CRPL-F 138 PART B

FOR OFFICIAL USE

PART B

SOLAR - GEOPHYSICAL DATA

ISSUED
FEBRUARY 1956

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

CRPL-F 138
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INTRODUCTION

This monthly report series is intended to keep research workers abreast of the major particulars of solar activity and the associated ionospheric, radio propagation and other geophysical effects. It is made possible through the cooperation of many observatories, laboratories and agencies as recorded in the detailed description of the tables and graphs which follows. The Editor is Miss J. V. Lincoln.

I RELATIVE SUNSPOT NUMBERS

American and Zürich Daily Numbers -- The table lists (1) the daily American relative sunspot numbers, R_A', as compiled by the Solar Division of the American Association of Variable Star Observers, and (2) the provisional daily Zürich relative sunspot numbers, R_Z, as communicated by the Swiss Federal Observatory. Because of the time required to collect and reduce the observations, R_A' will normally appear one month later than R_Z.

The relative sunspot number is an index of the activity of the entire visible disk. It is determined each day without reference to preceding days. Each isolated cluster of sunspots is termed a sunspot group and it may consist of one or a large number of distinct spots whose size can range from 10 or more square degrees of the solar surface down to the limit of resolution (e.g. 1/8 square degrees). The relative sunspot number is defined as $R=K(10g+s)$, where g is the number of sunspot groups and s is the total number of distinct spots. The scale factor K (usually less than unity) depends on the observer and is intended to effect the conversion to the scale originated by Wolf. The observations for sunspot numbers are made by a rather small group of extraordinarily faithful observers, many of them amateurs, each with many years of experience. The counts are made visually with small, suitably protected telescopes.

Final values of R_Z appear in the IAU Quarterly Bulletin on Solar Activity, the Journal of Geophysical Research and elsewhere. They usually differ slightly from the provisional values. The American numbers, R_A', are not revised.

Graph of Sunspot Cycle -- The graph illustrates the recent trend of Cycle 19 of the 11-year sunspot cycle and some predictions of the future level of activity. The customary "12-month" smoothed index, $\overline{R}$, is used throughout, the data being final R_Z numbers except for the current year. Predictions shown are those made for one year after the latest available datum by the method of A. G. McNish and J. V. Lincoln (Trans. Am. Geophys. Union, 30, 673-685, 1949) modified by the use of regression coefficients and mean cycle values recomputed for Cycles 8 through 18. Cycle 19 began April 1954, when the minimum $\overline{R}$ of 3.4 was reached.

II SOLAR CENTERS OF ACTIVITY

Calcium Plage and Sunspot Regions -- The table gives particulars of the centers of activity visible on the solar disk during the preceding month. These are based on estimates made and reported on the day of observation and are therefore of limited reliability.

The table gives the heliographic coordinates of each center (taken as the calcium plage unless two or more significantly and individually active sunspot groups are included in an extended plage) in terms of the Greenwich date of passage of the sun's central meridian (CMP) and the latitude; the serial number of the plage as assigned by McMath-Hulbert Observatory; the serial number of the center in the previous solar rotation, if it is a persisting region; particulars of the plage at three times during its transit of the visible disk (first appearance, maximum development, last appearance): the date, the area, the central intensity; particulars of the associated sunspot group, if any, at analogous times: the date, the area, the spot count. The unit of area is a millionth of the area of a solar hemisphere; the central intensity of calcium plages is roughly estimated on a scale of 1=faint to 5=very bright.

Calcium plage data are available through the cooperation of the McMath-Hulbert Observatory of the University of Michigan and the Mt. Wilson Observatory. The sunspot data are compiled from reports from the U. S. Naval Observatory, Mt. Wilson Observatory, and from reports from Europe and Japan received through the daily Ursigram messages.

Coronal Line Emission Indices -- In the table are summarized solar coronal emission intensity indices for the green (Fe XIV at $\lambda 5303$) and red (Fe X at $\lambda 6374$) coronal lines. The indices are based on measurements made at 5° intervals around the periphery of the solar disk by the High Altitude Observatory at Climax, Colorado, and by Harvard University observers at Sacramento Peak (The USAF Upper Air Research Observatory at Sunspot, New Mexico, under contract AF 19(604)-146). The measurements are expressed as the number of millionths of an Angstrom of the continuum of the center of the solar disk (at the same wavelength as the line) that would contain the same energy as the observed coronal line. The indices have the following meanings:

G_6 = mean of six highest line intensities in quadrant for λ 5303.

R_6 = same for λ 6374.

G_1 = highest value of intensity in quadrant, for λ 5303.

R_1 = same for λ 6374.

The dates given in the table correspond to the approximate time of CMP of the longitude zone represented by the indices. The actual observations were made for the North East and South East quadrants 7 days before; for the South West and North West quadrants 7 days after the CMP date given.

To obtain rough measures of the integrated emission of the entire solar disk in either of the lines, assuming the coronal changes to be small in a half solar rotation, it is satisfactory to perform the following type of summation given in example for 15 October:

$$\left(\begin{matrix}\text{MEAN DISK EMISSION} \\ \text{IN } \lambda\, 5303\end{matrix}\right)_{15\text{ OCT}} = \frac{1}{N}\left[\sum_{15\text{ OCT}}^{22\text{ OCT}}\left\{(G_6)_{NE} + (G_6)_{SE}\right\} + \sum_{8\text{ OCT}}^{14\text{ OCT}}\left\{(G_6)_{SW} + (G_6)_{NW}\right\}\right]$$

where N is the number of indices entering the summation.

Such integrated disk indices as well as integrated whole-sun indices are computed for each day and are published quarterly in the "Solar Activity Summary" issued by the High Altitude Observatory at Boulder, Colorado. In the same reports are given maps of the intensity distribution of coronal emission derived from all available Climax and Sacramento Peak observations, as well as other information on solar activity, such as maps made from daily limb prominence surveys in Hα and notes regarding the history of active regions on the solar disk.

Preliminary summaries of solar activity, prepared on a fast schedule, are issued Friday of each week from High Altitude Observatory in conjunction with CRPL and include solar activity through the preceding day. These are useful to groups needing information on the current status of activity on the visible solar disk, but are not recommended for research uses unless such a prompt schedule of reporting is essential. The same information is included in the subsequent quarterly reports, with extensive additions, corrections and evaluations.

III SOLAR FLARES

Optical Observations -- The table presents the preliminary record of solar flares as reported to the CRPL on a rapid schedule at the sacrifice of detailed accuracy. Definitive and complete data are published later in the Quarterly Bulletin of Solar Activity, I.A.U., in various observatory publications and elsewhere. The present listing serves to identify and roughly describe the phenomena observed.

Reporting directly to the CRPL are the following observatories: Mt. Wilson, McMath-Hulbert, U. S. Naval, Wendelstein, and Sacramento Peak. The remainder report through the URSIgram centers in Europe and Japan. Observations are in the light of the center of the H-alpha line unless noted otherwise. The reports from Sacramento Peak, New Mexico (communicated to CRPL by the High Altitude Observatory at Boulder) are from observations at the USAF Upper Air Research Observatory at Sunspot, New Mexico, by Harvard University observers, under contract AF 19(604)-146.

For each flare are listed the reporting observatory, date, times of beginning and ending of observing period, duration of flare (when known), total area in millionths of visible hemisphere, the McMath serial number of the region with which the flare is associated, the heliographic coordinates in degrees, the time of maximum phase, maximum intensity of flare, fractional area having nearly maximum brightness, and finally the flare importance on the IAU scale of 1- to 3+. A final column lists provisionally the occurrence of simultaneous ionospheric effects as observed on selected field strength recordings of distant high-frequency radio transmissions; a more nearly definitive list of these ionospheric effects, including particulars, appears in these reports after the lapse of a month (see below). All times are Universal Time (UT or GCT).

Ionospheric Effects -- SID (and GID--gradual ionospheric disturbances) may be detected in a number of ways: short wave fadeouts, enhancement of low frequency atmospherics, increases in cosmic absorption, and so forth. The table lists events that have been recognized on field strength recordings of distant high-frequency radio transmissions. Under a coordinated program, the staffs at the following ionospheric sounding stations contribute reports that are screened and synthesized at CRPL-Boulder: Puerto Rico, Ft. Belvoir, Va., and Anchorage, Alaska (CRPL Stations: PR, BE, AN); Huancayo, Peru, and College, Alaska (CRPL-Associated Laboratories: HU, CO); and White Sands, N. Mex., Adak, Alaska, and Okinawa (U. S. Signal Corps Stations: WS, AD, OK). McMath-Hulbert Observatory (MC) also contributes such reports. In addition, reports are volunteered by RCA Communications Inc., Marconi Wireless, Netherlands Postal and Telecommunications Services, Swedish Telecommunications, and others; these usually specify times of SID and the radio paths involved.

