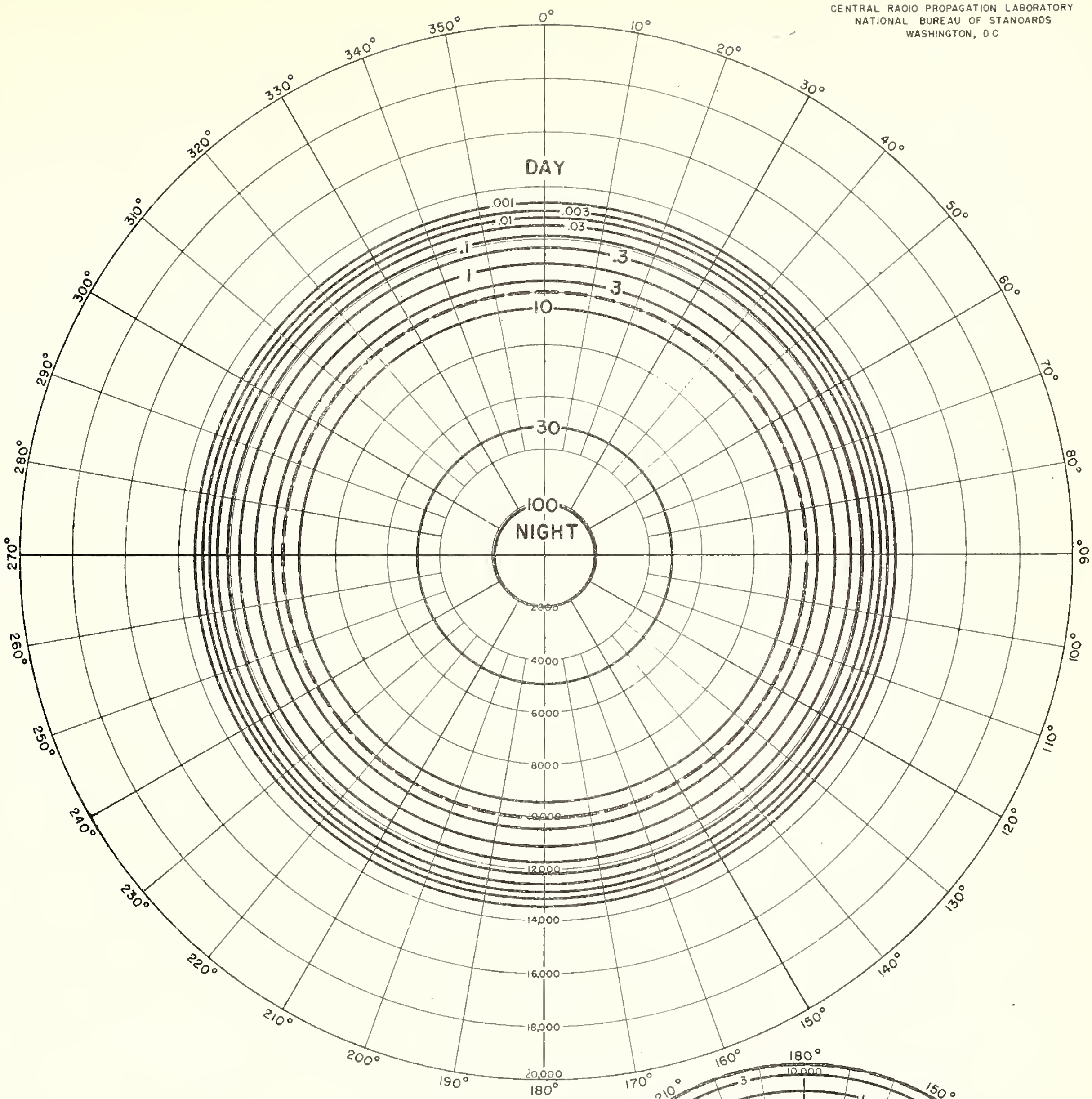
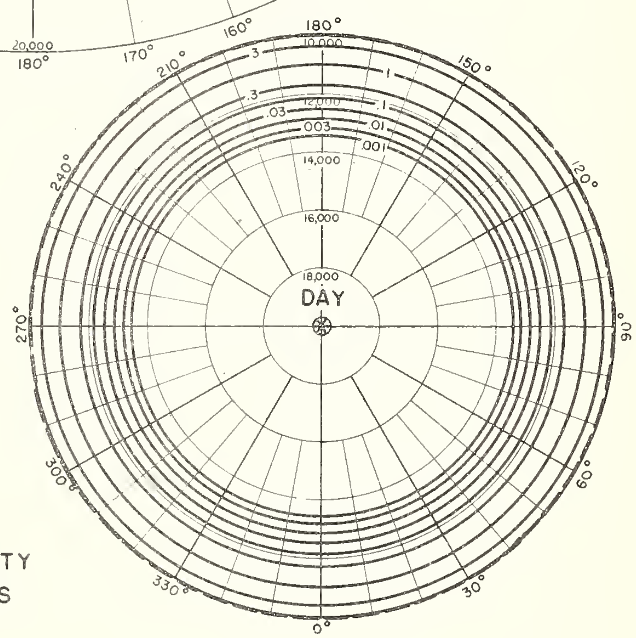



Fig. 104
FIELD INTENSITY, $\mu$v/m, 1 KW, 5 Mc
SUBSOLAR DISTANCE, 20,000 km (180°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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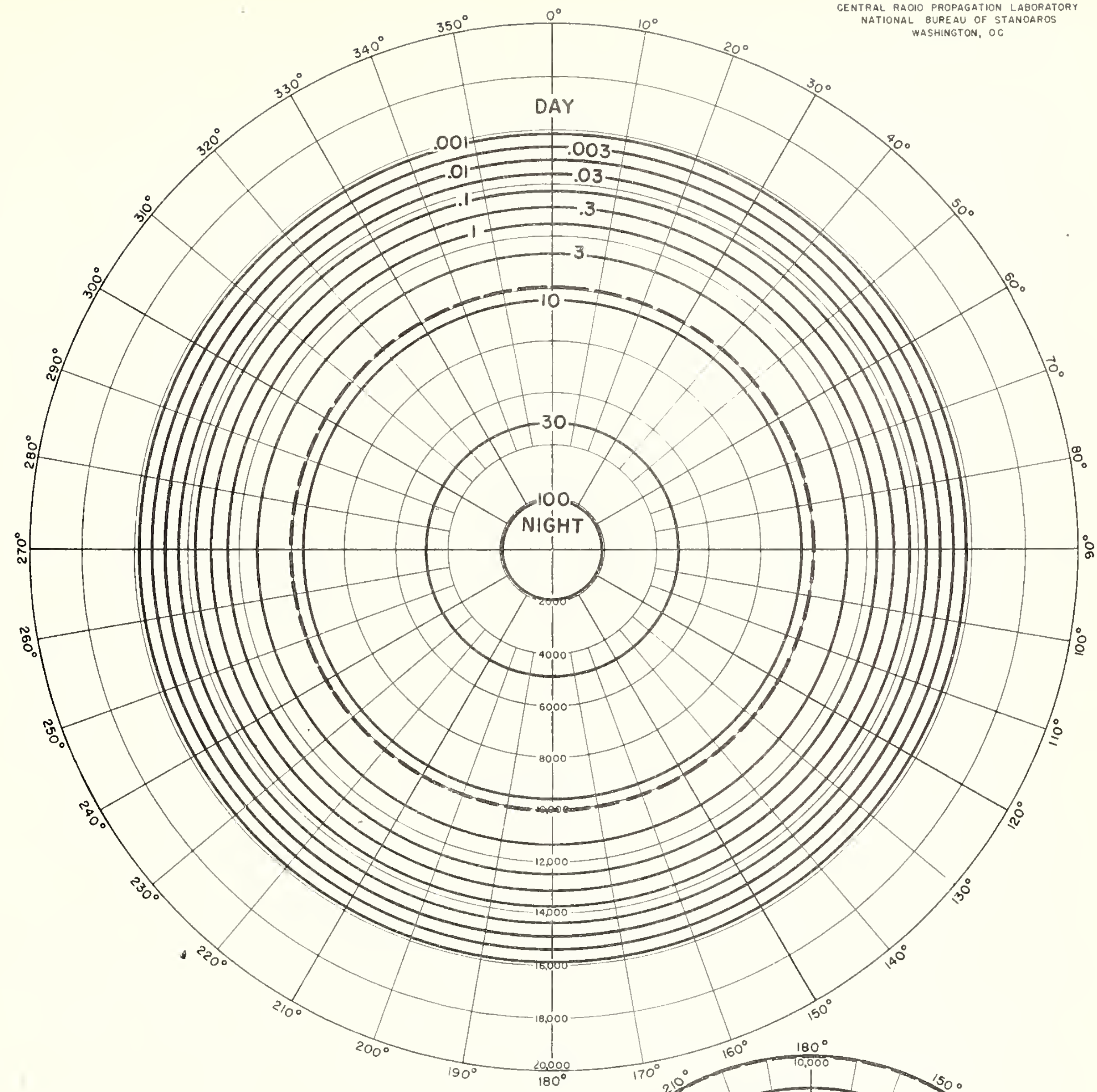
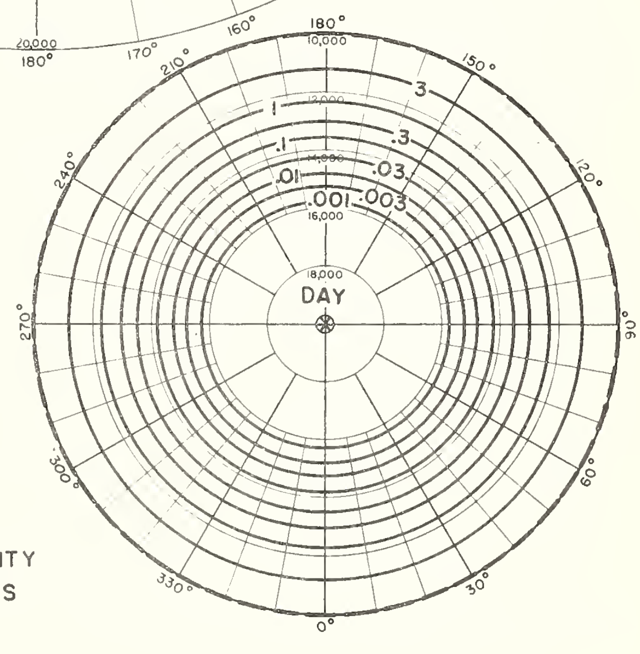



Fig. 105
FIELD INTENSITY, μv/m, 1 KW, 7 Mc
SUBSOLAR DISTANCE, 20,000 km (180°)
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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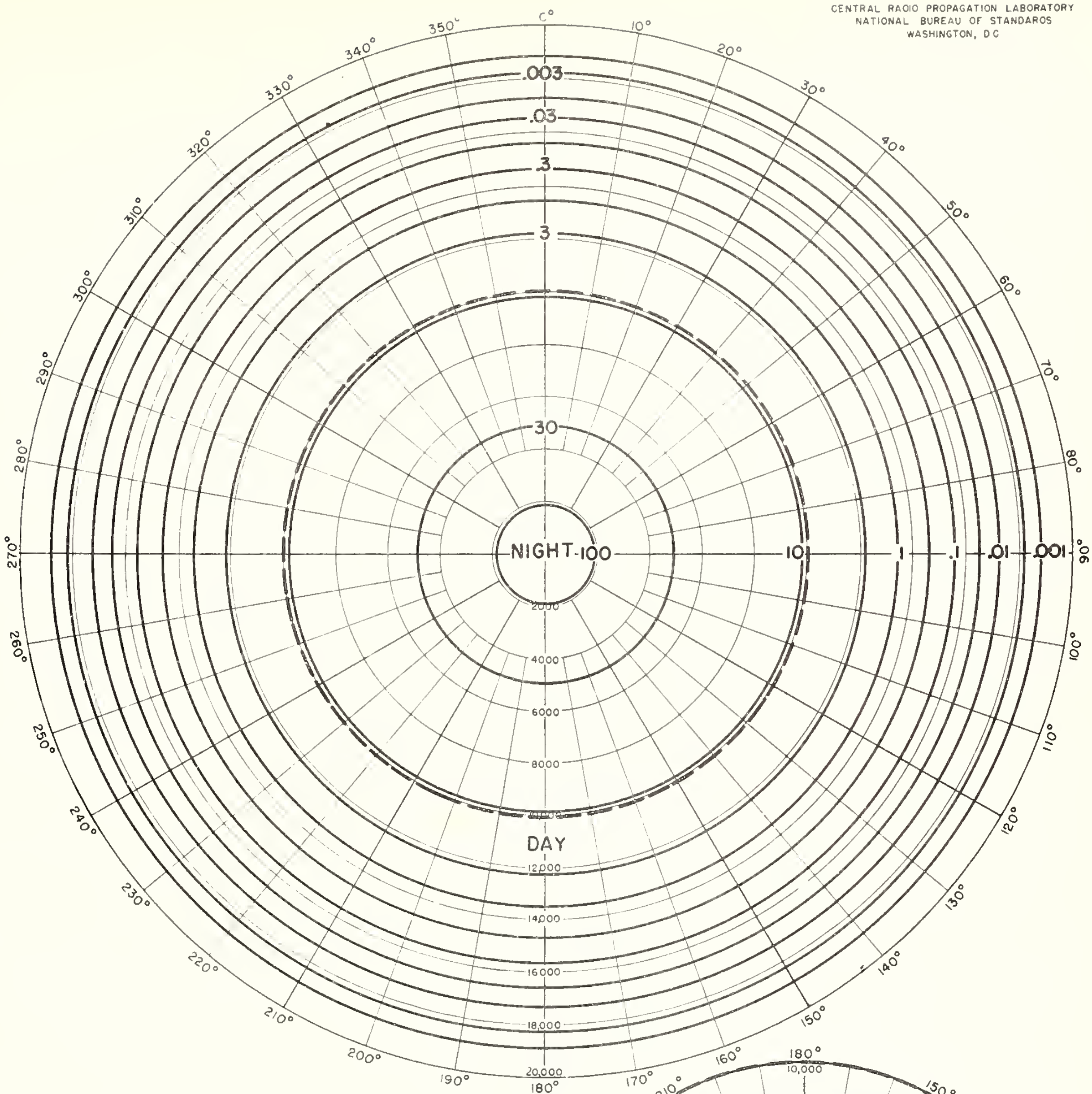
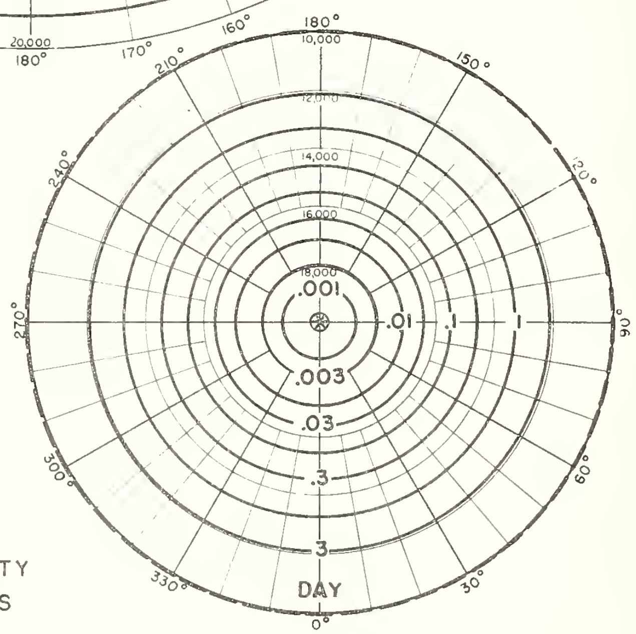



Fig. 106
FIELD INTENSITY, μv/m, 1 KW, 10 Mc
SUBSOLAR DISTANCE, 20,000 km (180°)
SUNSPOT MAXIMUM

* SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
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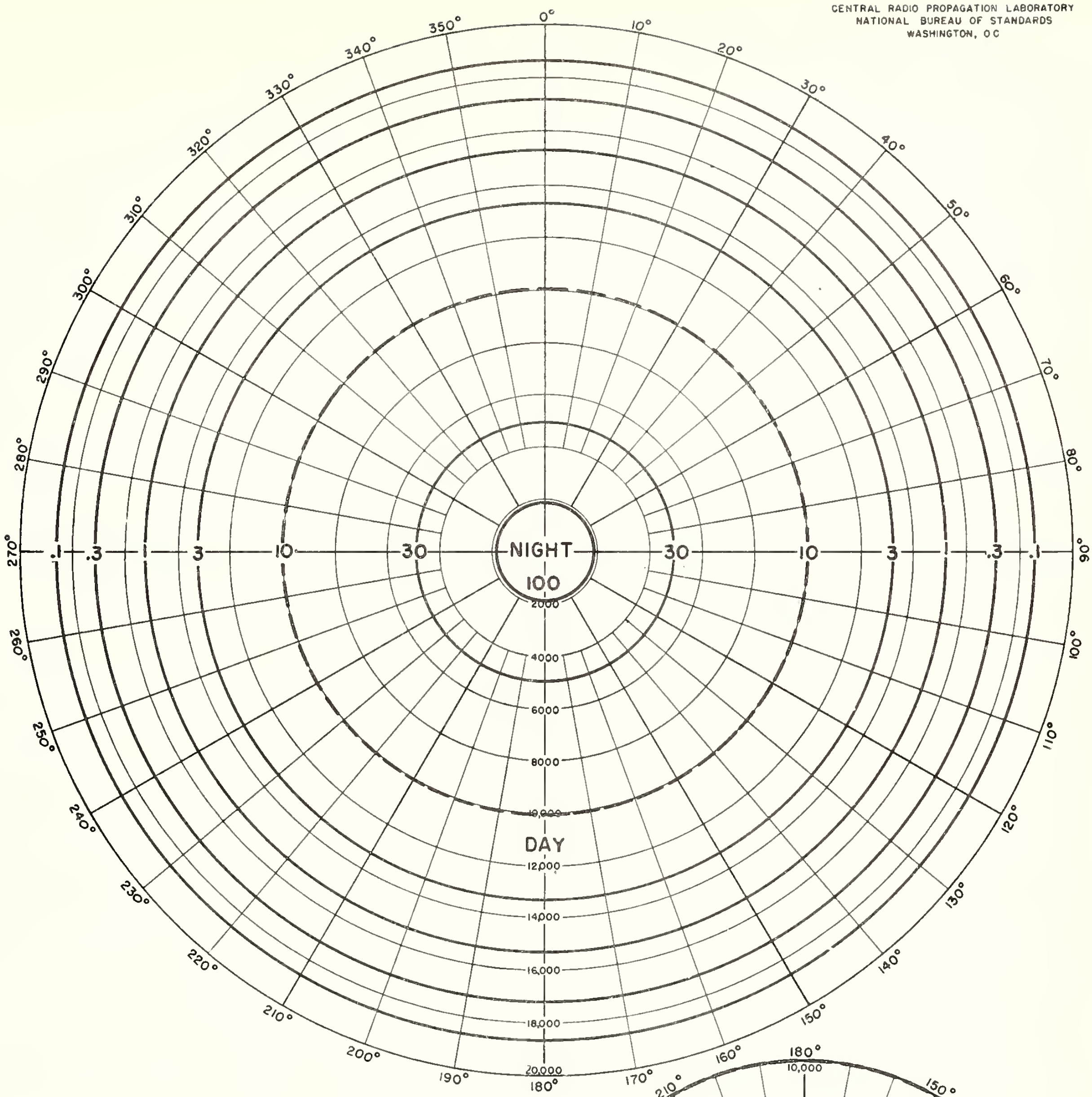
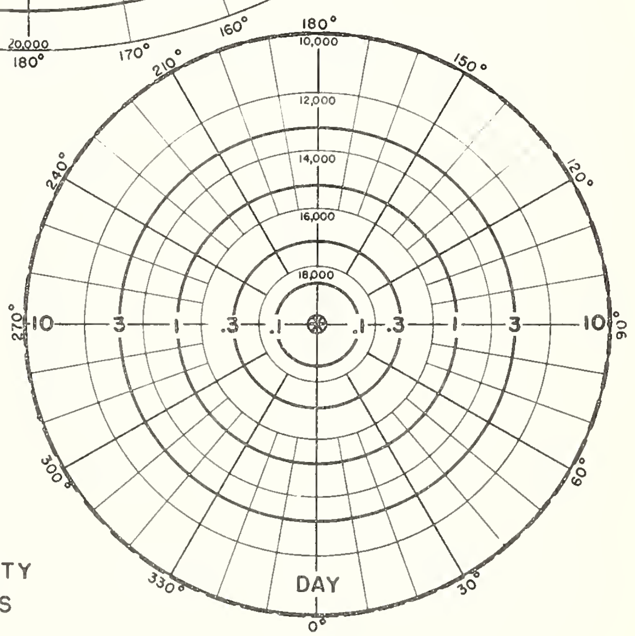



Fig. 107
FIELD INTENSITY, μv/m, 1 KW, 15 Mc
SUBSOLAR DISTANCE, 20,000 km (180°)
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

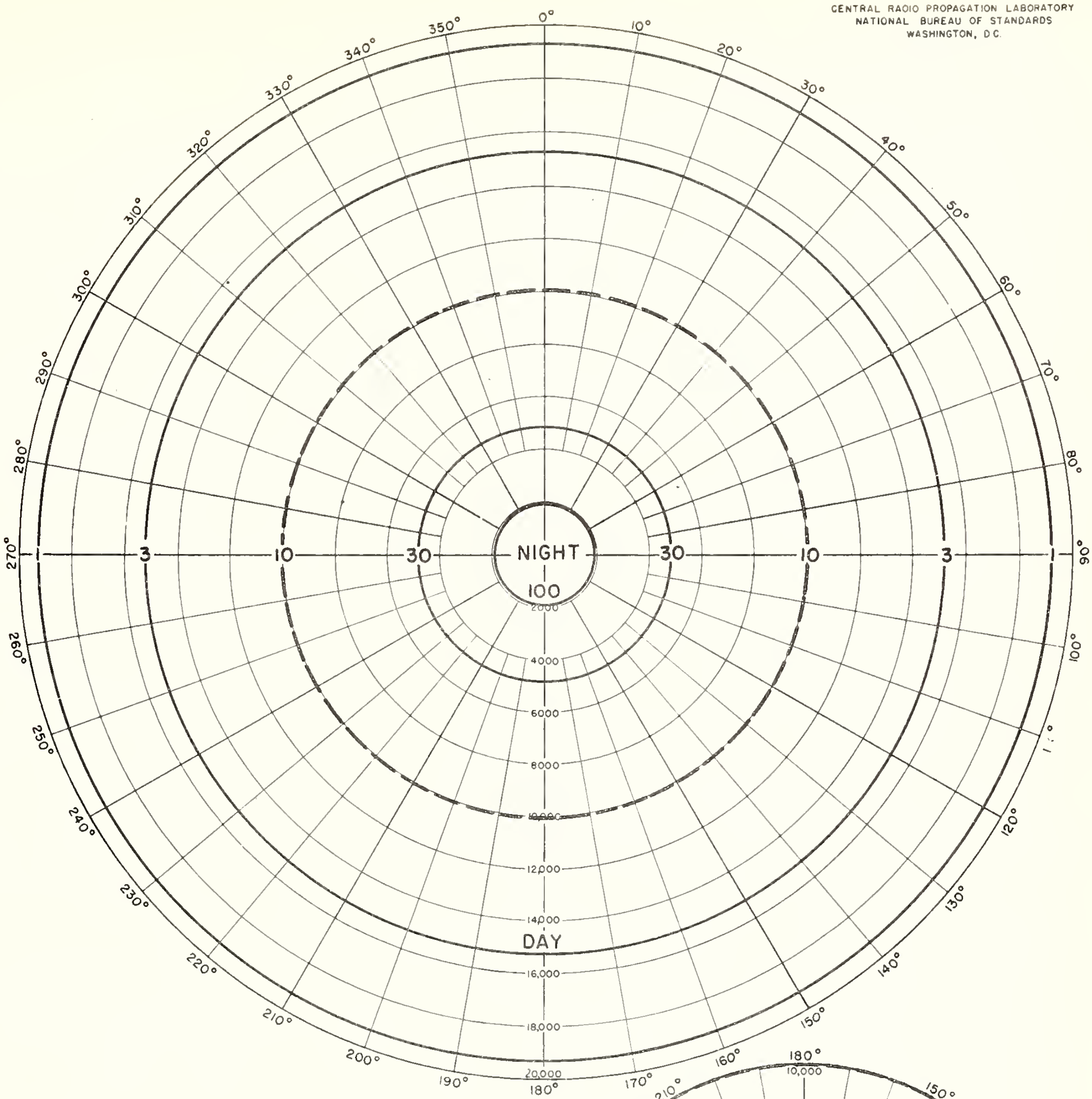
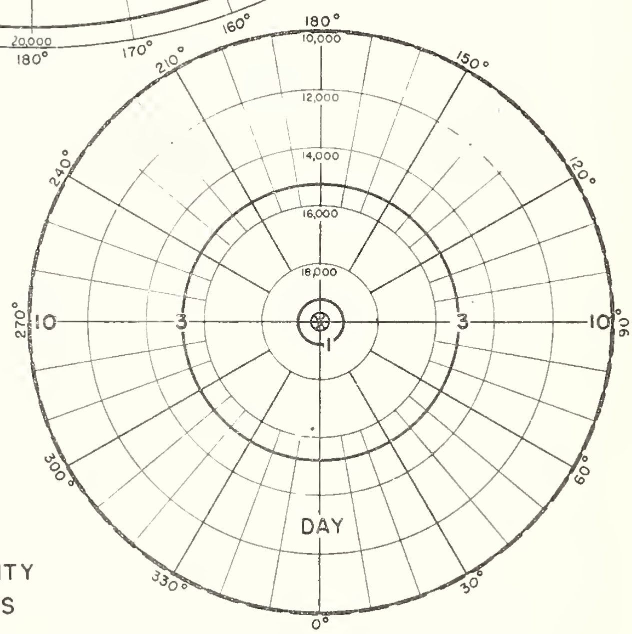



