IONOSPHERIC NETWORK ADVISORY GROUP

Ionosphere Station Information Bulletin No. 9

Page

Note: page numbers are incorrect because, among other things, the page and font sizes were changed.

* Under auspices of the Solar-Terrestrial Physics Committee of the International Union of Radio Science (URSI/STP Committee).

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IONOSPHERIC NETWORK ADVISORY GROUP (INAG)*

Ionosphere Station Information Bulletin No. 9**

I. Introduction

The URSI/STP Committee at Brussels July 1971 discussed the possibility of opening the columns of the INAG Bulletin for contributions on Absorption, Drifts, Incoherent Scatter, Whistlers, i.e. to the ground based networks whose data contribute to our knowledge of the Ionosphere and Magnetosphere. It recommended that the views of the URSI Consultants in these fields be obtained. This has been done, and replies were received from Dr. J. Taubenheim, Absorption, Professor R.W.H. Wright, Drifts, and Professor D. L. Carpenter, Whistlers, all of whom welcome the suggestion. INAG will, therefore, be willing to accept contributions on these fields, particularly contributions designed to facilitate International cooperation or to provoke V.I. groups to take up experiments in these fields. Conversely V.I. articles which bear on problems in these fields will also be welcome. The possibility of sending copies of these Bulletins to synoptic stations in these fields is being examined.

The new version of the URSI Handbook of Ionogram Interpretations and Reductions is now with WDC-A, who are preparing it for publication as a UAG-Report.

This Bulletin contains some further notes on possible changes in the International rules (see INAG-8, p. 1-8). The change in accuracy rules discussed at Leningrad and Brussels appears to have general support, and INAG, therefore, proposes that the IQSY high latitude rules be applied everywhere effective January 1, 1972. There also appears to be general agreement on the rules for fl which have now been included in the Handbook. Any further clarifications needed should be sent to INAG in time to be considered at Warsaw, August 1972.

The main point of controversy which still needs resolving is the question of a change in rules for fbEs so that numerical values can be obtained in cases of total blanketing. At present, the pressure for a change is greater than the pressure for keeping the old rules. We can only judge your views by your letters. Hence, if you wish to keep the old rules or to make alternative proposals for new, please write soon.

There is a case for typing spread F to help the analysis of the morphology of these phenomena. While there is a considerable literature on the interpretation of spread F there have been no wide spread experiments on typing problems. To start discussion the system proposed by Penndorf is reproduced below. Your chairman feels that this needs some additions and possibly serious modification before it would be suitable for general use. What is your view? You may care to propose an alternative system, e.g. one based on the type of structure likely to be present. In any system, it is essential that the different classes can be adequately separated, and it is preferable that the number of classes is restricted to the minimum needed to classify different physical situations.

W. R. Piggott
Chairman, INAG and URSI/STP VI Consultant

II. Modification to Accuracy Rules

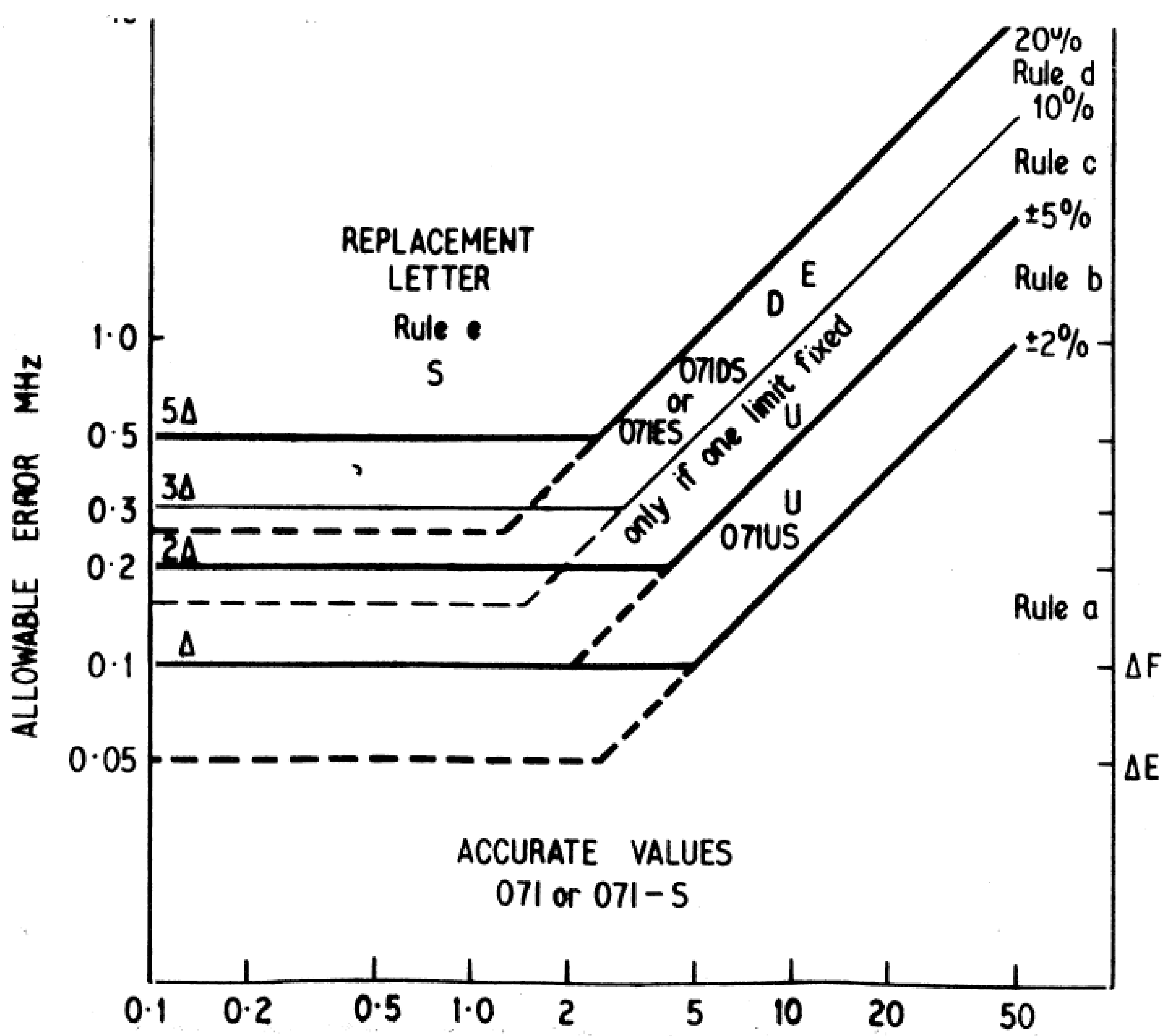
The possibility of adopting the IQSY accuracy rules for the use of D and E at all stations was gully discussed at Leningrad (INAG-2 Bulletin) and at Brussels (INAG-8 Bulletin, p. 6-8). A full description with examples has been given in the latter reference. This proposal has met with general approval and INAG, therefore, recommends that it be adopted to take effect January 1, 1972, or from such a date as is approved by the administration responsible for the station.

The new rules are:

Uncertainty	Action Tabulated value is
greater than + 5% or + 2Δ from middle value but not exceeding + 20% or + 5Δ from the lower limit value	numerical lower limit value qualified by D with appropriate descriptive letter
greater than + 5% or + 2Δ from middle value but not exceeding —20% or —5Δ from the upper limit value	numerical upper limit value qualified by E with appropriate descriptive letter

The proposed modified rules are reproduced above. These will be discussed and adopted or modified at Warsaw.

The use of the rules applied to frequency parameters is shown in Fig. 1, which replaces Fig. 2.1 on p. 28 of the first edition of the Handbook.



III. Night E

INAG proposes the following definition for night E. Note that this only differs from the old definition in that it allows the presence of normal E at night.

The ionogram pattern corresponding to night E is very similar to that for normal E. The difference is that the critical frequency is significantly larger than would be expected for normal E at the time involved and varies rapidly with time. Night E is often preceded or followed by retardation type Es or auroral type Es and is due to particle bombardment causing excess ionization in the E layer. Night E always causes retardation in the traces from higher layers.

Night E is identified in the normal E Table by descriptive letter K. When night E is present with no other Es traces foEs fbEs foE and all three are entered in the appropriate tables with descriptive letter K. On an f-plot, night E is shown as fbEs, i.e. by an open circle with the fbEs dashes, or if fbEs is present on successive entries, by lines joining the values of fbEs. For a thin Es layer a solid dot is used. h'E and h'Es are also described by letter K.

IV. A Possible Convention for fbEs when Complete Blanketing is Present

The problem of evaluating fbEs when total blanketing is present have been discussed in these Bulletins at Leningrad and at Brussels. The users of the data are pressing INAG for an improved system, but the views of the operators are still confused. Unless the F layer is tilted, fbEs is relatively unaffected by horizontal changes in the Es layer and by the sensitivity of the equipment. It is, therefore, a valuable practical index of Es behavior. The problem is that of obtaining a representative value of fbEs accurate to the limits imposed by horizontal changes in the layer. In some zones, fbEs usually does not vary much with position at a given time, in others it changes rapidly. For the first class there is strong support for a change, for the second, the view .is that of variability of the data is too great to justify more than the crudest measure. It is a matter of opinion at present which class is the more widespread.

An examination of many ionograms suggests that totally blanketing Es most often shows a solid trace to foEs. The main exception is the equatorial zone when q type Es is superposed on a totally blanketing Es. The second and higher order traces suggest that fbEs is close to foEs in this case, the difference is often small compared with the time variations of foEs and fbEs. Any errors due to the breakdown of this condition would distort the distribution of fbEs values but the distortion would be small compared with the normal time variation, (i.e. sampling errors).

A possible convention is given below. There are three alternatives, most cases are in (a), a few in (b) and a very few in (c). This is based on the principle that when the Es does not vary with position, the top frequency of the second order trace will show the frequency at which F trace would have been seen. Examination of the first order trace often shows that it is stronger below than above this frequency. When the Es layer varies with position the top frequencies of the multiple orders cease to show a gradual fall of top frequency with order and are inconsistent with the solid part of the Es trace. In practice, for these high values of fbEs, the difference between foEs and fbEs is negligible compared with the time variation of fbEs provided foEs is given by a solid trace.