In the coordinated program, the abnormal fades of field strength not obviously ascribable to other causes, are described as short wave fadeouts with the following further classification:

S-SWF: sudden drop-out and gradual recovery
Slow S-SWF: drop-out taking 5 to 15 minutes and gradual recovery
G-SWF: gradual disturbance; fade irregular in both drop-out and recovery.

When there is agreement among the various reporting stations on the time (UT) of an event, it is accepted as a widespread phenomenon and listed in the table.

The degree of confidence in identifying the event, a subjective estimate, is reported by the stations and this is summarized in an index of certainty that the event is widespread, ranging from 1 (possible) to 5 (definite). The times given in the table for the event are from the report of a station (underlined in table) that identified it with high confidence. The criteria for the subjective importance rating assigned by each station on a scale of 1- to 3+ include amplitude of the fade, duration and confidence; greater consideration is given to reports on paths near the subsolar point in arriving at the summary importance rating given in the table.
Note: The tables of SID observed at Washington included in CRPL F-reports prior to F-135 were restricted to events classed here as S-SWF.

IV SOLAR RADIO WAVES

The data on solar radio waves are from observations at 167 Mc and 460 Mc made at the Gunbarrel Hill (Boulder) station of the National Bureau of Standards. The half-width of the antenna lobe is appreciably greater than the solar disk. Polarization has not been determined. All times are in Universal Time (UT or GCT); when the observing period extends slightly into the next Greenwich day, the time scale is extended beyond 24 hours.

3-hourly and Daily Flux -- Flux is given in power units. These units are approximately 10^{-22} watt meter^{-2}(c/s)$^{-1}$ for both polarizations together. They will be subject to a correction factor when gain measurements of the antenna have been made. The median flux is measured for every one-hour period that contains a usable calibration and at least thirty minutes of usable record. A three-hour value of flux is obtained by averaging the available one-hour medians (at least two required). A daily value of flux is obtained by averaging all available one-hour medians (at least 4 required). A dash indicates that insufficient measurements were made to meet the above requirements or that the records were not of usable quality. Parentheses indicate that the value is somewhat doubtful because of atmospheric noise or local interference.

The variability index, given for each three-hour interval, is on a scale 0 to 3 defined as follows:

0 - The instantaneous flux did not drop below one-half the median level or exceed twice the median level at any time.

1 - The instantaneous flux made from one to ten excursions outside the range described above.

2 - The instantaneous flux made from ten to one hundred excursions outside the range described above.

3 - The instantaneous flux made more than one hundred excursions outside the range described above.

For the purpose of the variability index, an excursion whose maximum intensity is M times the median level is counted as M excursions. A dash is used to indicate that measurements were made for less than one hour during the period. Parentheses surround variability indices which are in doubt because of atmospheric noise or local interference.

Outstanding Events -- A separate table lists the occurrences that are not adequately described by the three-hourly values of median flux and variability. These are classified in general accordance with the system described and illustrated by Dodson, Hedeman, and Owren (Ap. J. 118, 169, 1953). The categories of events are identified in the table by numbers, which do not necessarily indicate the magnitude of the event:

0 - Rise in base level -- A temporary increase in the continuum with duration of the order of tens of minutes to an hour.

1 - Series of bursts -- Bursts or groups of bursts, occurring intermittently over an interval of time of the order of minutes or hours. Such series of bursts are assigned as distinctive events only when they occur on a smooth record or show as a distinct change in the activity.

2 - Groups of bursts -- A cluster of bursts occurring in an interval of time of the order of minutes.

3 - Minor burst -- A burst of moderate or small amplitude, and duration of the order of one or two minutes.

4 - Minor burst and second part -- A double rise in flux in which the early rise is a minor burst.

5 - Noise storm ends -- A noise storm (see 6) which ceases at some time during the observing period.

6 - Noise storm -- A temporary increase in radiation characterized by numerous closely spaced bursts, by an increase in the continuum, or by both. Duration is of the order of hours or days.

7 - Noise storm begins -- The onset of a noise storm occurs at some time during the observing period.

8 - Major burst -- An outburst, or other burst of large amplitude and more than average duration. A major burst is usually complex, with a duration of the order of one to ten minutes.

9 - Major burst and second part -- A double rise in flux, the first part of which is a major burst. The second part may consist of a rise in base level, a group or series of bursts, or the onset of a noise storm.

Starting times and durations are enclosed in parentheses when they are limited by the period of observation. The maximum instantaneous flux (Inst. Flux) is measured from the sky level as are the hourly medians. The maximum smoothed flux (Smd. Flux) is that obtained by taking the difference of the maximum value of a smooth curve drawn through the outstanding occurrence with a smoothing period of 20 percent to 50 percent of the total duration, and the value of the interpolated hourly median at that same time had the event not occurred, both measured from the sky level.

V GEOMAGNETIC ACTIVITY INDICES

C, Kp, Ap, and Selected Quiet and Disturbed Days -- The data in the table are: (1) preliminary international character figures, C; (2) geomagnetic planetary three-hour range indices, Kp; (3) daily "equivalent amplitude," Ap; (4) magnetically selected quiet and disturbed days.

This table is made available by the Committee on Characterization of Magnetic Disturbance of IAGA, IUGG. The Meteorological Office, De Bilt, Holland collects the data from magnetic observatories distributed throughout the world, and compiles C and selected days. The Chairman of the Committee computes the planetary and equivalent amplitude indices. The same data are also published quarterly in the Journal of Geophysical Research along with data on sudden commencements (sc) and solar flare effects (sfe).

The C-figure is the arithmetic mean of the subjective classification by all observatories of each day's magnetic activity on a scale of 0 (quiet) to 2 (storm).

Kp is the mean standardized K-index from 12 observatories between geomagnetic latitudes 47 and 63 degrees. The scale is 0 (very quiet) to 9 (extremely disturbed), expressed in thirds of a unit, e.g. 5- is 4 2/3, 5o is 5 0/3, and 5+ is 5 1/3. This planetary index is designed to measure solar particle-radiation by its magnetic effects, specifically to meet the needs of research workers in the ionospheric field. A complete description of Kp has appeared in Bulletin 12b, "Geomagnetic Indices C and K, 1948" of the Association of Terrestrial Magnetism and Electricity (IATME), International Union of Geodesy and Geophysics.

Ap is a daily index of magnetic activity on a linear scale rather than on the quasi-logarithmic scale of the K-indices. It is the average of the eight values of an intermediate 3-hourly index "ap," defined as one-half the average gamma range of the most disturbed of the three force components, in the three-hour interval at standard stations; in practice, ap is computed from the Kp for the 3-hour interval. The extreme range of the scale of Ap is 0 to 400. The method is described in IATME Bulletin No. 12h (for 1953) p. viii f. Values of Ap (like Kp and Cp) have been published for the Polar Year 1932/33 and for the years 1937 onwards.

The magnetically quiet and disturbed days are selected in accordance with the general outline in Terr. Mag. (predecessor to J. Geophys. Res.) 48, pp 219-227, December 1943. The method in current use calls for ranking the days of a month by their geomagnetic activity as determined from the following three criteria with equal weight: (1) the sum of the eight Kp's; (2) the sum of the squares of the eight Kp's; and (3) the greatest Kp.

Chart of Kp by Solar Rotations -- The graph of Kp by solar rotations is furnished through the courtesy of Dr. J. Bartels, Geophysikalisches Institute, Göttingen.

VI RADIO PROPAGATION QUALITY INDICES

One can take as the definition of a radio propagation quality index: the measure of the efficiency of a medium-powered radio circuit operated under ideal conditions in all respects, except for the variable effect of the ionosphere on the propagation of the transmitted signal. The indices given here are derived from monitoring and circuit performance reports, and are the nearest practical approximation to the ideal index of propagation quality.

Quality indices are usually expressed on a scale that ranges from one to nine. Indices of four or less are generally taken to represent significant disturbance. (Note that for geomagnetic K-indices, disturbance is represented by higher numbers.) The adjectival equivalents of the integral quality indices are as follows:

1 = useless	4 = poor-to-fair	7 = good
2 = very poor	5 = fair	8 = very good
3 = poor	6 = fair-to-good	9 = excellent

CRPL forecasts are expressed on the same scale. The tables summarizing the outcome of forecasts include categories P-Perfect; S-Satisfactory; U-Unsatisfactory; F-Failure. The following conventions apply:

P - forecast quality equal to observed

S - forecast quality one grade different from observed

U - forecast quality two or more grades different from observed when both forecast and observed were $\geqslant 5$, or both $\leqslant 5$

F - other times when forecast quality two or more grades different from observed

Full discussion of the reliability of forecasts requires consideration of many factors besides the over-simplified summary given.