Fig. 108
FIELD INTENSITY, $\mu$V/m, 1 KW, 25 Mc
SUBSOLAR DISTANCE, 20,000 km (180°)
SUNSPOT MAXIMUM

∗ SUBSOLAR POINT
⊙ POINT OF MINIMUM FIELD INTENSITY




FIELD INTENSITY
AT ANTIPODES

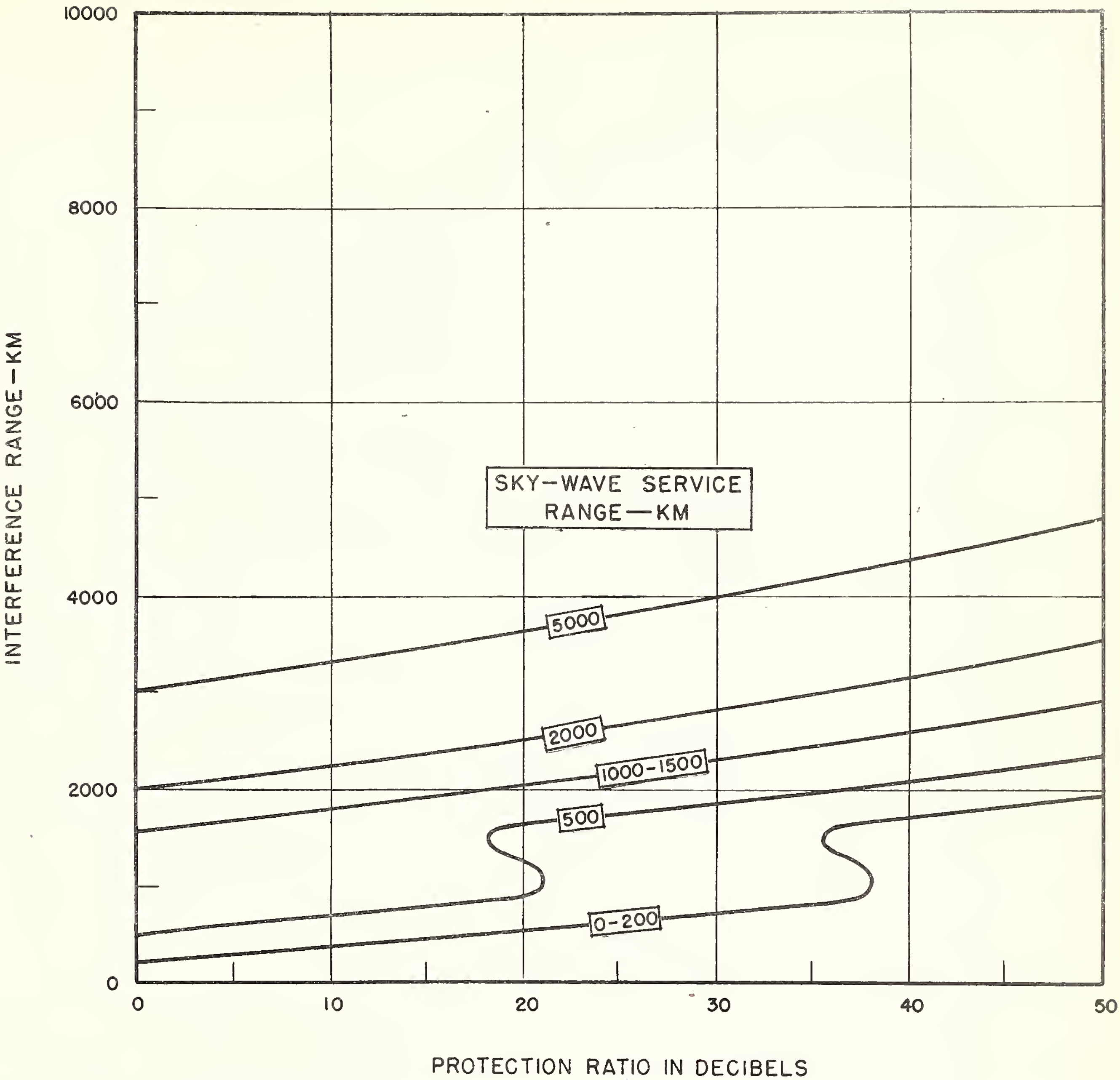



Fig. 109
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

4 MC. TRANSMITTER AT THE SUBSOLAR POINT.

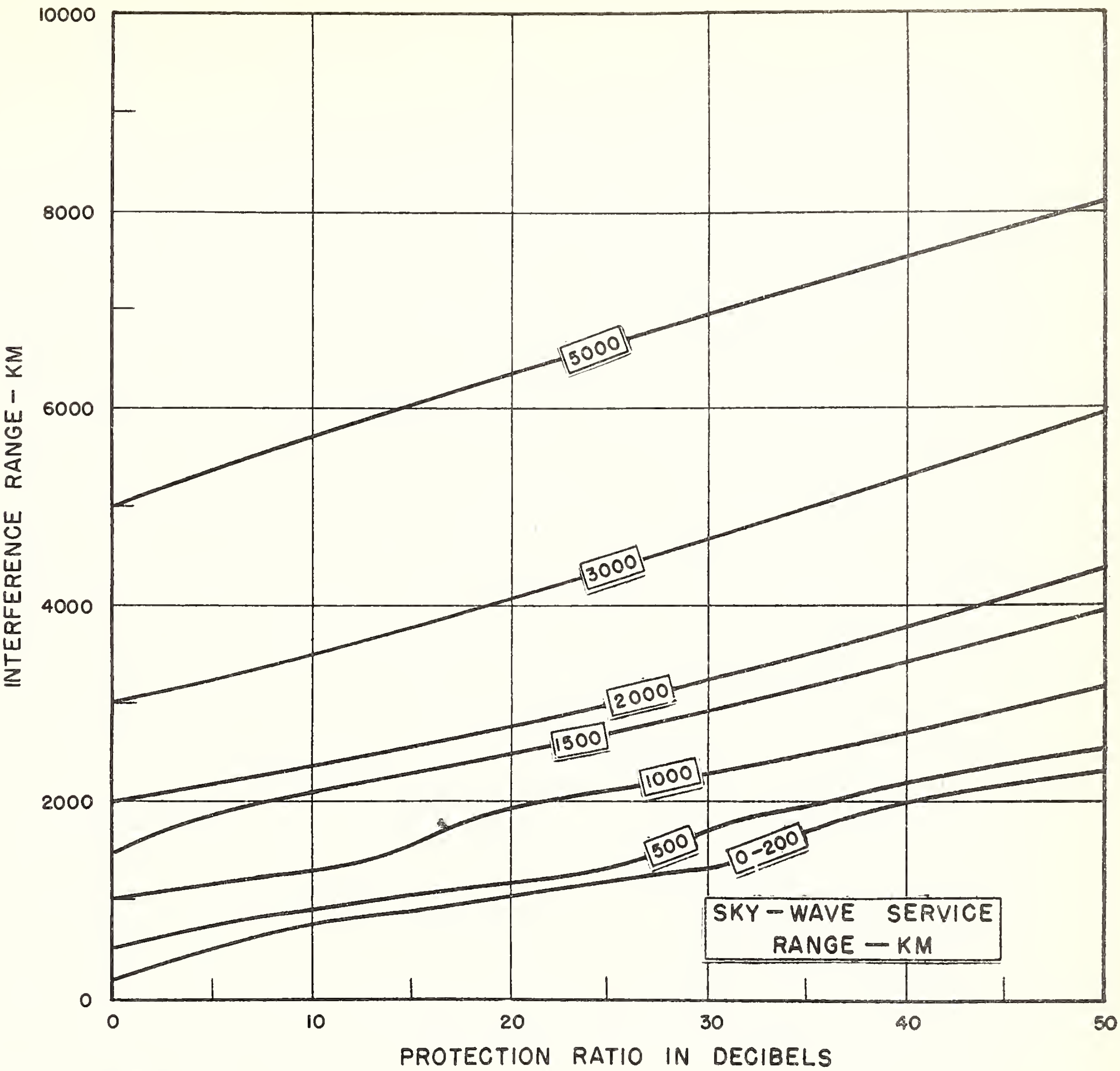



Fig. 110
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

6 MC. TRANSMITTER AT THE SUBSOLAR POINT.

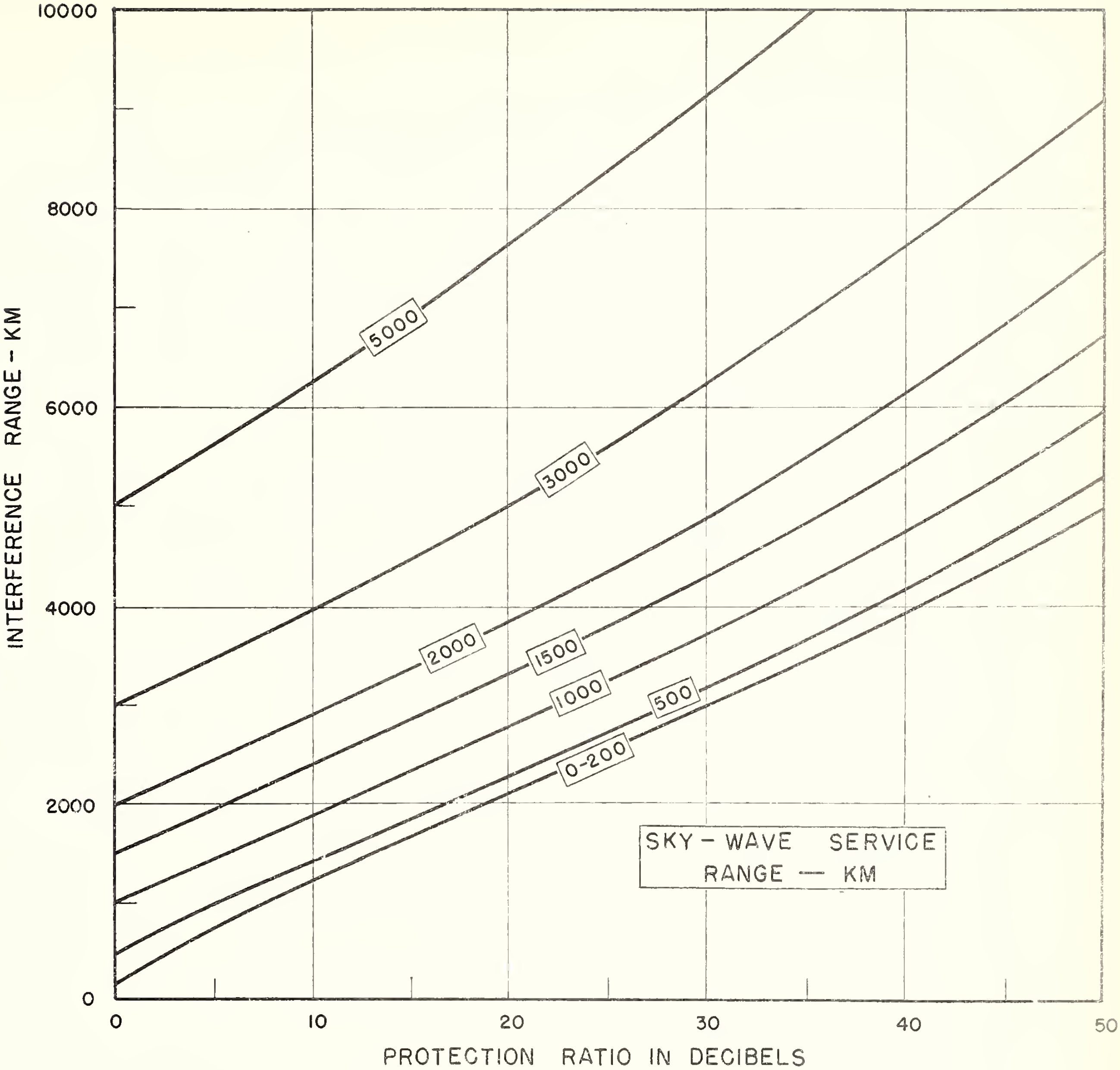



Fig. III
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

10 MC. TRANSMITTER AT SUBSOLAR POINT.

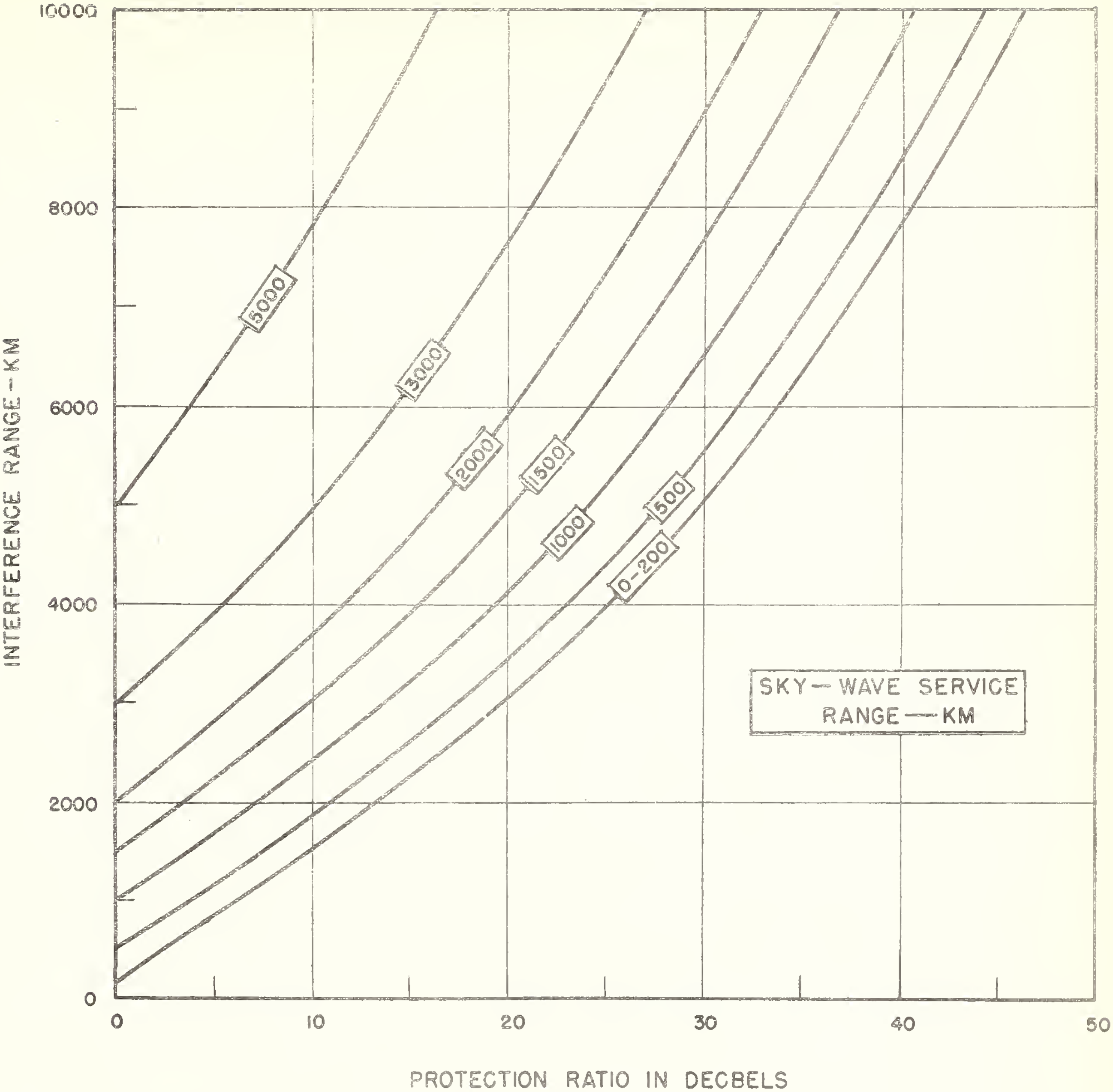



Fig.112
INTEREERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

15 MC. TRANSMITTER AT THE SUBSOLAR POINT.

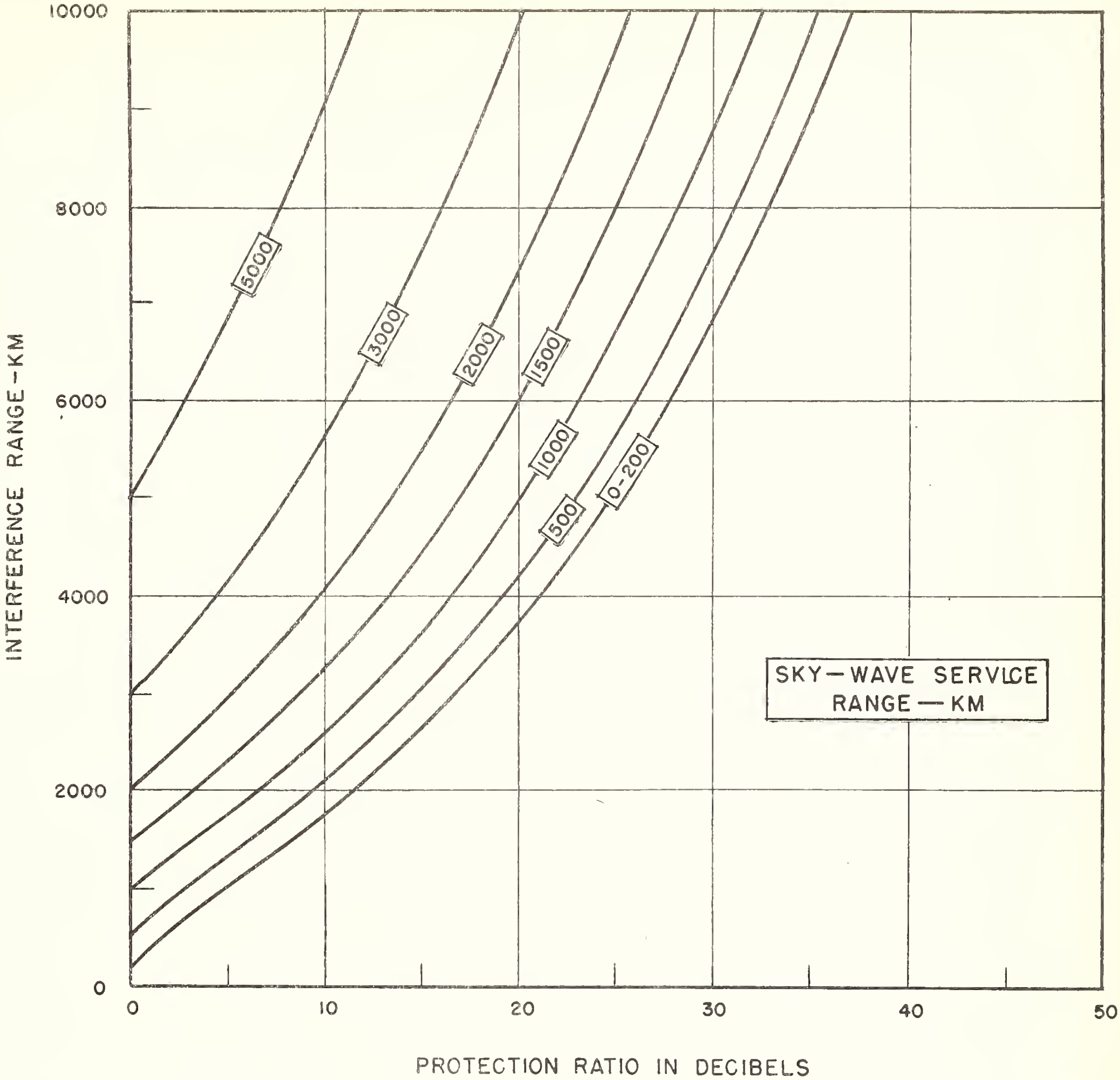



Fig. 113
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

20 MC. TRANSMITTER AT THE SUBSOLAR POINT.

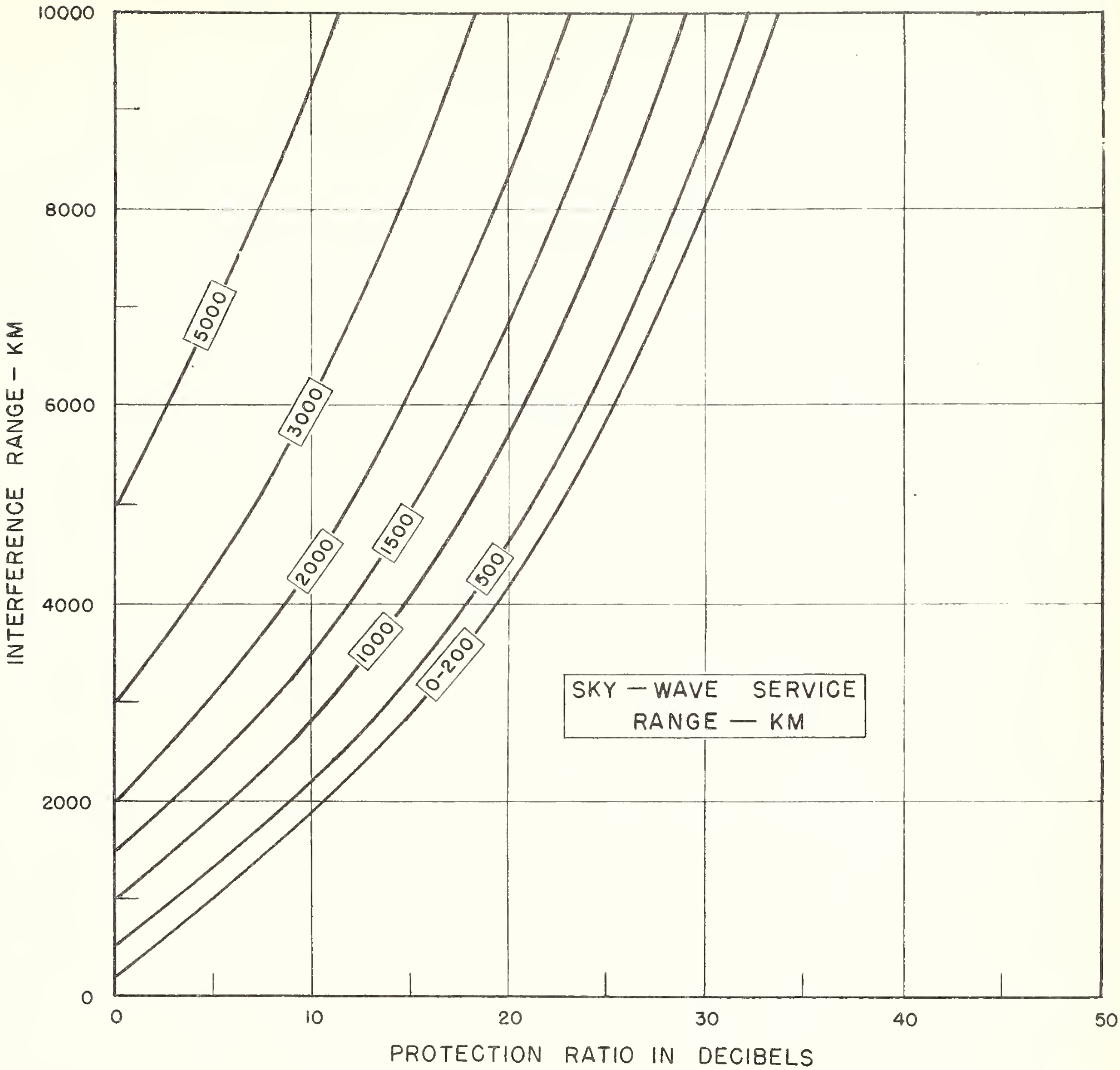



Fig. 114.
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

25 MC TRANSMITTER AT SUBSOLAR POINT.

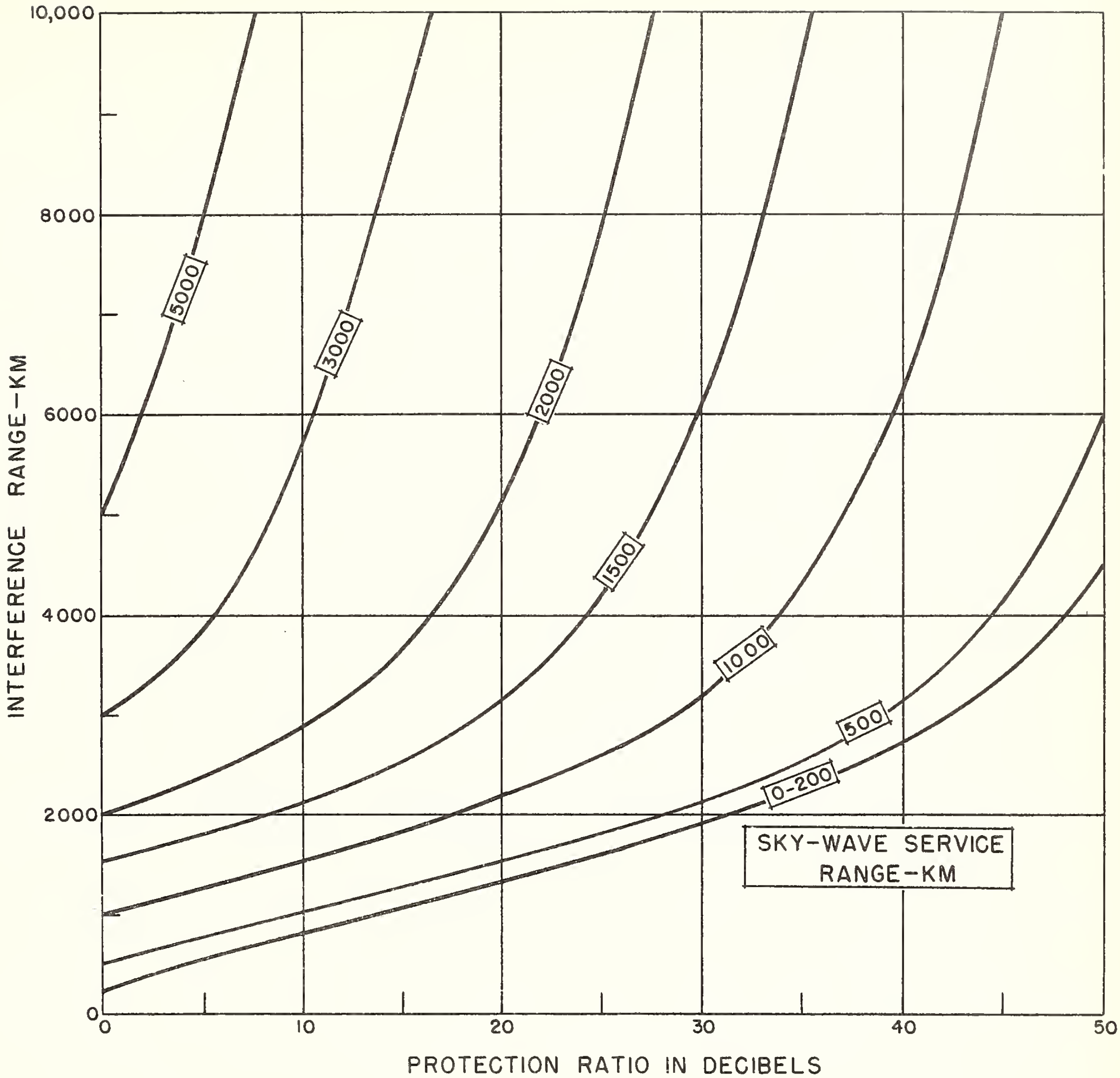



Fig. 115
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

4 MC TRANSMITTER 30° FROM THE DAY-NIGHT LINE TRANSMITTING TOWARD IT.

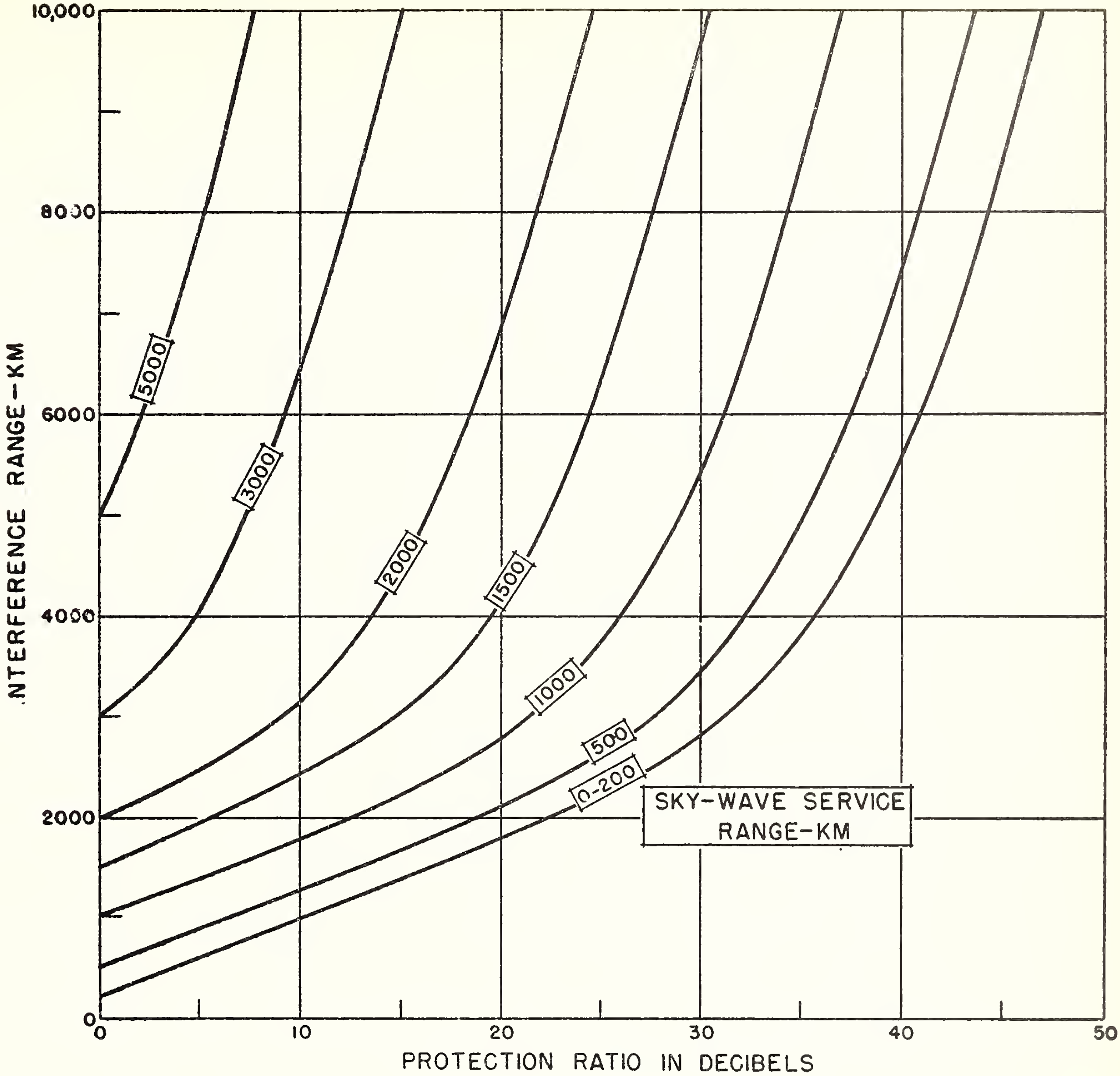



Fig. 116
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

6 MC. TRANSMITTER 30° FROM THE DAY-NIGHT LINE TRANSMITTING TOWARD IT.

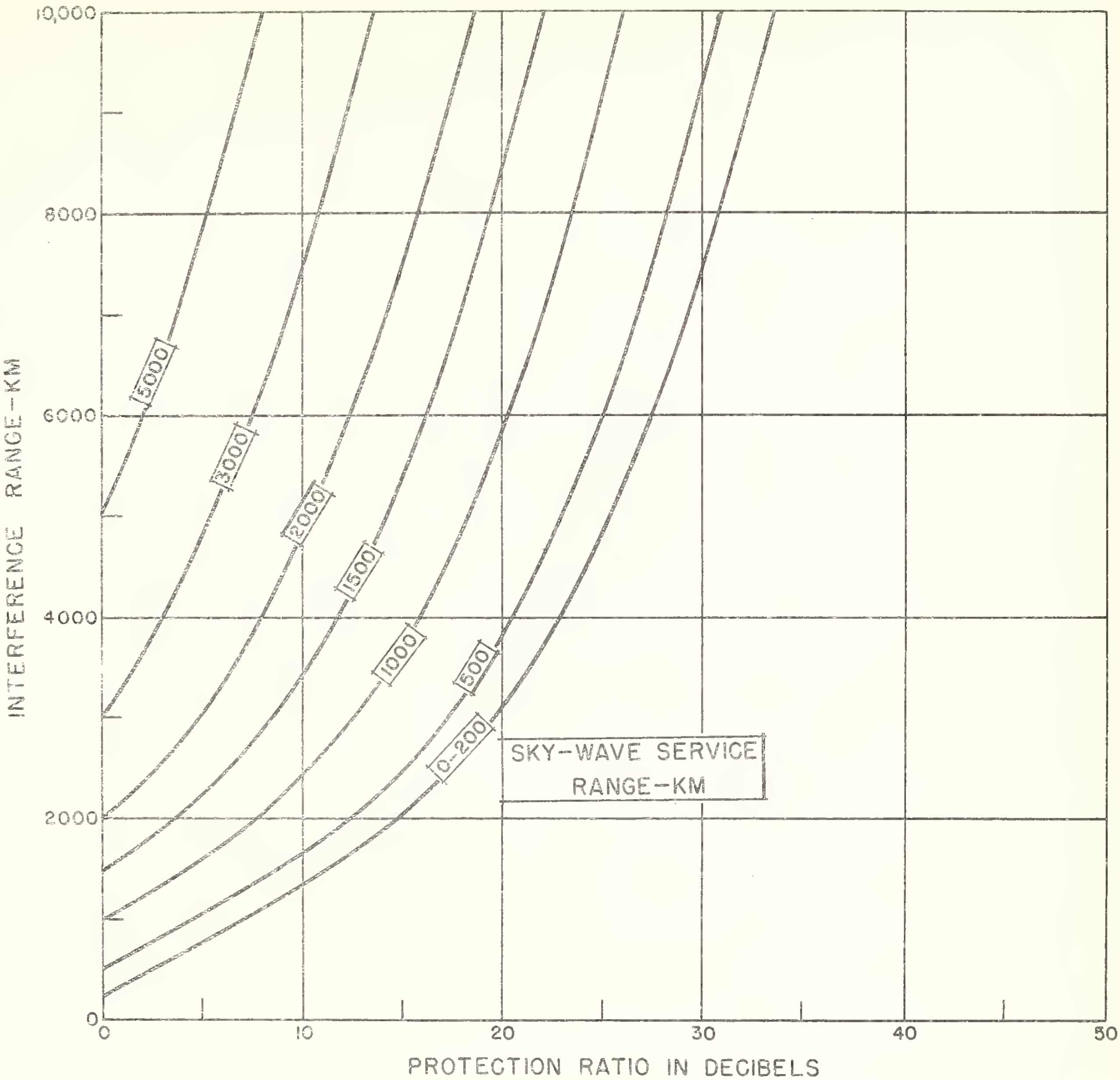



Fig. 117
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

10MC. TRANSMITTER 30° FROM THE DAY-NIGHT LINE TRANSMITTING TOWARD IT.