(a) If the trace is solid to foEs, tabulate foEs AA.
(b) If the trace is not solid to foEs, or if more than two multiple traces are present with the value of the top frequency of the second order trace much smaller than foEs, tabulate the value of foEs deduced from the top frequency of the second order trace with qualification AA, respectively. (Note: If these values have to be deduced from the x-mode trace, AA should be used in preference to JA in case (a) or (b).) Values deduced using (a) and (b) should agree within the accuracy rules for limit values, otherwise use (c).
(c) When the top frequencies of the higher order traces are inconsistent with each other or with foEs (Es varying with position) use the best estimate of foF2 with DA. This should be found from the sequence of foF2 values near the time involved, or from corresponding values on other days. <u>Your views on this text are requested and your opinion on whether (a) and (b) are usually consistent at your station would be valuable</u>.

Note: This convention does not change the rules when partial blanketing is present.

V. Relation between fxEs and foEs

The attached letter from Dr. J. D. Whitehead, the URSI/C.C.I.R. consultant for Es problems, raises some interesting problems on the interpretation of Es. It would be most valuable if Dr. Whitehead's experiment could be repeated in other parts of the world since the results obtained are likely to be dependent on the types of Es phenomena most frequently present.

"Dear Mr. Piggott,

I have some interesting but disturbing results from an experiment performed in Oklahoma, U.S.A. measuring sporadic E parameters. The unusual feature about the experiment was that the receiving antenna was circularly polarized and the 0- and X-ray data were recorded on alternate sweeps. It was found that

fxEs - foEs 0.64 $\pm$ 0.34 MHz

and fbxEs - fboEs = 0.79 $\pm$ 0.38 MHz

(theoretical value about 0.8 MHz)

Notice the substantial S.D. of the individual measurements. This means that values of foEs determined from fxEs may be in considerable error. The differences may have a significant diurnal variation which opens the possibility of systematic errors. I wonder if you could stress the importance of recording the polarization of the echoes: it is easy to separate the 0- and X-rays with an additional antenna plus a switchable 900 phase-shifter which costs about $100.

I noticed the remarks about the "lacune F" in INAG-6 Feb. 1971. We notice it even on Brisbane records, though the gaps are small (~15 kHz - 100 kHz). It is probably due to a tilt of F region plus a gradient in the peak electron density in E region."

Your Chairman adds the following comments which may help discussion. The large systematic discrepancy between the theoretical and observed average values of fxEs - foEs obtained in Dr. White-head's experiment suggests that much of the data were taken at times when absorption was significant. Except near the magnetic equator, the absorption difference at the theoretical values of fxEs and foEs, ΔL dB is determined by the absorption at foEs, L dB and a ratio given approximately by fB/fxEs where fB is the gyrofrequency. With L = 20dB, a typical daytime value, and fB/fxEs = 1/4, ΔL is about 5 dB, a big enough difference to be detected on an ionogram where the echo is weak, This would cause the observed value of fxEs to be lower than that corresponding to foEs as is seen. It would be interesting to repeat the experiment at night or at times when foEs and fxEs were large (say above 7 MHz) when the absorption difference would be much smaller. So far as synoptic measurements are concerned, when the absorption difference is large enough to affect fxEs - foEs significantly, it is very likely that foEs can be measured directly in most cases so that little or no systematic error is probable. This point should be checked and you are invited to do this by measuring foEs and fxEs when both are present and communicate your results to INAG.

In general foEs and fxEs are determined by the densest Es ionization in an area of at least 1000 km^2, fbEs values by the least dense Es ionization in an area at least ten times smaller. Thus fbEs values are more strictly representative of near overhead conditions than are foEs or fxEs. Also fbEs generally varies much less with changes in the underlying absorption than does foEs or fxEs. In the absence of other information, the near agreement of fbxEs - fboEs with the expected value suggests that the variation may be due primarily to the spatial variation in the Es - the areas sounded by the O and X modes are usually shifted relative to each other by magnetic-ionic effects, in daytime by more than the radius of the first Fresnel zone. It should be noted that tilts in the F region can also alter the relative positions in E at which blanketing occurs for the 0 and X modes when these tilts have a component in the magnetic meridian and that these displacements can be much larger than those discussed above.

It would be very interesting to compare the SD for fbxEs - fboEs with that for changes of fbxEs or fboEs in time. This evidence suggests that the Es being studied was made up of clouds with rather variable electron densities over distances of a few kilometers.

VI. F - Lacuna

The F-lacuna phenomena, frequently observed in polar regions during summer, correspond to a total or partial disappearance of the F-region echoes, whereas the normal E echoes remain visible on the ionogram.

Fig. 1 to 6 show diagrams of the various cases likely to appear: total F lacuna, F1 lacuna, F2 lacuna, quasi-total F lacuna, F1 quasi-lacuna, F2 quasi-lacuna.

This lack of echo can last for several hours. The echo trace reappears either suddenly or progressively, without any apparent modification of the virtual heights or critical frequencies of F1 or F2 observed before they have disappeared. The disappearance or the reappearance of the traces always seems to affect a whole layer.

This phenomenon is not ascribed to:

- a blackout (because the f min remains unchanged)
- a selective absorption phenomenon (which affects the “retardation” part of the trace more than the horizontal part)
- a blanketing phenomenon (as only the E trace remains).Note only Es slant is the only Es trace which is normally visible.
- a failure of the equipment.

This lacuna phenomenon is frequent and regular at Dumont d’Urville (Terre Adelie).

An examination of Godhavn ionograms (from 1952 to 1963) has shown that the same phenomenon occurs at this station although the monthly tables of ionospheric characteristics do not show it. The reason is that various symbols (R, C, A or B) have been used according to the interpretation given by the operator. As a matter of fact, the URSI rules do not allow this phenomenon to be identified.

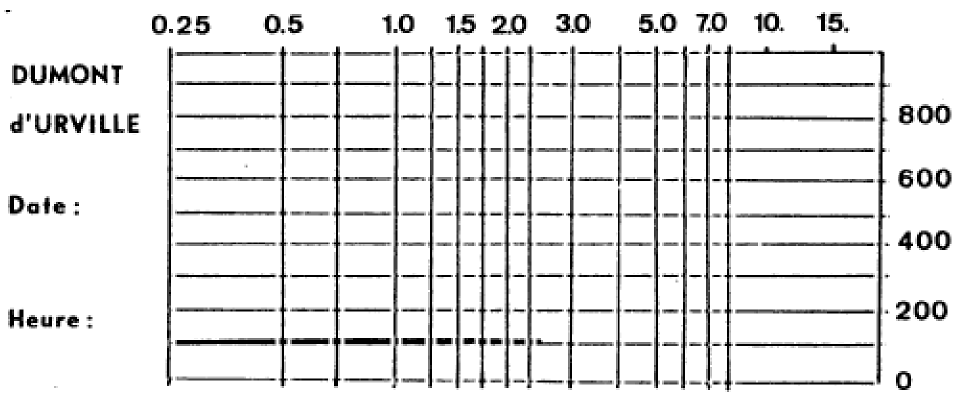
Since 1957, the lacuna have been noticed on the Terre Adelie ionograms and the symbol N is used (in the URSI Handbook, N means: conditions are such that the measurement cannot be interpreted) with the following meaning: “very strong weakening or complete disappearance of the part of the echo where the characteristic concerned has to be read.”

At the Brussels meeting (July 1971), the use of the descriptive letter Y has been proposed to identify and to qualify or replace the parameter it influences.

Examples of the use of the symbol Y are given in the tables below Figs. 1 to 6.

Attention is called to the case in Fig. 3, as the same ionogram can correspond to a “G situation” for the F2 layer (with the following readings: h’F2 = G, foF2 = E4OG, M3000F2 = G). Distinction between both possibilities (G situation or F lacuna) can be made only by examination of the preceding and following ionograms. A clear variation of foF2 (and h’F2) will be seen in the “G situation” case, and not in the case of lacuna.

Studies of the occurrence of lacunas in Terre Adelie and of their correlations with other geophysical phenomena are being carried out in GRI (Doctorate thesis) and will be published at the end of the present year.



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
E		Y	G	G	G	
h'F	foF_1	$M3000F_1$	$h'F_2$	foF_2	$M3000F_2$	fxI
Y	Y	Y	Y	Y	Y	

Fig. 1. "Total F Lacuna"
<u>Observations</u>: All F region parameters and foE are replaced by Y.

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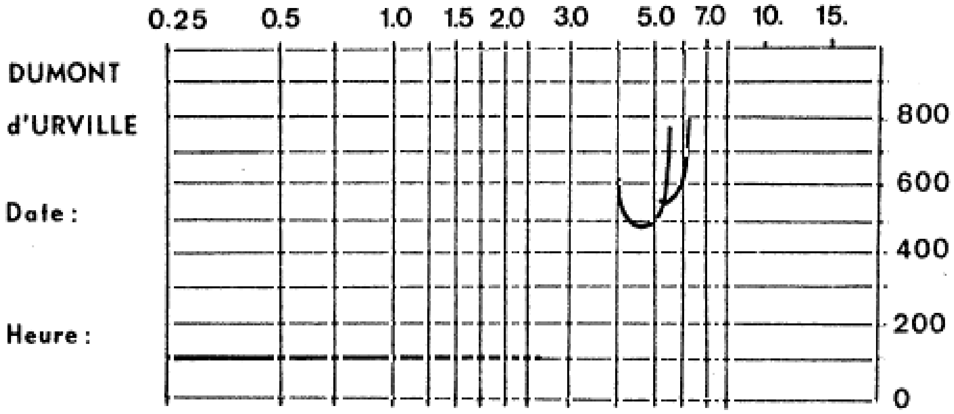
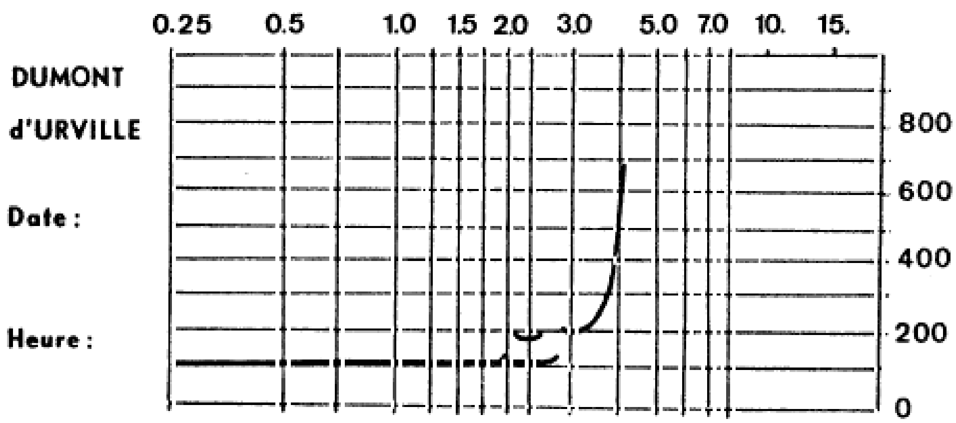


fmin	h'E	foE	h'Es	foEs	fbEs	type Es
E	100	Y	G	G	G	
h'F	foF_1	$M3000F_1$	$h'F_2$	foF_2	$M3000F_2$	fxI
Y	$U40^{Y}$	Y	485	56	245	