The quality figures represent a consensus of experience with radio propagation conditions. Since they are based entirely on monitoring or traffic reports, the reasons for low quality are not necessarily known and may not be limited to ionospheric storminess. For instance, low quality may result from improper frequency usage for the path and time of day. Although, wherever it is reported, frequency usage is included in the rating of reports, it must often be an assumption that the reports refer to optimum working frequencies. It is more difficult to eliminate from the indices conditions of low quality for reasons such as multipath or interference. These considerations should be taken into account in interpreting research correlations between the Q-figures and solar, auroral, geomagnetic or similar indices.

North Atlantic Radio Path -- The CRPL quality figures, Qa, are compiled by the North Atlantic Radio Warning Service (NARWS), the CRPL forecasting center at Ft. Belvoir, Virginia, from radio traffic data for North Atlantic transmission paths closely approximating New York-to-London. These are reported to CRPL by the Canadian Defense Research Board, Canadian Broadcasting Company, and the following agencies of the U. S. Government:--Coast Guard, Navy, Army Signal Corps, U. S. Information Agency. Supplementing these data are CRPL monitoring, direction-finding observations and field strength measurements of North Atlantic transmissions made at Belvoir.

The original reports are submitted on various scales and for various time intervals. The observations for each 6-hour interval are averaged on the original scale. These 6-hour indices are then adjusted to the 1 to 9 quality-figure scale by a conversion table prepared by comparing the distribution of these indices for at least four months, usually a year, with a master distribution determined from analysis of the reports originally made on the 1 to 9 quality-figure scale. A report whose distribution is the same as the master is thereby converted linearly to the Q-figure scale. The 6-hourly quality figure is the mean of the reports available for that period.

The 6-hourly quality figures are given in this table to the nearest one-third of a unit, e.g. 5o is 5 and 0/3; 5- is 4 and 2/3; 5+ is 5 and 1/3. Other data included are:

(a) Whole-day radio quality indices, which are weighted averages of the four 6-hourly indices, with half weight given to quality grades 5 and 6. This procedure tends to give whole-day indices suitable for comparison with whole-day advance forecasts which seek to designate the days of significant disturbance or unusually quiet conditions.

(b) Short-term forecasts, issued every six hours by the North Atlantic Radio Warning Service. These are issued one hour before 00^h, 06^h, 12^h, 18^h, UT and are applicable to the period 1 to 7 hours ahead.

(c) Advance forecasts, issued twice weekly by the NARWS (CRPL-J reports) and applicable 1 to 3 or 4 days ahead, 4 or 5 to 7 days ahead, and 8 to 25 days ahead. These forecasts are scored against the whole-day quality indices.

(d) Half-day averages of the geomagnetic K indices measured by the Cheltenham Magnetic Observatory of the U. S. Coast and Geodetic Survey.

A chart compares the short-term forecasts with Qa-figures. A second chart compares the outcome of advance forecasts (1 to 3 or 4 days ahead) with a type of "blind" forecast . For the latter, the frequency for each quality grade, as determined from the distribution of quality grades in the four most recent months of the current season, is partitioned among the grades observed in the current month in proportion to the frequencies observed in the current month.

Ranges of useful frequencies on the North Atlantic radio path are shown in a series of diagrams, one for each day. Time is the angular coordinate and radio frequency in Mc is the radius vector. The shaded area indicates the range of frequencies for which transmissions of quality 5 or greater were observed. The blacker the diagram, the quieter the day has been; a narrow strip indicates either high LUHF, low MUF or both. These diagrams are based on data reported to CRPL by the German Post Office through the Fernmeldetechnischen Zentralamtes, Darmstadt, Germany, being observations every one and a half hours of selected transmitters located in the eastern portion of North America.

Note: Beginning with data for September 1955, Qa has been determined from reports that are available within a few hours or at most within a few days, including for the first time, the CRPL observations. Therefore these are the indices by which the forecasters assess every day the conditions in the recent past. Over a period of several years, they have closely paralleled the former Qa indices which included CRPL observations and included three additional reports received after a considerable lag. Qa was first published to the nearest one-third of a unit at the same time.

North Pacific Radio Path -- The CRPL quality figures, Qp, are compiled by the North Pacific Radio Warning Service (NPRWS), the CRPL forecasting center at Anchorage, Alaska, from radio traffic data for moderately long transmission paths in the North Pacific equivalent to Seattle-to-Anchorage or Anchorage-to-Tokyo. These include reports to CRPL by the Alaskan Communications Service, Aeronautical Radio, Inc., U. S. Air Force and Civil Aeronautical Administration. In addition, there are CRPL monitoring, direction-finder observations and field strength measurements of suitable transmissions.

The original reports are on various scales and for various time intervals. The observations for each 9 hours or 24 hour period are averaged on the original scale. This average is compared with reports for the same period in the preceding two months and expressed as a deviation from the 3-month mean. The deviations are put on the 1 to 9 scale of quality which is assumed to have a standard deviation of 1.25 and a mean for the various periods as follows:

03-12 hours UT	5.33
09-18	5.33
18-03	6.00
00-24	5.67

The 9-hour and 24-hour indices Qp are determined separately. Each index is a weighted mean where the CRPL observations have unit weight and the others are weighted by the correlation coefficient with the CRPL observations.

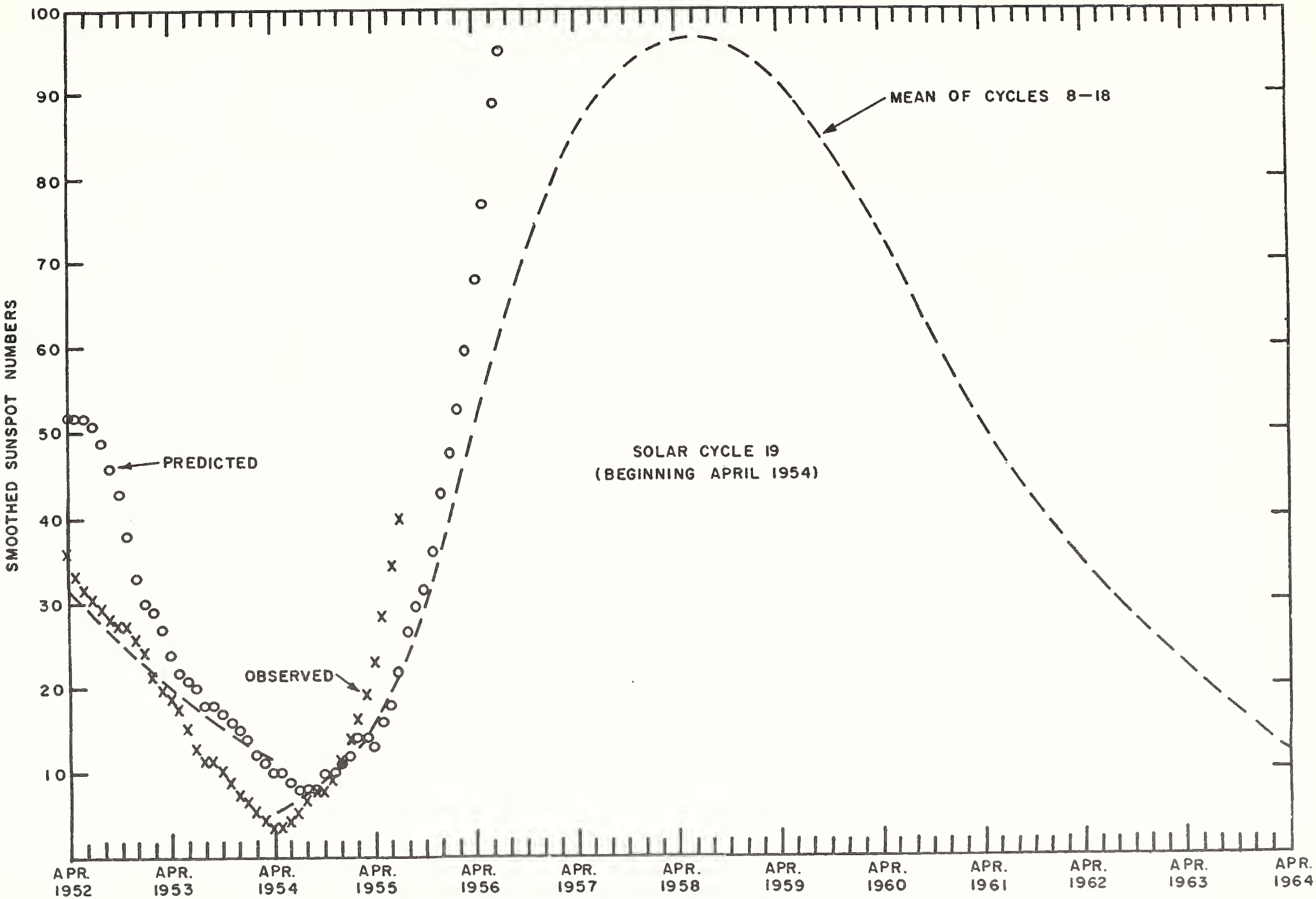
The table, analagous to that for Qa, includes the 9-hourly quality figures; whole day quality figures; short term forecasts issued by NPRWS three times dailv at 02^h, 09^h, and 18^h UT, applicable to the stated 9-hour periods; advance forecasts issued twice weekly by NPRWS (CRPL-Jp report); and half-day averages of geomagnetic K indices from Sitka.