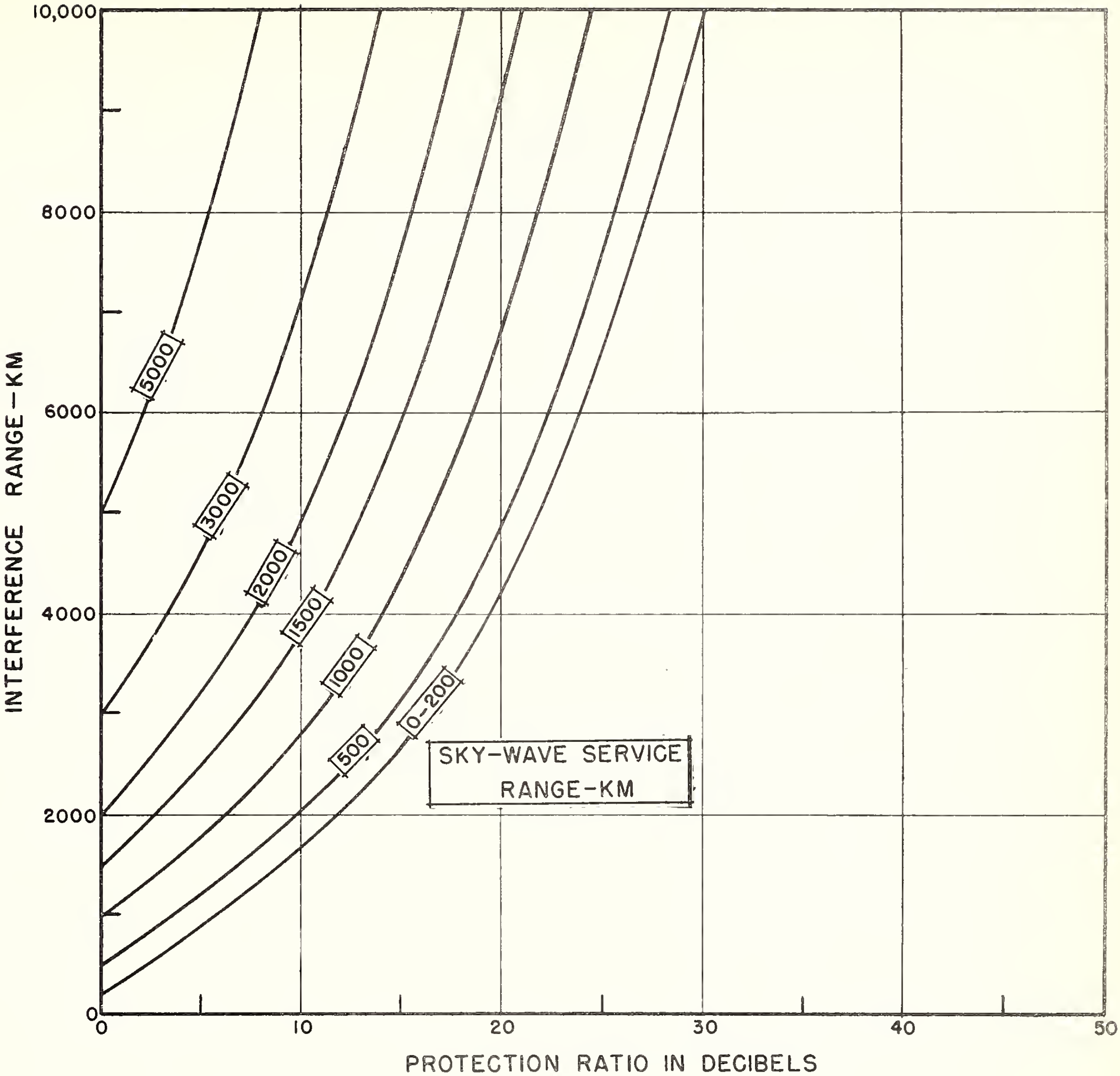



Fig. 118
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

15 MC. TRANSMITTER 30° FROM THE DAY-NIGHT LINE TRANSMITTING TOWARD IT.

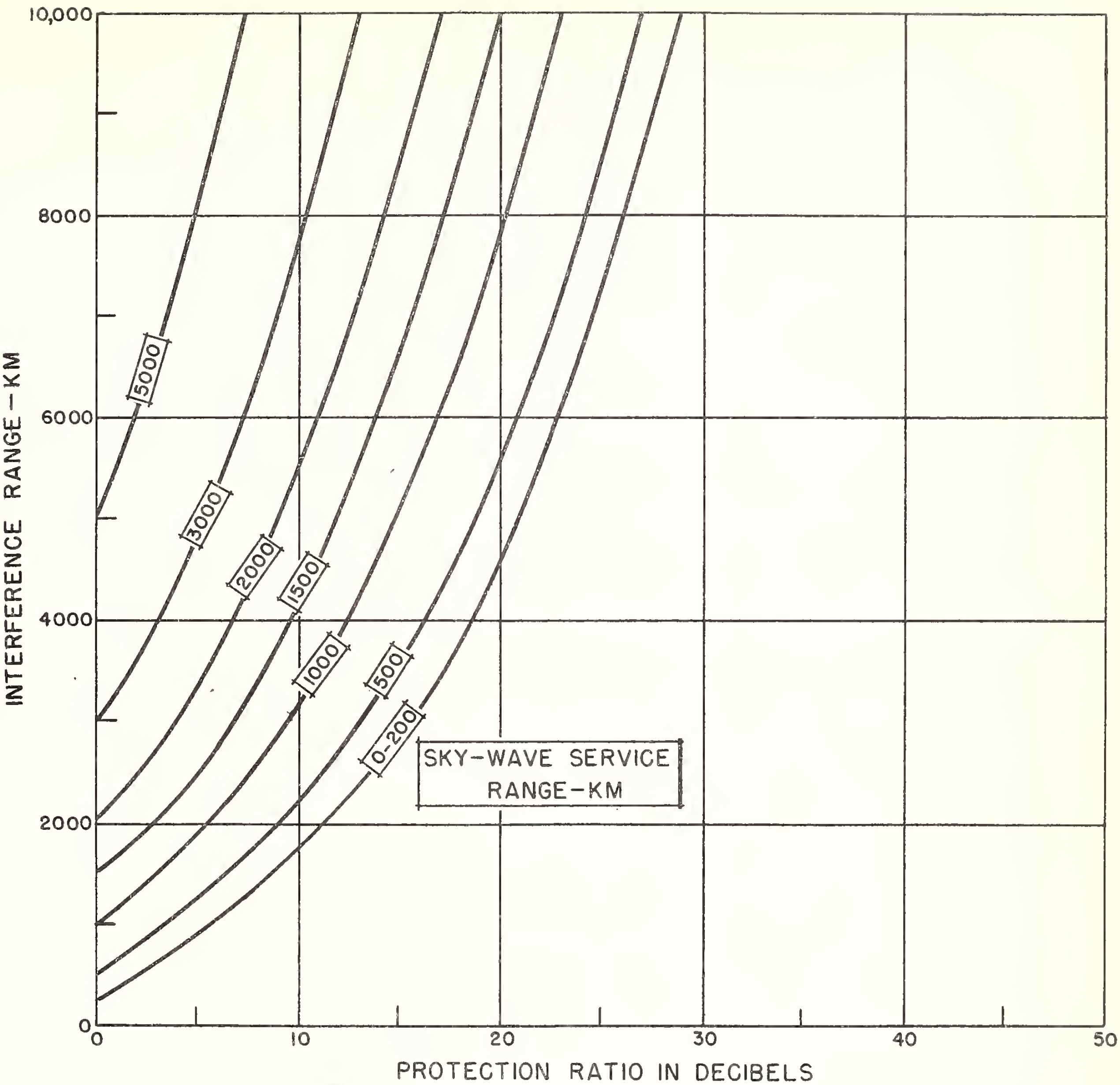



Fig. 119

INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

20 MC. TRANSMITTER 30° FROM THE DAY-NIGHT LINE TRANSMITTING TOWARD IT.

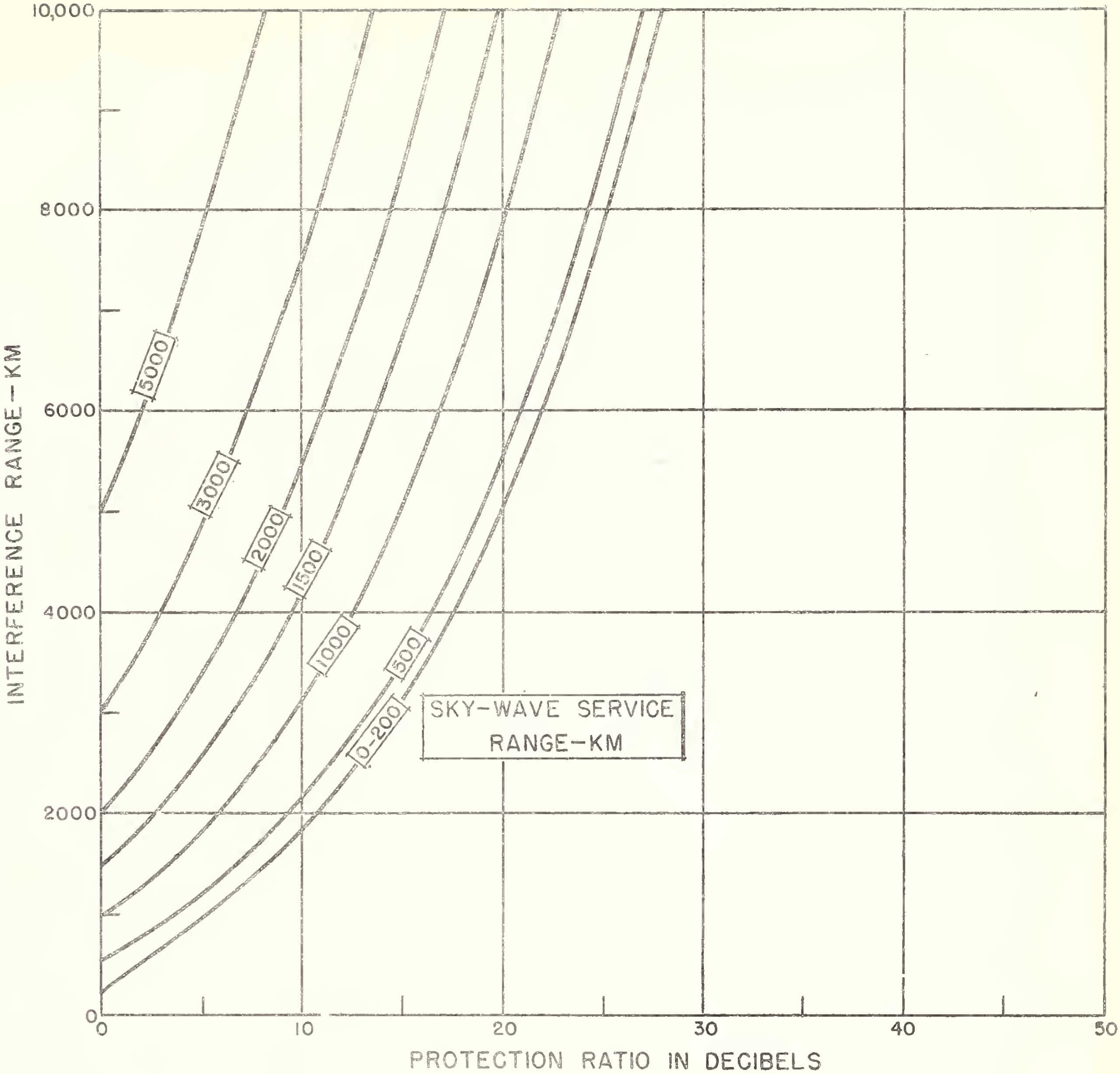



Fig. 120
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

25 MC. TRANSMITTER 30° FROM THE DAY-NIGHT LINE TRANSMITTING TOWARD IT.

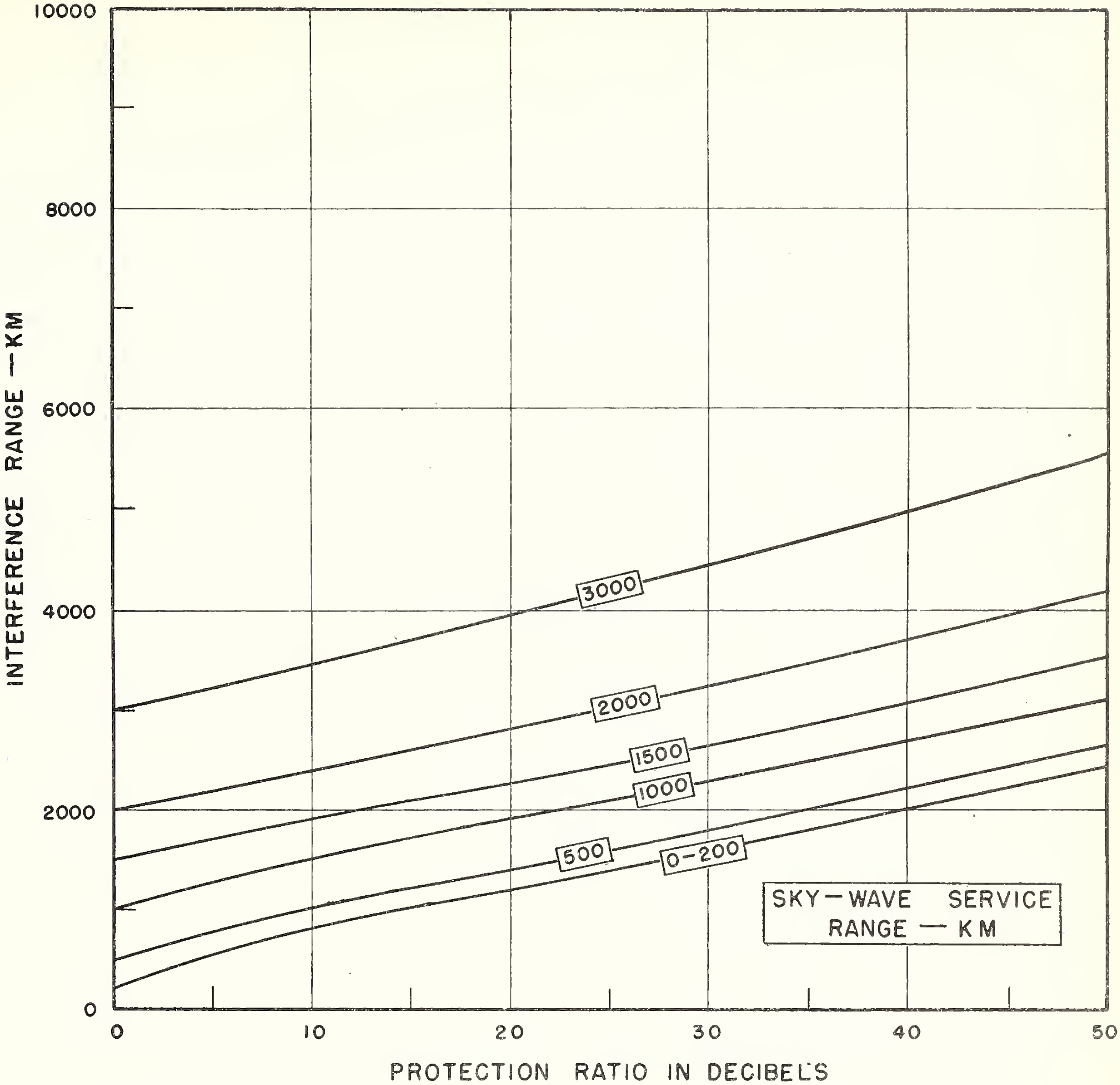



Fig. 121
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

4 MC. TRANSMITTER 30° FROM THE DAY—NIGHT LINE TRANSMITTING PARALLEL TO IT.

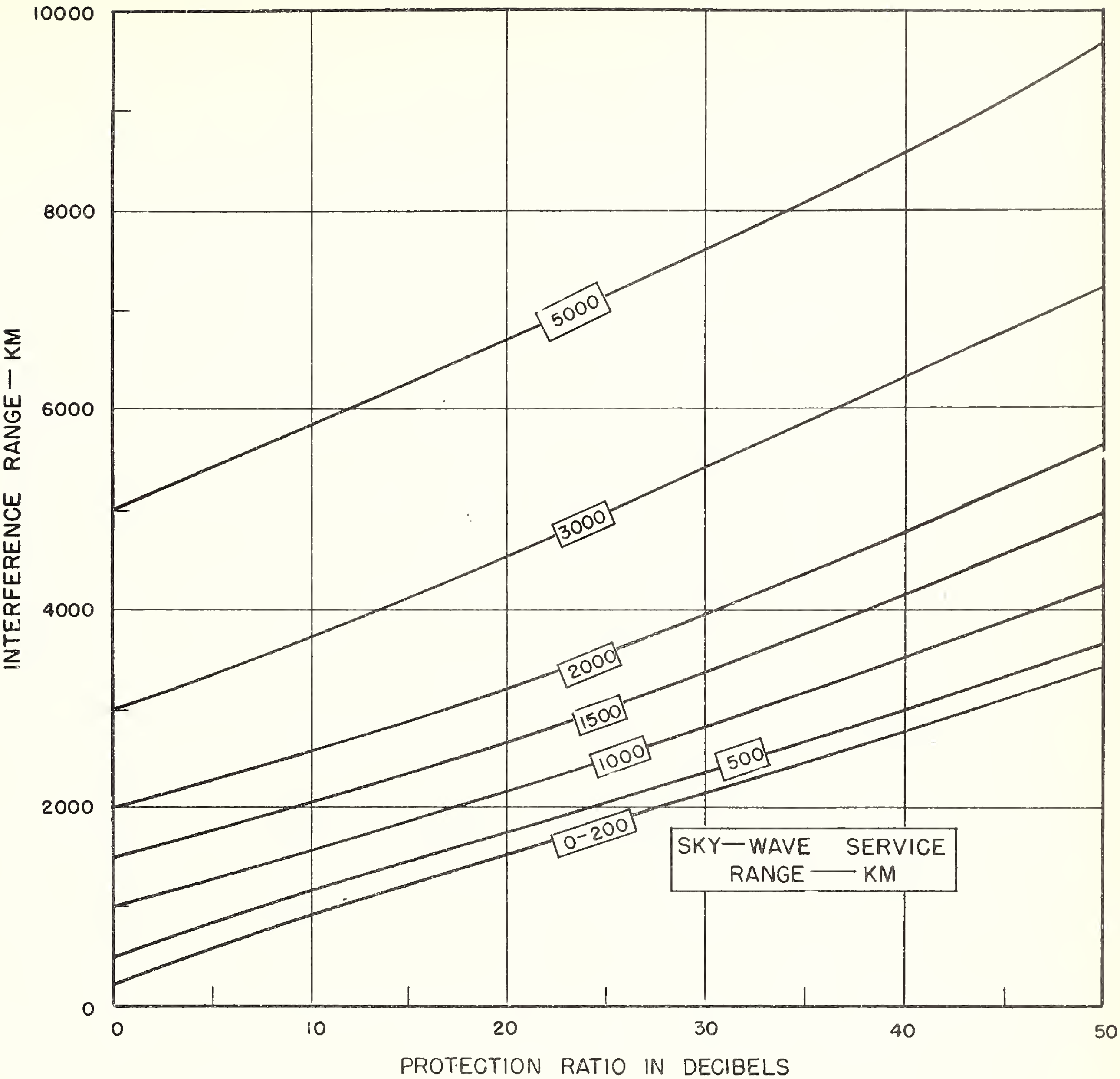



Fig. 122
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

6 MC TRANSMITTER 30° FROM THE DAY—NIGHT LINE TRANSMITTING PARALLEL TO IT.

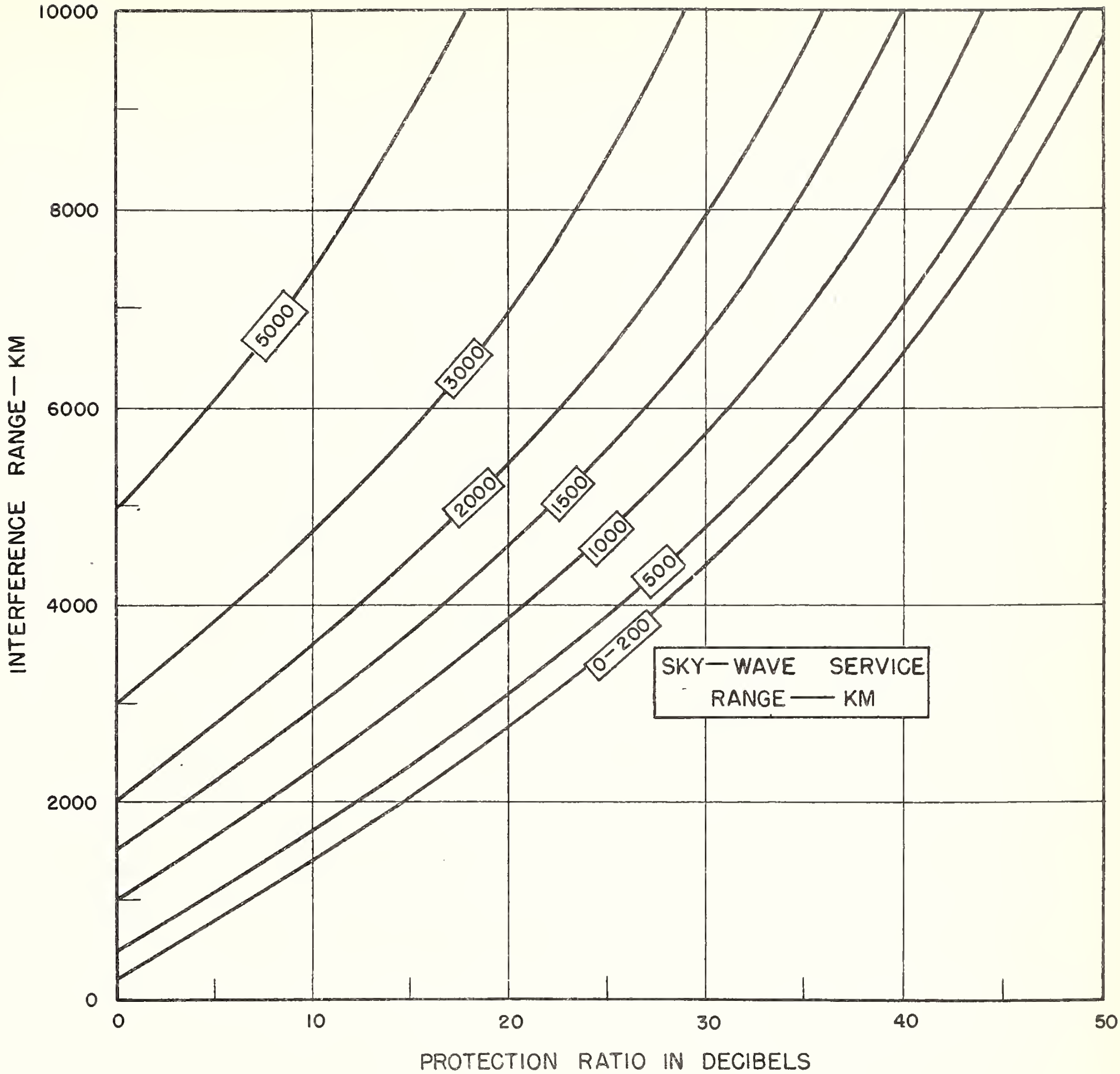



Fig. 123
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

10 MC. TRANSMITTER 30° FROM THE DAY—NIGHT LINE TRANSMITTING PARALLEL TO IT.

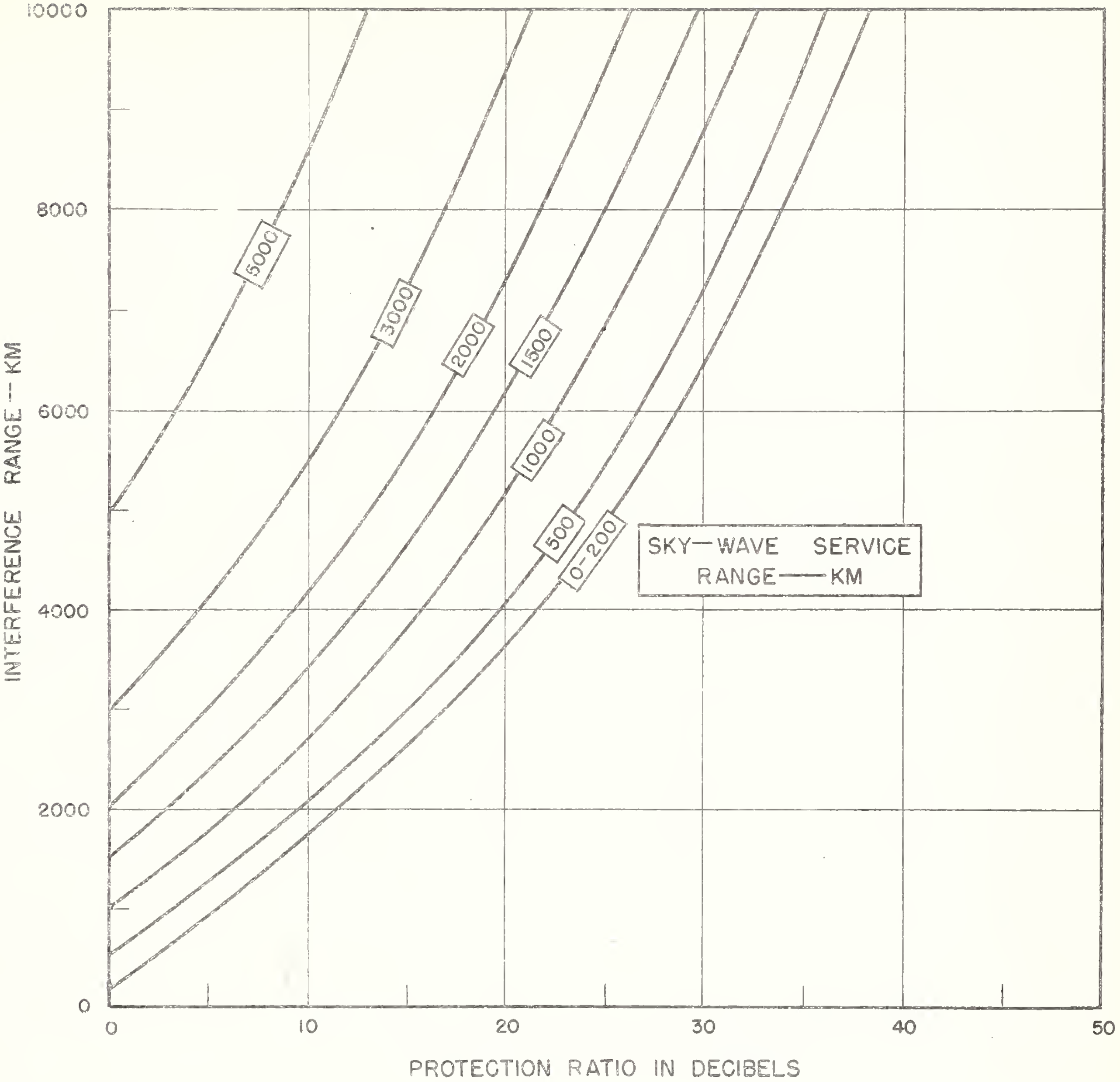



Fig. 124
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

15 MC. TRANSMITTER 30° FROM THE DAY—NIGHT LINE TRANSMITTING PARALLEL TO IT.

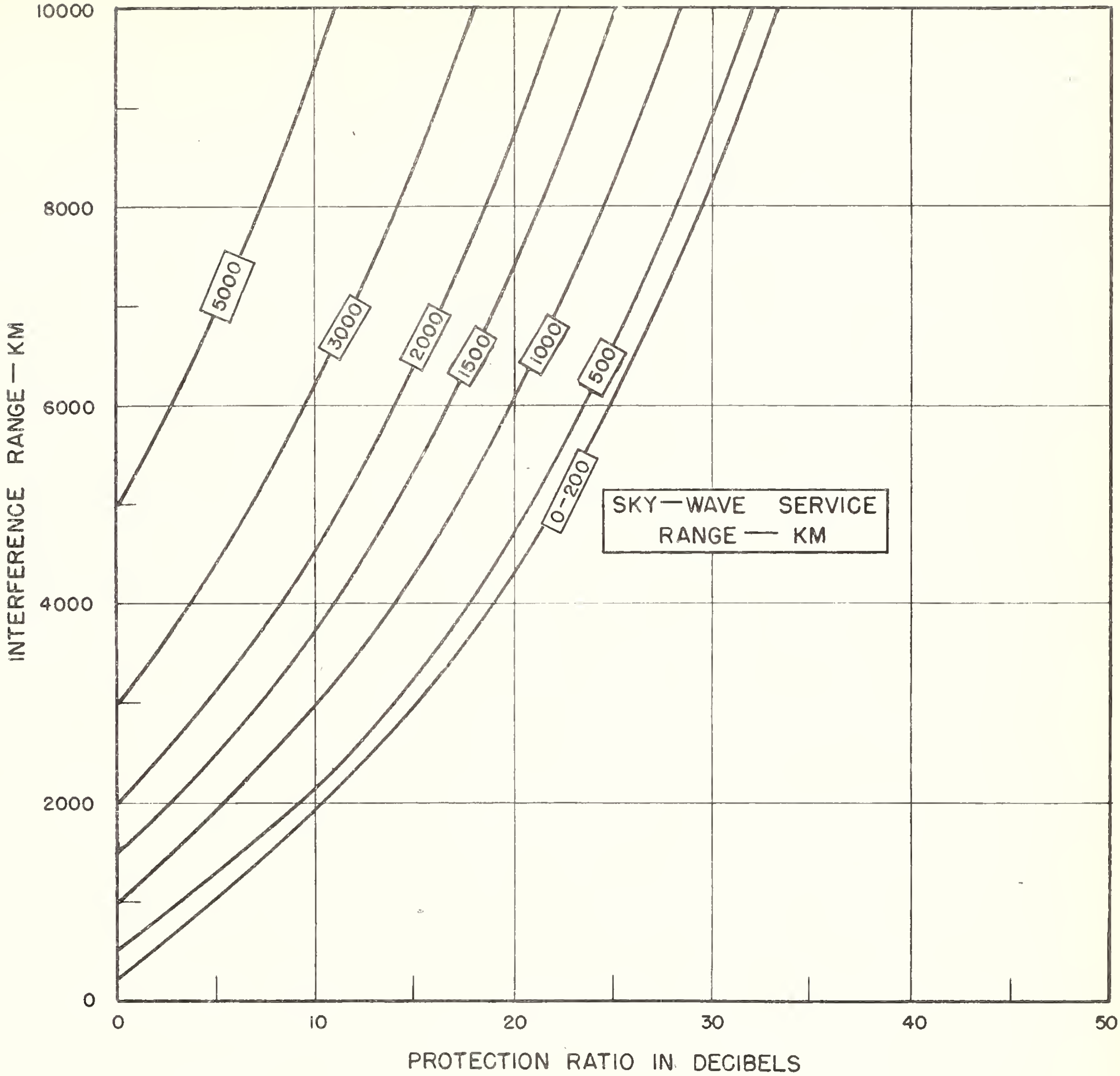



Fig. 125
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