Fig. 2. "F1 Lacuna"

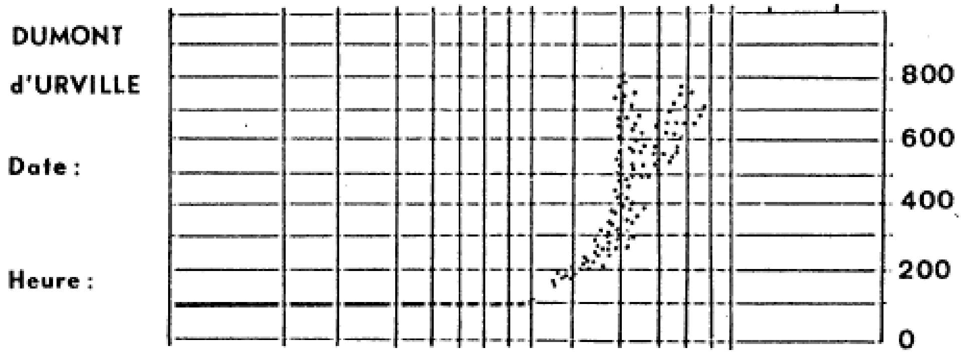
Observations: foE, h'F and M3000F2 are replaced by Y. foF1 can be deduced from the retardation of the F2 trace but is doubtful, hence qualify by U and describe by Y.



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
E	100^{Z}	280	G	G	G	
h'F	foF_1	$M3000F_1$	$h'F_2$	foF_2	$M3000F_2$	fxI
195^{Z}	40^{Y}	350	Y	Y	Y	

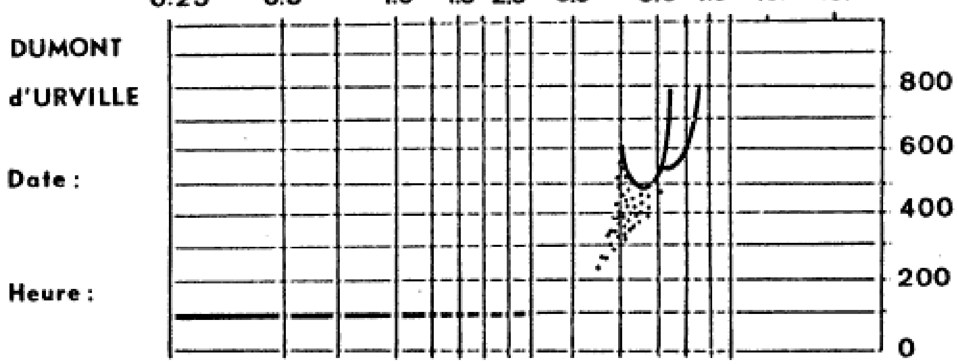
Fig. 3. "F2 Lacuna"

Observations: All F2 parameters are replaced by Y. It is important to distinguish between the proper use of Y and that of G in this type of pattern. The value of foF1 is described by Y and qualified or not by U depending on the doubt in the reliability of foF1. (Apply accuracy rules and compare with normal patterns for similar time.) If in doubt, use U. Note F1x-trace may be present or absent, as shown here.



fmin	h'E	foE	h'Es	foEs	fb Es	type Es
E		$D\,225^{Y}$	G	G	G	
h'F	foF_1	$M3000F_1$	$h'F_2$	foF_2	$M3000F_2$	fxI
	$U\,40^{F}$	Y	Y	$U\,60\,F$	Y	68

Fig. 4. "Quasi-total F Lacuna"
Observations: Use of Y and F to indicate weakening (Y) and spread (F) of the traces



fmin	h'E	foE	h'Es	foEs	fb Es	type Es
E	100	Y.	G	G	G	
h'F	foF_1	$M3000F_1$	$h'F_2$	foF_2	$M3000F_2$	fxI
Y	U 40 Y	F	485	55	240	

Fig. 5. "Quasi-Fl Lacuna"
Observations: Note the presence of clean F2 traces makes the identification of partial lacuna Fl certain.M3000Fl could be replaced by F or by Y, the former is slightly preferable as the immediate cause is the spread, Y could imply no trace present.

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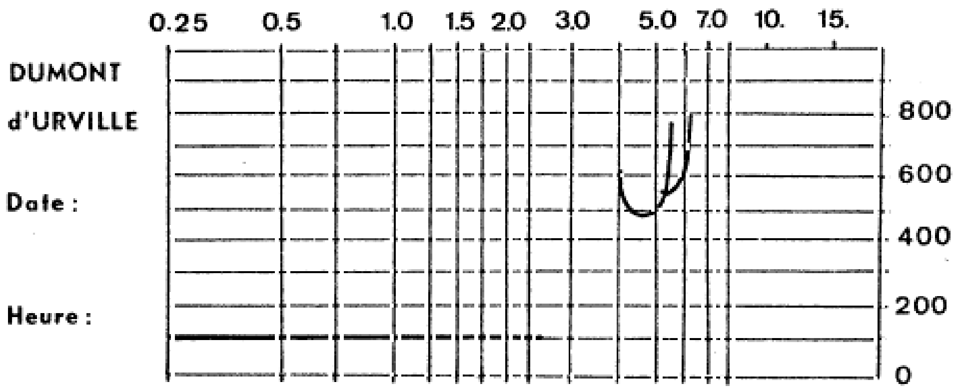
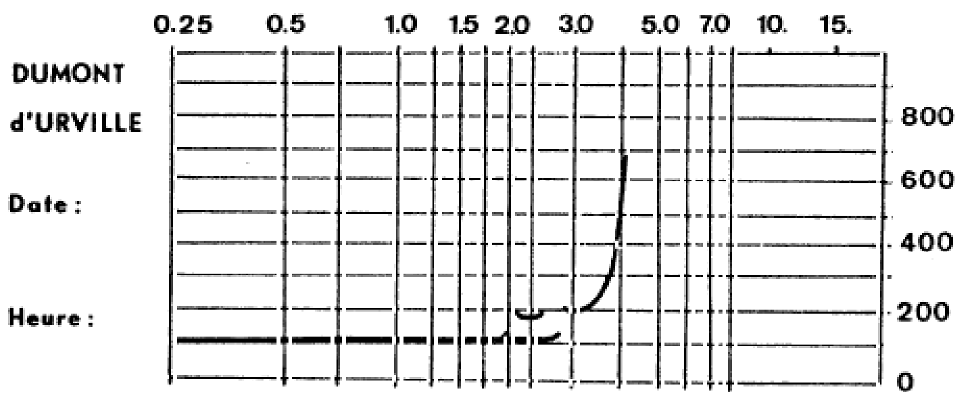


fmin	h'E	foE	h'Es	foEs	fbEs	type Es
E	100	Y	G	G	G	
h'F	foF_1	$M3000F_1$	$h'F_2$	foF_2	$M3000F_2$	fxI
Y	$U40^{Y}$	Y	485	56	245	

Fig. 2. "F1 Lacuna"

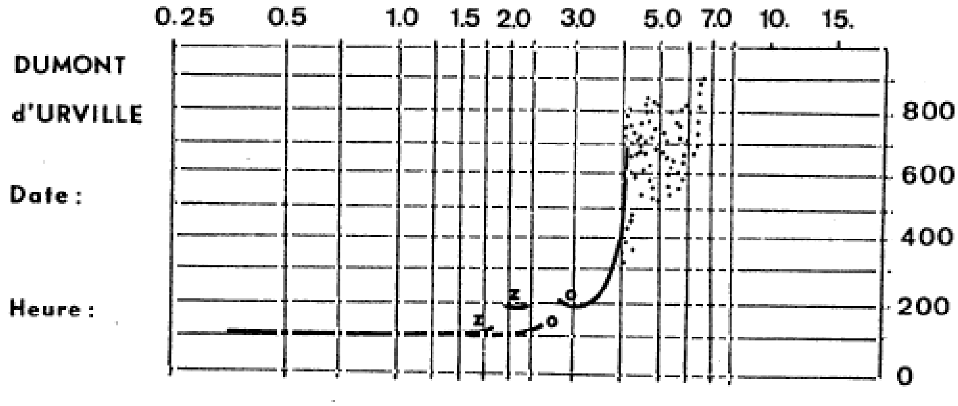
Observations: foE, h'F and M3000F2 are replaced by Y. foF1 can be deduced from the retardation of the F2 trace but is doubtful, hence qualify by U and describe by Y.



fmin	h'E	foE	h'Es	foEs	fbEs	type Es
E	100^{Z}	280	G	G	G	
h'F	foF_1	$M3000F_1$	$h'F_2$	foF_2	$M3000F_2$	fxI
195^{Z}	40^{Y}	350	Y	Y	Y	

Fig. 3. "F2 Lacuna"

Observations: All F2 parameters are replaced by Y. It is important to distinguish between the proper use of Y and that of G in this type of pattern. The value of foF1 is described by Y and qualified or not by U depending on the doubt in the reliability of foF1. (Apply accuracy rules and compare with normal patterns for similar time.) If in doubt, use U. Note F1x-trace may be present or absent, as shown here.



f min	h'E	foE	h'Es	foEs	fb Es	type Es
E	100^Z	260	G	G	G	
h'F	foF_1	$M3000F_1$	$h'F_2$	foF_2	$M3000F_2$	fxI
195^Z	40 Y	350	Y	Y	F	65

Fig. 6. "Quasi-F2 Lacuna"

E	100^Z	260	G	G	G	
h'F	foF_1	$M3000F_1$	$h'F_2$	foF_2	$M3000F_2$	fxI
195^Z	40 Y	350	Y	Y	F	65

Fig. 6. "Quasi-F2 Lacuna"