The chart compares the outcome of advance forecasts, on the same basis as the similar chart for the North Atlantic Radio Path.

RELATIVE SUNSPOT NUMBERS

American Relative Sunspot Numbers December 1955	
Date	$R_{A'}$
1	80
2	83
3	71
4	79
5	75
6	85
7	80
8	67
9	79
10	63
11	57
12	60
13	69
14	57
15	75
16	54
17	70
18	63
19	94
20	91
21	78
22	62
23	44
24	47
25	45
26	54
27	64
28	62
29	73
30	63
31	48
Mean:	67.5

Zürich Provisional Relative Sunspot Numbers January 1956	
Date	R_Z
1	54
2	49
3	44
4	38
5	49
6	47
7	52
8	52
9	52
10	32
11	38
12	35
13	78
14	80
15	90
16	118
17	126
18	127
19	128
20	120
21	110
22	100
23	91
24	87
25	103
26	69
27	48
28	45
29	43
30	45
31	36
Mean:	70.5



PREDICTED AND OBSERVED SUNSPOT NUMBERS

CALCIUM PLAGE AND SUNSPOT REGIONS

JANUARY 1956

CMP Jan. 1956	Lat.	McMath Plage Number	Return of Region	Calcium Plage Data Date-Area-Intensity First seen	Maximum	Last seen	Sunspot Data Date-Area-Count First seen	Maximum	Last seen
1.7	S25	3365	3343	27- 200-1	02- 4000-1	06- 5000-1.5	26- 50a-x	28- 50a-x	30- 50a-x
2.8	N28	3366	3344	02-4000-2	02- 4000-2	07- 2200-1.5	03- 10 -x	03- 10 -x	03- 10 -x
3.7	S25	3367	3347	30-2000-3	02- 4000-3	08- 2800-2	29-200a-x	30- 200a-x	08- 70 -1
5.7	S17	3368	3348	03- 700-2	08- 1400-3	09- 2000-3	03- 10 -x	06- 160 -6	09- 50a-x
7.5	N30	3370	3350	02- *	06- 5500-2.5	10- *			
9.2	N28	3371	3353	02- *	06- 5000-2.5	14- 2000-1			
9.3	S28	3372	3352	06-1600-2.5	08- 2000-3	16- 1000-2	08- 50a-x	09- 50a-x	14- 50a-x
11.2	S17	3373	New	06- 600-3	08- 1000-2	16- 1400-2	06- 40 -2	08- 120 -2	09- 50a-x
12.6	N24	3374	3354,55	06-2000-2	07- 4000-2	18- 1400-1	06-140 -1	07- 200a-x	18- 10 -x
12.6	S25	3375	New	06-1000-2	16- 4000-3	18- 3500-2.5	07- 50a-x	13- 710 -10	17- 120 -2
15.0	N27	3376	3356	13-1200-2	13- 1200-2	18- 600-1.5			
16.8	S31	3378	3357	16-2000-2	16- 2000-2	21- 1200-2	09-200a-x	18- 270 -6	19- 10 -x
17.6	N26	3377	3358	13- 800-2	14- 1100-2	18- 800-1.5			
19.8	N24	3379	New	13-4000-4	22-15000-3.5	26-12000-3	{13-270 -1	18-1320 -13	25- 390 -1
							{14-480 -2	20-1930 -18	26-1400 -2
20.5	S22	3380	3360	16-1600-1.5	22- 1800-1	26- 1200-1	20- 50a-x	20- 50a-x	20- 50a-x
24.0	N25	3382	---**	18-6000-3.5	27- 6200-3	27- 6200-3+	17-410 -2	20- 940 -6	29- 150a-x
27.4	N30	3383	3364++	21-1200-2	23- 3000-2.5	27- 1900-2.5+			
28.9	S16	3384	3365++	22-1500-4	24- 2900-3	03- 2500-2	22- 50 -x	24- 460 -5	01- 20 -1
29.1	N24	3385	3366++	23-2000-2.5	27- 5600-3	04- 2000-3	24- 10 -x	26- 160 -5	04- xx -6

* No area and intensity estimates available.

** Unnumbered region, CMP 28.1 Dec. 1955.

\+ No plage observations Jan. 28-31.

++ Identification uncertain because of lack of observations.

CORONAL LINE EMISSION INDICES

JANUARY 1956

CMP Date 1956	North East Quadrant (observed 7 days earlier)				South East Quadrant (observed 7 days earlier)				South West Quadrant (observed 7 days later)				North West Quadrant (observed 7 days later)			
	G_6	G_1	R_6	R_1	G_6	G_1	R_6	R_1	G_6	G_1	R_6	R_1	G_6	G_1	R_6	R_1
Jan.																
1	76*	130	24	53	32	75	11	17	33	60	28	50	78	126	54	94
2	51	88	15	30	33	53	5	6	66	110	18	25	84	119	18	30
3	61	92	16	28	40	57	8	15	50	91	X	X	36	49	22[a]	40[a]
4	43	65	17	23	41	64	13	16	35	49	26	50	30	39	16	20
5	22[a]	25[a]	17[a]	20[a]	19[a]	23[a]	17[a]	24[a]	36	45	24	36	42	49	17	19
6	22	31	23	34	18	20	9	18	X	X	X	X	X	X	X	X
7	41	69	28	38	31	40	18	35	X	X	X	X	X	X	X	X
8	84	160	20	30	52	83	17	31	X	X	X	X	X	X	X	X
9	60	103	10	18	41	69	10	16	X	X	X	X	X	X	X	X
10	70	120	7	13	26	34	10	13	49[a]	68[a]	X	X	25[a]	40[a]	X	X
11	26	30	16	20	21	29	12	13	37	49	25	31	38	49	14	25
12	112	236	37	58	23	36	17	21	43	53	30	50	56	83	17	26
13	63	113	29	58	X	X	X	X	X	X	X	X	X	X	X	X
14	55	95	19	29	X	X	X	X	X	X	X	X	X	X	X	X
15	31	57	29	63	39	86	11	16	X	X	X	X	X	X	X	X
16	53	78	X	X	49	90	X	X	X	X	X	X	X	X	X	X
17	31	63	8[a]	16[a]	38	56	5[a]	10[a]	X	X	X	X	X	X	X	X
18	23	31	21	28	19	25	12	20	X	X	X	X	X	X	X	X
19	46*	79	22	28	46	58	15	25	21	23	10	19	48*	83	24	28
20	34*	64	X	X	33	42	X	X	X	X	X	X	X	X	X	X
21	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
22	X	X	X	X	X	X	X	X	X	X	X	X	53[a]	100[a]	X	X
23	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
24	X	X	–[a]	–[a]	X	X	15[a]	20[a]	X	X	X	X	X	X	X	X
25	30	35	13	16	4	4	11	11	X	X	X	X	X	X	X	X
26	48	58	14	20	4	3	14	16	–	–	12	14	78	142	16	26
27	X	X	X	X	X	X	X	X	19[a]	37[a]	13[a]	25[a]	87[a]	117[a]	X	X
28	X	X	X	X	X	X	X	X	61[a]	129[a]	24[a]	40[a]	121[a]	161[a]	24[a]	33[a]
29	X	X	X	X	X	X	X	X	15	45	13	17	33	49	14	24
30	X	X	X	X	X	X	X	X	13	17	9	14	23	30	12	16
31	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

* Yellow line observed.
a Index computed from low weight data.