20 MC. TRANSMITTER 30° FROM THE DAY—NIGHT LINE TRANSMITTING PARALLEL TO IT.

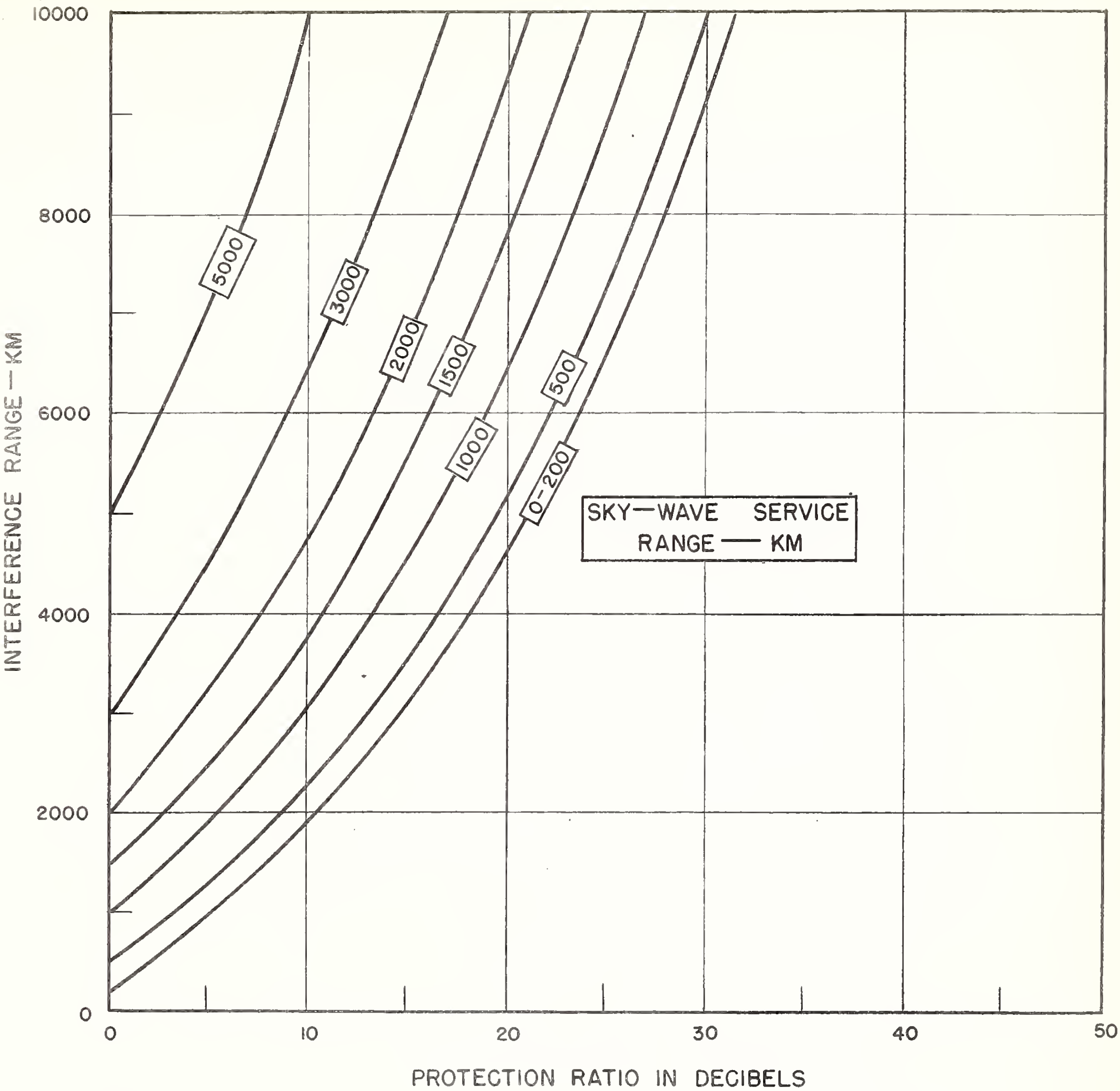



Fig. 126
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

25 MC. TRANSMITTER 30° FROM THE DAY—NIGHT LINE TRANSMITTING PARALLEL TO IT.

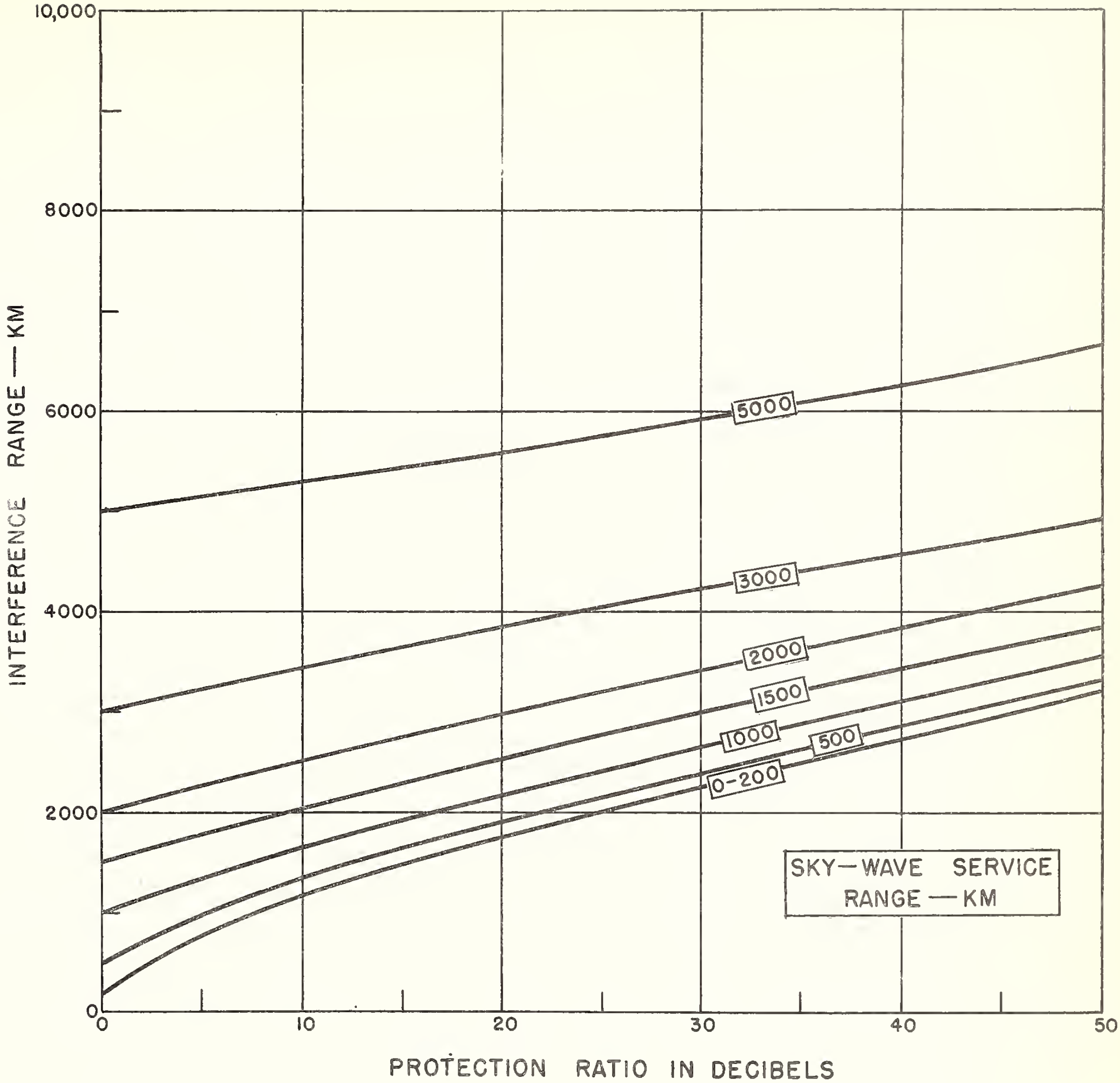



Fig. 127
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

4 MC. TRANSMITTER AT THE DAY-NIGHT LINE TRANSMITTING TOWARD THE SUBSOLAR POINT.

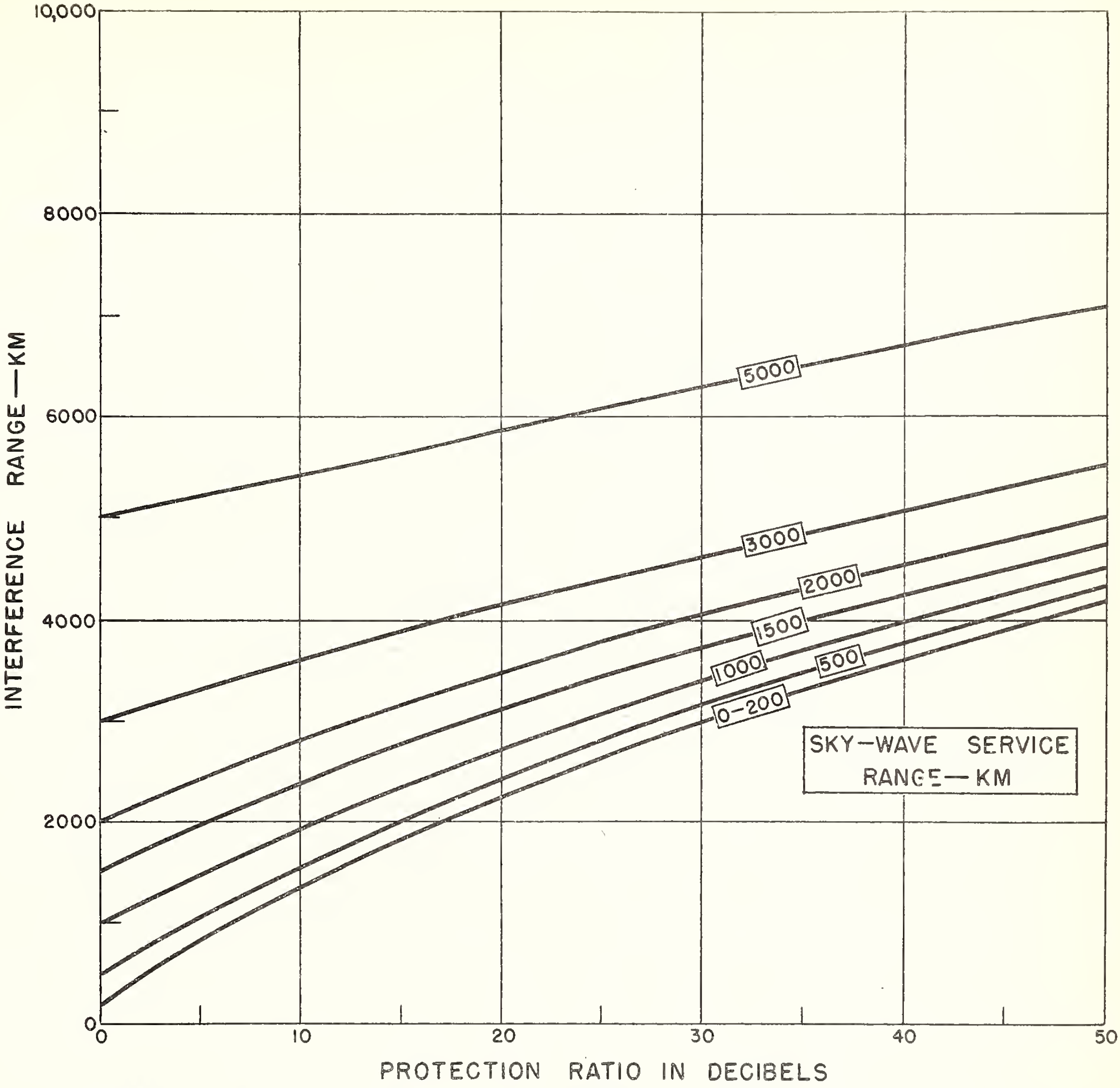



Fig. 128
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

6 MC. TRANSMITTER AT THE DAY-NIGHT LINE TRANSMITTING TOWARD THE SUBSOLAR POINT.

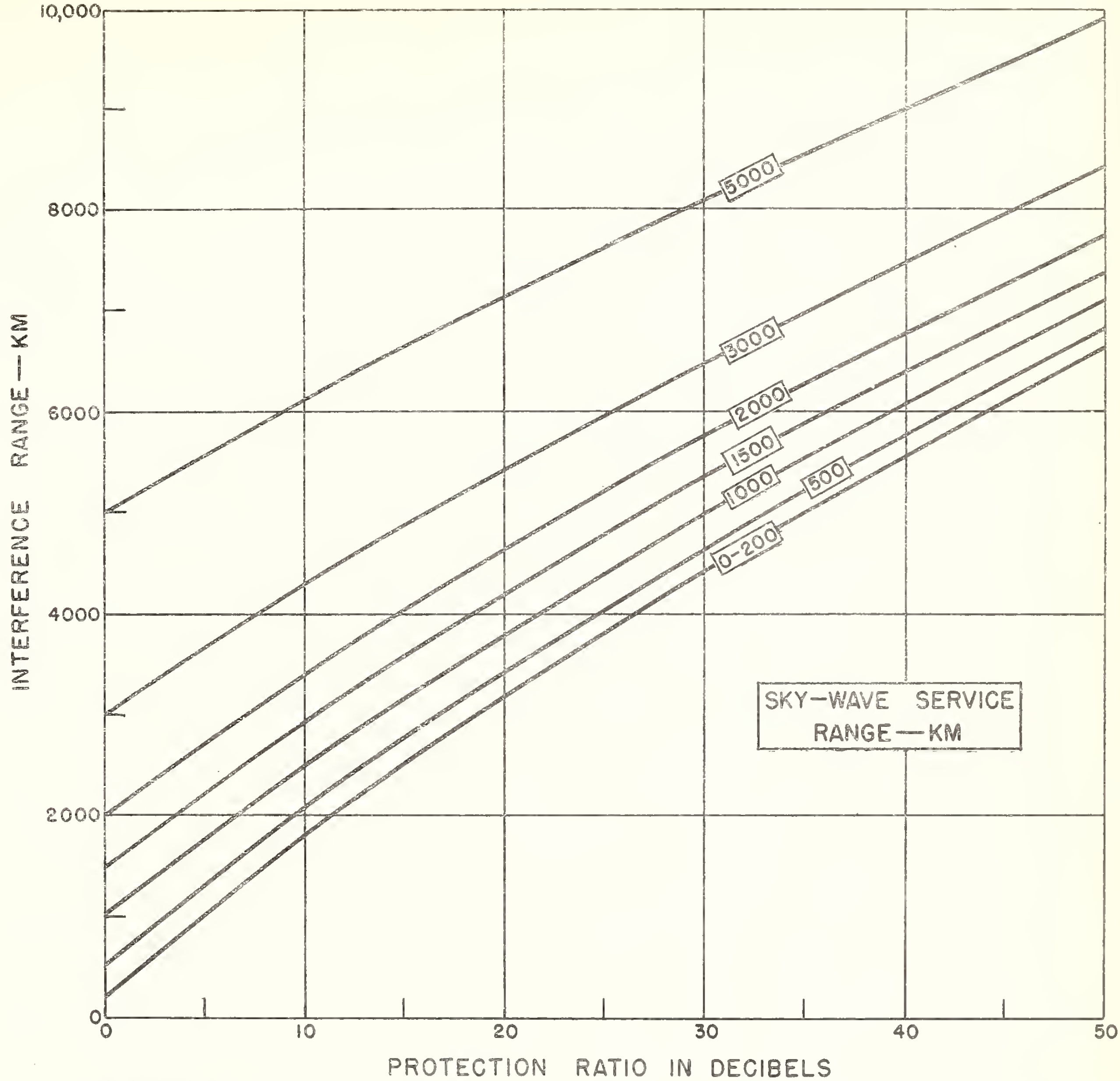



Fig. 129
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

10 MC. TRANSMITTER AT THE DAY-NIGHT LINE TRANSMITTING TOWARD THE SUBSOLAR POINT.

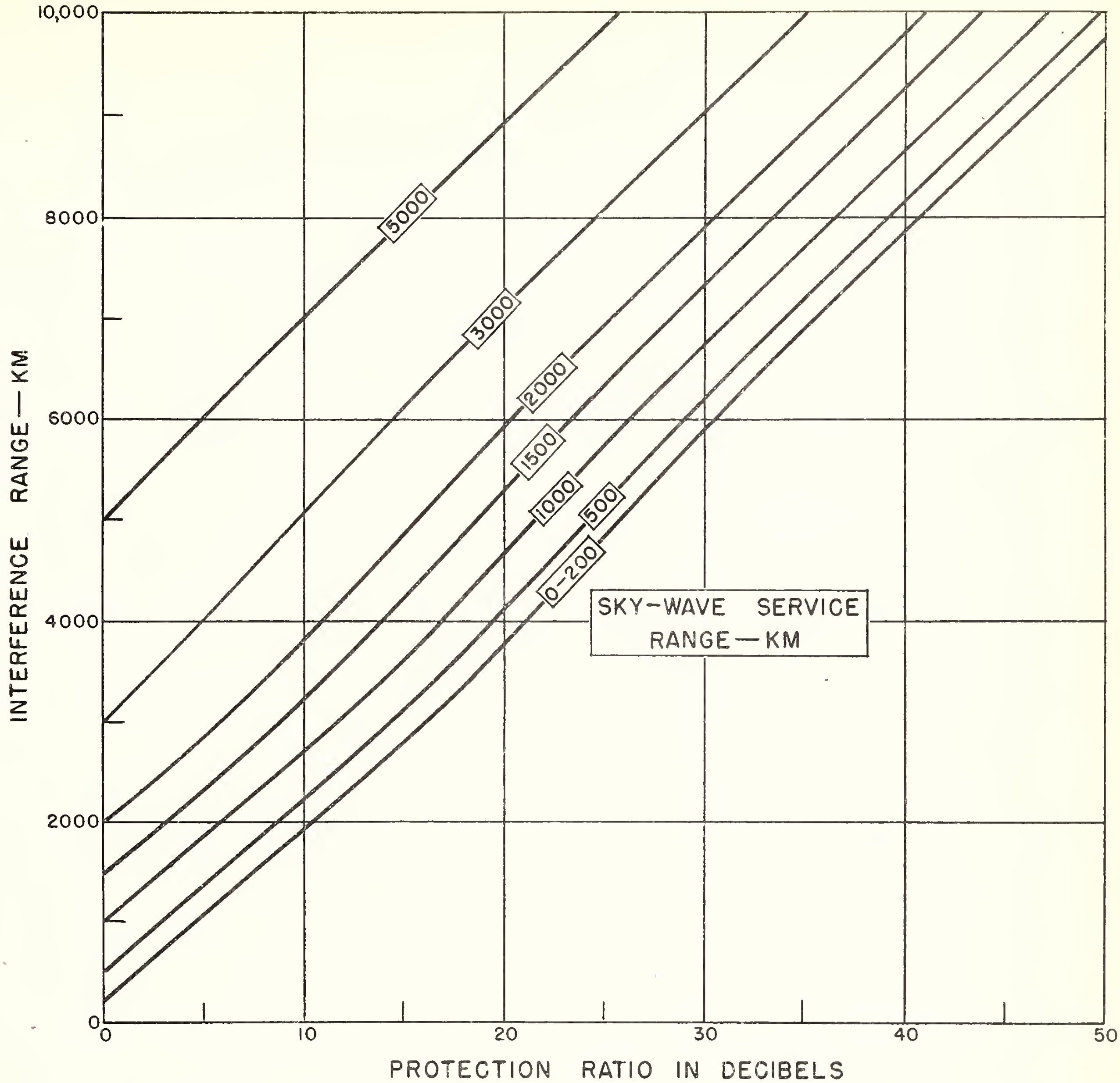



Fig. 130
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

15 MC. TRANSMITTER AT THE DAY-NIGHT LINE TRANSMITTING TOWARD THE SUBSOLAR POINT.

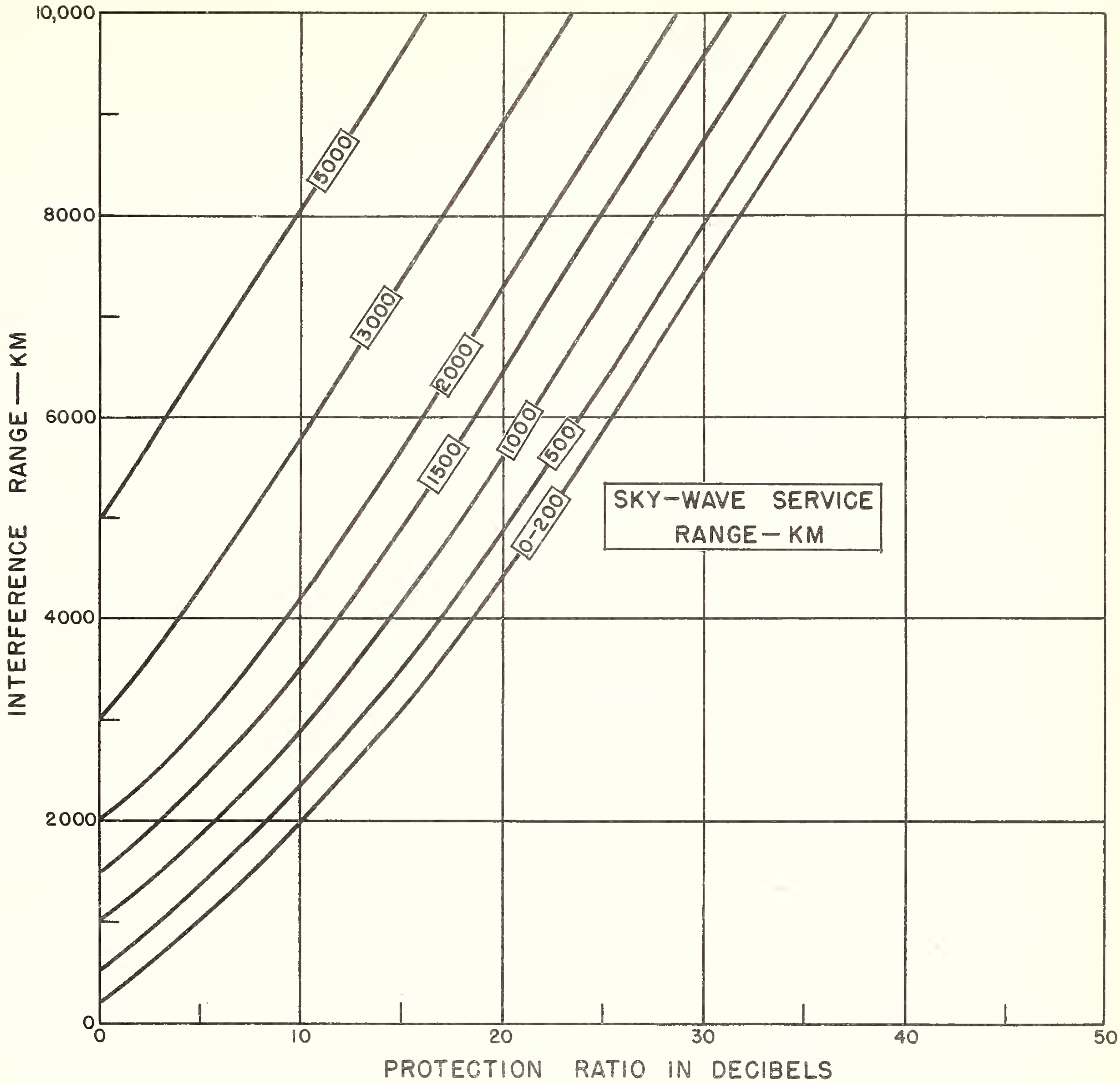



Fig. 131
INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

20 MC. TRANSMITTER AT THE DAY-NIGHT LINE TRANSMITTING TOWARD THE SUBSOLAR POINT.

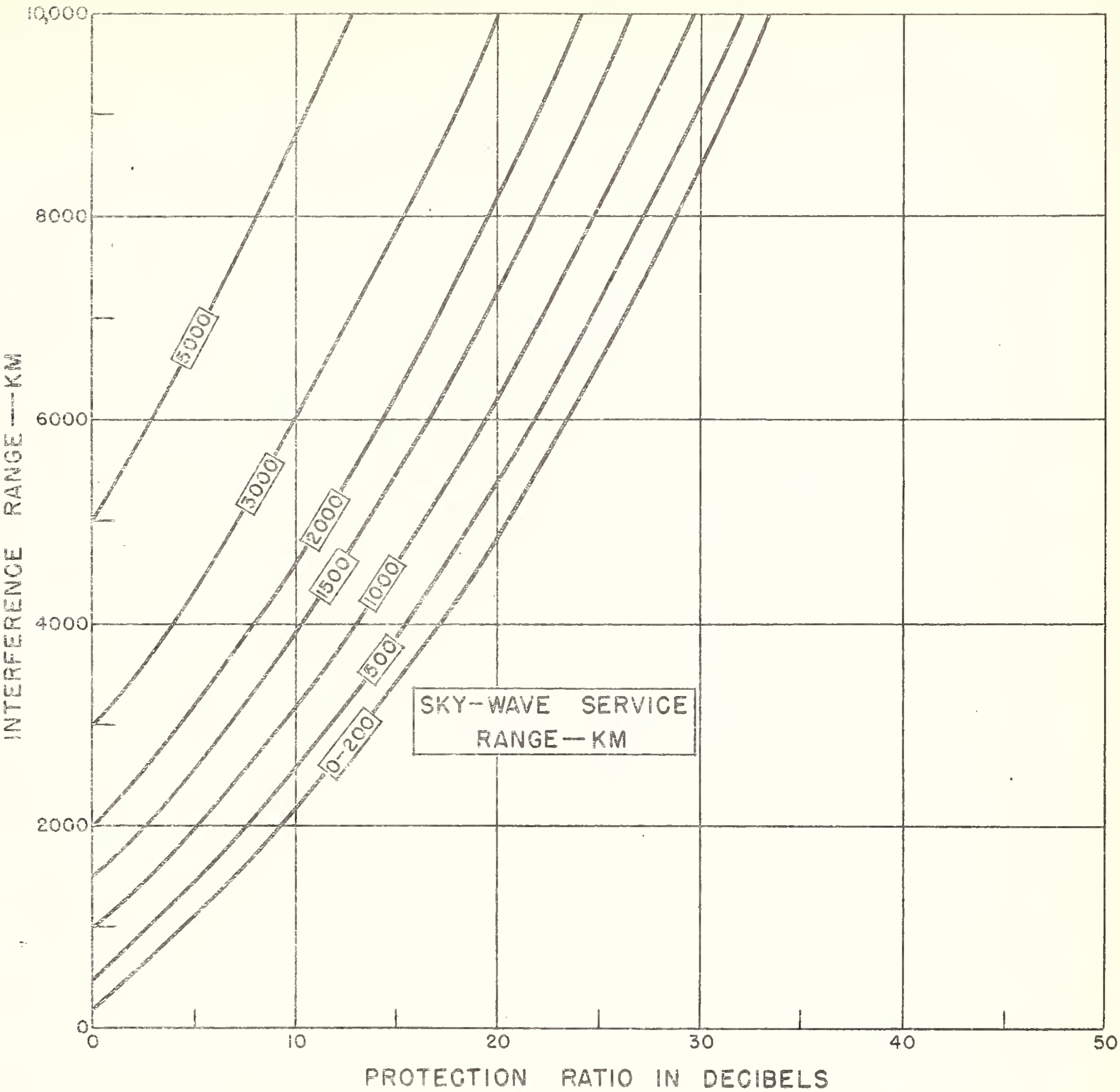



Fig. 132

INTERFERENCE AND SERVICE RANGES FOR A GIVEN PROTECTION RATIO AT SUNSPOT MINIMUM.