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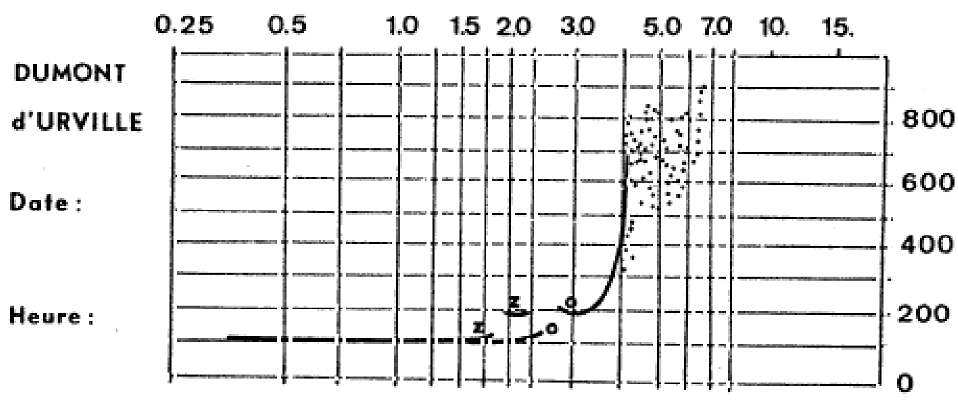

f min	h'E	foE	h'Es	foEs	fb Es	type Es
E	100^Z	260	G	G	G	
h'F	foF_1	$M3000F_1$	$h'F_2$	foF_2	$M3000F_2$	fxI
195^Z	40 Y	350	Y	Y	F	65

Fig. 6. "Quasi-F2 Lacuna"

The cases of partial lacuna shown above in Figs. 4, 5, 6, involve some difficulty in that it is not obvious to an operator whether Y or F is the more appropriate letter to use. There is, therefore, a question whether the gain in completeness in recognizing partial lacuna is worth the trouble needed to train operators to make the distinction accurately. Physically, whenever the surfaces of constant electron density become convex, there is a considerable chance that weak reflections will be seen over a range of angles, giving scattered traces with no solid trace present. However, a similar pattern can arise when the F region is severely irregular -- a normal spread F situation. The non-distinction is in the time variation, lacuna occurs suddenly and ends suddenly, the absent or diffuse traces being replaced by normal traces almost discontinuously whereas spread F gradually recovers to more normal traces.

A practical compromise might be to restrict the use of Y in partial lacuna cases to stations where full lacuna are common and the typical changes, therefore, well known to the operators. Continuity with past practice also implies that care should be taken before replacing F by Y in doubtful cases.

INAG would like to have the views of both operators at high latitude stations and those interested in lacuna phenomena so that a good compromise can be attained. Pending such agreement, the editors of the Handbook propose to describe the full lacuna phenomena under letter Y but not to give instructions for the analysis of partial lacuna. Such cases would then be described by letter F.

A possible text for Y is given below. Please comment, particularly if you feel that the text is wrong or should not be adopted.

> Letter Y is used to show the presence of wide gaps in the trace pattern due to defocusing, the Lacuna phenomenon. When the parameter is missing Y is used as a replacement letter. Examples of the use of Y when Lacuna is present are shown in Figs. 1, 2, 3, which represent total F Lacuna, Fl Lacuna and F2 Lacuna respectively. It is necessary to distinguish the proper use of Y from that of A, B, C and R. These rules are:

(a) Absorption is usually normal when Lacuna is present as shown by a normal value of fmin, number of multiple traces, or the presence of the x component. This can often be confirmed by finding if the relative values of fmin for the o and x traces are normal.

(i) If fmin is approximately normal, e.g. as shown by ionograms taken at about the same time and the traces are missing at higher frequencies these are Lacuna cases

(ii) If fmin is high but the traces at higher frequencies are much weaker then would be expected from the value of fmin, Lacuna is present.

Defocusing can modify the o trace or the x trace or both. Absorption always causes a greater weakening of the x trace than of the o trace, the lowest frequencies being most affected.

(iii) The relative changes in the o and x traces therefore give useful criteria for distinguishing absorption from defocusing effects.

(iv) When the trace determining fmin is affected by defocusing the distinction is based on the fact that absorption weakens all traces whereas Lacuna affects particular traces. Thus, when absorption increases scattered traces and multiple traces disappear first, leaving the main reflection traces; when Lacuna is present, the scattered reflections are scarcely altered but the main traces are greatly weakened.

(b) The normal E trace is unaffected at least up to the frequency where it usually shows group retardation. With strong total or Fl Lacuna the retarded part of the E trace is sometimes missing, the remaining trace looks like an Es. Comparison with normal ionograms shows that it is E.

(c) If sporadic E is present slant Es is common during Lacuna.

(d) The F traces disappear suddenly when Lacuna occurs and reappear suddenly, with relatively little change in shape.

(e) The remaining traces are strong up to frequency where they disappear in contrast with B or R which show gradual weakening of the traces.

The most difficult distinction is between Y and C. This is based on the sequence and whether the day is magnetically quiet or disturbed. When the F2 layer disappears due to C conditions it varies rapidly in time, either foF2 or h'F2 or both changing considerably. When it is due to Lacuna both foF2 and h'F2 show normal diurnal changes only the amplitude of the traces changes.

A particular difficulty arises when the F layer is very tilted. The trace rises in the normal manner to a frequency near the expected value of foF2 (as shown by sequence) and then turns over so as to run horizontally. When the signal-to-noise ratio is good it stops suddenly. In this case the wave has been reflected at oblique incidence and the value of foF2 overhead is certainly less than the limit frequency observed. This is probably true in all cases where the trace is concave downwards, the residual doubt is less important than obtaining a numerical limit. Use the top frequency observed qualified by E and described by Y. This procedure can only be used when there is independent evidence of tilt or curvature, convex or linear traces are more likely to be normal traces which are absorbed, UR, DR, or R, when tilt is not present. These conditions may last several hours but are usually short lived. A similar effect can be caused by inadequate antennas or ionosonde, letter symbol C, and this possibility should be considered if the condition is seen regularly.

VII. Use of Auroral Oval in Arctic Ionogram Mapping

At the AGARD Technical Meeting in Lindau/Harz, Germany, September 1971, R. A. Wagner and C. F. Pike of the USAF Cambridge Research Laboratories presented a paper, "A Discussion of Arctic Ionograms Examples of Arctic ionogram sequences, recorded on the AFCRL Flying Ionospheric Laboratory, were presented. The purpose of this paper was to show that: a) ionogram sequences, recorded on arctic flights, facilitate the interpretation of oblique incidence echoes from E- and F-layer heights, b) parameters of the Arctic ionosphere can be mapped by using the "auroral oval" as an ordering system, c) vertical and oblique incidence echoes, appearing on ground station ionograms, can be interpreted in terms of the station's position relative to the auroral oval.

The analysis of a three hour flight with 6 latitudinal scans underneath an auroral band shows the close relationship between auroral type sporadic E echoes (Esa) and discrete aurora. The investigation of 49 latitudinal scans through the auroral oval during times of low magnetic activity revealed the existence of a particle produced E layer which is oval aligned, is 2° to 6° wide in corrected geomagnetic latitude and occurs at all corrected geomagnetic times. This layer produces the night E echoes.

A new ionogram analysis procedure, which uses oblique incidence F-layer echoes was demonstrated, and the feasibility of monitoring the latitude of the southern edge of the polar F-layer irregularity zone by using this new analysis procedure was demonstrated.

VIII. Third Seminar on the Cause and Structure of Temperate Latitude Sporadic E by

E. K. Smith, Associate Director, ITS, NOAA, Boulder, Colorado and
S. Matsushita, HAO, Boulder, Colorado

The "Third Seminar on the Cause and Structure of Temperate Latitude Sporadic E" was held on the campus of the Utah State University, Logan, Utah, September 13 through 15, 1971. The Third Seminar was very similar to the first two in structure and attendance in that it provided a forum for ground-based measurements of sporadic E and rocket measurements of sporadic E to be brought together with presentations on theoretical aspects.

The first seminar of the series was held in Estes Park, Colorado, in 1965, and its primary output came out as a special issue of Radio Science (February 1966). The second seminar took place in Vail, Colorado, in the summer of 1968, and its output is contained in a two-volume unpublished proceedings. The primary output of the third seminar is currently projected to appear in the March 1972 issue of Radio Science. In addition, a quick proceedings is expected. Those wishing copies of the quick proceedings may write to Mrs. Mary Landers, Institute for Telecommunication Sciences, Department of Commerce Boulder Laboratories, Boulder, Colorado 80302. The attendance at each of the three conferences has been by invitation and has been approximately 40 individuals. All three conferences have been sponsored by the Voice of America, the Department of Commerce Laboratories in Boulder, and the National Center for Atmospheric Research.

In this third conference, interesting discussions of ionosonde results from sporadic E were presented by E. Harnischmacher and by L. Bossy both of whom discussed the vertical-incidence measurements made in Europe, by J. D. Whitehead from Australia, and also by D. N. Anderson and S. Matsushita, and by R. Taur and R. D. Harris from the United States. E. K. Smith described the progress of International Working Party (IWP) 8 of C.C.I.R., which is concerned with VHF sporadic E. Amateur radio observations on 50 MHz were described by P. J. Dyer and also by M, S. Wilson. Comparison of vertical incidence and rocket measurements was discussed by L. B. Smith and J. W. Wright regarding measurements made in Hawaii.

There was a general consensus that future experimental work should involve integrated experiments making use of both ground-based and rocket measurements. For the special experiments it is particularly desirous to have closely spaced vertical-incidence stations which are capable of making continuous or near continuous ionograms. Dr. Whitehead made a plea for the separate recordings of the ordinary and the extraordinary trace during sporadic-E periods. Dr. E. K. Smith indicated that reliance would have to be made on records of sporadic-E occurrence (foEs >10 MHz) as observed on the worldwide network of ionosonde stations in order to carry out the work of IWP 8 in C.C.I.R.

A tentative proposal was raised at the conclusion of the third seminar that a concentrated week of sporadic-E observations around the summer solstice, probably in 1973, would have considerable merit. This program would specifically involve stations at geomagnetic latitudes between 5° and 60° in the north and south temperate zones. This special week is currently conceived as one which would involve both ionosonde and rocket measurements. One current complication is that many of the appropriate rocket groups are currently involved in making measurements during the African eclipse of around that period.