SOLAR FLARES

JANUARY 1956

Observatory	Date Jan. 1956	Time Observed Start UT	Time Observed End UT	Duration Min.	Total Area Mill.	McMath Plage Region Number	Approx. Position Lat.	Approx. Position Mer. Dist.	Time Max. Phase UT	Max. Int. Arb.	Rel. Area of Max. Tenths	Importance	Provis. Ionospheric Effect
Neder	04	b0909	0924	>15		3364	N25	W35				1	
McMath	13	b1615				3375	S25	W14				1	G-SWF
S.Peak	13	b1718	1740	>22	130	3375	S24	W18	1719	18	5	1	G-SWF
Wendel	14	1007	1031	24	242	3379	N20	E84	1012			2	S-SWF
Wendel	14	1039	1052	13	291	3379	N21	E83	1043			1	
Schau	16	b1357	1360	> 3		3379	N26	E62				1+	Slow S-SWF
Wendel	17	1105	1123	18	194	3379	N22	E49	1114			1+	
Schau	19	b0953	1007	>14		3379	N21	E22				1+	
S.Peak	19	1555	1735	100	221	3379	N22	E17	1620	15	3	1	Slow S-SWF
S.Peak	19	2115	2200	45	240	3379	N22	E13	2137	16	6	1	
Mt.Wilson	19	b2244	2254	>10		3379	N25	W15				2	
Wendel	20	1156	1218	22	194	3379	N23	W01	1159			1	
Wendel	23	1245	1307	22	242	3379	N19	W49	1250			2	
Wendel	23	1444	1455	11	242	3379	N19	W50	1449			1	Slow S-SWF
McMath	23	b1620	1705	>45		3379	N22	W48				2	G-SWF

Subflares noted as follows (Date, time (UT), region):

Jan. 1, 2025 (**)
3, 1600 (3364)
1625 (3365)
4, 1920 (3367)
2005 (3367)
2055 (3367)
5, 1510 (3367)
1935 (3367)
8, 1720 (3372)
12, 1509 (3375)
13, b1445 (3375) *
17, 2155 (3379)

Jan.18, 1755 (3379)
b2030 (3379)
b2129 (3379)
19, 1628 (3379)
b1800 (3379)
1905 (3379)
1921 (3379)
1934 (3379)
1950 (3379)
b2202 (3382)
2238 (3379)
20, b2123 (3379)

Jan. 20, b2136 (3383)
b2154 (3379)
23, 2000 (3379) ***
24, b1615 (3379) *
b1933 (3385)
25, b1725 (3379)
b1750 (3379)
b1815 (3379)
26, 1645 (3379) ***
27, 2030 (3382)
2110 (3384)

* McMath observation, all others are Sac. Peak.
** Unnumbered region CMP 28.1 Dec. 1955.
*** Observed by both McMath and Sac. Peak.

IONOSPHERIC EFFECTS OF SOLAR FLARES

DECEMBER 1955

Dec. 1955	Start UT	End UT	Type	Wide-spread Index	Impor-tance	Observation Stations
2	1320	1435	G-SWF	3	1+	BE, HU, PR
	1623	1715	G-SWF	2	1-	HU, MC, PR
3	1105	1125	S-SWF	5	3	HU, PR, NE*, RCA**
4	1505	1605	Slow S-SWF	5	2	BE, HU, MC, PR
6	2140	2202	G-SWF	3	1+	AN, HU, PR
9	1945	2000	Slow S-SWF	2	1-	AN, MC, PR
	2030	2100	Slow S-SWF	2	1-	AN, HU, MC
10	1909	1940	G-SWF	5	2	AN, BE, HU, MC, PR
25	1426	1450	S-SWF	4	1+	HU, MC, PR, NE*
	2322	2346	G-SWF	4	1+	AN, OK, PR
29	1830	1850	Slow S-SWF	2	1+	AN, HU, PR

* Nederhorst den Berg, Netherlands.

** RCA Communications Inc. at Somerton, England.

Note: Nederhorst den Berg reported S-SWF in November 1955 as follows:
Nov. 7, 1600-1638 UT; Nov. 9, 1320-1334 UT; Nov. 12, 1130-1154 UT;
Nov. 15, 1251-1306 UT, 1734.5-1800 UT; and Nov. 18, 0838-0900 UT.

SOLAR RADIO WAVES (BOULDER) -- 167 MC

3-HOURLY AND DAILY FLUX

JANUARY 1956

	Flux					Variability					Observed Periods
	Hours UT					Hours UT					
Jan. 1956	12 15	15 18	18 21	21 24	Daily	12 15	15 18	18 21	21 24	Daily	Hours UT

No Scalable Records

SOLAR RADIO WAVES (BOULDER) -- 460 MC

3-HOURLY AND DAILY FLUX

JANUARY 1956

Jan. 1956	Flux: Hours UT 12-15	15-18	18-21	21-24	Daily	Variability: Hours UT 12-15	15-18	18-21	21-24	Daily	Observed Periods: Hours UT
1	--	--	32	31	32	--	0	0	0	0	1422-2330
2	--	32	32	32	32	--	0	0	0	0	1422-2330
3	--	32	32	32	32	--	0	0	0	0	1422-2331
4	--	32	32	32	32	--	0	0	(0)	(0)	1422-2332
5	--	31	31	31	31	--	0	0	0	0	1422-2333
6	--	31	33	32	32	--	0	0	0	0	1422-2334
7	--	34	33	33	33	--	0	0	0	0	1422-2335
8	--	34	34	34	34	--	0	0	0	0	1422-2336
9	--	--	32	--	32	--	0	0	0	0	1422-2337
10	--	32	34	--	33	--	0	0	0	0	1422-2338
11	--	34	34	34	34	--	0	0	0	0	1422-1800, 1835-1930*
12	--	37	37	37	37	--	0	0	0	0	1421-2340
13	--	(33)	35	34	(34)	--	0	0	0	0	1421-2341
14	--	32	32	33	32	--	0	0	0	0	1421-2342
15	--	33	34	34	34	--	0	0	0	0	1421-2343
16	--	33	37	38	36	--	0	0	1	1	1420-2344
17	--	37	36	37	37	--	0	0	1	1	1420-2345
18	--	36	35	37	35	--	0	0	0	0	1419-2347
19	--	53	70	60	62	--	(1)	2	1	2	1419-2348
20	--	43	48	77	56	--	(0)	1	2	2	1418-2349
21	--	>650	190	70	>310	--	3	2	0	3	1418-2350
22	--	36	--	39	37	--	1	0	0	1	1417-2352
23	--	--	34	34	34	--	1	1	0	1	1417-1730, 1804-2354
24	--	35	33	--	34	--	0	0	(0)	(0)	1416-2355
25	--	--	33	--	32	--	1	(0)	(0)	1	1415-2356
26	--	32	30	30	30	--	0	0	(0)	(0)	1414-2358
27	--	--	30	30	30	--	(0)	(0)	(0)	(0)	1414-1701 1742-2359
28	--	29	30	30	30	--	1	0	(0)	1	1413-2400
29	--	29	31	30	30	--	0	0	0	0	1412-2401
30	--	32	32	--	32	--	0	0	0	0	1411-2001, 2033-2402
31	--	32	34	--	34	--	0	0	0	0	1410-2404

* Additional Observed Period 2038-2339.

SOLAR RADIO WAVES (BOULDER) -- 167 MC

OUTSTANDING EVENTS

JANUARY 1956

Jan. 1956	Type	Start UT	Duration Hrs:Mins	Maximum			Remarks
				Time UT	Inst. Flux	Smd. Flux	