25 MC. TRANSMITTER AT THE DAY-NIGHT LINE TRANSMITTING TOWARD THE SUBSOLAR POINT.

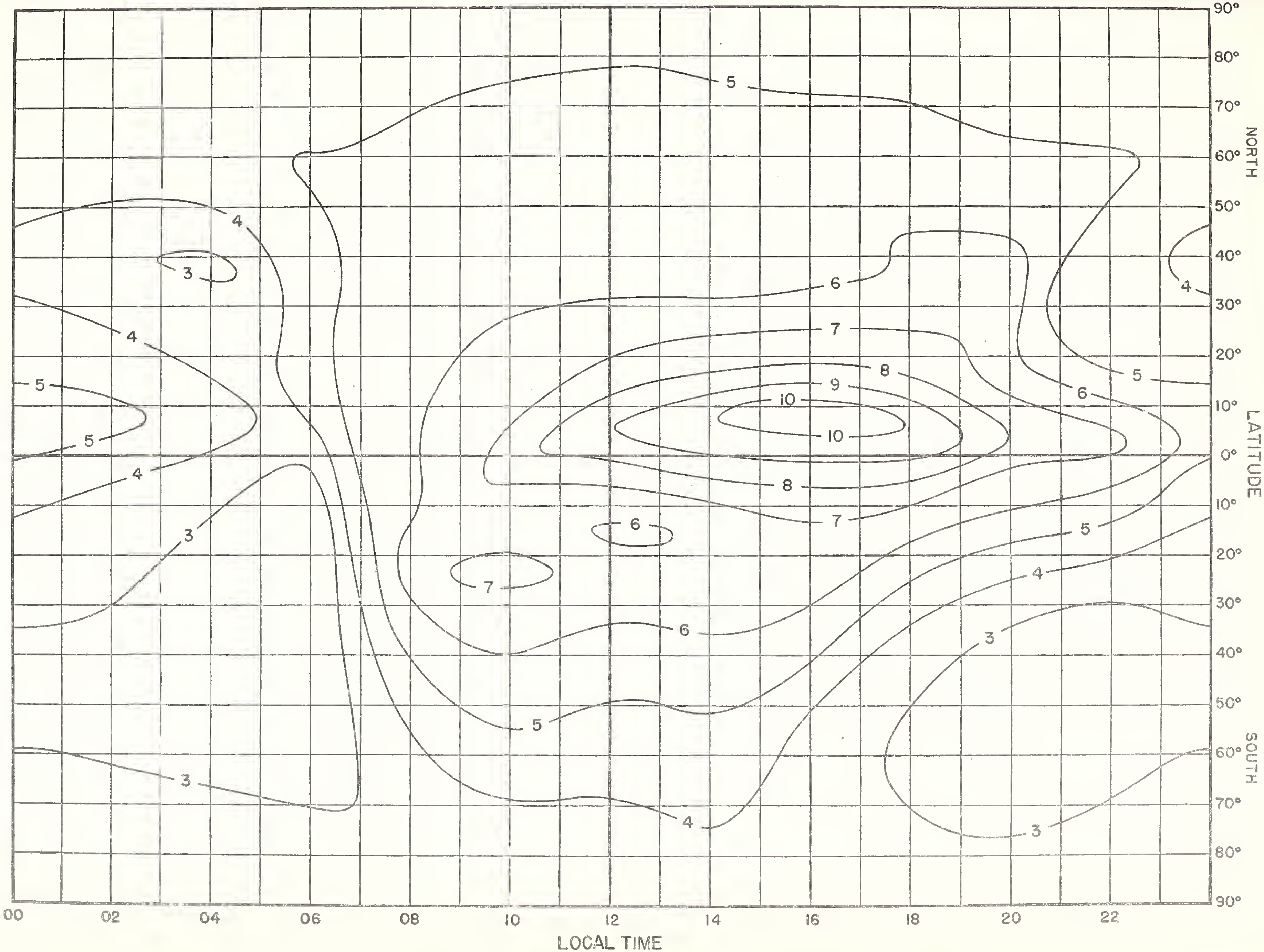



Fig. 133 $F_2$ ZERO-MUF —— JUNE —— W ZONE —— SUNSPOT NUMBER 0

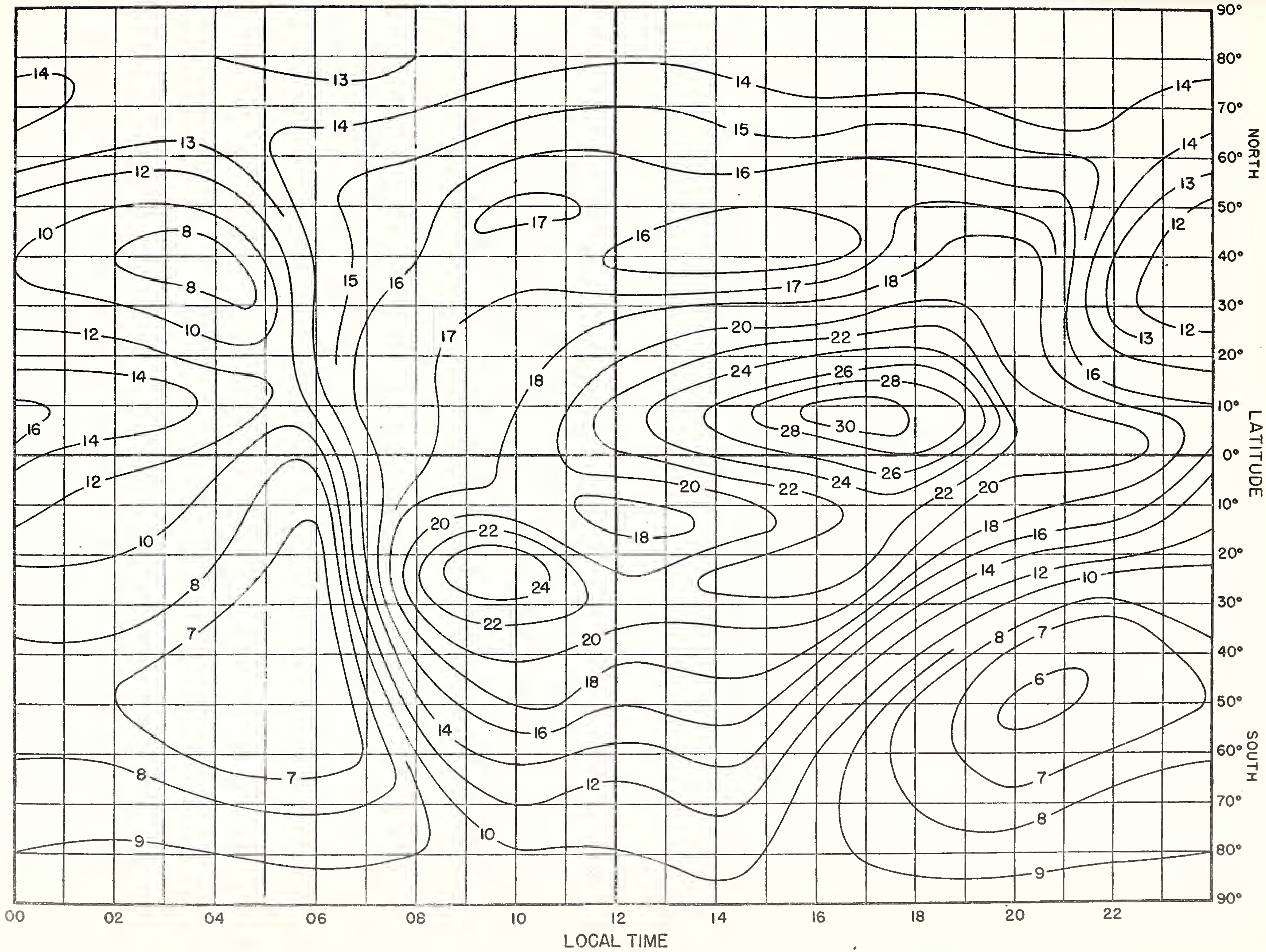



Fig. 134 $F_2$ 4000-MUF —— JUNE —— W ZONE —— SUNSPOT NUMBER 0

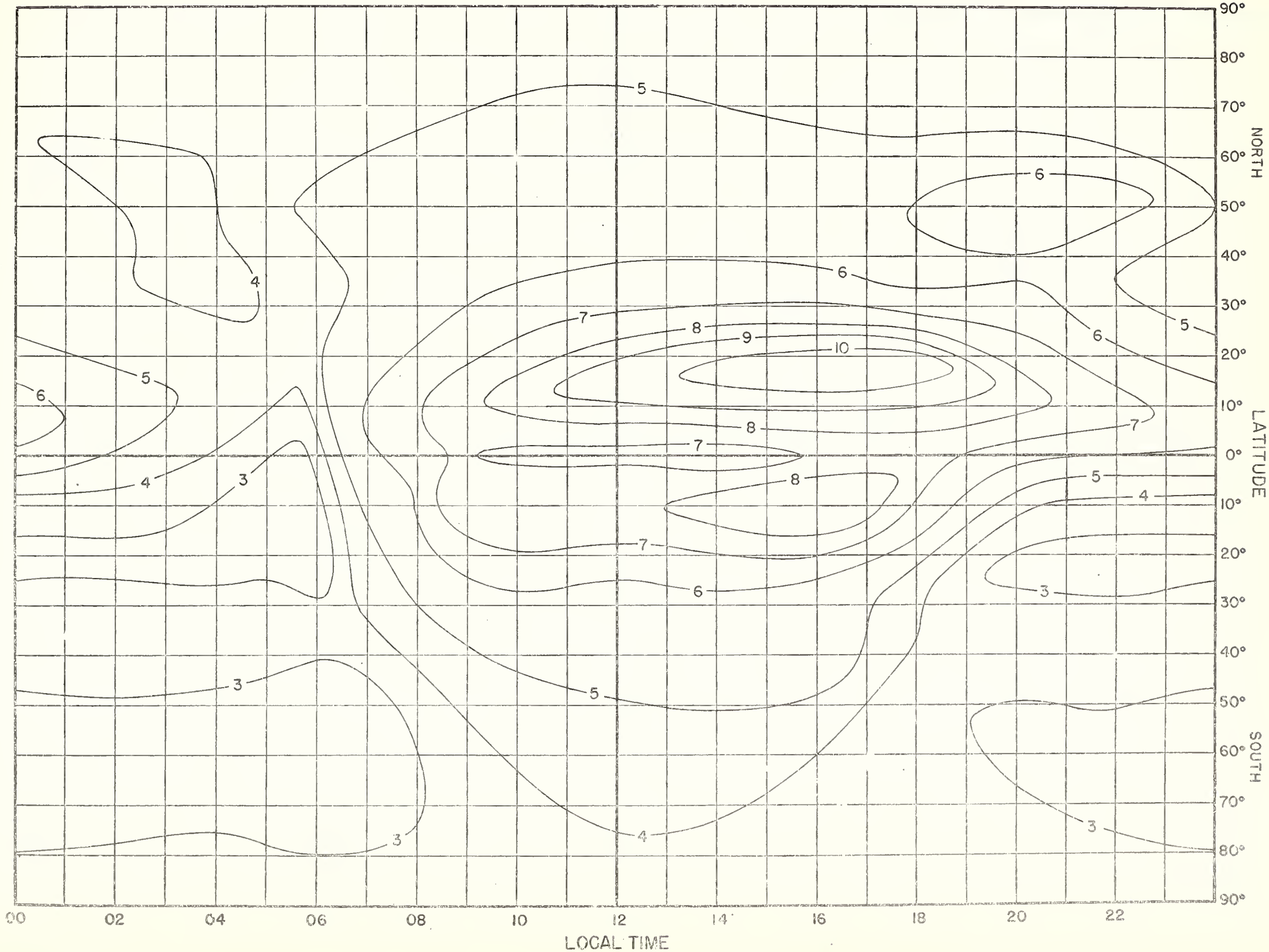



Fig. 135 $F_2$ ZERO-MUF —— JUNE —— I ZONE SUNSPOT NUMBER 0

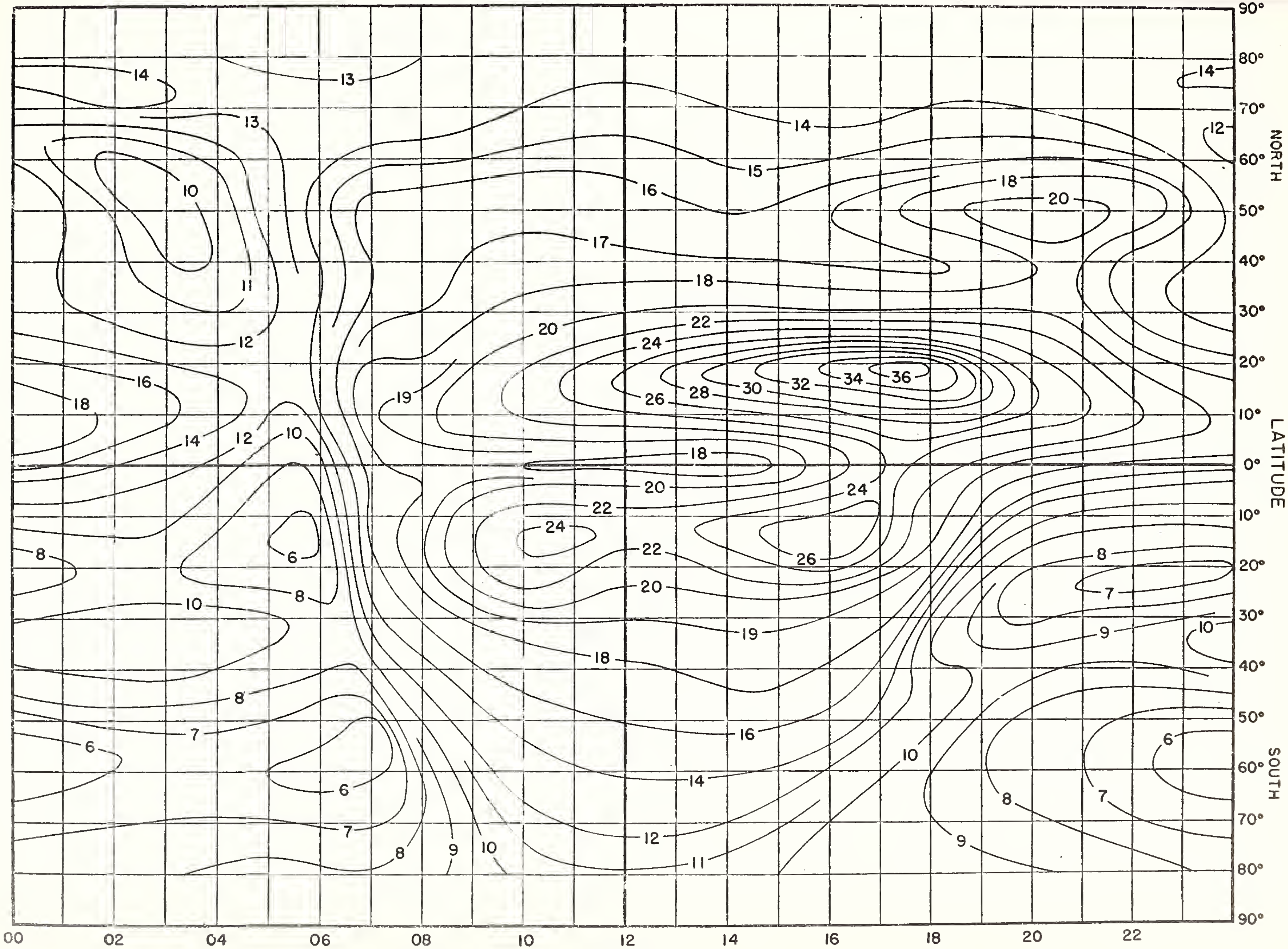



Fig. 136 $F_2$ 4000-MUF —— JUNE —— I ZONE SUNSPOT NUMBER 0

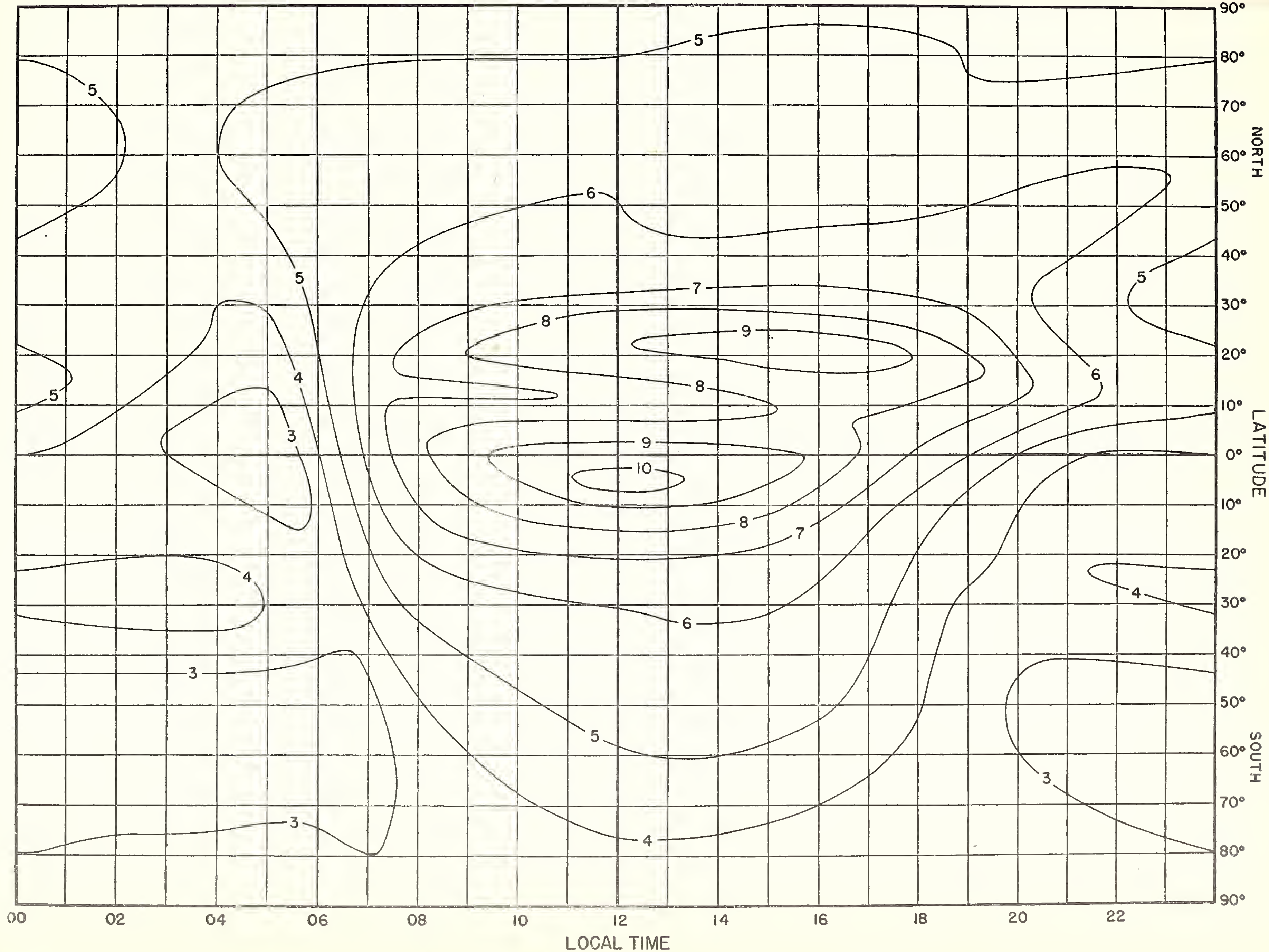



Fig. 137 $F_2$ ZERO-MUF —— JUNE —— E ZONE SUNSPOT NUMBER 0

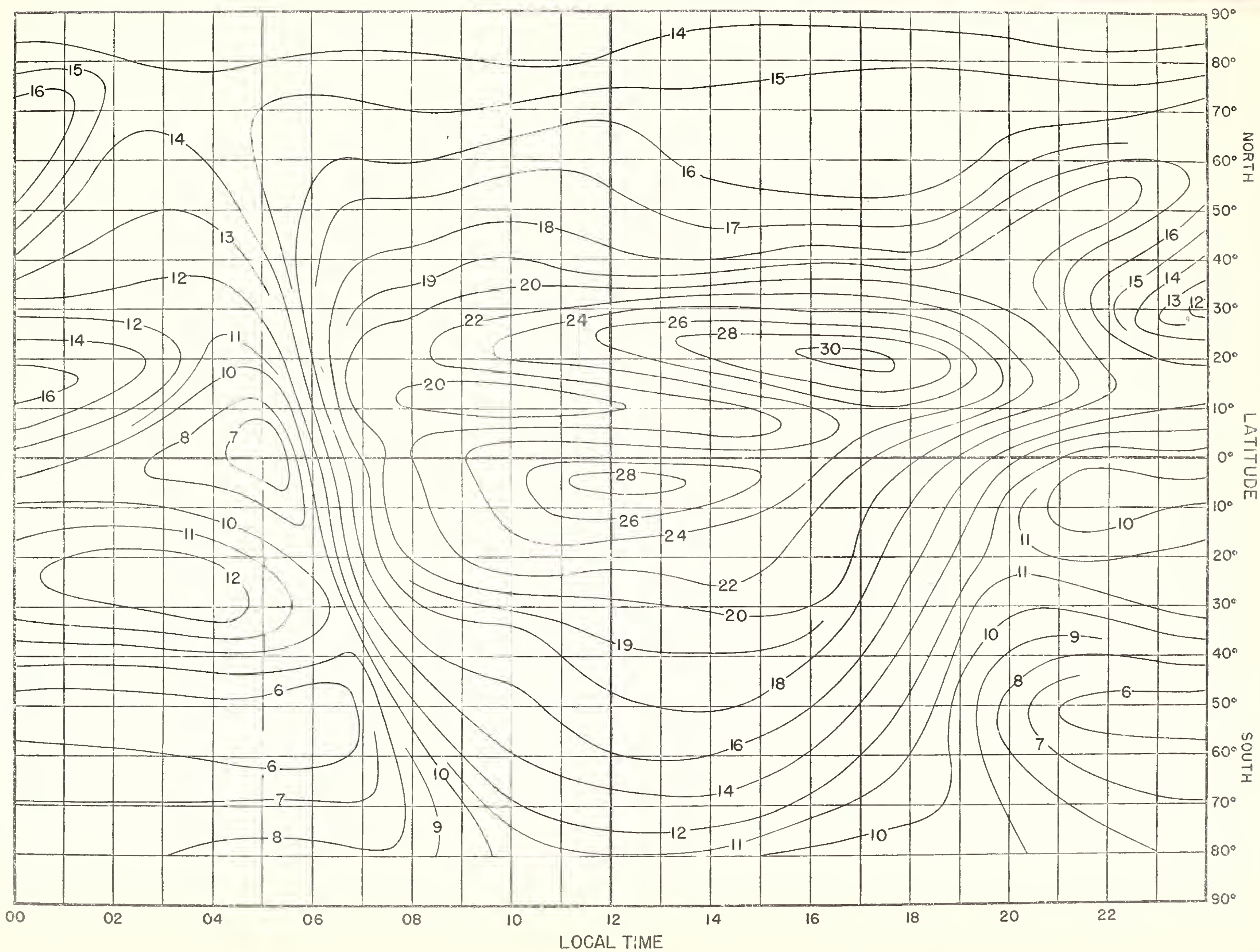



Fig. 138 $F_2$ 4000—MUF —— JUNE —— E ZONE SUNSPOT NUMBER 0

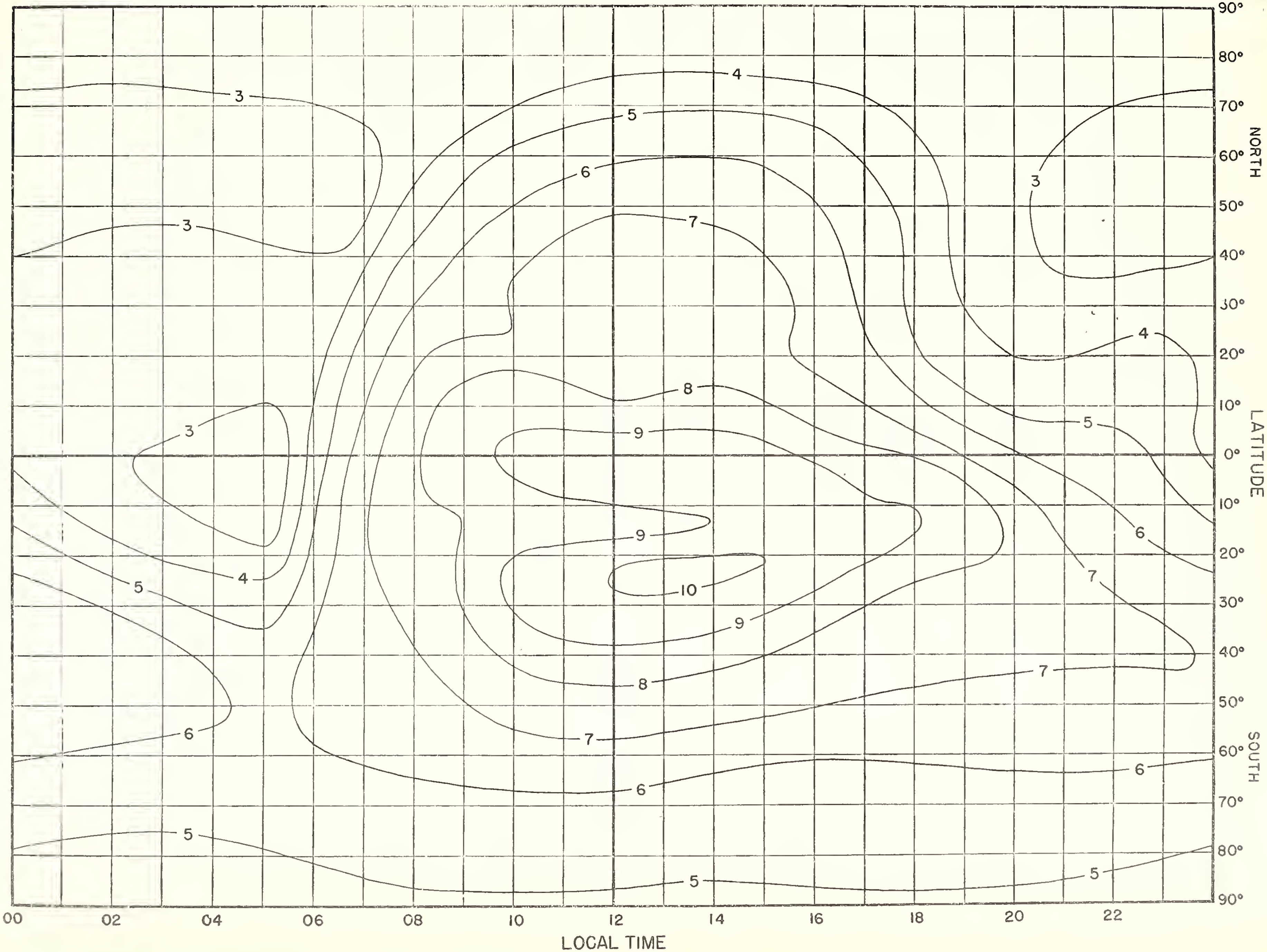



Fig. 139 $F_2$ ZERO-MUF — DECEMBER — W ZONE —— SUNSPOT NUMBER 0

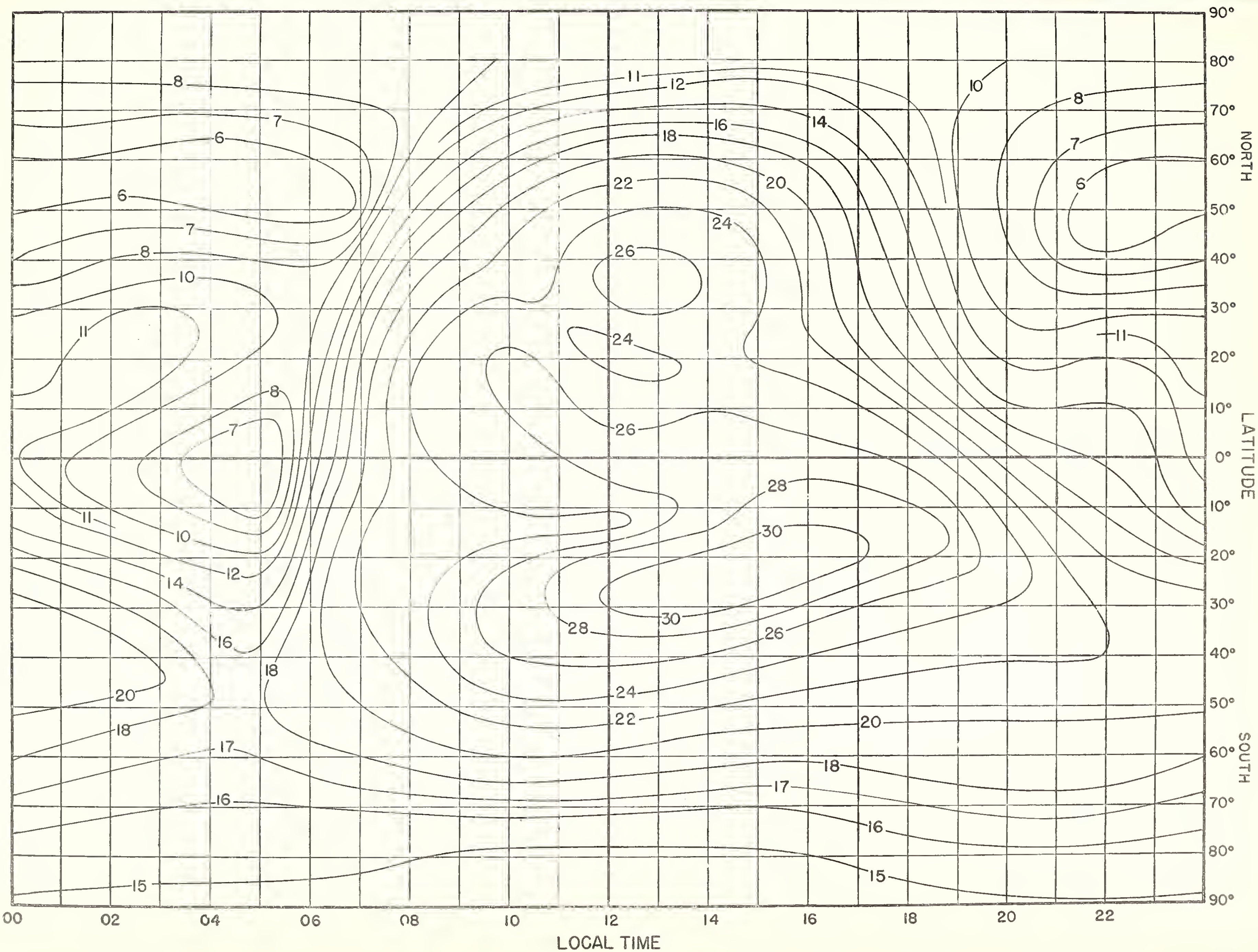



Fig. 140 $F_2$ 4000—MUF—DECEMBER—W ZONE SUNSPOT NUMBER 0

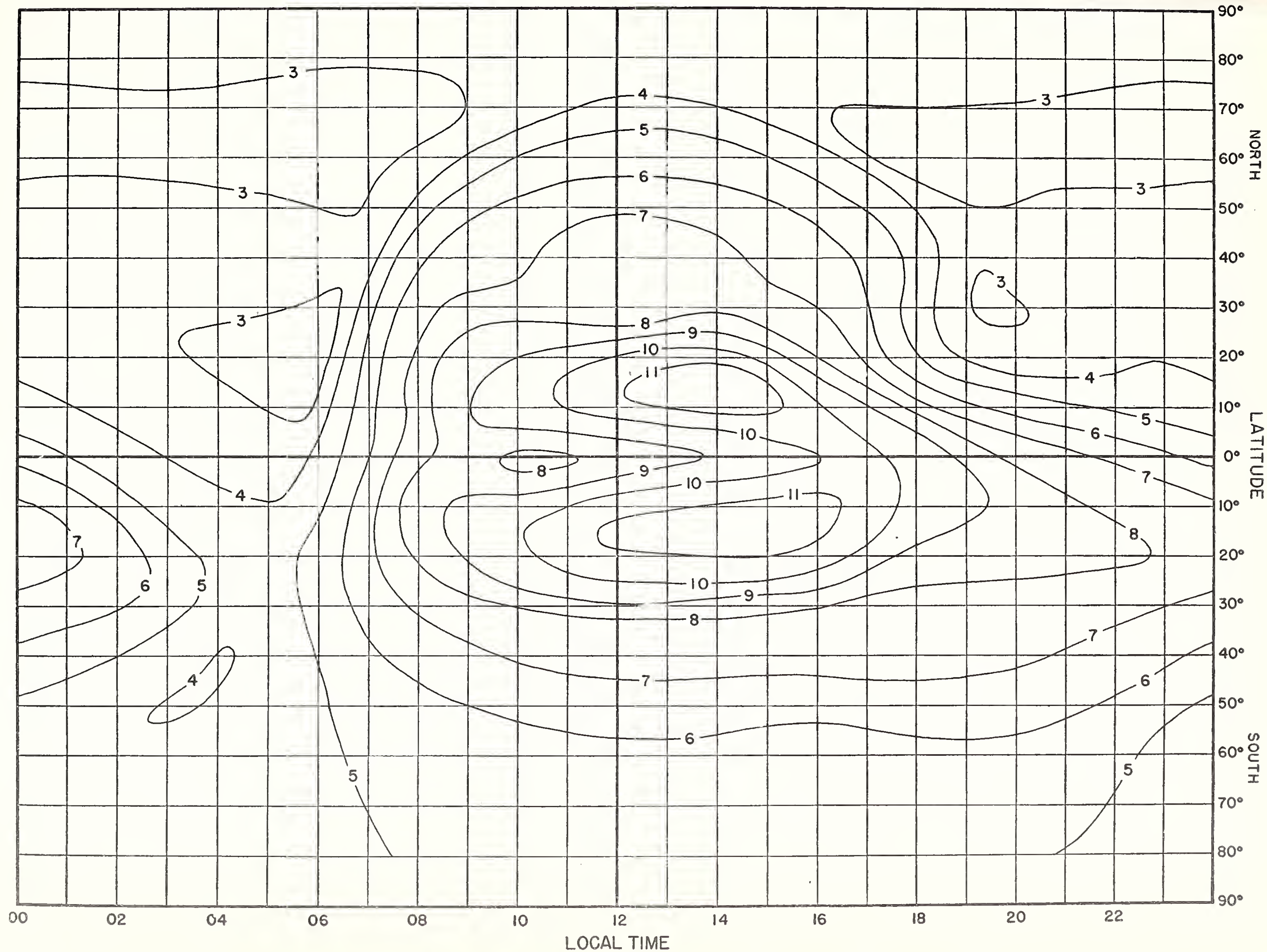



Fig. 141 $F_2$ ZERO-MUF—DECEMBER—I ZONE —— SUNSPOT NUMBER 0

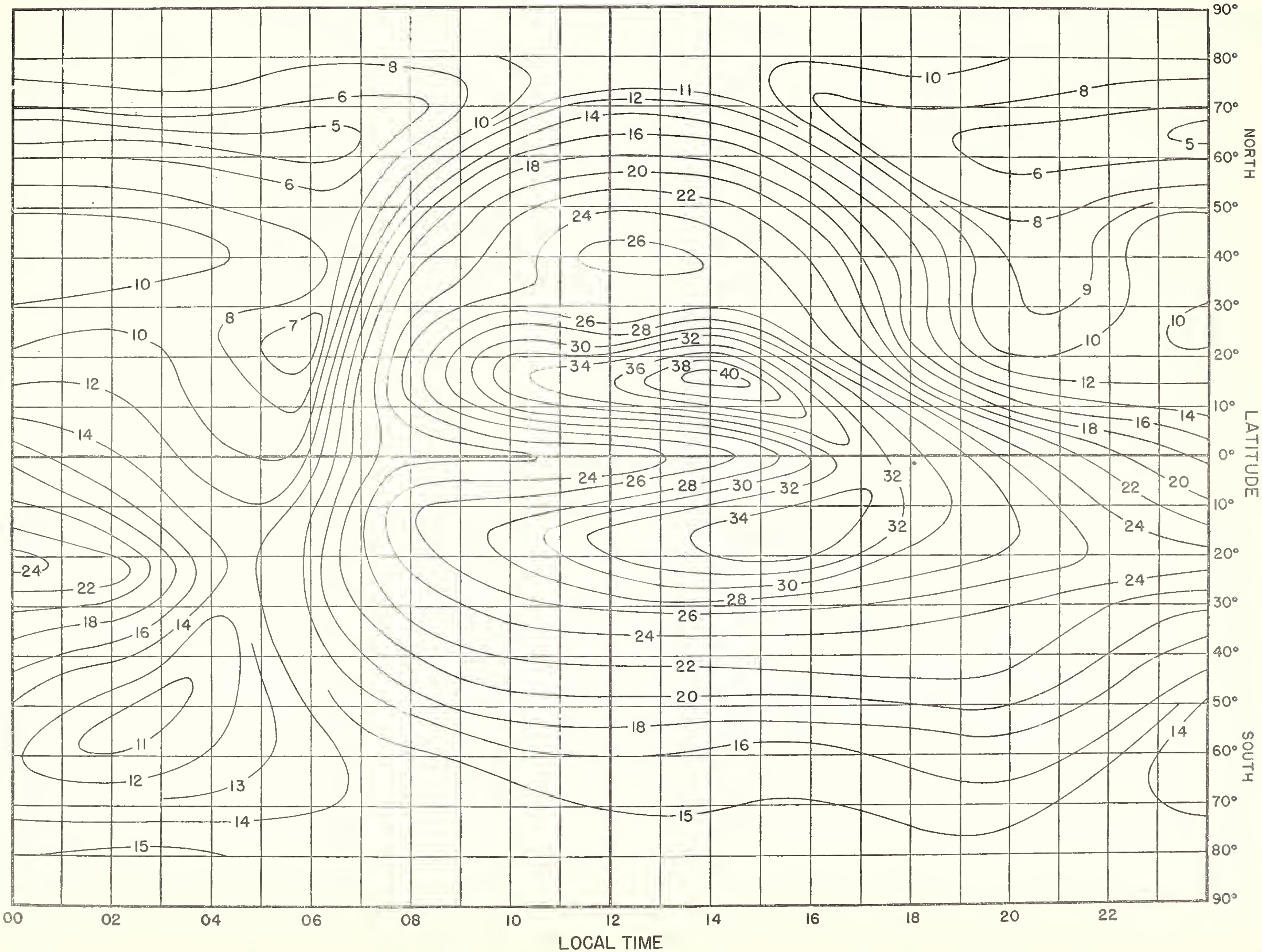