IX. The Southern Hemisphere Ionospheric Studies Group Bulletin No. 1

The first Bulletin of SHISG (INAG-2, p. 18; INAG-4, p. 1) has recently been issued in August 1971 by Professor S. M. Radicella (Universidad Nacional de la Plata, La Plata, Argentina). INAG wishes to express its congratulations and to draw the attention of any who wish to receive this Bulletin (which is written in English) to its existence. It is hoped to issue further Bulletins at roughly six month intervals. The Bulletin is divided into three parts:

(a) A directory of sounding stations in the Southern Hemisphere giving location, geographic coordinates, organization and mailing address, equipment in use and schedule of observations. The soundings stations are collected into groups:

(i)	Bottomside vertical soundings	(38)
(ii)	Topside vertical soundings	(2)
(iii)	Satellite signals observations	(9)
(iv)	Airglow measurements	(7)
(v)	Long distance propagation	(6)
(vi)	Ionospheric drift measurements	(3)
(vii)	Absorption measurements	(5)
(viii)	VLF reception	(5)
(ix)	Partial reflections	(3)

(x) Phase measurements (3)
(xi) Other types of measurements (7)

The number of stations listed in each group is shown in brackets. The value of this directory will be greatly increased if any stations not listed will send details to Professor Radicella.

(b) Lines of research which are active together with investigation name, organization and mailing address. These are grouped under

(i) Topside soundings (6)
(ii) F region (52)
(iii) E region (31)
(iv) D region (21)

(c) References of papers recently published on Southern Hemisphere problems or from Southern Hemisphere groups (67).

This should be a very valuable addition to the literature and help to keep Southern Hemisphere workers in touch with each other.

X. Fourth International Symposium on Equatorial Aeronomy

The Symposium will be held in Ibadan, Nigeria from September 4 - 11, 1972. It is the fourth of its kind and it normally attracts top scientists in the field of Aeronomy from all over the world. The official language of the Symposium is English. Intending participants should contact the Secretary of the Local Arrangements Committee for the Symposium for further information at the address given below:

Dr. J. 0. Oyinloye
Secretary - Local Arrangements Committee
(4th International Symposium on Equatorial Aeronomy)
do Physics Department
University of Ibadan
Ibadan, Nigeria

XI. Spanish Translations for INAG

The following letter has been received from the Instituto de Fisica, Universidad de Concepcion, Casilla 947, Concepcion, Chile:

"Dear Dr. Piggott:

We read in INAG 7 that you need a volunteer to translate the INAG's Bulletin. Mrs. Maria Cristina Bustos, a member of our Group here in Concepcion, has volunteered to do this work. We would appreciate if you would indicate to us what to do next in order to get the translation going.

It would be very interesting to know how many people would receive the Spanish translation, who would print and distribute the bulletins, etc.

We hope to hear from you soon and we remain,

Yours sincerely,

/s/ Alberto Foppiano B.
Jefe Seccion Aeronomy."

XII. Notes from WDCs

World Data Center A. Upper Atmosphere Geophysics. Boulder. Colorado. U.S.A.

During the months of September and October the Data Center was moved to a new location. Thus, productivity decreased for a time, but we are in full swing again in our new location. We were even able to participate in the Open House celebrating the First Anniversary of the National Oceanic and Atmospheric Administration, showing off our present facilities.

A special study of October 1971 indicated that during the month 30 new requests for ionospheric data were received. Incoming ionospheric data consisted of 70 station months of tabulations; 42 station months of ionograms and 10 station months of vertical incidence data on punched cards. Our data center provided to requesters 1088 station months of tabulations on paper, 25 station months of tabulations on microfilm, and 3 station months of ionograms. Thus, we stay busy serving the scientific and technological community.

XIII. Geophysical Data

A. The Condensed Calendar Record

A Calendar record, in which the geophysical events occurring for every day of the month has now been prepared for many years. This is invaluable for selecting periods for special study, for finding out whether particular periods were quiet or disturbed and for giving background information applicable to the synoptic analysis of ionograms. Recent inquiries by INAG show that not all groups who would like to use these data know of their existence. The note below, which is abstracted from STP NOTES No, 9 - 71, 72, describes the current Condensed Calendar Record and shows a typical month.

CONDENSED CALENDAR RECORD

May 1970-September 1970

(this is obsolete and probably formated incorrectly. If you need this information, please contact me: phil@ips.gov.au)

EXPLANATIONS

The Condensed Calendar Record replaces the Abbreviated Calendar Record formerly published in STP NOTES. The abbreviated records are now routinely published in NOAA's monthly "Solar-Geophysical Data".

The tables presented here give a condensed summary chronological account of solar and geophysical activity and events. They give background information for the early interpretation of solar-geophysical results. The condensed version began with data for December 1968 in STP NOTES No. 7. The Abbreviated Calendar Record was published in IQSY NOTES beginning with data for January 1964 in No. 7 through data for December 1966 in No. 21, and for January 1967 through April 1970 in STP NOTES Nos. 1, 3, 5 7 and 8. It is similar to the Calendar Record compiled for the IGY and IGC-1959 (Annals of the IGY, Vol. 16) and compiled for 1960-1965 (Annals of the IQSY, Vol. 2). It is prepared from data reports available at the World Data Center A - Upper Atmosphere Geophysics. However, it is compiled rapidly, including some provisional data, and should not be relied on for details of solar and geophysical events in preference to standard publications. The compilation has been done by Miss Hope I. Leighton and Mrs. H. Virginia Blacker under the supervision of the Deputy Secretary of the IUWDS (Miss J. Virginia Lincoln, NOAA, Boulder, Colorado, 80302, USA).

The format is as follows:

The Condensed Calendar Record lists for each day of the month the Rz, 10 cm flux, Ap, I, Ip, Ia, number of confirmed flares of greater than or equal to importance 1, the number of significant events of solar radio emission simultaneous with SID and solar x-rays, the occurrence of type IV spectral bursts, a proton event index (highest daily exponent, base 10, of Explorer 41 proton energy greater than 10 MeV for the duration of event as judged from the hourly values) and remarks on aurora, cosmic ray decreases or enhancements at Deep River, sudden commencements, etc. Below the table are given

The final daily relative sunspot number Rz is communicated by Professor M. Waldmeier of the Swiss Federal Observatory. The 10 cm flux is the solar radio noise at 2800 MHz as observed at the Algonquin Radio Observatory by National Research Council, Canada, at about 1700 UT daily. It is expressed in units of 10^{-22} Wm^{-2} Hz^{-1}. It is the observed flux, which should be used for most solar-terrestrial studies. The values adjusted for the varying Sun-Earth distance are published elsewhere.

The Ap for the day is given. This daily planetary Ap index is derived from the 3-hourly KP indices, which are based on reports from a selected standard group of geomagnetic observatories. The Ap index increases with increasing magnetic activity to a maximum of 400. The data are provided by the Permanent Service of Geomagnetic Indices (Göttingen) of IACA. Reference: Annals of the IGY, Vol. 4, pp. 227-236. The five disturbed (D), five (QQ) or ten (Q) quiet magnetic days are indicated adjacent to the Ap value.

I is an F-region disturbance index first published for the IGY. (Piggott, W. R., A daily index of F2 layer disturbance during the ICY. Proc. URSI IGY Symposium Brussels, Sept. 1959. Elsevier, pp. 116-123. Ed. W.J.G. Beynon.) It has since been included in the Calendar Records in an abbreviated form. The principles of the index have been maintained throughout the series as described for the ICY. It is based on a battery of criteria. In practice the limits for the different types of comment have remaimed constant for many years and the numerical index given below is consistent with past usage. During recent years the battery has been split into two halves, factors which affect foF2 and factors affecting hmF2. These are given equal weight in deciding the degree of disturbance. In general the correlation between the two halves is not very high, some sectors at some seasons showing effects in one, others in the other. During the ICY it was possible to arrange all days in order of decreasing disturbance, but in solar minimum years this cannot be done objectively. Many apparently quiet days show peculiar the CMP dates and latitudes of the McMath calcium plages which were centers of many flares throughout their disk passage. Suitable statements concerning quiet and disturbed periods will also be made.

F-region phenomena which may make them non-typical to a comparable extent to the difference between conventionally disturbed (storm) days and quiet days. A special code has been provided for such occasions called "uncertain". In most cases these show some typically quiet day phenomena, but the overall behavior of the F region is peculiar in a way not similar to the effects associated with magnetic storm. For this reason the criteria for low index values are not well defined in sunspot minimum years. In any typical month there are usually one or two days which are borderline and could be shifted by one unit of scale, and the mode of analysis tends to decrease the contrast between quiet and disturbed months to the same extent, The number code is as follows:

0	very quiet
1	quiet
2	relatively quiet
3	uncertain
4	average
5	slightly disturbed some sectors
6	slightly disturbed
7	disturbed
8	very disturbed
9	extremely disturbed

For analysis purposes 6-9 represent definite disturbance, 5 a disturbance starting or ending on the day involved, and 0-2 the quietest days. 9 is used only two or three times in a solar cycle, and 3 is not used in solar maximum years.

The indices Ip and Ia are computed by the method of Y. Hakura, Y. Takenoshita and K. Matsuoka in "Influence of solar activity on the ionosphere blackout index", J. Radio Res. Labs. Japan, 14, No. 73, 1967. If a "-" is entered, it signifies less than 12 hours of data, so no value has been computed. The index Ip is for polar cap blackout, and the index Ia is for auroral zone blackout. The indices are on a scale from "o" representing 0.4 hours or less of blackout per day increasing to "9" representing 20.1 to 24 hours of blackout per day. Ionospheric f-min data from selected stations are used. The indices differ from Hakura et al. in that College data have been substituted for Point Barrow for Ia, and Resolute Bay data only are available for Ip.

The flares are counted from the confirmed list published in "Solar-Geophysical Data". The significant events of solar radio emission simultaneous with SIDs and solar x-rays have been selected from the Abbreviated Calendar Records, and the data presented in the remaining columns have been selected either from the Abbreviated Calendar Records or other data compilations as published in "Solar-Geophysical Data". The auroral data are supplied by J. Paton, N. V. Pushkov and P. M. Millman.