No Scalable Records

SOLAR RADIO WAVES (BOULDER) -- 460 MC

OUTSTANDING EVENTS

JANUARY 1956

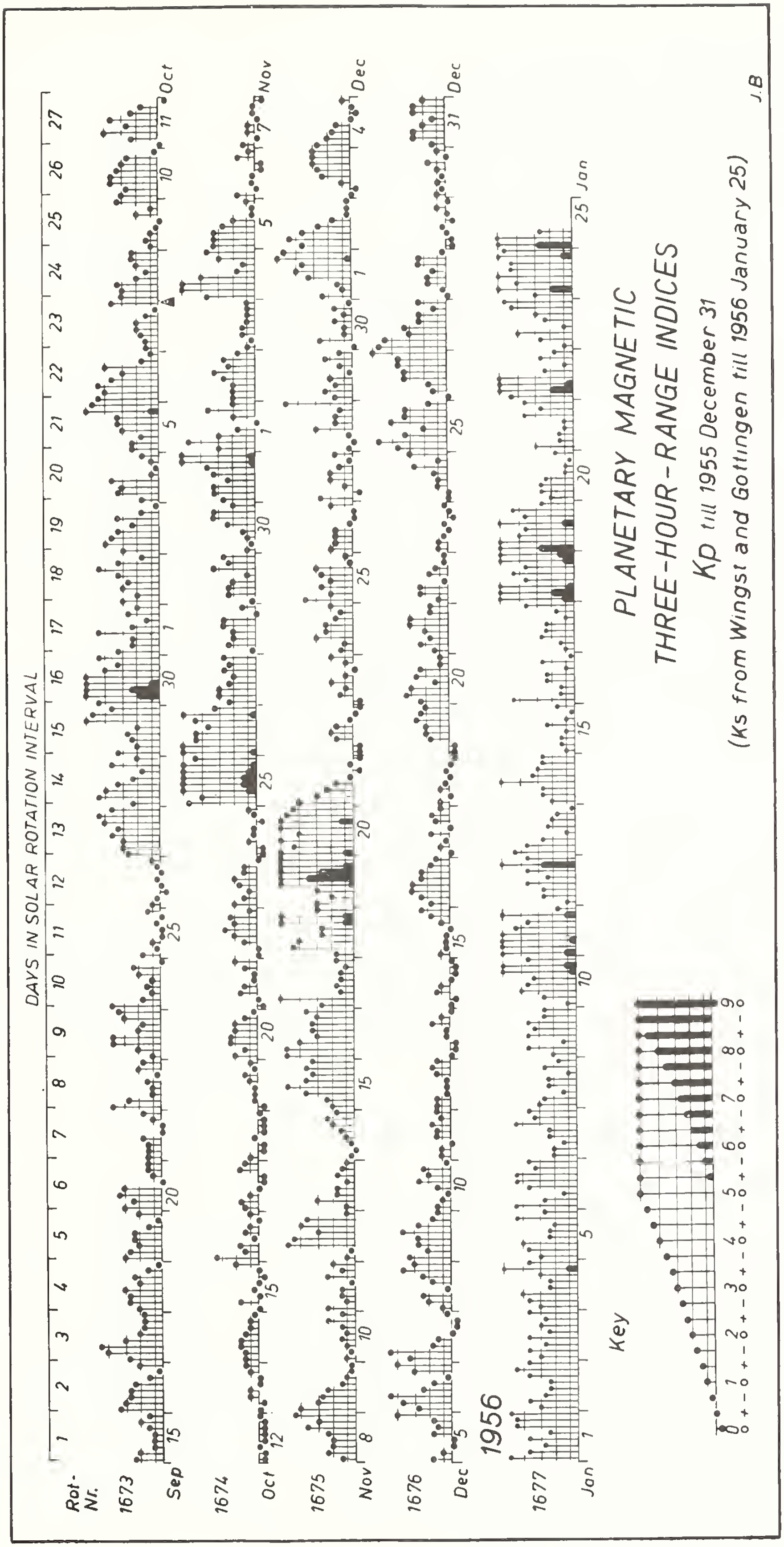
Jan. 1956	Type	Start UT	Duration Hrs:Mins	Maximum Time UT	Maximum Inst. Flux	Maximum Smd. Flux	Remarks
8	2	2020.6	00:04.0	2024.5	58	3	
12	6	(1421)	(09:19)	~1900	--	5	
14	3	1745.3	00:00.6	1745.4	69	-	
16	3	1648.7	00:02.8	1650.2	51	4	
16	1	1954	03:03	2123.8	99	-	
17	8	2156.4	00:12.3	2158.4	87	7	
18	1	(1419)	(09:28)	2324.1	80	-	
19	6	(1419)	(04:44)	~1500	--	19	
19	9	1903	01:27	~1905	360	50	
19	6	2030	(03:18)	~2200	--	29	
19	8	2236	00:09	2242	>790	48	
20	6	(1418)	(07:30)	~2000	--	39	
20	9	2148	(02:01)	~2220	230	43	
21	9	1430	05:25	1530	>1800	>590	See note
21	8	1955	01:10	~2015	>760	340	
21	6	2105	(02:45)	~2200	--	39	
22	6	(1417)	(09:35)	~2245	--	8	
23	6	(1417)	(09:37)	~1540	--	4	
25	1	(1415)	(03:45)	1725.5	120	-	
28	2	1701.5	00:17.5	1709.5	73	4	
29	3	1722.1	00:01.0	1722.3	51	5	

Largest energy output to date for any event during present sunspot cycle.

GEOMAGNETIC ACTIVITY INDICES

DECEMBER 1955

Dec. 1955	C	Values Kp, Three-hour Gr. interval: 1	2	3	4	5	6	7	8	Sum	Ap	Final Selected Days
1	1.3	2+	1o	1+	3+	4o	4-	5+	5-	26-	22	Five
2	0.6	4-	4+	4-	3-	2-	1-	1-	1-	18o	13	Quiet
3	0.8	0+	0o	1o	2+	3-	3o	3o	3o	15+	9	
4	0.2	3-	2o	2-	1+	0+	0o	0+	1o	9+	5	13
5	0.7	2-	1o	0+	0+	2-	1+	2-	4o	12o	7	14
												18
6	1.0	3-	4-	4+	2+	2-	1-	3o	4o	22+	16	23
7	0.3	3+	4+	2-	1+	0+	0o	0o	1-	12-	8	29
8	0.5	1o	2o	2+	1-	2-	2+	4-	3o	17-	9	
9	0.8	3+	2o	3-	3-	4-	3-	2-	1+	20o	12	
10	0.3	1+	1o	1-	1+	3-	2o	2+	1-	12o	6	
11	0.1	1o	1o	0+	1+	1+	2-	1o	1+	9o	4	Five
12	0.1	1+	1+	1-	1-	1-	1+	2-	1+	9o	4	Disturbed
13	0.0	0+	0o	0o	1-	1-	2-	1o	0+	5-	2	
14	0.0	0+	0o	1+	1o	0+	0o	0o	0+	3+	2	1
15	0.3	1o	1-	1-	1-	0+	1o	2-	2+	8+	4	6
												25
16	0.6	2-	2+	3o	3o	2+	2+	2-	1+	18-	9	26
17	0.2	0+	1o	1-	2-	0+	1+	2-	1o	8o	4	27
18	0.0	1o	0+	1o	1-	0+	1-	0+	0o	4+	2	
19	0.6	0o	0o	2-	2o	2o	3-	2+	2o	13-	6	
20	0.4	2+	3+	3o	1+	3-	2+	1o	1o	17o	10	
21	0.6	1+	2+	2-	2o	3o	3o	2-	2-	17-	9	Ten
22	0.2	1o	2+	2+	1-	2-	1+	1-	1-	11-	5	Quiet
23	0.0	1o	1o	1-	0+	1-	0o	0+	1-	5-	3	
24	0.5	0+	0+	1o	1o	1+	3-	1o	3o	11-	6	11
25	1.2	4-	5-	3+	2o	4o	3+	3+	2-	26o	19	12
												13
26	1.2	0+	1+	2-	3+	3+	4-	4-	5o	22+	18	14
27	0.9	5-	4+	3o	3+	2+	2+	1+	2+	24-	17	15
28	0.4	0+	1-	2-	2-	1+	2+	2+	1-	11o	5	17
29	0.0	0o	0o	0+	1-	0o	0+	1o	0+	3-	2	18
30	0.1	1o	1-	1o	1-	1o	2-	0+	1o	7+	4	23
31	0.7	1+	3-	3-	2o	1+	3-	3-	2o	17+	9	29
Mean:	0.47									Mean:	8	30


PLANETARY MAGNETIC
THREE-HOUR-RANGE INDICES
Kp till 1955 December 31
(Ks from Wingst and Göttingen till 1956 January 25)
DAYS IN SOLAR ROTATION INTERVAL
Rot-Nr.
1673
1674
1675
1676
1677
1956
Key
J.B