Fig. 142 $F_2$ 4000—MUF—DECEMBER—I ZONE SUNSPOT NUMBER 0

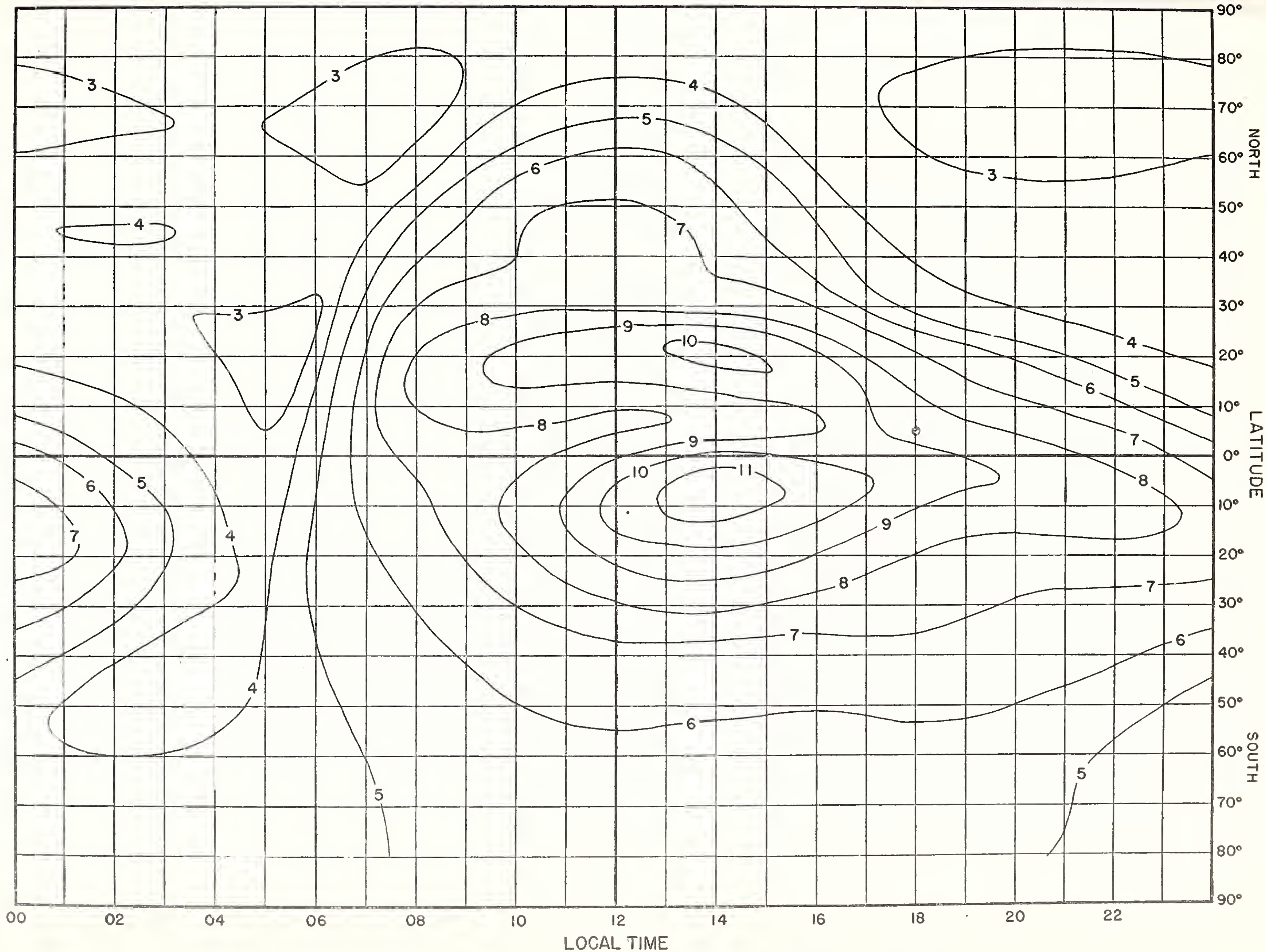



Fig. 143 $F_2$ ZERO-MUF—DECEMBER—E ZONE —— SUNSPOT NUMBER 0

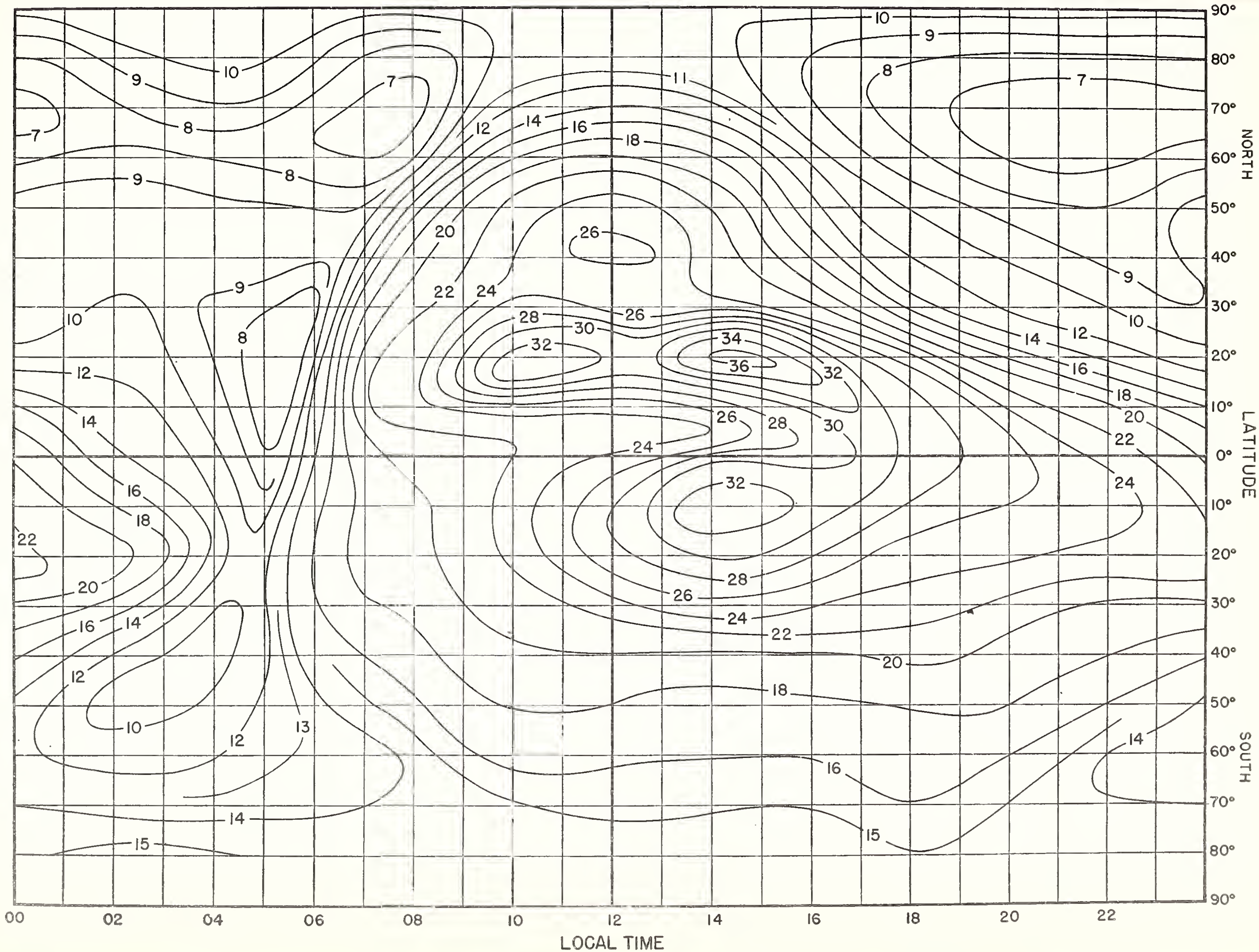



Fig. 144 $F_2$ 4000—MUF—DECEMBER—E ZONE . SUNSPOT NUMBER 0

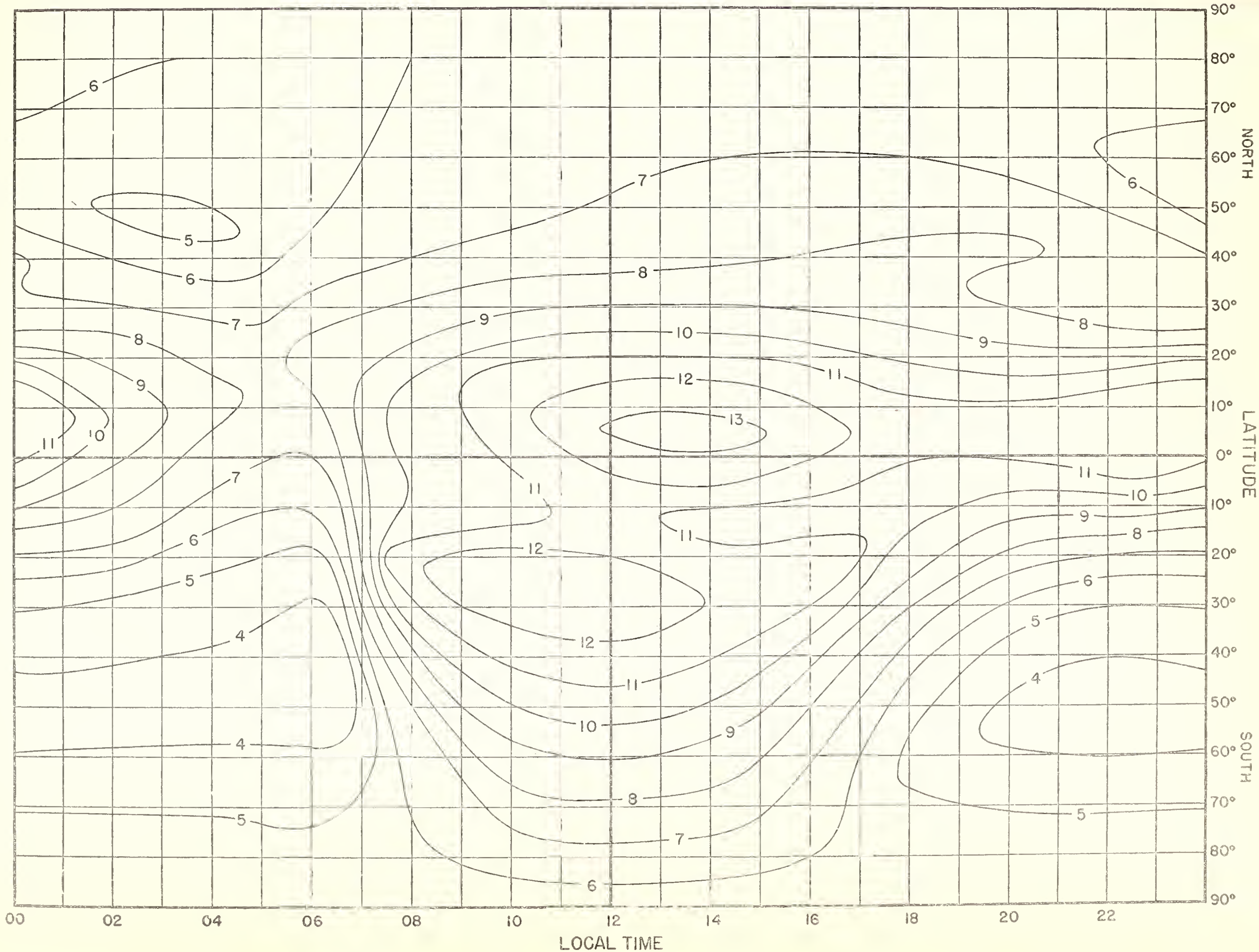



Fig. 145 $F_2$ ZERO—MUF—JUNE—W ZONE SUNSPOT NUMBER 125

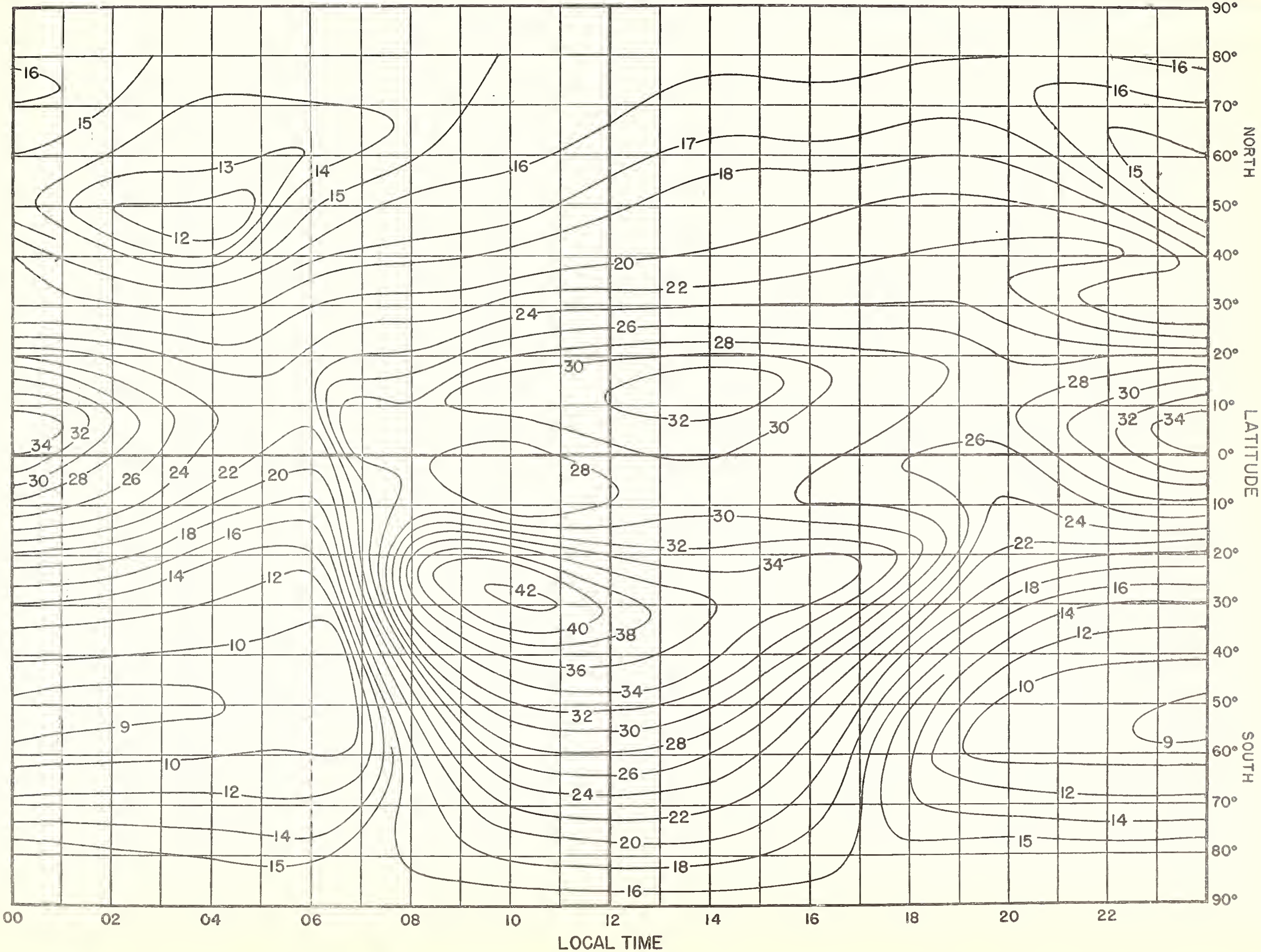



Fig. 146 $F_2$ 4000—MUF —— JUNE —— W ZONE SUNSPOT NUMBER 125

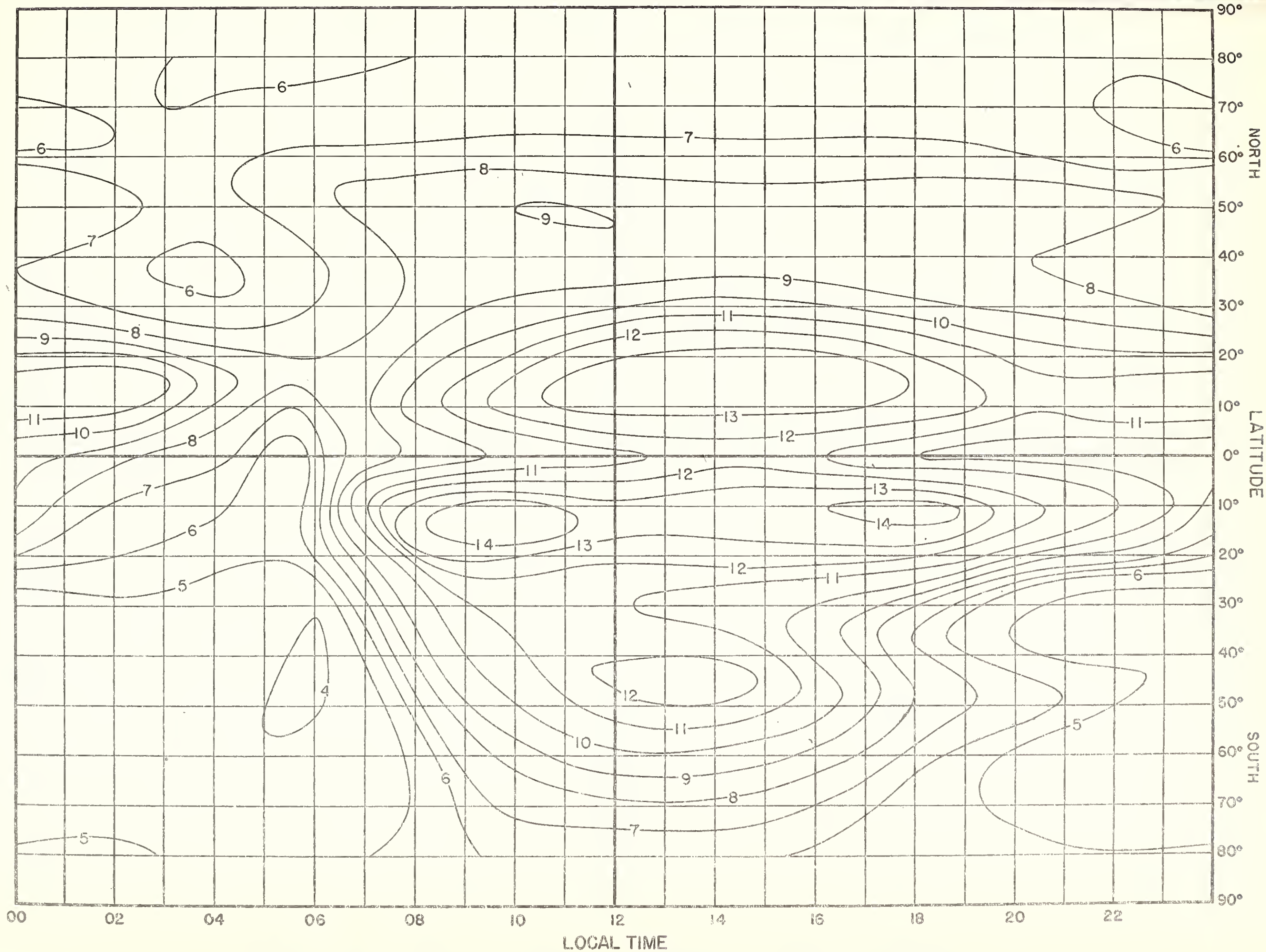



Fig. 147 $F_2$ ZERO MUF —— JUNE —— I ZONE SUNSPOT NUMBER 125

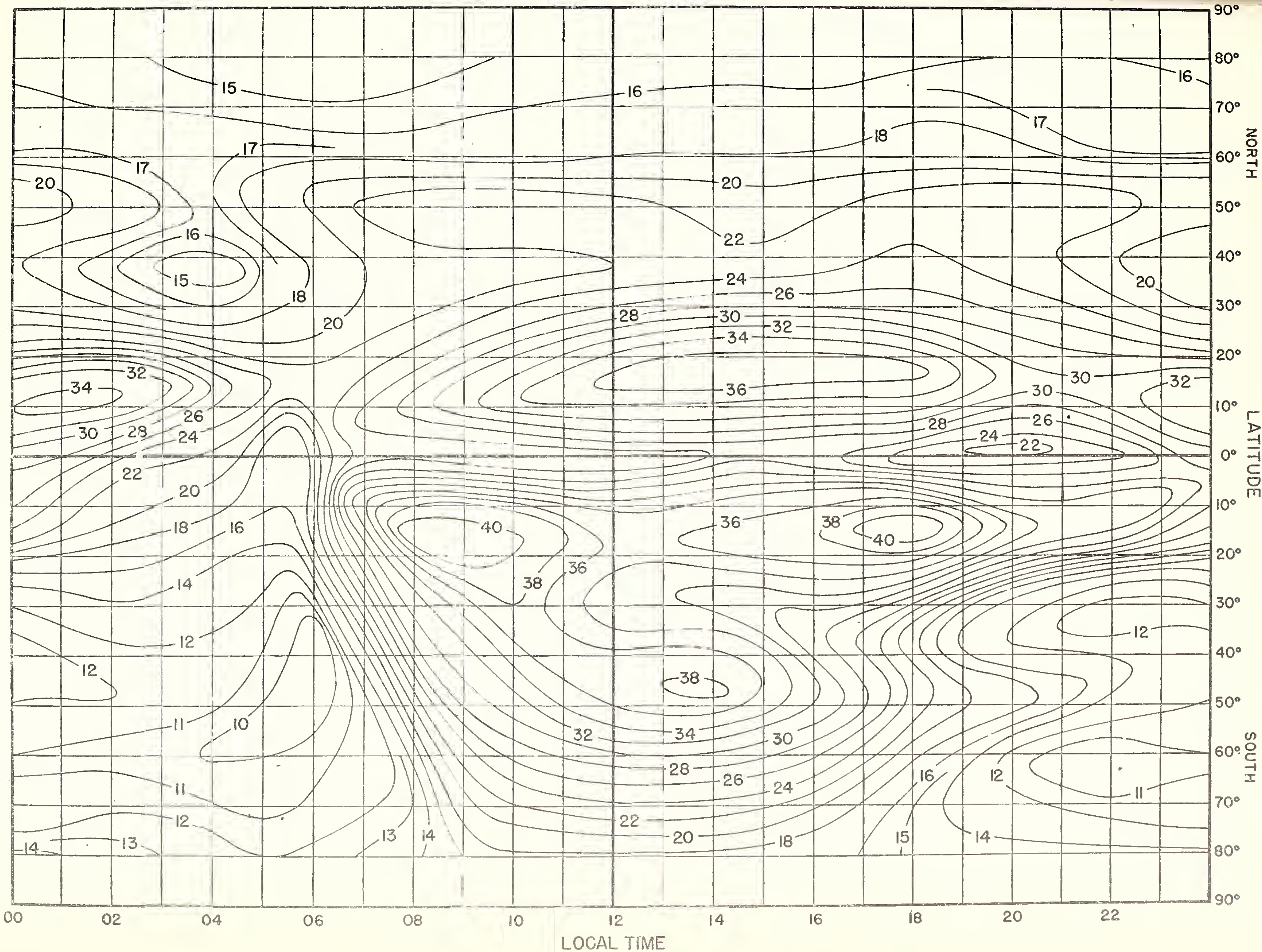



Fig. 148 $F_2$ 4000—MUF —— JUNE —— I ZONE SUNSPOT NUMBER 125

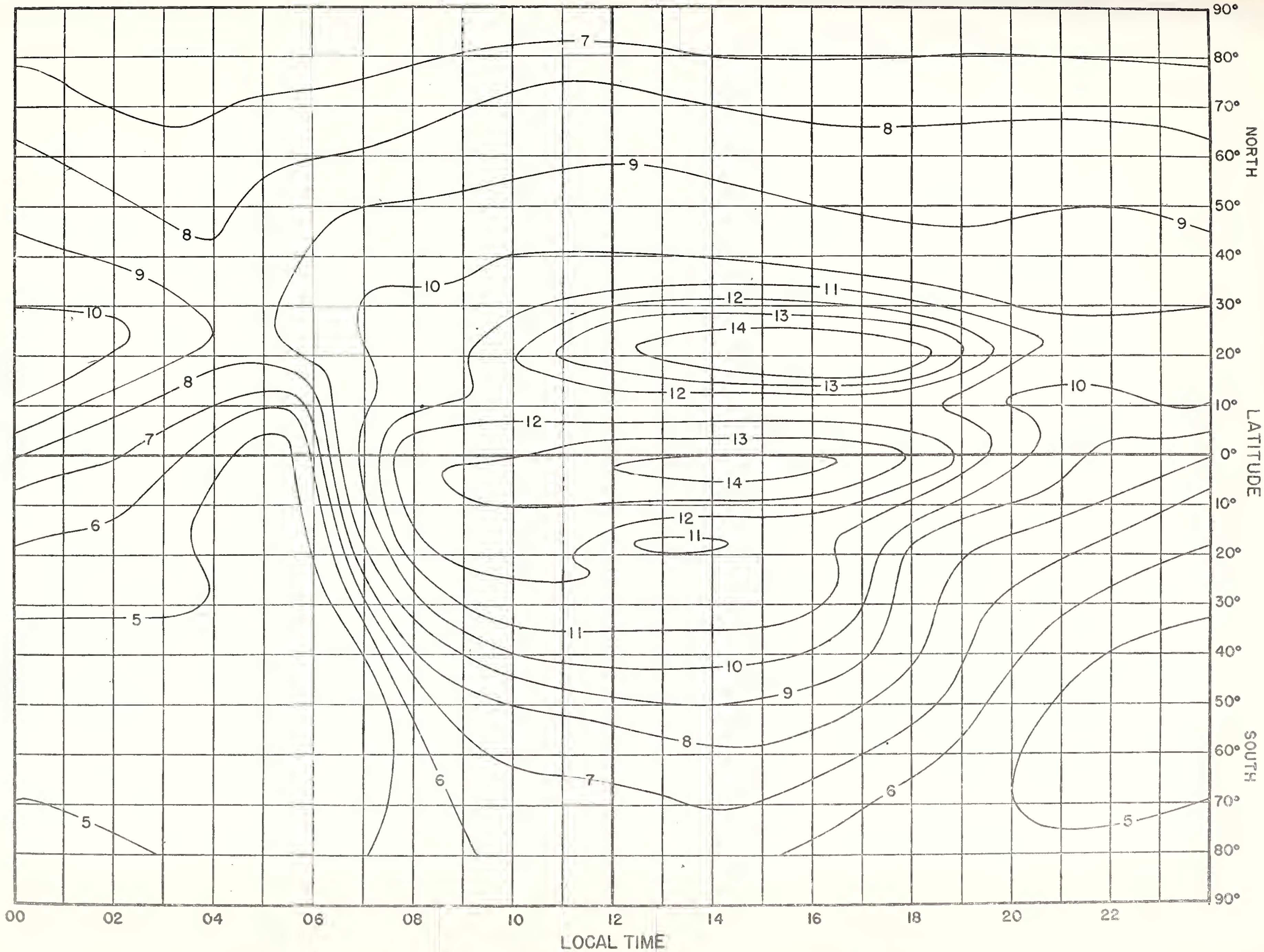



Fig. 149 $F_2$ ZERO-MUF —— JUNE —— E ZONE SUNSPOT NUMBER 125

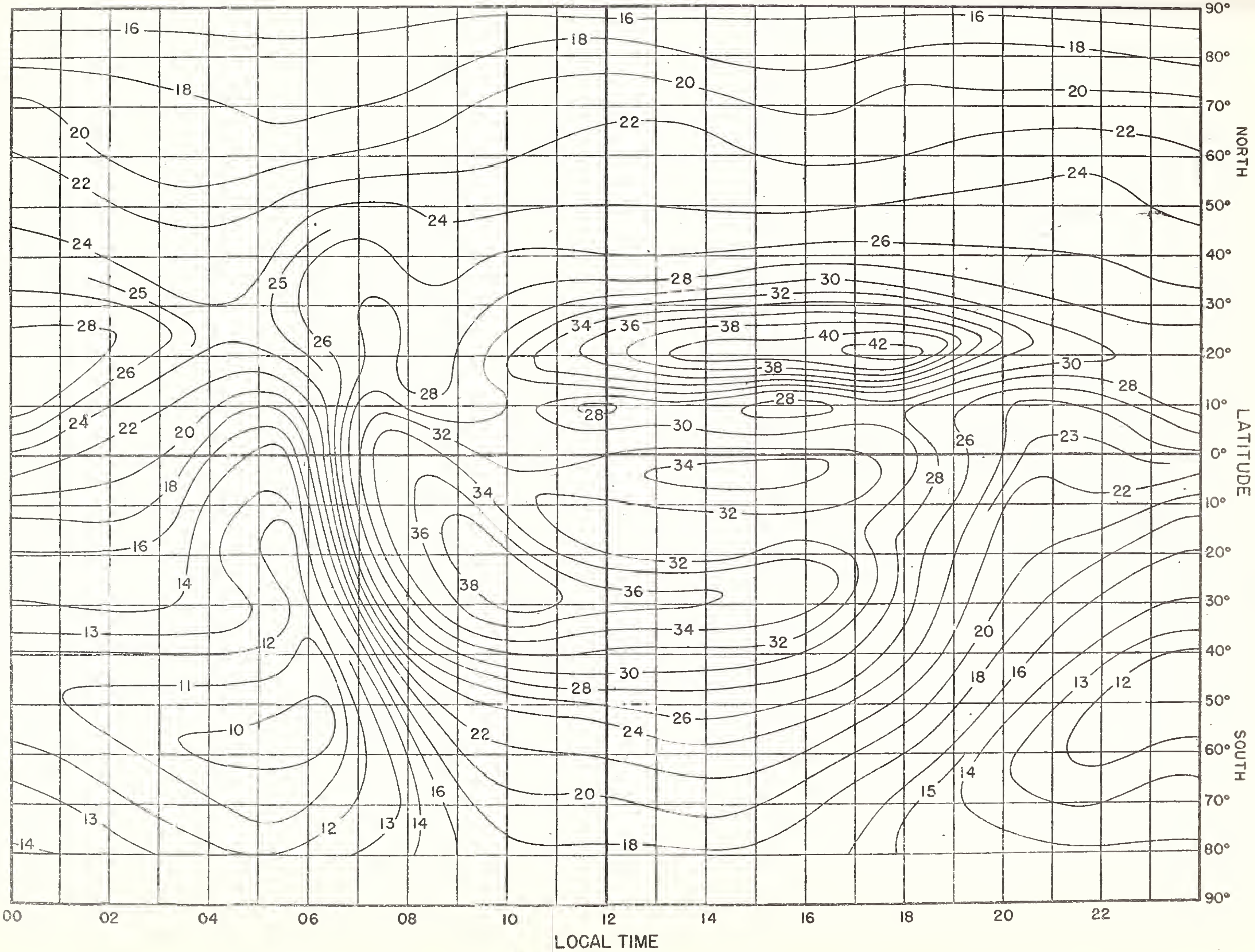



Fig. 150 $F_2$ 4000—MUF —— JUNE —— E ZONE SUNSPOT NUMBER 125

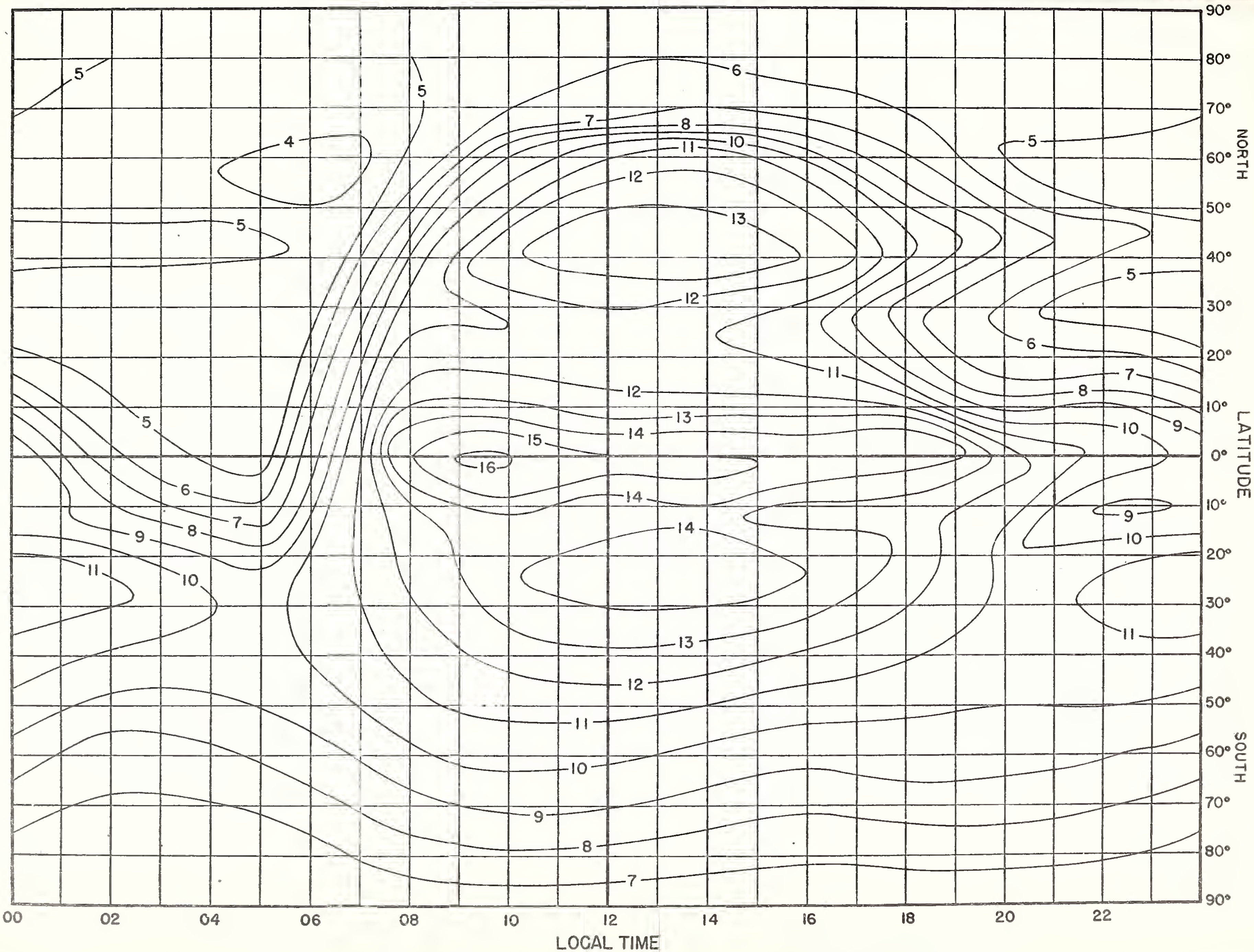



Fig. 151 $F_2$ ZERO—MUF—DECEMBER—W ZONE SUNSPOT NUMBER 125

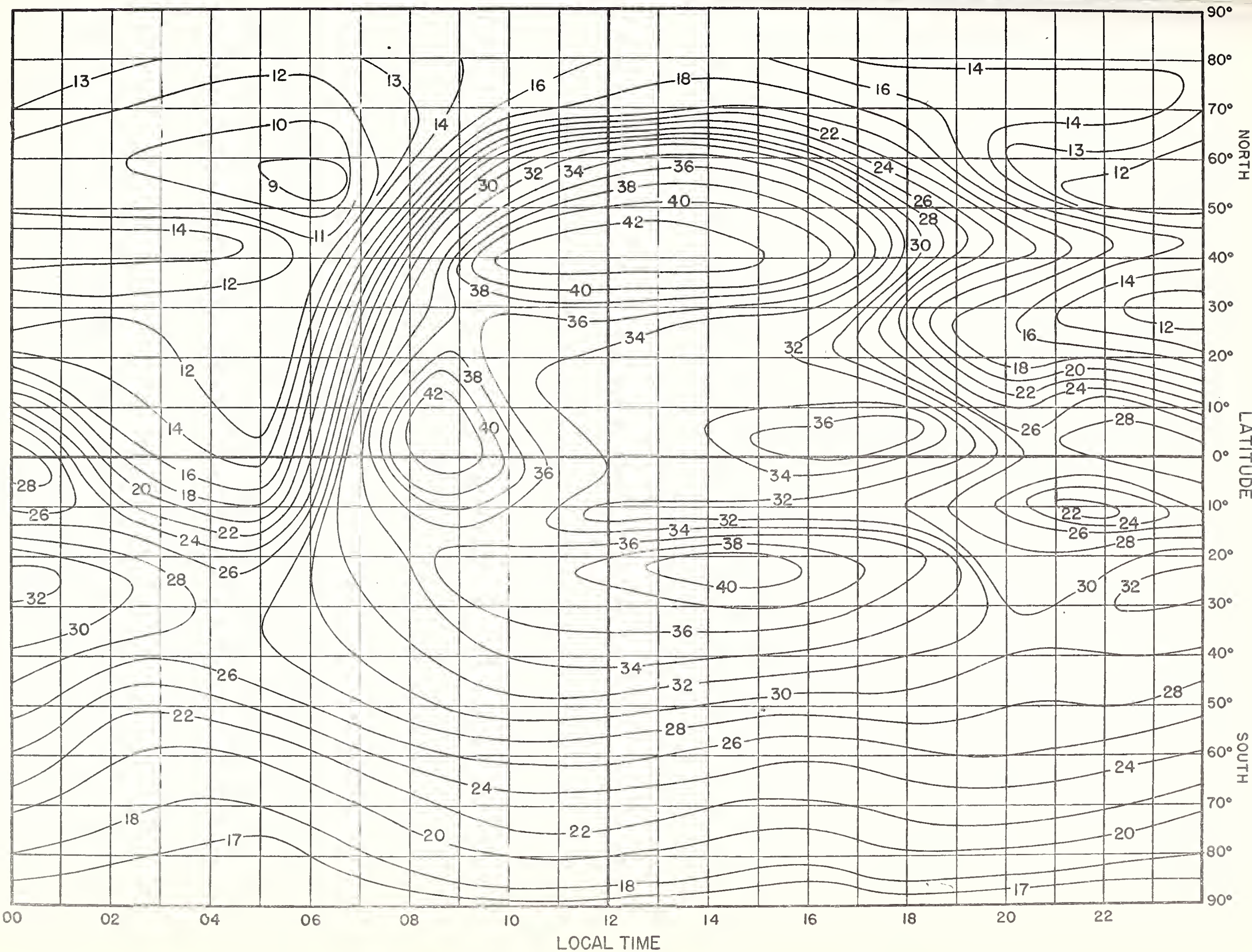