May 1970

Day	Rz*	10 cm flux	Ap	I	Ip	Ia	No. of flares ≥ Impt.1	No. of X-ray SID,etc. Events	Type IV	Proton event index	Remarks
1	118	157	11	6	-	0	1	1	2 Dkm		CR decrease 5%
2	118	158	9	5	-	0	0				
3	122	161	10	2	0	1	1				
4	119	160	6	4	0	0	1	2			
5	113	165	12	4	0	1	2	2			
6	115	160	6 Q	4	0	0	1	3			
7	98	159	6 Q	1	0	0	2	3			Aurora N. Am.
8	87	154	4 QQ	2	0	0	1	5			
9	90	152	4 QQ	3	0	0	2	3			
10	111	160	2 QQ	1	0	0	0				
11	132	173	3 QQ	1	0	0	3	1			
12	134	177	15 D	5	0	0	2	3			
13	142	189	6	5	0	0	1	1			
14	145	193	13	5	0	4	1	1			
15	159	202	10	5	0	3	2	4			
16	161	201	6 Q	1	0	0	4	6			
17	169	193	10	4	0	1	3	1			
18	173	190	5 Q	4	0	0	1	1			
19	176	193	6	4	0	1	3	2			
20	146	180	13 D	7	0	3	0	1			
21	143	171	8	6	0	1	2		m		
22	125	166	6	5	0	2	5	6			
23	106	160	7	1	0	0	1	4			
24	122	158	6	2	0	0	2	2			
25	110	156	7	5	0	0	1	1			
26	125	158	2 QQ	4	0	0	5	6			
27	126	151	15 D	7	0	0	1				sc 0514(9)
28	106	150	45 D	8	0	0	0	1			
29	118	154	13 D	8	0	0	3	9		-1	Aurora N. Am.
30	116	159	11	5	8	3	1	1		1	
31	127	161	6 Q	5	0	0	3	2		1	

Active flare centers: 10725 N16 CMP 10.4; 10740 S09 CMP 14.7; 10743 N15 CMP 18.3; 10760 S09 CMP 28.0
May 10 and 11 very quiet magnetically.
* Final Numbers

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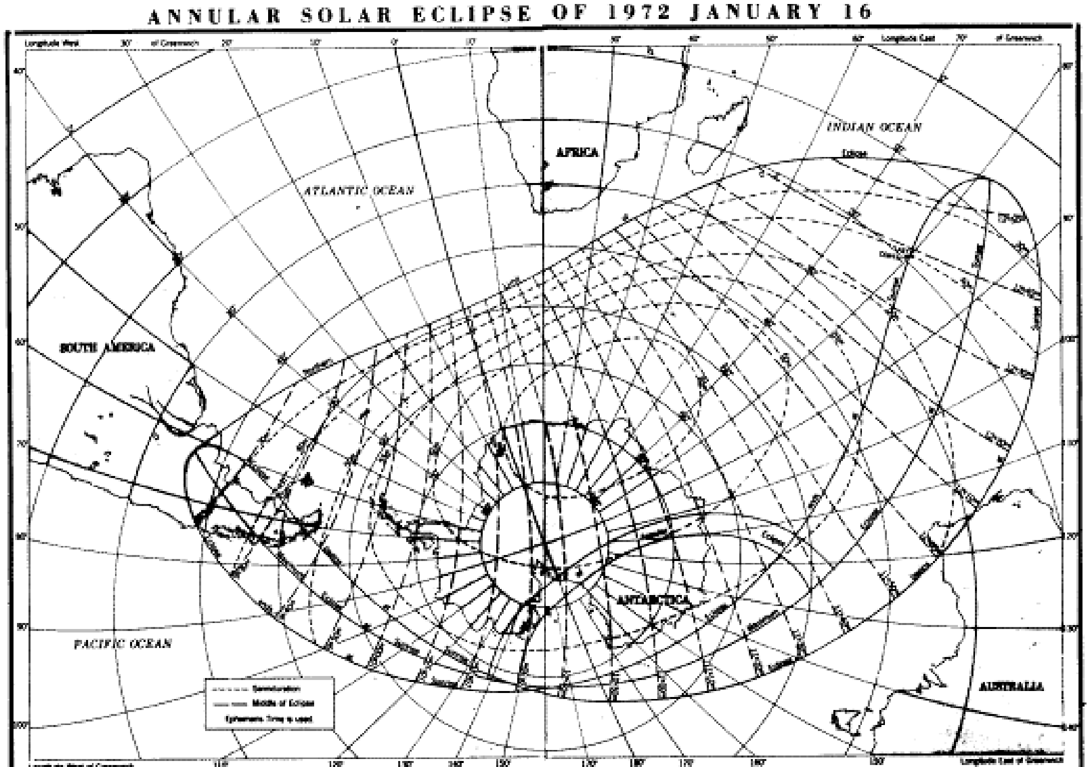
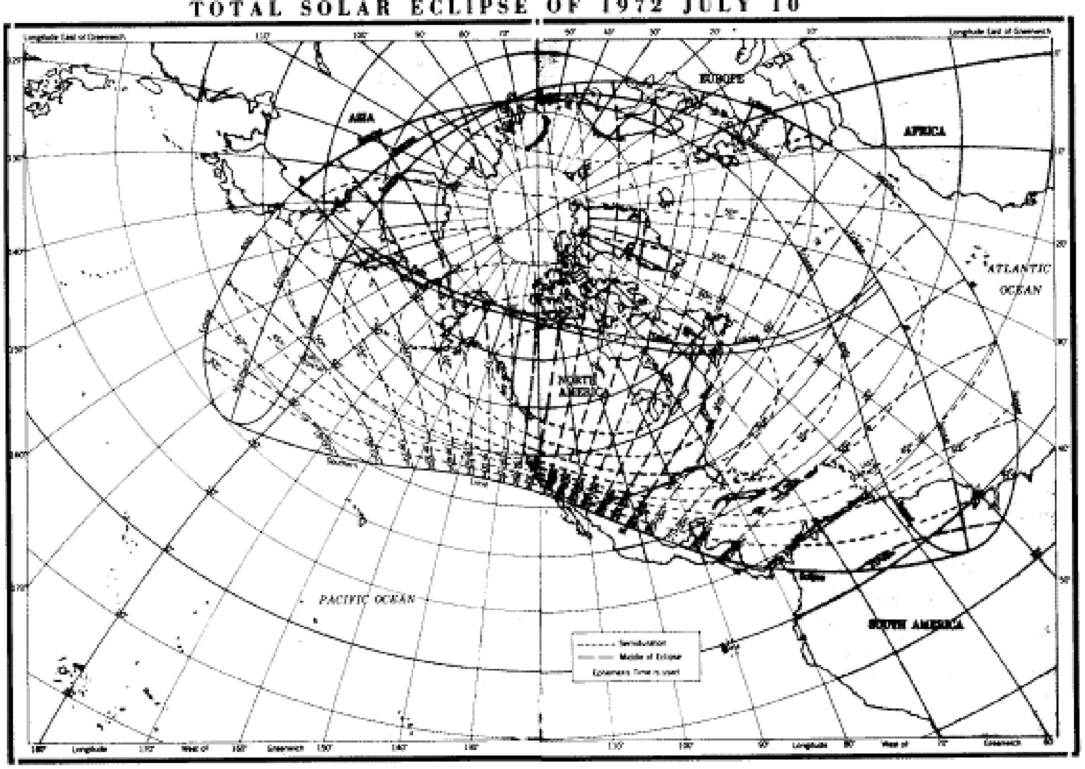
B. <u>Solar Eclipses in 1972</u>

There will be an Annular solar eclipse between about 0920 and 1250 UT on January 16, 1972 visible from Antarctica and the Southern parts of South America and the Indian Ocean, There will be a total solar eclipse between about 1800 and 2140 UT on July 10, 1972 visible from North and East Asia, North America and the central and North Atlantic regions. Details of both eclipses are available in STP NOTES No. 9, p. 67, and Nautical Almanacs. Geophysical stations in the eclipse zones and their conjugate areas are asked to treat these days as Priority World Days.

ANNULAR SOLAR ECLIPSE OF 1972 JANUARY 16



TOTAL SOLAR ECLIPSE OF 1972 JULY 10



C. WDC-A Upper Atmosphere Geophysics Reports

The fourth special data compilation in the World Data Center A, Upper Atmosphere Geophysics UAG Report series was issued in April 1971. Report UAG-12, "Solar-Geophysical Activity Associated with the Major Geomagnetic Storm of March 8, 1970", consists of 465 pages published in three parts for convenience of handling. It contains 103 contributions from scientists in 17 countries located worldwide. The compilation was prepared upon the recommendation of IUCSTP at the time of the Leningrad Symposium May 1970. This period includes the greatest magnetic storm to date of this solar cycle. In addition, a well observed total eclipse took place on March 7.

UAG-13 was prepared for the COSPAR Symposium on the November 1969 Solar Proton Event, June 16-18, 1971, Boston, Massachusetts. It was "Data on the Solar Proton Event of November 2, 1969 through the Geomagnetic Storm of November 8-10, 1969", issued May 1971.

"An Experimental Comprehensive Flare Index and its Derivation for 'Major' Flares 1955-1969" by Helen tJ. Dodson and E. Ruth Hedeman is Report UAG-14, issued July 1971.

The World Data Center A holdings are given in Report UAG-15, "Catalogue of Data on Solar-Terrestrial Physics", issued July 1971.

Under the coordination of Bengt Hultqvist, six groups analyzed 30 auroral absorption events observed by riometers. The results of the analysis appear in Report UAG-16, "Temporal Development of the Geographic Distribution of Auroral Absorption for 30 Substorm Events in each of IQSY (1964-65) and IASY (1969)", issued September 1971.

The data presented in Report UAG-17, "Ionospheric Drift Velocity Measurements at Jicamarca, Peru (July 1967-March 1970)", issued October 1971, should aid in the understanding of a variety of ionospheric and magnetospheric processes. They are measurements of the vertical component of the electron drift velocity in the F region and the east-west component of the electron drift velocity in the E region.

D. International Geophysical Calendar for 1972

The Operational Edition has now been distributed. If you need a copy, please apply to the Secretary of INAG.

H. Broadcasts of Solar and Geophysical Information on WWV and WWVH

Effective July 1, 1971 the solar and geophysical information broadcasts on NBS Radio Stations WWV and WWVH are given by voice in the English language. A Circular Letter RWC-123 has been issued to the scientific community. These voice announcements provide both statements for solar-terrestrial conditions for the immediate past day and broadcasts for the following day of the GEOALERT type of messages prepared by IUWDS. The information broadcast is provided by the NOAA Space Environment Services Center of the Space Environment Laboratory as the IUWDS World Warning Agency. If you wish to receive this letter and are not on the list for past letters, please apply to the Secretary of INAG.

XIV. The MONSEE Program

International Program for Monitoring the Solar-Terrestrial Environment

The IUCSTP, through its Working Group 1, is responsible for the scientific oversight of the international system for the gathering of monitoring data on the Sun-Earth environment by the station nets, and for the exchange of these data. The IUCSTP Bureau gave the name MONSEE to the future continuation of the monitoring program, after the IASY. Many details of the topic are given in INAG. Provisional station lists appear in STP NOTES No. 6, "Guide to the International Exchange of Data in Solar Terrestrial Physics."