CRPL RADIO PROPAGATION QUALITY FIGURES AND FORECASTS

NORTH ATLANTIC

DECEMBER 1955

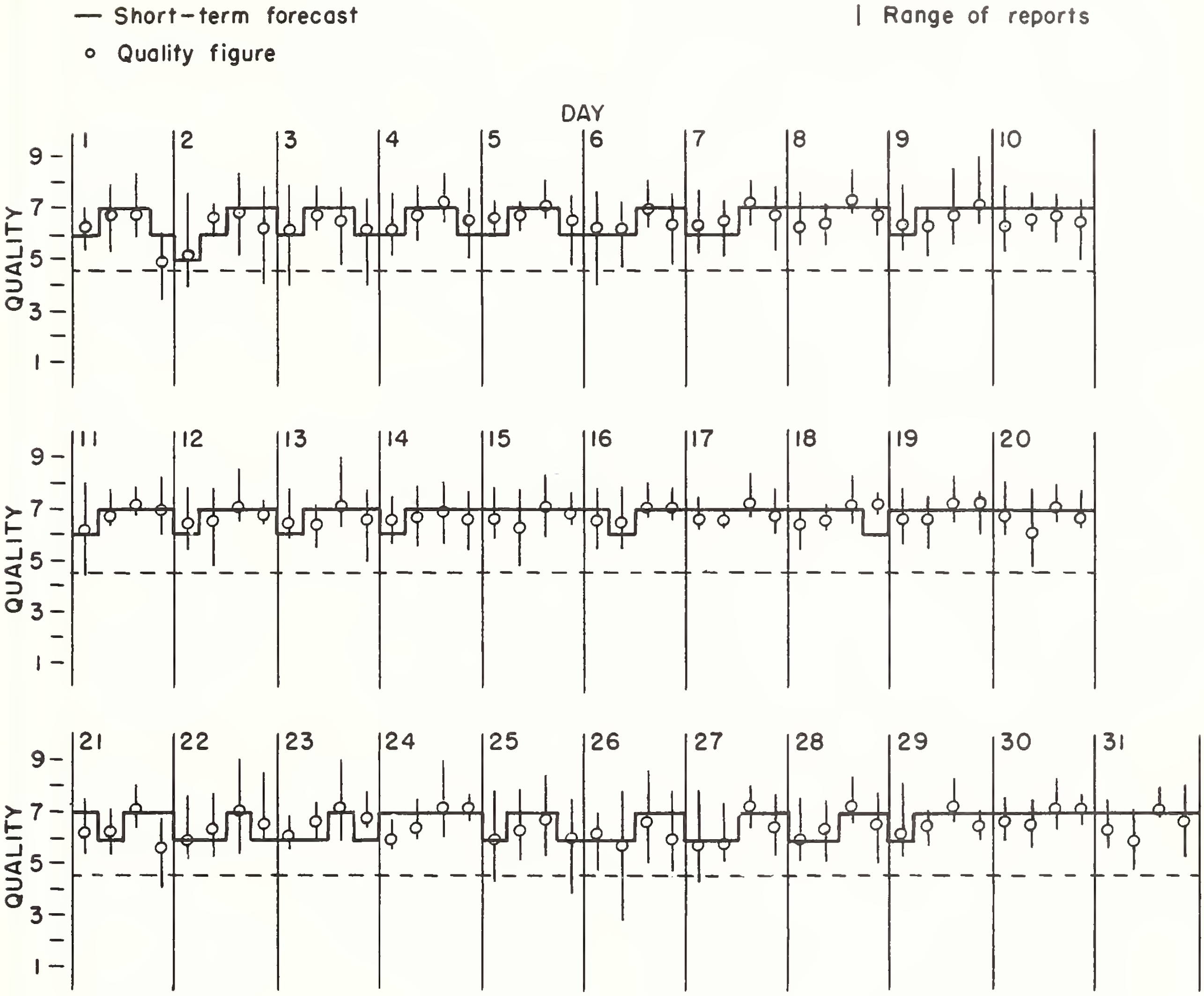
Dec. 1955	North Atlantic 6-hourly quality figures				Short-term forecasts issued about one hour in advance of:				Whole day index	Advance forecasts (J-reports) for whole day; issued in advance by:			Geomagnetic K_{Ch}	
	00 to 06	06 to 12	12 to 18	18 to 24	00	06	12	18		1-4 days	4-7 days	8-25 days	Half (1)	Day (2)
1	6+	7-	7-	5o	6	7	7	6	6+	7	6		2	3
2	5+	7-	7o	6+	5	6	7	7	7-	6	7		3	1
3	6+	7-	7-	6o	6	7	7	6	7-	6	7		1	2
4	6+	7-	7+	7-	6	7	7	6	7-	6	7		2	1
5	7-	7-	7o	7-	6	7	7	6	7-	6	7		1	2
6	6+	6+	7o	6+	6	6	7	7	7-	7	7		3	2
7	6+	7-	7+	7-	6	6	7	7	7-	7	7		2	1
8	6+	7-	7+	7-	7	7	7	7	7-	7	7		1	3
9	6+	6+	7-	7o	6	7	7	7	7-	7	7		2	2
10	6+	7-	7o	7-	7	7	7	7	7-	7	7		1	1
11	6+	7-	7+	7o	6	7	7	7	7o	7	7		0	1
12	7-	7-	7o	7o	6	7	7	7	7-	7	7		1	1
13	7-	7-	7+	7-	6	7	7	7	7-	7	7		0	1
14	7-	7-	7o	7-	6	7	7	7	7-	6	6		1	0
15	7-	6+	7+	7o	7	7	7	7	7-	4	4	x	0	1
16	7-	7-	7+	7o	7	6	7	7	7-	7	4	x	3	2
17	7-	7-	7+	7o	7	7	7	7	7o	5	5		1	1
18	7-	7-	7+	7+	7	7	7	6	7o	4	6		1	0
19	7-	7-	7+	7o	7	7	7	7	7o	4	6		1	1
20	7-	6+	7o	7o	7	7	7	7	7-	7	5		2	1
21	6+	6+	7o	6-	7	6	7	7	7-	7	6	x	2	1
22	6o	7-	7o	7-	6	6	7	6	7-	7	6	x	2	1
23	6+	7-	7+	7o	6	6	7	6	7-	7	7		1	0
24	6o	7-	7+	7+	7	7	7	7	7o	7	7		0	2
25	6o	7-	7o	6+	6	7	7	6	7-	7	7		3	2
26	6+	6o	7-	6+	6	6	7	7	6+	7	7		2	3
27	6o	6o	7+	7-	6	6	7	7	7-	*	7		3	1
28	6o	7-	7+	7-	6	6	7	7	7-	7	7		1	1
29	6+	7-	7+	7-	6	7	7	7	7-	7	7		0	1
30	7-	7-	7+	7o	7	7	7	7	7o	7	7		1	1
31	7-	6+	7+	7o	7	7	7	7	7-	7	7		2	2
Score: Quiet Periods				P	23	21	31	21		19	21			
				S	8	10	0	10		7	6			
				U	0	0	0	0		1	2			
				F	0	0	0	0		3	2			
Disturbed Periods				P	0	0	0	0		0	0			
				S	0	0	0	0		0	0			
				U	0	0	0	0		0	0			
				F	0	0	0	0		0	0			

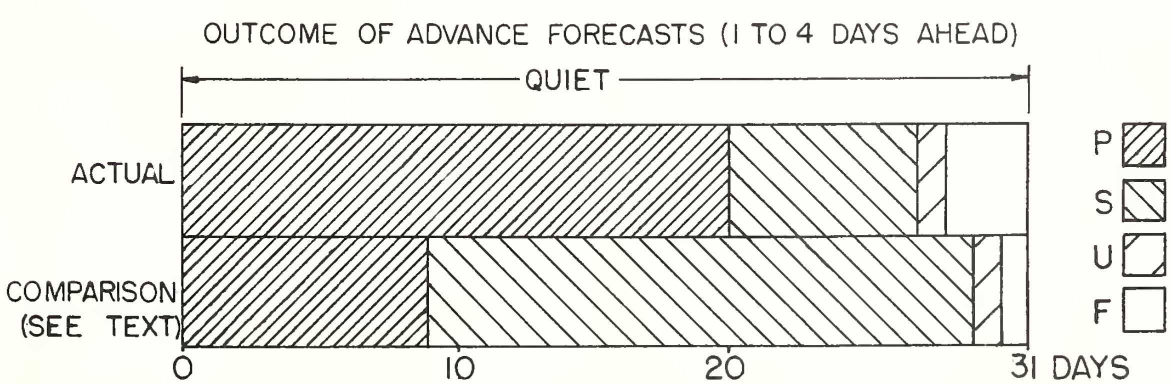
( ) represent disturbed values.

* Because of forecasting schedules, no forecast was made 1-4 days in advance of this date. The forecast made 4-7 days in advance used in comparison graph.