Fig. 152 $F_2$ 4000—MUF—DECEMBER—W ZONE SUNSPOT NUMBER 125

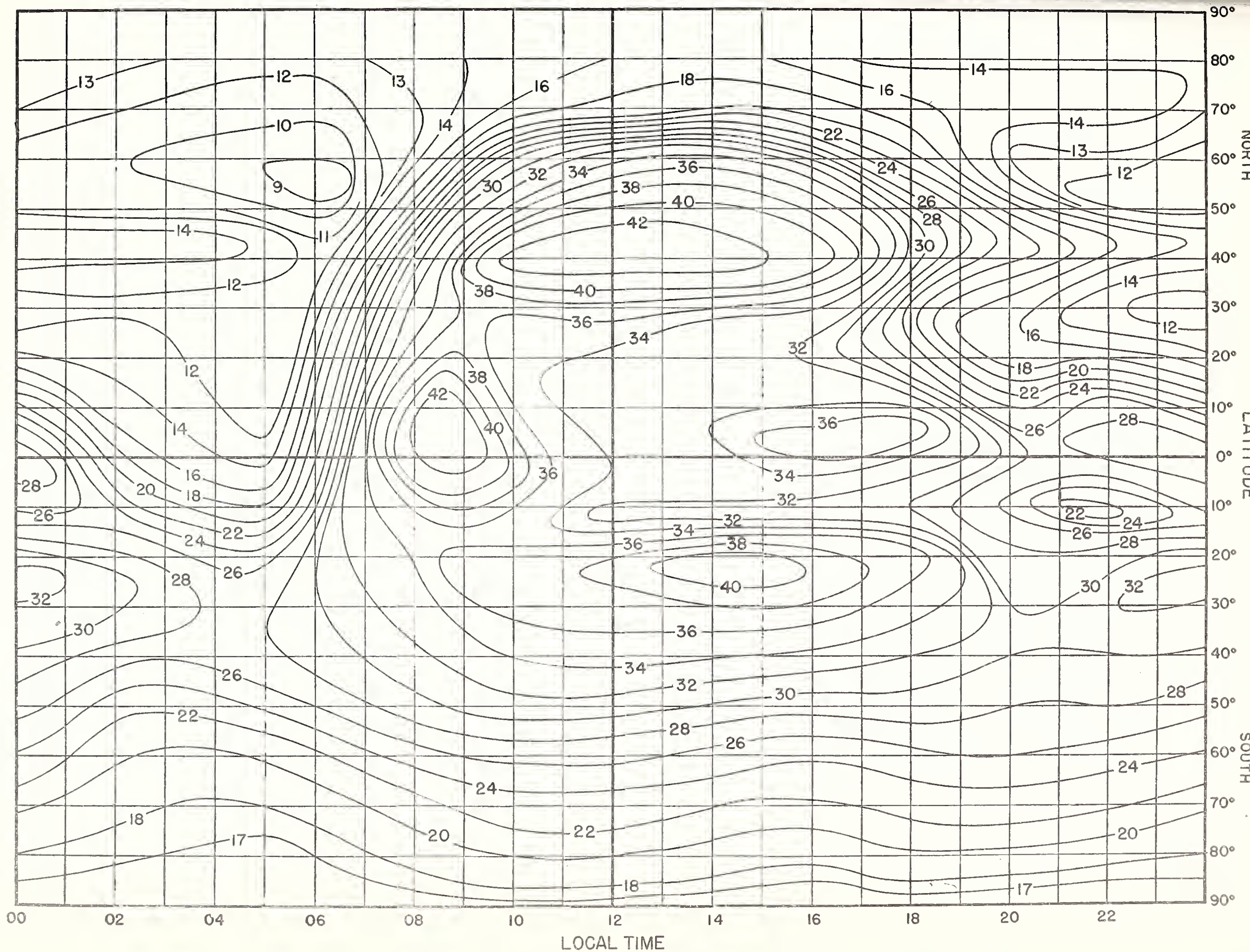



Fig. 152 $F_2$ 4000—MUF—DECEMBER—W ZONE SUNSPOT NUMBER 125

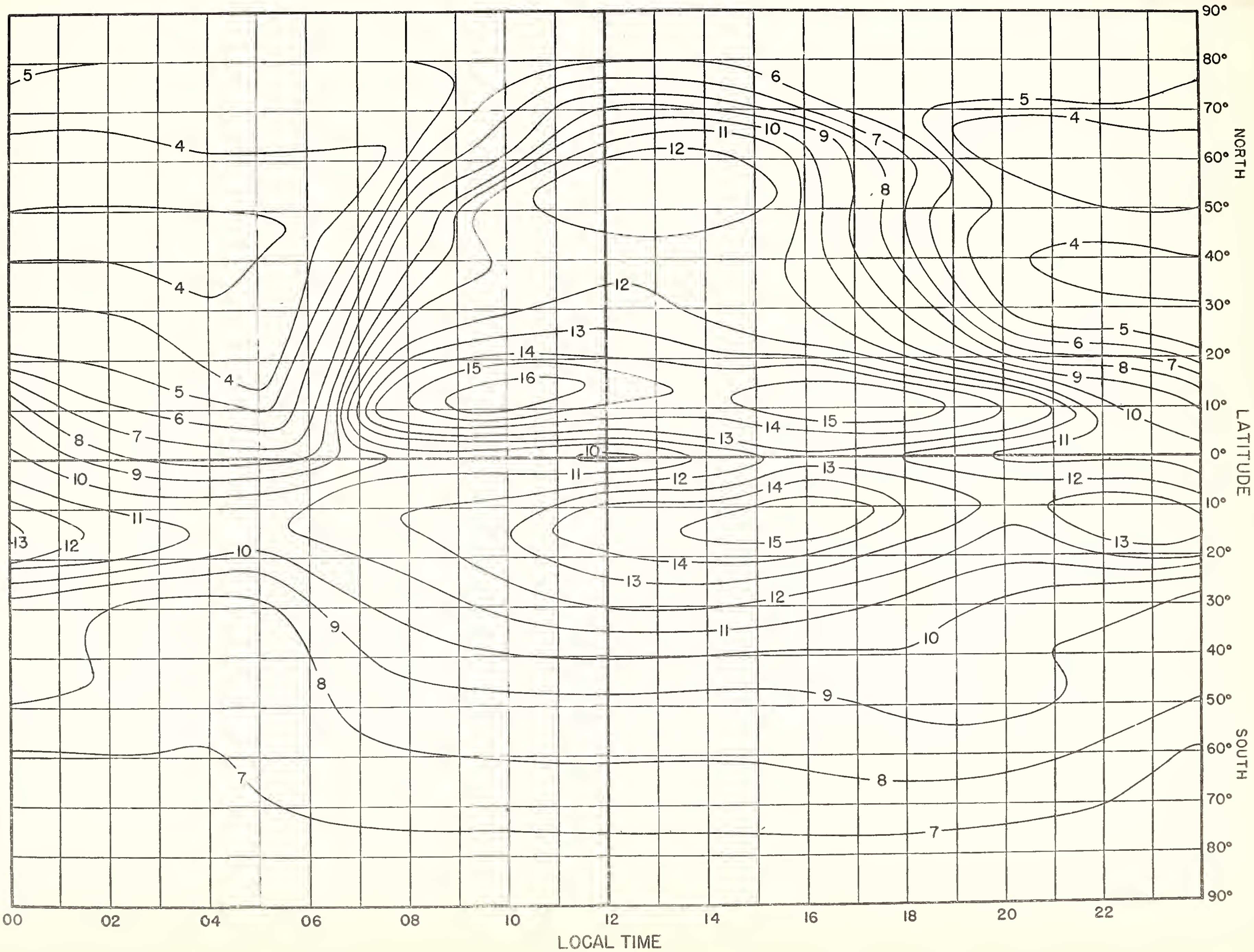



Fig. 153 $F_2$ ZERO-MUF—DECEMBER—I ZONE SUNSPOT NUMBER 125

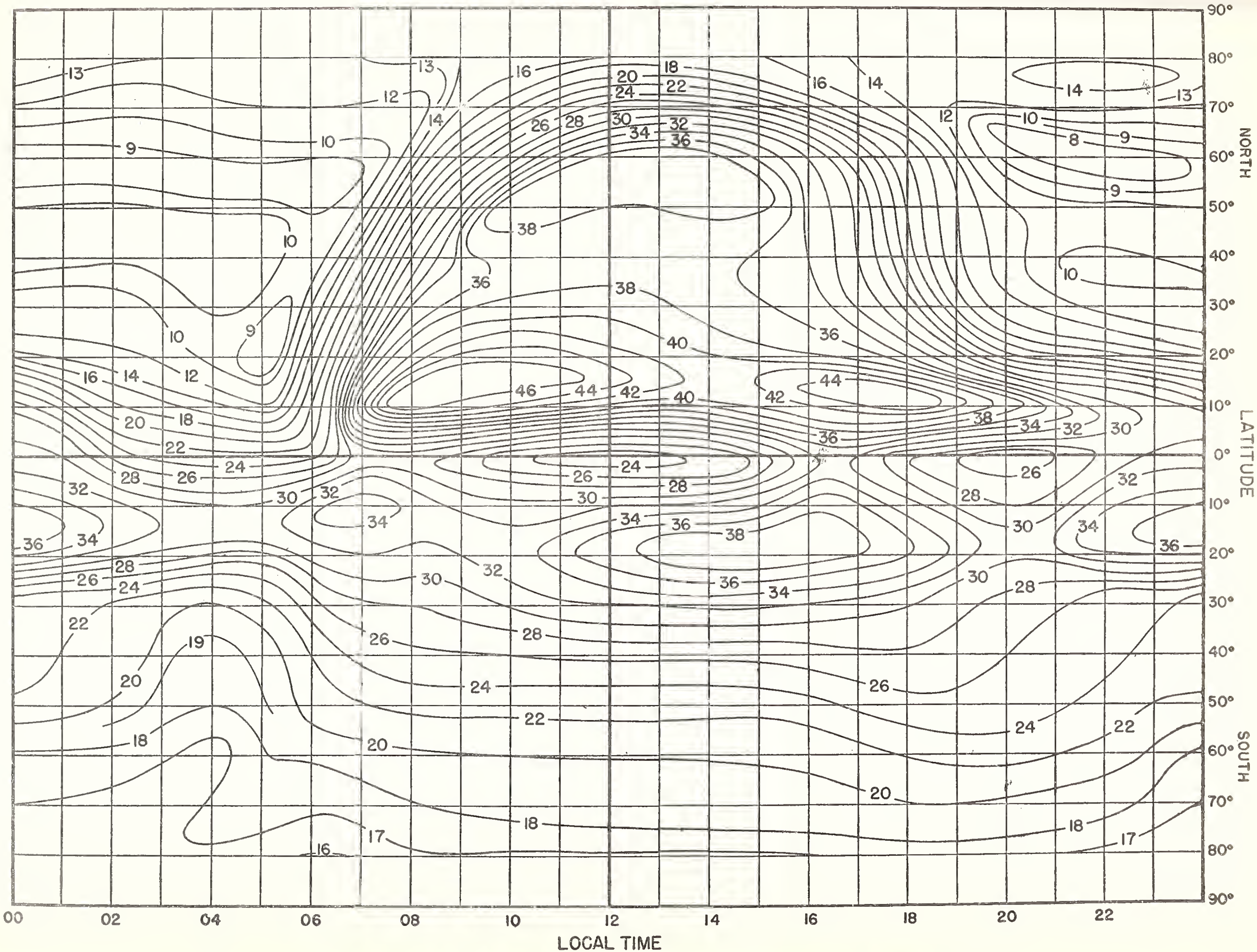



Fig. 154 $F_2$ 4000—MUF—DECEMBER—I ZONE SUNSPOT NUMBER 125

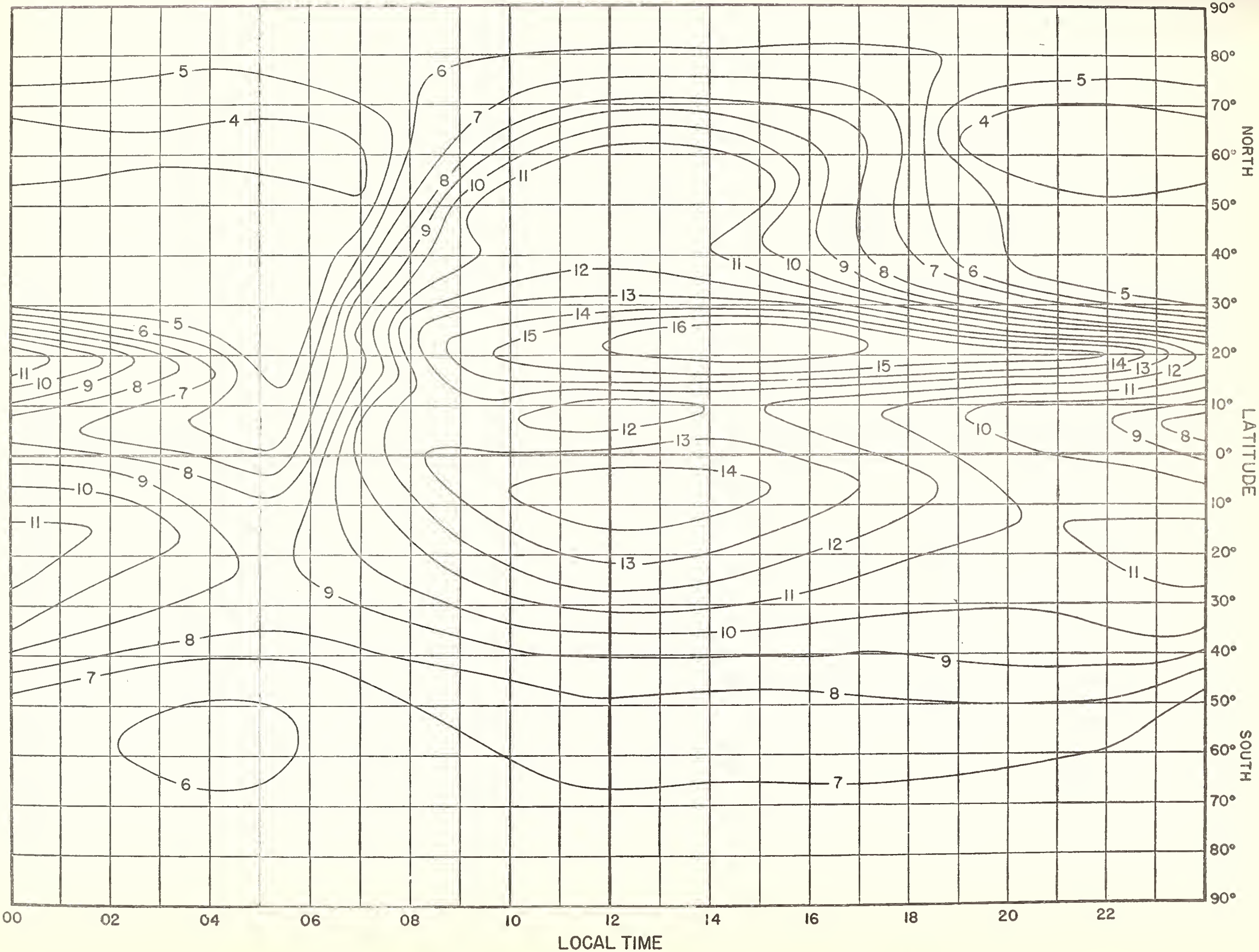



Fig. 155 $F_2$ ZERO—MUF—DECEMBER—E ZONE SUNSPOT NUMBER 125

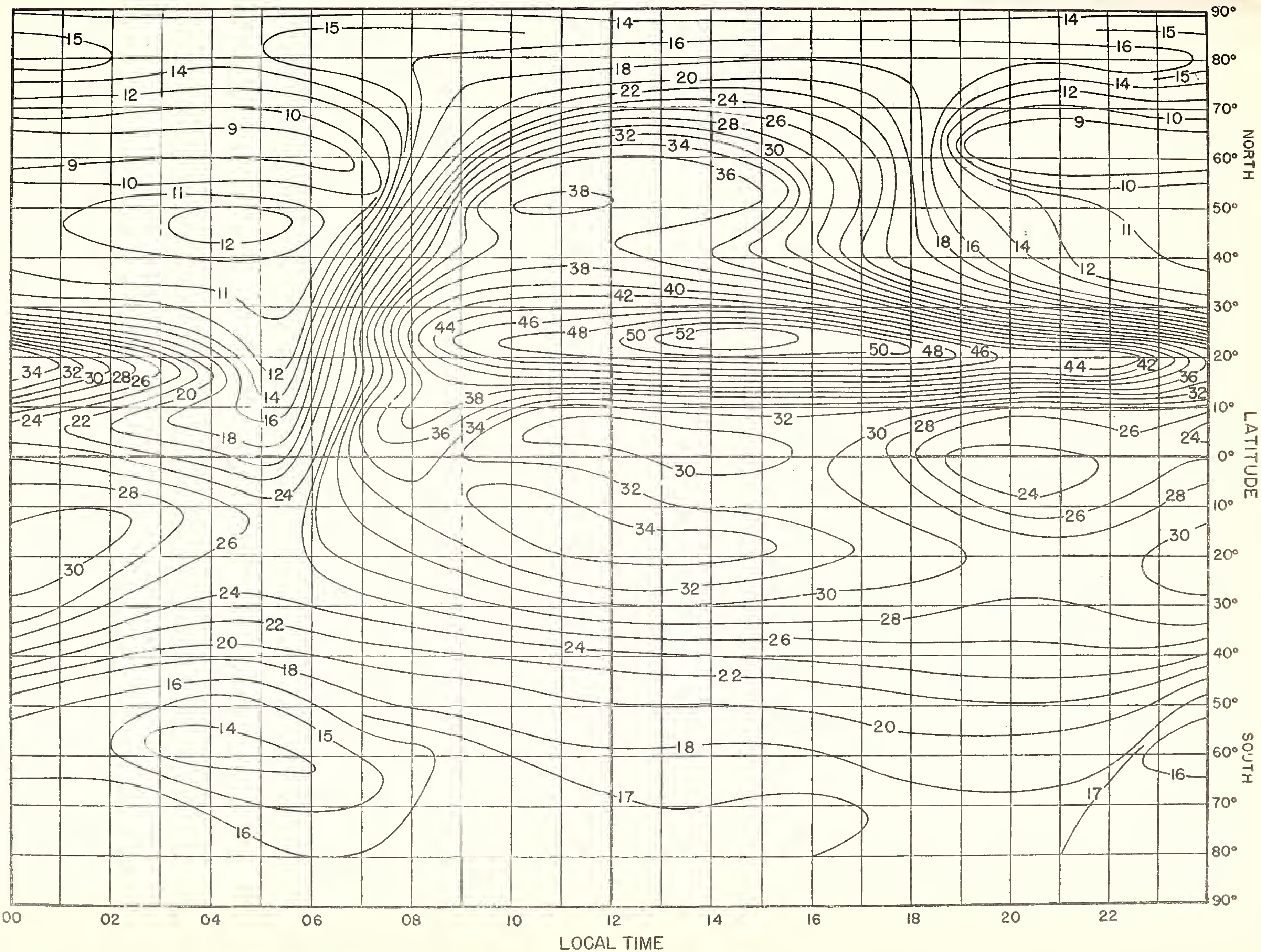



Fig. 156 $F_2$ 4000—MUF—DECEMBER—E ZONE SUNSPOT NUMBER 125

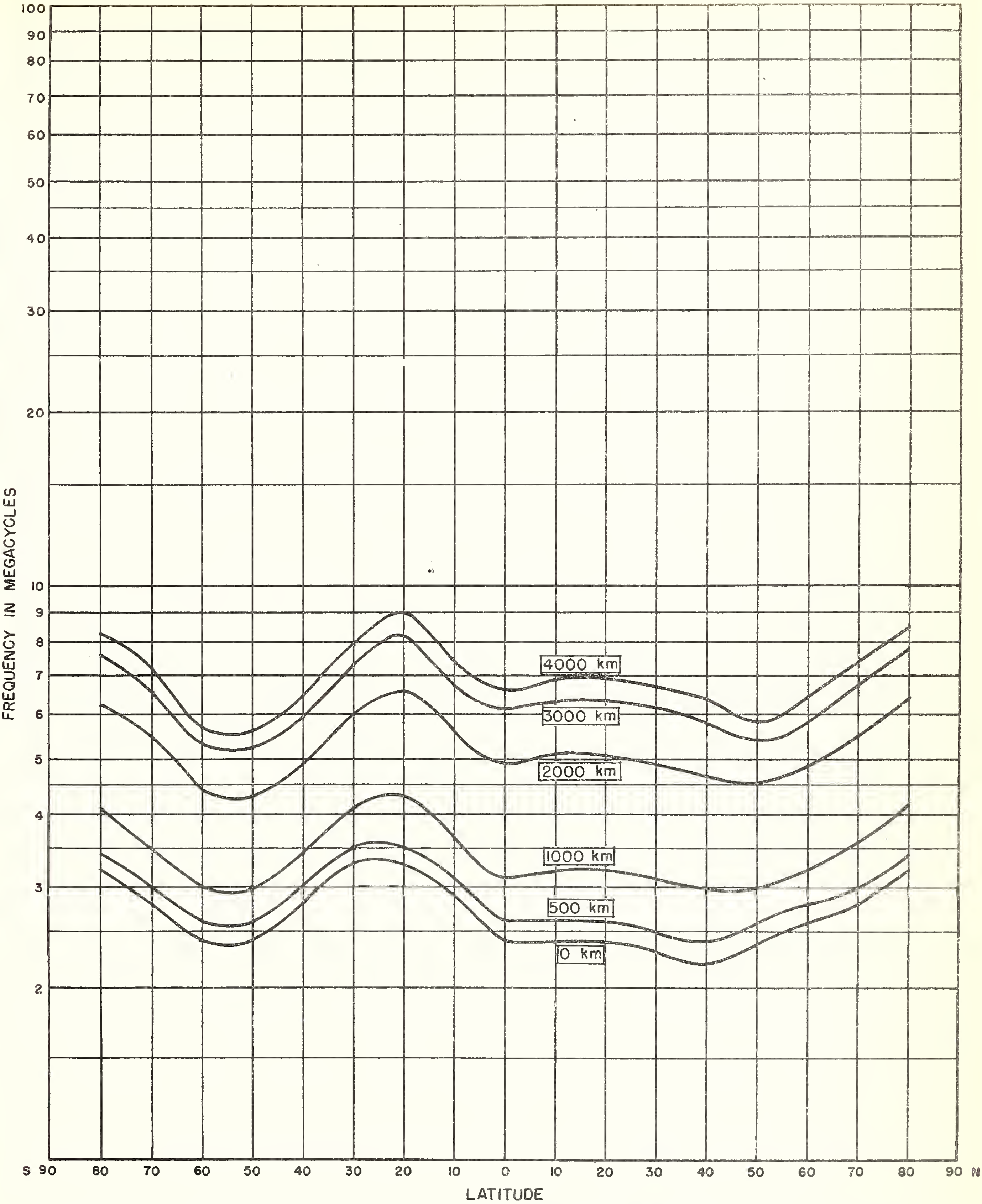



Fig. 157 PREDICTED MINIMUM MUF FOR SUNSPOT NUMBER 0 AS A FUNCTION OF LATITUDE AND DISTANCE IN KILOMETERS, W ZONE.

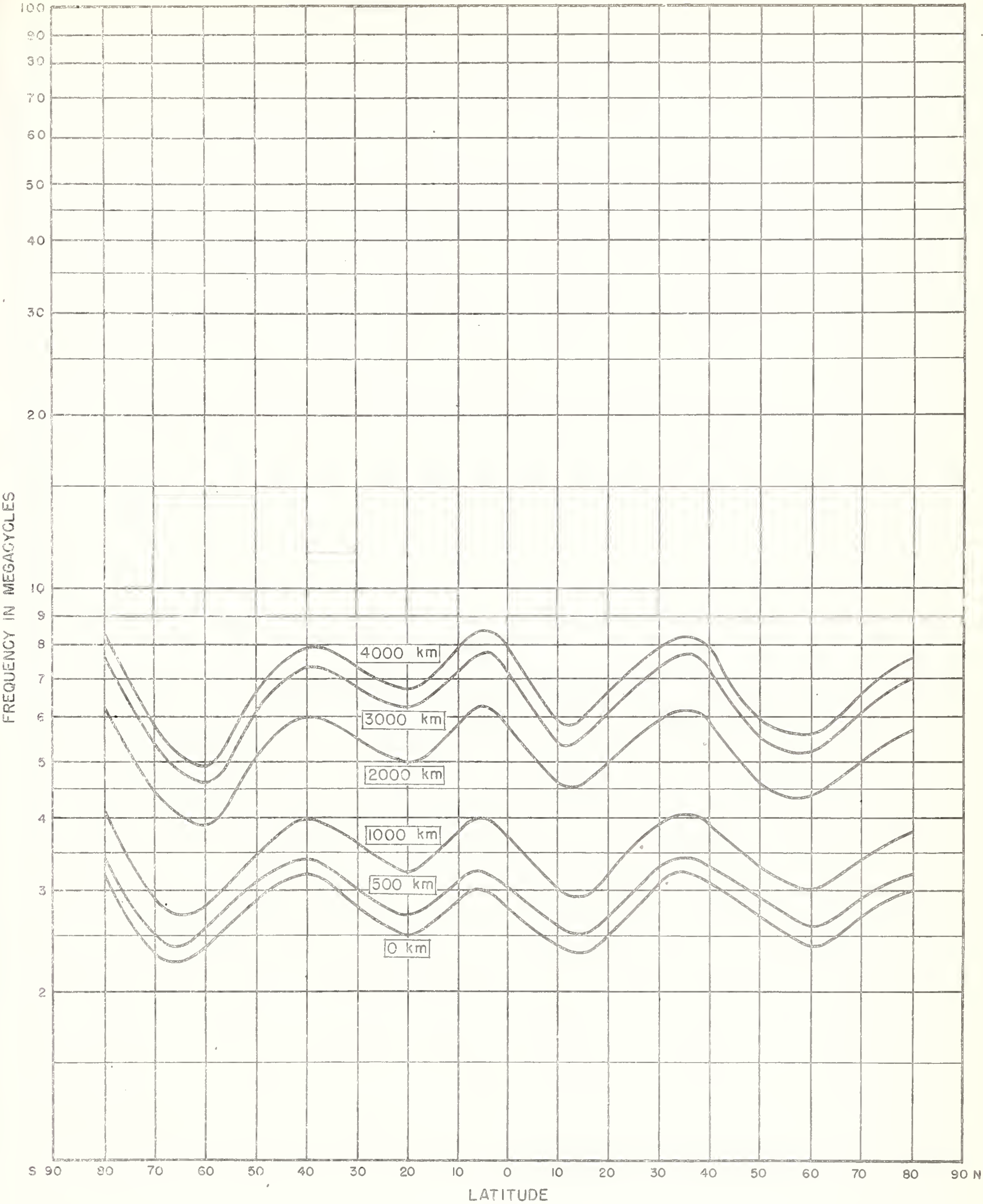



Fig. 158 PREDICTED MINIMUM MUF FOR SUNSPOT NUMBER 0 AS A FUNCTION OF LATITUDE AND DISTANCE IN KILOMETERS, I ZONE.

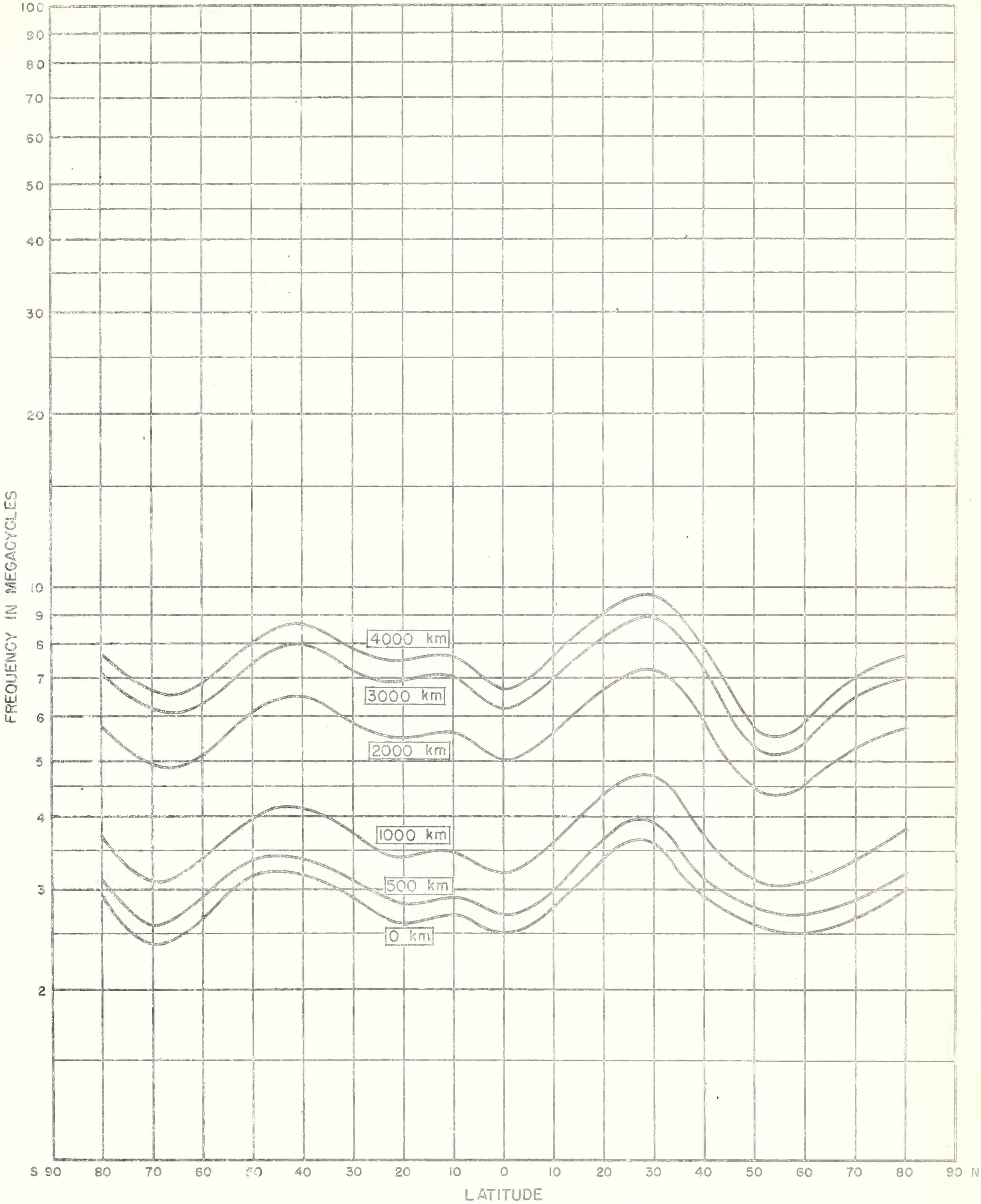



Fig. 159 PREDICTED MINIMUM MUF FOR SUNSPOT NUMBER 0 AS A FUNCTION OF LATITUDE AND DISTANCE IN KILOMETERS, E ZONE.