The main monitoring categories for MONSEE appear to be the following:

A,l Sunspot Positions, etc. (19)*
A.2 Sunspot Number (19)
A.3 Solar Magnetic Fields (10)
A.8 Total Radio Flux Measurements (27)
A.9 Radio Maps of the Solar Disk (4)
A.10 Radio East-West Scans of the Solar Disk (3)
A.ll Solar X-Ray and IN Background Levels (2S)
A.12 Energetic Solar Protons (6S)
A.13 Solar Wind (6S)

B.l Ionosphere Vertical Sounding (137)
B.2 Topside-Vertical Incidence Soundings and Satellite Probe Data (3S)
B.6 Total Electron Content - Satellite Beacons (3)
B.7 Ionospheric Absorption - Method A1 (Pulse Echo) (5)
B.8 Ionospheric Absorption – Method A2 (Riometer) (20)
B.9 Ionospheric Absorption - Method A3 (CW Field Strength) (9)

C.l H-alpha Flares (45)
C.3 Solar Radio Events, Fixed Frequency (37)
C.4 Solar Radio Spectrograms of Events (6)
C.5 Solar X-ray Observations (8S)
C.6 Sudden Ionospheric Disturbances -- Ground-Based Obs. (104)
C.7 Solar Protons - Direct Measurements (2S)
C.8 Solar Protons - Riometer (20)
C.9 Solar Protons - Ionospheric Vertical Incidence Soundings (18)

D.1 Standard and Rapid Run Geomagnetic (and Earth Current) Measurements (125)

F.1 Neutron Monitors and Supermonitors (76)
F.2 Magnetospheric Micropulsation Phenomena (19)
F.3 Meson Telescopes (cubical, crossed, narrow and wide angle) (63)

G.1 Airgiow: Ground-Based Observations (5)

Note: The numbers in brackets ( ) are the approximate numbers of stations which reported data to WDCs in 1969, given here to indicate the general size of the monitoring effort. “S” denotes Satellite. This list is subject to modification.

XV. Notes from Stations

Ibadan, Nigeria

Prof. 0. Awe has acknowledged receipt of a rebuilt C sounder from the Aeronomy and Space Data Center, National Oceanic and Atmospheric Administration, Boulder, Colorado. This equipment is on loan replacing an old Union sounder of U.K. manufacture.

XVI. Abstracts from URSI Information Bulletins

A. From No. 179, June 1971, pp. 12-17:

XVIIGeneral Assembly of URSI. Warsaw 1972

The general timetable for the Assembly is reproduced after this report.

The Polish Committee will send copies of the First Announcement about the Assembly to all Member Committees of URSI in June 1971. The Second Announcement will be sent out in February 1972 to Member Committees and also to individuals who have completed the provisional attendance form included in the First Announcement.

So as to keep the total number of participants within reasonable limits, attendance at the Assembly will, as usual, be restricted to members of the delegations of the Member Committees of URSI and a few observers invited by the President of the Union or by the Polish Committee.

The Board agreed to repeat the Young Scientists Scheme and, as for the Ottawa Assembly, to make available a sum of $10,000 which will be used to give partial financial support to 15-20 young research workers. Later this year, the Secretary General will write to Member Committees asking for suggested names of young scientists.

Topics selected for the scientific sessions of the Commissions are listed below. Sessions that will be jointly organized by two Commissions are indicted by adding the numbers of the Commissions after the title, The first Commission thus indicated will be responsible for organizthe session.

Commission III. - Ionosphere.

3.1 The lower ionosphere : ion chemistry and the interpretation of data obtained using different methods.
3.2 Reports on recent symposia.
3.3 Flow in the plasmasphere (IV-III).
3.4 Workshop meetings.
3.5 Regional and world-wide coordination of ionospheric observations.

3.6 Instabilities in the polar ionosphere; the need for future experimental programmes (IV-III).

3.7 (a) Workshop meetings;
(b) Ionospheric propagations at ELF and VLF (III-VIII).
3.8 Combination of ionospheric data from satellites and ground stations for ionospheric profiles and for propagation problems.

Commission IV. - Magnetosphere.

4.1 Report of Working Group on measurement of low electron densities.
4.2 Radiation from the earth's plasma environment (IV-V). Symposium on Ionosphere-Magnetosphere Coupling (IV-III):
4.3 Flow in the plasmasphere;
4.4 Flow at high L-values;
4.5 Magnetospheric substorms;
4.6 Instabilities in the polar ionosphere; the need for future experimental programmes.
4.7 New topics.
4.8 Meetings of small groups.

Commission VIII. - Radio Noise of Terrestrial Origin.

8.1 Communications aspects of radio noise.
8.2 ELF noise
8.3 Location of thunderstorms.
8.4 The man-made noise environment.
8.5 Meteorological influences in the generation of radio noise.
8.6 Ionospheric propagation at ELF and VLF (III-VIII).
8.7 Whistlers : source and propagation.

Parts of Commission II program may be of interest to Ionospheric workers, particularly 2.5 and 2.7.
Commission II. - Radio and Non-Ionized Media.

2.1 Reports on recent symposia.
2.2 Radio propagation above 10 GHz : Ground-to-space communications.
2.3 Radio propagation above 10 GHz : Ground-to-ground communications.
2.4 Radio propagation above 10 GHz : Precipitation problems and models.
2.5 Radiometry, the structure of atmospheric spectrum lines, and related experiments.
2.6 Remote sensing of the earth : mapping and detection of earth resources.

2.7 Atmospheric probing by radar and lidar.
2.8 New topics, future directions of research.

B. From No. 179, June 1971, pp. 17-18:

Standard Frequency and Time Signal Emissions

The information given below is a resume of the detailed instructions for the implementation of Recommendation 460 (XII Plenary Assembly, New Delhi 1970) as given in CCIR Report 517 by Study Group 7. Persons directly concerned with standard frequency and time signal emissions should refer to the Report mentioned for further details.

A special adjustment to these emissions should be made at the end of 1971 so that the reading of the INC (Coordinated Universal Time) scale will be 1 January 1972, 0 h 0 m 0 s at the instant when the reading of Atomic Time (AT), indicated by BIH, will be 1 January 1972, 0 h 0 m 10 s.

The departure of UTC from UT1 should not normally exceed 0.7 s and whole seconds will be inserted or omitted (positive and negative leap seconds respectively) when required preferably at the last UTC second of 31 December and/or 30 June. BIH will make announcements about these adjustments at least eight weeks in advance.

The approximate difference UT1 - UTC is referred to as DUT1 and will be disseminated using the following code:

-- a positive value of DUT1 (n x 0.1 s) is indicated by emphasizing seconds numbers 1 to n inclusive following the minute markers;
-- a negative value of DUT1 (m x 0.1 s) is indicated by emphasizing seconds numbers 9 to 8 + m inclusive following the minute markers.

DUT1 will be determined by BIH and circulated one month in advance.

It is important to note that m and n are integers in the range 1 to 7 inclusive. Thus the coded sequence will always occur in the range covered by seconds 1 to 15 inclusive after the minute marker. If DUT1 = 0, there will be no emphasized second marker.

The emphasis may be achieved by lengthening, doubling, splitting or tone modulation of the normal second markers.

Special rules are given for the dating of events which occur in the vicinity of a leap second.

In connection with the precise definitions of Universal Time (UT), it should be recalled that UT1 is a form of UT in which corrections have been applied for the effects of small movements of the Earth relative to the axis of rotation. UT2 is the same as UT1 but with an additional correction for small seasonal changes in the rate of rotation of the Earth.

C. From No. 179, June 1971, pp. 18-28:

International Reference Ionosphere IRI Present Status

A full report on the present status of the IRI has been prepared by K. Rawer and published in the URSI Information Bulletin 179 1971 p. 18-28. Copies can be obtained from:

Prof. K. Rawer
Arbeitsgruppe fur physikalische Weltraumforschung

Kronnenstrasse 13
78 Freiburg im Breisgau
F. R. Germany

This describes the contents and tables proposed in some detail:

D. From No. 179, June 1971, pp. 28-29:

Radio Phenomena Associated with Solar Flares

The following terminology for the various flare-associated phenomena observed at radio frequencies is in general use:

SNB	Solar noise burst	UHF, VHF
SCNA	Sudden cosmic noise absorption	VHF, HF
SWF	Short-wave fade-out	HF, HF
SFD	Sudden frequency deviation	HF
SPA	Sudden phase anomaly	VLF
SEA	Sudden enhancement of atmospherics	27 kHz
SES	Sudden enhancement of signal	any frequencies

Dr. S. N. Mitra (1970) proposes the introduction of a new term:

SCL	Sudden change in long-wave field	VLF

This term would be used to denote both increases and decreases, in the fieldstrength of a long-wave radio signal, caused by a solar flare. Mitra suggests also the deletion of the term SES on the grounds that, apart from SEA, there is no other phenomenon characterized always by an increase in signal strength during a solar flare.

Mitra has found that there are three different types of SCL (sudden change in long-wave field).
The classification is based on a long series of observations on the Tashkent-Delhi path at a frequency of 164 kHz.

Type A - Sudden increase of signal followed by gradual recovery (X rays: > 8-1OA; 65-70 km).
Type B - Sudden decrease followed by a sudden increase in signal, and then a gradual recovery (X rays: 2-1OA; below 65 km).
Type C - Sudden decrease of signal followed by gradual recovery (X rays: O.4A; 55-65 km).

Radio scientists and others who are interested in solar flares and their effects on radio signals are invited to express their opinions on Dr. Mitra's proposals namely:

(1) the introduction of the term SCL; (2) the deletion of the term SES.

Comments should be sent to Secretary General URSI, 7 Place E. Danco, 1180 Brussels, Belgium.

REFERENCE

MITRA, S. N. 1970 Solar Physics, 15, 249-252.

E. The International Ursigram and World Days Service Report of Activity During 1970

The International Ursigram and World Days Service (IUWDS) is an interdisciplinary service created and administered by the International Union of Radio Science (URSI) in association with the International Astronomical Union (IAU) and the International Union for Geodesy and Geophysics (IUGG). Its scientific field concerns all solar-terrestrial physics, and other geophysical fields in appropriate instances.