CRPL RADIO PROPAGATION QUALITY FIGURES AND FORECASTS
NORTH ATLANTIC

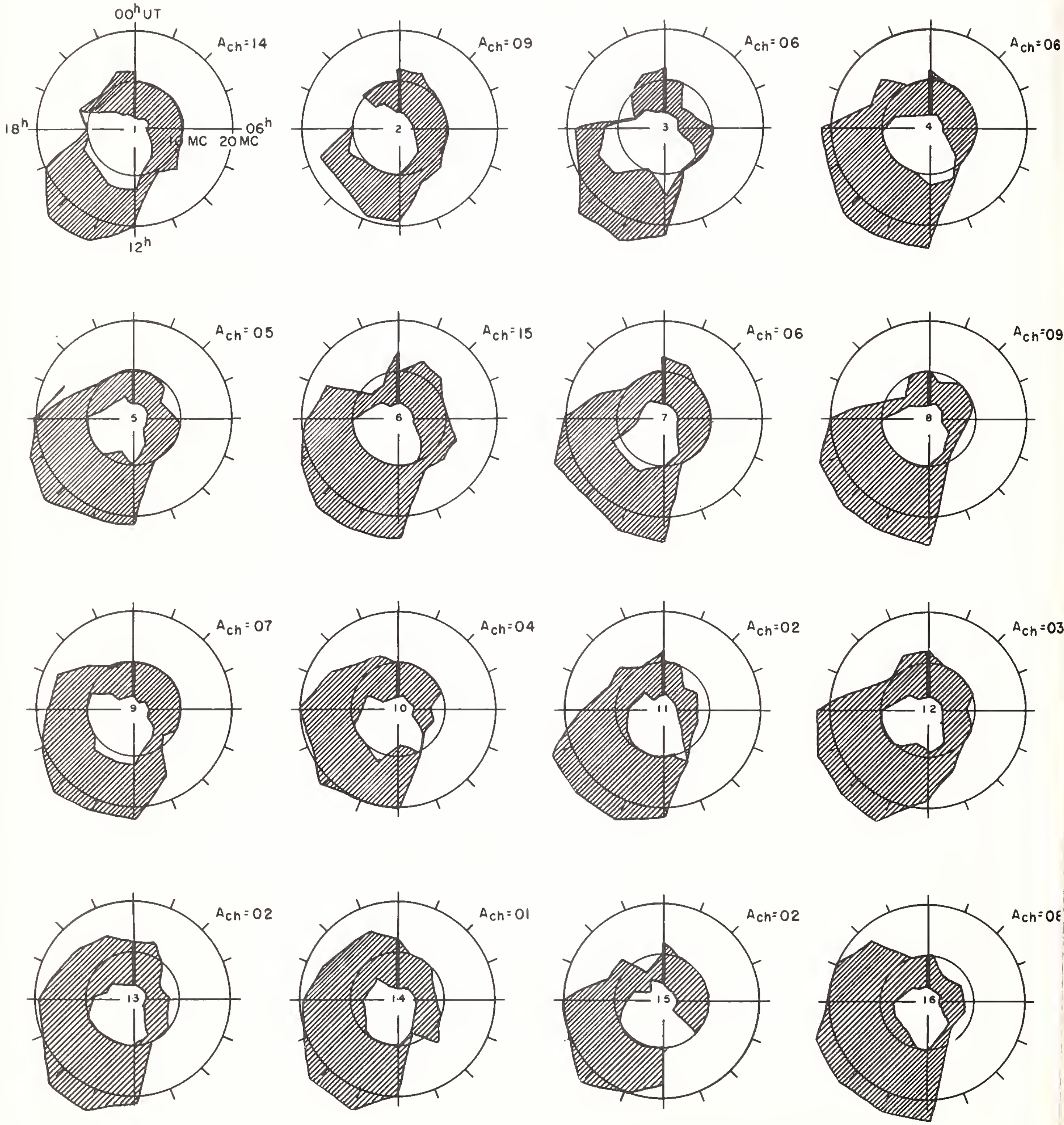
DECEMBER 1955



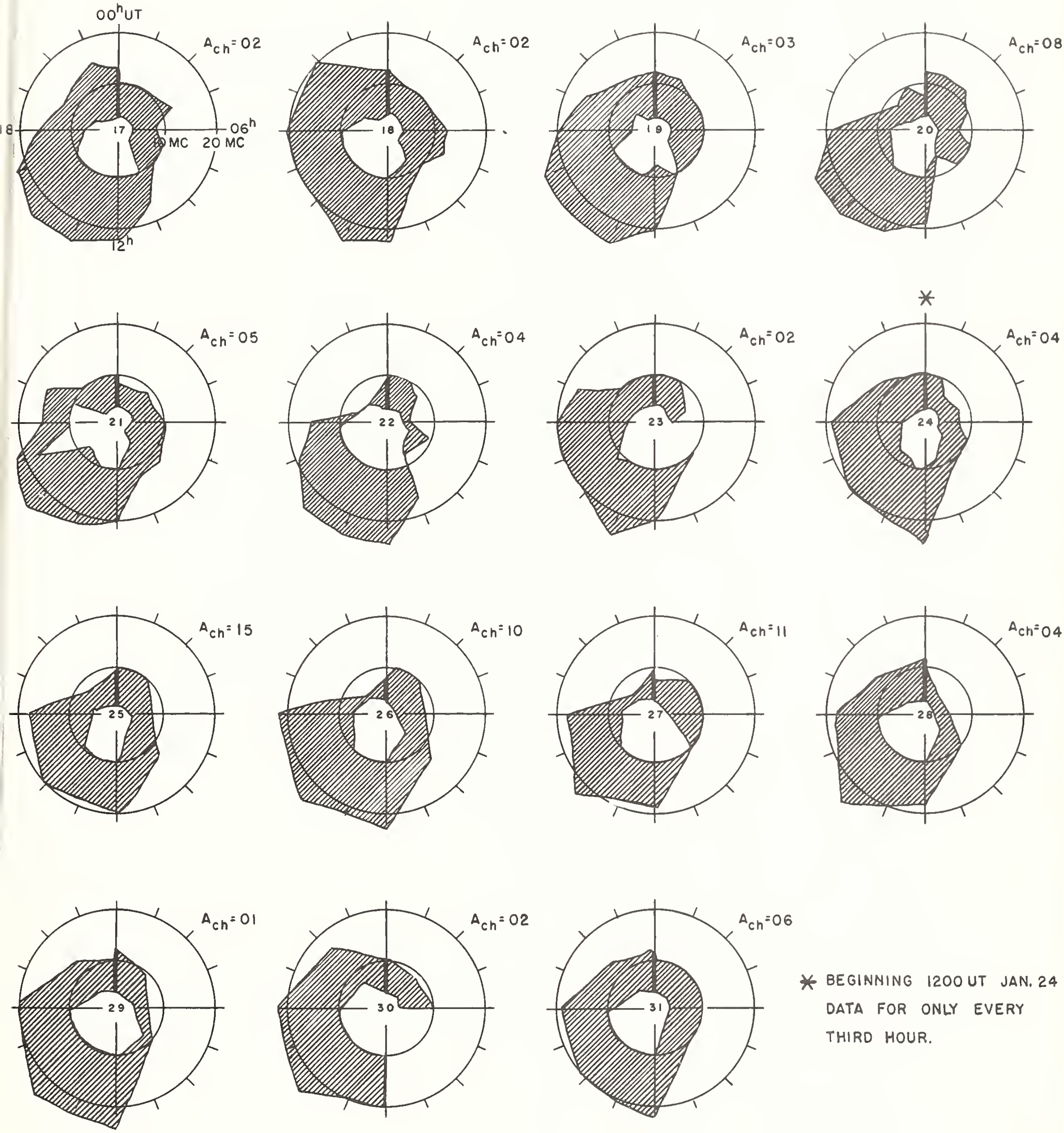


USEFUL FREQUENCY RANGES -- NORTH ATLANTIC PATH

DECEMBER 1955



DECEMBER 1955



Adapted from Observations by Deutschen Bundespost

NORTH PACIFIC

DECEMBER 1955

Dec. 1955	North Pacific 9-hourly quality figures			Short-term fore-casts issued at			Whole day index	Advance forecasts (Jp reports) for whole day; issued in advance by:			Geomag-netic K_{Si}	
	03 to 12	09 to 18	18 to 03	02	09	18		1-4 days	4-7 days	8-25 days	Half day (1)	(2)
1	6	6	4	6	5	5	6	5	5		1	(4)
2	6	6	6	4	4	6	6	5	5		(4)	1
3	5	6	7	6	5	6	6	6	5		1	3
4	6	6	6	6	6	7	7	4	4		2	1
5	5	6	6	6	6	6	6	4	4		0	2
6	6	6	5	6	5	7	6	6	5		3	2
7	5	6	6	5	5	7	6	6	6		2	0
8	6	6	6	6	6	6	6	6	6		1	2
9	5	5	7	6	5	6	5	6	5		2	2
10	6	6	7	6	6	7	6	6	6		0	2
11	6	5	6	6	6	6	6	6	6		0	1
12	4	5	6	6	5	6	5	6	4	x	0	1
13	5	5	7	5	5	6	6	5	4	x	0	1
14	6	6	7	6	6	6	6	6	5	x	1	0
15	6	6	7	5	6	7	6	4	3	x	1	1
16	6	6	7	5	5	6	7	3	3	x	2	2
17	5	5	7	6	5	6	6	4	3	x	0	1
18	5	6	7	6	5	6	6	4	4	x	0	0
19	5	4	6	5	5	6	5	5	5		1	2
20	6	5	7	5	5	6	6	6	5		2	2
21	6	5	7	6	6	6	6	6	6		2	3
22	6	6	7	6	6	7	6	6	6		1	1
23	6	6	7	6	6	7	6	6	6		0	1
24	4	5	7	6	6	6	5	6	6		1	2
25	6	5	6	6	6	6	6	6	6		3	(4)
26	6	6	6	5	6	6	6	7	7		2	(4)
27	6	6	6	5	6	6	6	7	7		(4)	2
28	5	5	6	5	6	6	6	6	6		1	2
29	4	5	6	5	5	6	5	6	6		0	0
30	6	5	6	5	5	6	6	6	6		1	2
31	6	6	5	5	5	5	6	6	6		2	2
Score: Quiet Periods			P	15	17	17		16	13			
			S	12	12	12		9	11			
			U	0	0	1		0	0			
			F	1	1	0		6	7			
Disturbed Periods			P	0	0	0		0	0			
			S	1	1	1		0	0			
			U	0	0	0		0	0			
			F	2	0	0		0	0			

( ) represent disturbed values.

CRPL RADIO PROPAGATION QUALITY FIGURES AND FORECASTS

NORTH PACIFIC

DECEMBER 1955