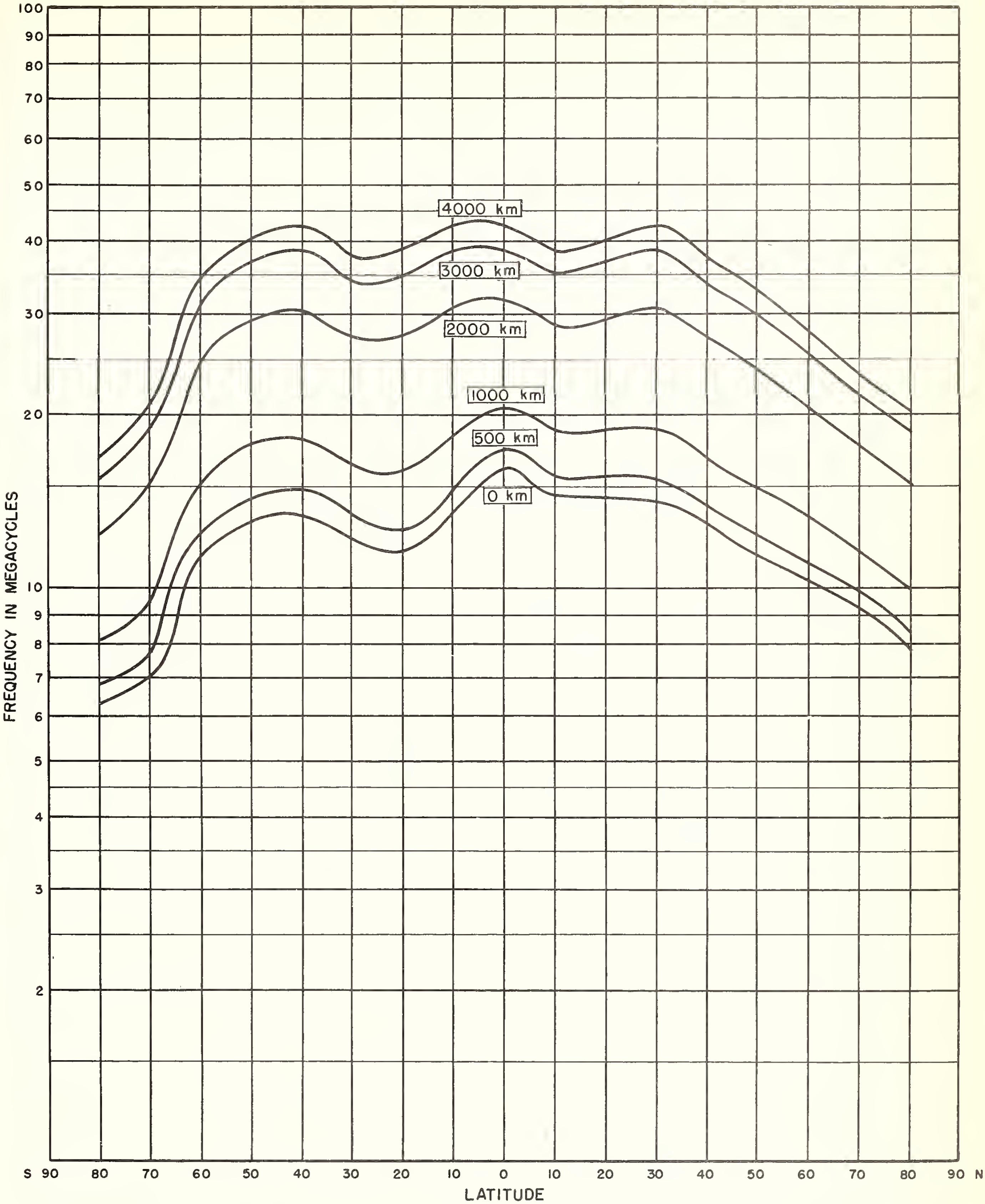



Fig. 160 PREDICTED MAXIMUM MUF FOR SUNSPOT NUMBER 125 AS A FUNCTION OF LATITUDE AND DISTANCE IN KILOMETERS, W ZONE.

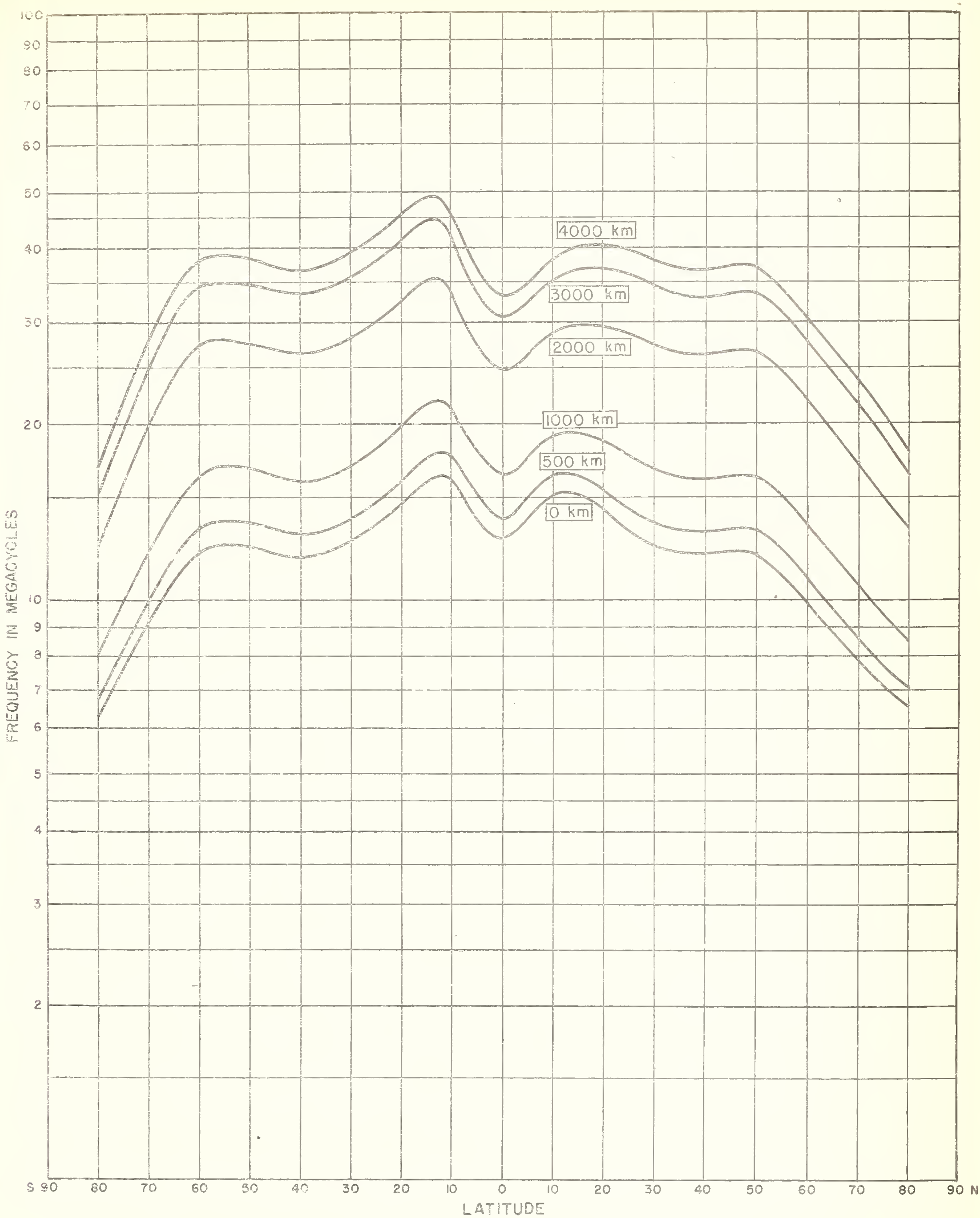



Fig. 161 PREDICTED MAXIMUM MUF FOR SUNSPOT NUMBER 125 AS A FUNCTION OF LATITUDE AND DISTANCE IN KILOMETERS, I ZONE.

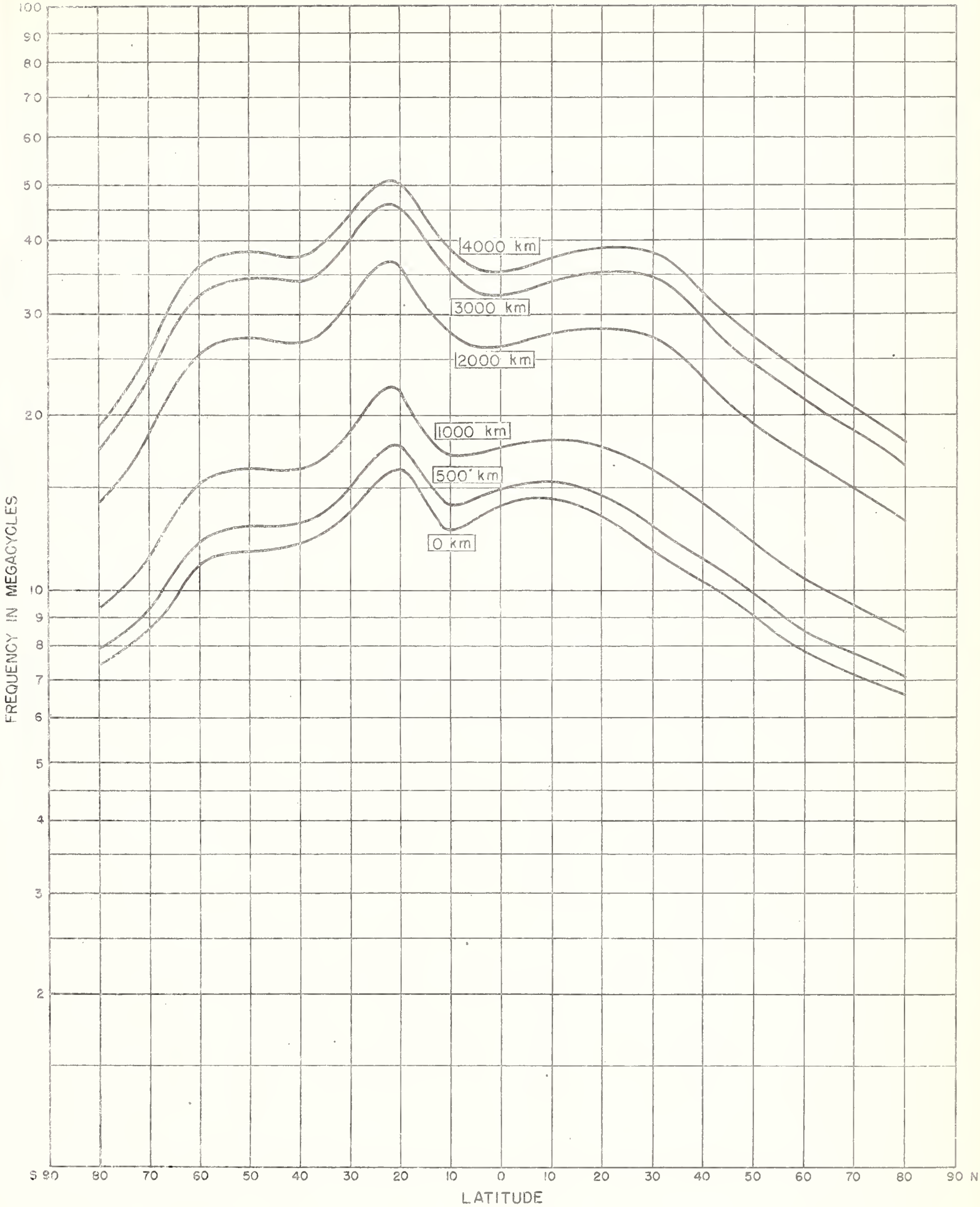



Fig. 162 PREDICTED MAXIMUM MUF FOR SUNSPOT NUMBER 125 AS A FUNCTION OF LATITUDE AND DISTANCE IN KILOMETERS, E ZONE.

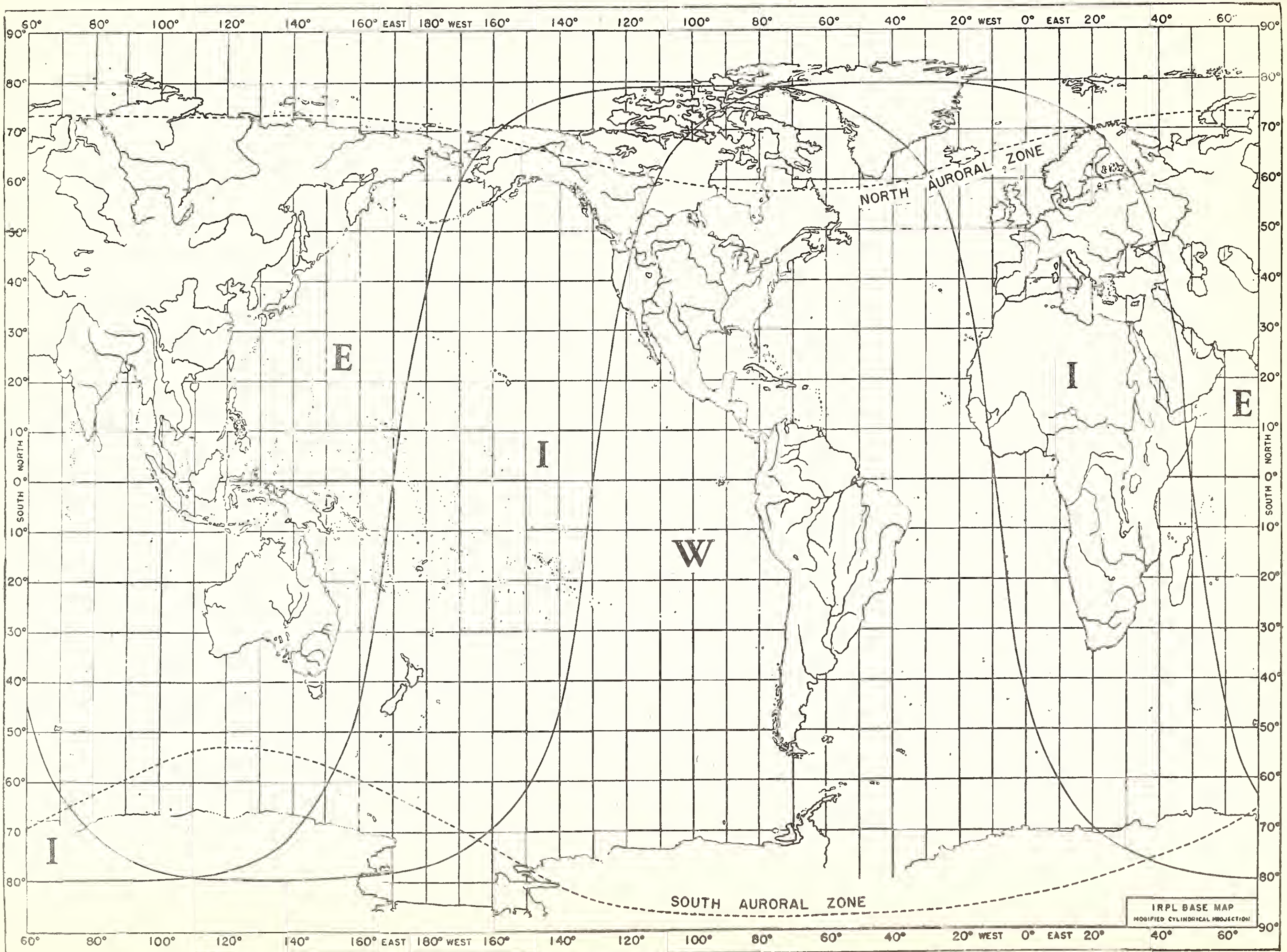



Fig. 163 WORLD MAP SHOWING ZONES COVERED BY PREDICTED CHARTS, AND AURORAL ZONES.

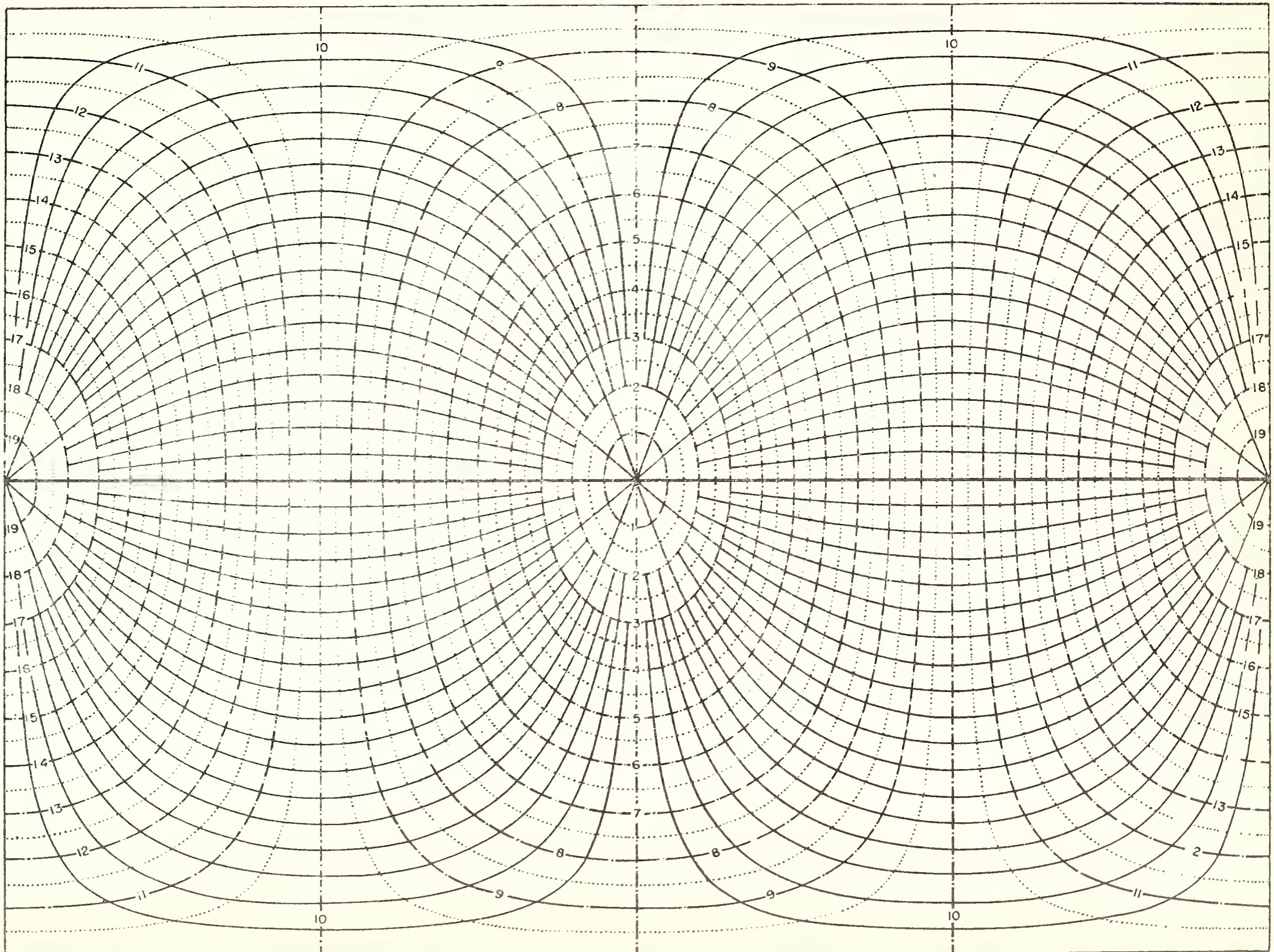


Fig. 164 GREAT CIRCLE CHART CENTERED ON EQUATOR. SOLID LINES REPRESENT GREAT CIRCLES. NUMBERED DOT-DASH LINES INDICATE DISTANCES IN THOUSANDS OF KILOMETERS.

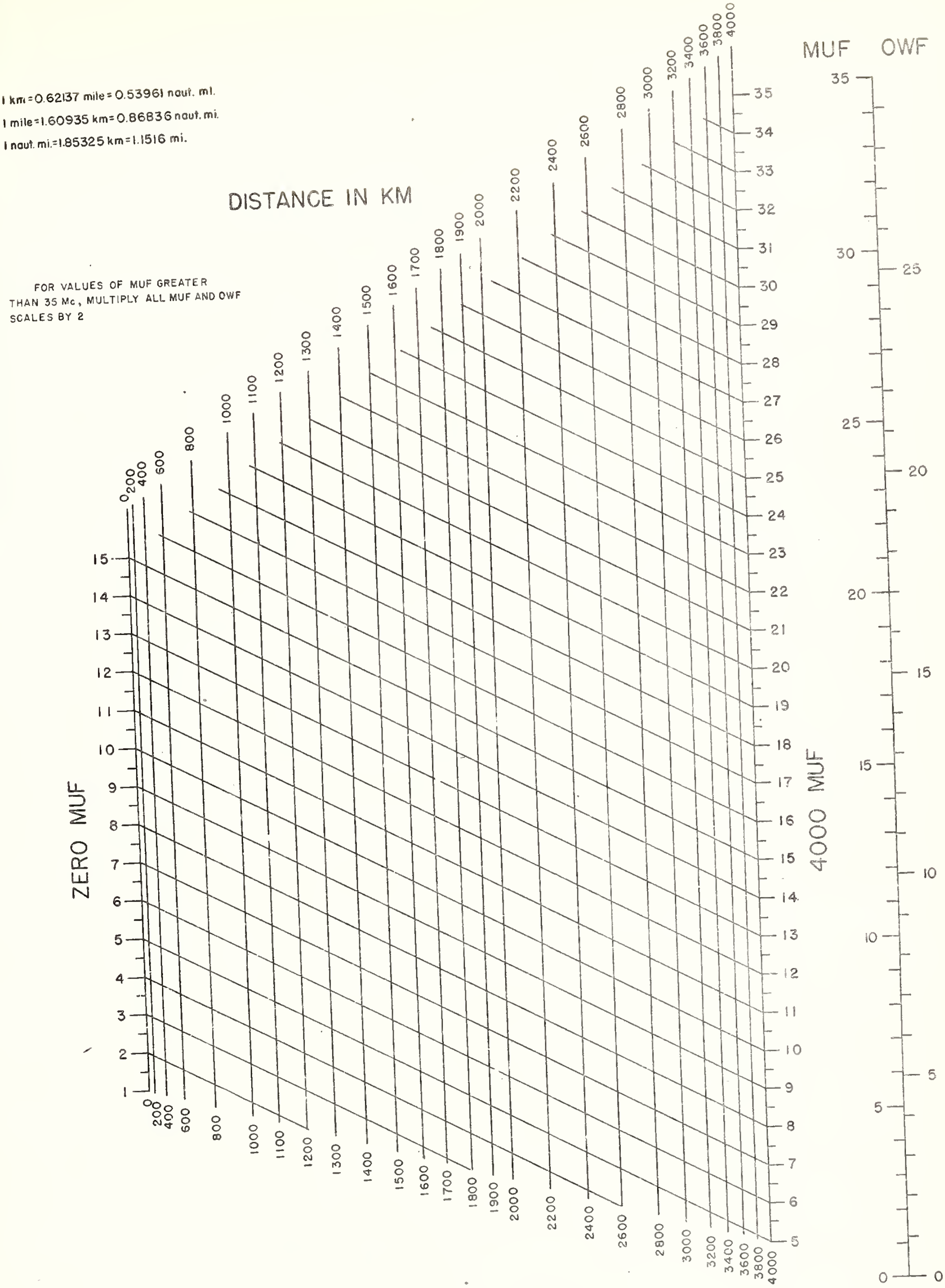



Fig. 165 NOMOGRAMS FOR TRANSFORMING $F_2$-ZERO-MUF AND $F_2$-4000-MUF TO EQUIVALENT MAXIMUM USABLE FREQUENCIES AT INTERMEDIATE TRANSMISSION DISTANCES; CONVERSION SCALE FOR OBTAINING OPTIMUM WORKING FREQUENCIES.

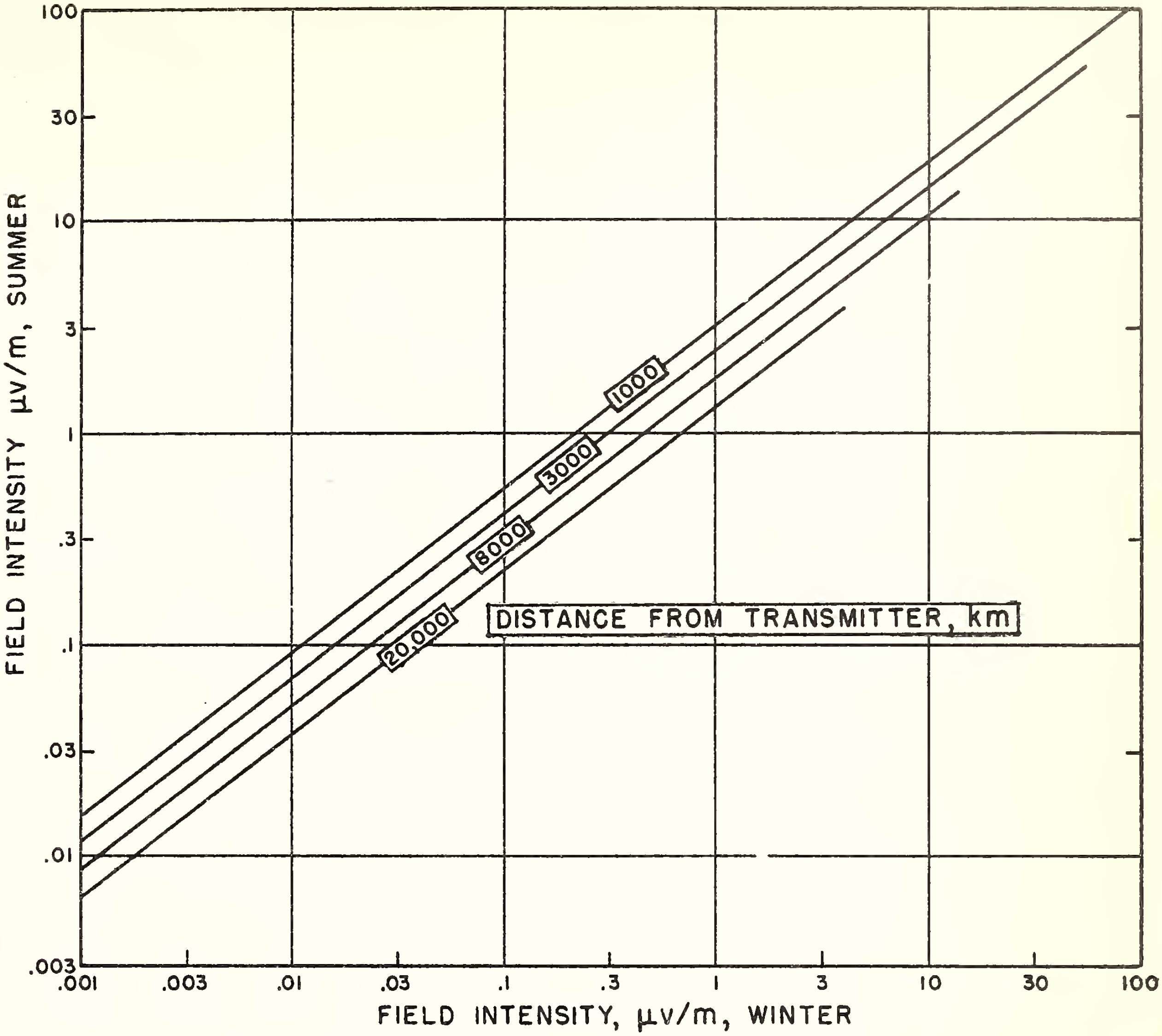



Fig. 166 RELATION BETWEEN SUMMER AND WINTER FIELD INTENSITIES FOR THE SAME SUBSOLAR DISTANCE.

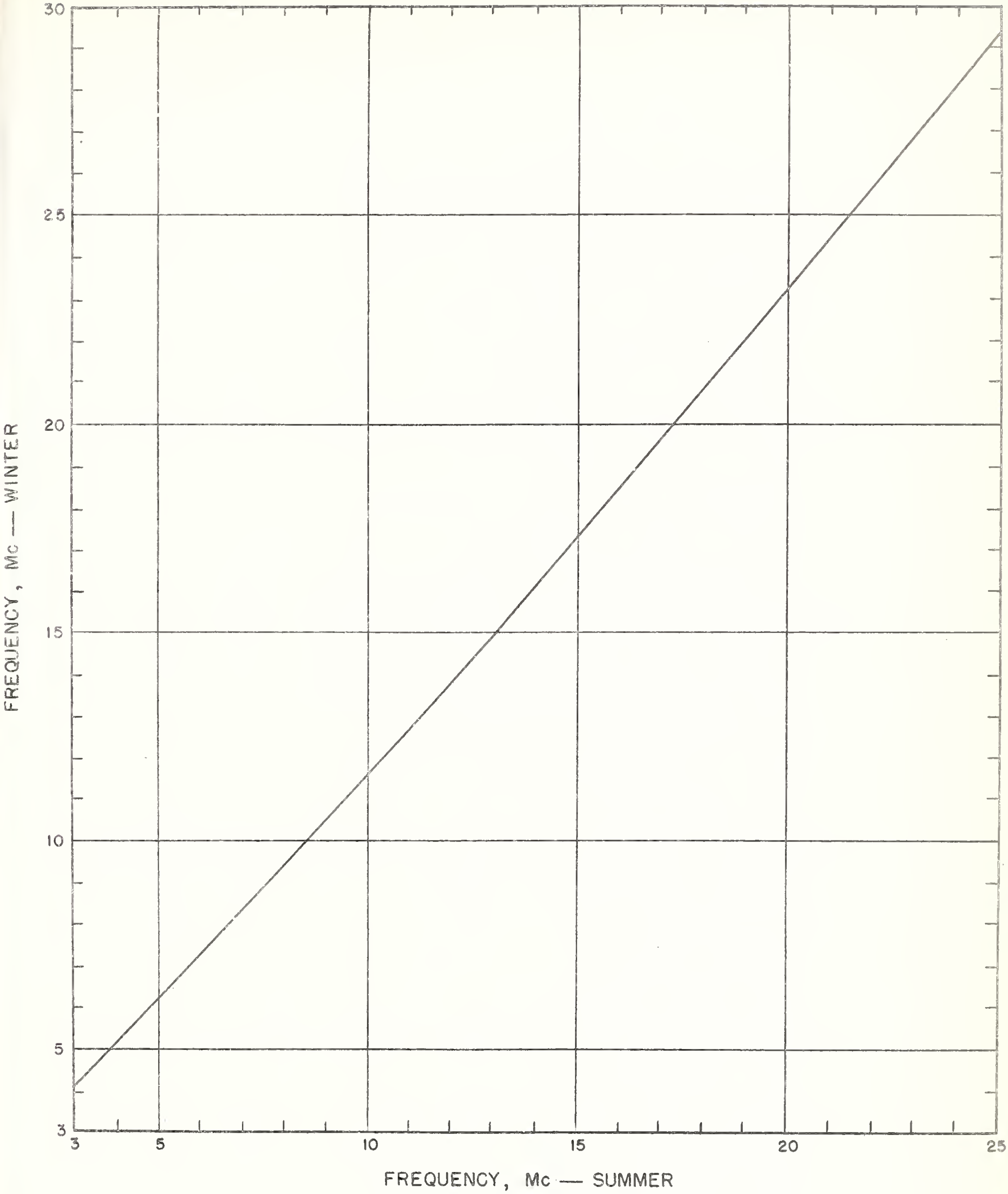



Fig. 167 PAIRS OF FREQUENCIES FOR WHICH THE FIELD INTENSITY IN WINTER AND SUMMER, RESPECTIVELY, IS THE SAME.