According to its terms of reference, IUWDS is a permanent service which "aims to provide information rapidly to the world scientific community to assist in the planning, coordination and conduct of scientific work in relevant disciplines". In carrying out its work, it has contributed to the large international enterprises of interdisciplinary cooperation like IQSY, and to more limited coordinated programs like the 1966 Proton Flare Project. Thanks to voluntary co-operation among the scientists of these various Unions and disciplines, it has the means and the flexibility to adapt itself to the changes of strategy of the scientists and thus to avoid the need to build a temporary organization for each new project. At any time, the parent Unions can make use of IUWDS or improve its organization for the better service of science.

Adhering to the Federation of Astronomical and Geophysical Services (FAGS), IUWDS receives a subvention from UNESCO for part of its publications activity and for the coordination of its Regional Warning Centers which are scattered around the world. But the Regional Centers and the World Warning Agency are entirely supported by national funds for their local activities and for their inter-regional exchanges of information.

As built up by the merger in 1962 of two previous services, the IUWDS follows two complementary policies. With the World Days Service, and according to the International Geophysical Year philosophy, it works for a better use of the systematic observation programs. With the International Ursigram Service, and according to the URSI philosophy, it acts as a bridge between pure research and the application of science to technology. As an inter-union permanent service, for several years it has distributed Astronomical Telegrams for IAU; on behalf of COSPAR it assigns international designations to satellite launchings and distributes a bi-weekly bulletin designed to aid certain types of international cooperation in scientific work involving satellites. The general IUWDS organization and program have been fully described in the second (1969) edition of the IUWDS booklet Synoptic Codes for Solar and Geophysical Data, and in successive annual reports.

The general activity of the service was fully reviewed in 1970 in Leningrad at the Steering Committee meeting on 19 May, and at the meetings of Warning Center representatives on 16 and 19 May.

The GEQALERT system, as used throughout the IQSY, may have decreased in value. Observatories, rather than using GEOALERTS to change observing programs, now seem to make use of the various forecasts issued by some one of the RWCs instead, and no formal changes in station operations take place on the receipt of the GEOALERTS. The GEQALERTS can and do provide, however, an advisory information.

The International Geophysical Calendar, which is a yearly planning of coordination of geophysical observations, seems to be quite effective according to the numbers of copies which are requested and to the comments received concerning the programs in meteorology, ionosphere and several other disciplines. The Abbreviated Calendar Record contains, after the event, summaries of the observed solar activity and geophysical situation and events, and is now published monthly in the series Solar-Geophysical Data by the WDC-A, Boulder, Colorado, U.S.A.

The establishment of IUCSTP by IAU, IUGG, IUPAP, URSI and COSPAR in 1966 has emphasized the evolution of research in solar-terrestrial physics and the new policy of attacking scientific problems in this field by interdisciplinary cooperation in the carrying out of definite and limited projects. This evolution reacts on IUWDS because, besides the continuing daily assistance to the telecommunication services, support is given to isolated or coordinated temporary experiments in any part of the world which have definitely increased in number during recent years. We have gained some experience which could be very useful for the various kinds of experiments which are planned in the framework of the International Magnetospheric Study, 1975-1977. Others are worldwide interdisciplinary projects like the Proton Flare Project or the more limited Ionospheric Storm Project; isolated rocket firings and balloon launchings for recording the start of an event or for a rendezvous with a satellite pass; coordinated balloon flights from large areas in the auroral zone or from conjugate point areas; etc.

The regional structure of IUWDS contributes to the efficiency of its assistance to the experimenters, but world-wide cooperation is the fundamental basis for its success. We must also point out that the links between IUWDS and the scientific community give the possibility of obtaining, on a temporary basis, many complementary data with scientific advice and support, all of which definitely helps to solve the various scientific problems associated with giving assistance to those responsible for scientific experiments. In fact the action taken by IUWDS consolidates interdisciplinary cooperation between scientists of various countries and contributes to the success of their new experiments.

But the permanent elements of IUWDS, which are mainly concerned with the technical or practical implications of the observations, form the necessary basis for temporary action designed to assist any scientific experiment. They provide most of the rapid communication links between distant countries, a permanent survey of the Sun and of geophysical conditions; the experience of those involved facilitates a quick reaction to events. In this field both sides are the gainers: the scientists for the success of their experiments and the technologists for the assistance provided by the scientists in helping to solve their problems.

We have reviewed our links with our parent Unions: URSI, IAU and IUGG, and the various bodies with which we are cooperating: FAGS, WMO, WDCs, COSPAR, IUCSTP, SPARNO, SCAR, etc. Following this review we hope that IUWDS will continue to evolve in accordance with the actual needs of scientists and within the limits of our technical resources and our knowledge of solar-terrestrial physics.

Meudon, 26 May 1971.

P. Simon
Secretary, IUWDS.

XVII. Literature Citations

RODIONOV, YA. S. and V. S. CUBENKO — 1971 — Cross-Correlation Characteristics of Deviations of F2-Layer Critical Frequencies, Geomagnetizm i Aeronomiya, Vol XI, No.2, 263-267.

At high-latitude stations there is a clearly expressed diurnal dependence of the correlation coefficient between deviations of the critical frequencies of the F2 layer (Δ foF2) at different stations, characterizing the spatial variability of Δ foF2. Investigations made by the authors confirmed this conclusion for middle-latitude stations and revealed the presence of a strong dependence of the correlation between Δ foF2 and season of the year (as applies for the autocorrelation characteristics). However, no quantitative laws of importance for practical application were discovered in earlier studies. Accordingly, a new study was made to obtain the averaged or quasistationary cross-correlation characteristics. The following conclusions were drawn. 1. In the high and middle latitudes the cross-correlation characteristics differ sharply from those for winter. The summer characteristics have r_{max} usually 2-2.5 times greater than for winter and a smooth change. The winter characteristics are very “choppy”, indicating a broader spectrum. 2. The cross-correlation characteristics for high-latitude stations and equatorial stations for both winter and summer have a “choppy” form and small r_{max} values. The cross-correlation characteristics for two equatorial stations have a similar form. 3. The maximum correlation between Δ foF2 at two widely separated stations does not usually coincide with either UT or LT. These properties of the cross-correlation characteristics can probably be explained by the following simplified model. The earth’s atmosphere can be regarded as a filter with parameters which are subject to diurnal, seasonal and possibly 11-year changes. The diurnal changes in properties of the filter are controlled by LT. The filter is acted upon by a stationary random process modulated by a nonrandom periodic function. This stationary process, related to solar activity, consists of two components: one with a more high-frequency spectrum and with a quite rapid decrease in spatial correlation and the other with a considerably lower-frequency spectrum and a high spatial correlation. During summer the filtering properties of the ionosphere are expressed more strongly, but its parameters change less sharply during the day. This accounts for the strong suppression of the high-frequency component of the process, and therefore the smoother cross-correlation curves. In winter, however, the weak suppression of the high-frequency component and the strong change in parameters during the day results in “choppiness” of the cross-correlation curves and a decrease in the r_{max} values.

FISAREVA, V. V. — 1971 — Distribution of the Frequency of Appearance of Es Over the Earth in 1958 and 1960 and Nature of the Layer, Geomagnetizm i Aeronomiya, Vol XI, No.2, 275-281.

The author compares and analyzes maps of the frequency of appearance of Es, pEs with foEs > 5 Mc/sec for 1958 and 1960. The patterns of distribution of pEs over the earth and the middle latitudes and peculiarities in the diurnal and seasonal variation of pEs are discussed. It was found that in the middle latitudes of both the northern and southern hemispheres there is a distinct zone of magnetic latitudes with increased pEs values for foEs > 3 Mc/sec and foEs > 5 Mc/sec. The region of increased pEs values coincides with the zone of maximum Sq variations of the magnetic field. This is also the zone characterized by sporadic layers with a great semitransparency range. In the region adjacent to the equatorial latitude zone, however, with low pEs values for foEs > 5 Mc/sec, dense screening Es layers are observed. These peculiarities in pEs distributed can be attributed to the wind shift mechanism (I. D. Whitehead, J. Atmos, and Terr. Phys., 20, 1961, 49) if it is assumed that the region adjacent to the equatorial latitude zone corresponds to the region of low wind velocities in an E-W direction in the E layer. The latitude zone corresponding to maximum Sq variations correlates with greater wind velocities and shifts and this favors the formation of thin Es layers with high (dN/dz) gradients and high semitransparency, On the other hand, high wind velocities and great wind shifts can give rise to small-scale turbulence in which Es layers with a high semitransparency can also arise.

M4DERSON, JAMES G. and CHARLES A. BARTH	1971	Rocket Investigation of the Mg I and Mg II Dayglow, J. Geophys. Res., 76, No. 16, 3723-3732.

The 2800-A dayglow of ionized magnesium in a sporadic E layer was measured by a rocket-borne ultraviolet spectrometer. Because the 2852-A line of neutral magnesium was less than 10 rayleighs while the ionized magnesium emission was measured to be 360 rayleighs, the ratio of Mg+ to Mg was determined to be greater than 22. A model of the ion chemistry in the sporadic E layer shows that neutral magnesium is ionized predominately by the charge transfer reaction with NO+ at a rate greater than 4.1×10^{-10} or $9.5 \times 1O^{-9} cm^3 sec^{-1}$ depending on the role MgO_2+ plays in the chemistry. In this model, Mg+ is converted back to Mg by radiative recombination.

(Wallops Island)

GROSSI, MARIO D. and VICTOR H. PADULA-PINTOS	1971	Ground-Based Radio Sounding of the Earth Magnetosphere, J. Geophys. Res., 76, No. 16, 3755-3763.

A sounding link at HF established between tightly synchronized ground-based terminals located at shell conjugate sites (Jupiter, Florida, and Ushuaia, Argentina) has obtained echoes with 62 millisec delay. The echoes can be interpreted as being due to propagation along an enhancement of electron density aligned with the L = 1.8 shell. The echoes are characterized by path losses 80 db worse than free space and were received at 7.46, 9.04, and 12.00 MHz for 7.6% of the over-all observing time, during night hours. Typically their strength was 15 db below noise and they were recovered with an integration time of 1 hour (3600 pulse repetition periods).

(Ushuaia and Grand Bahama)

STERLING, D. L., W. H. HOOKE and R. COHEN	1971	Traveling Ionospheric Disturbances Observed at the Magnetic Equator, J. Geophys. Res,, 76, No. 16, 3777-3782.

Electron concentration profiles taken every 3 min with an incoherent scatter radar at the Jicamarca Radar Observatory (near Lima, Peru) sometimes exhibit weak wavelike disturbances in the equatorial F region. The associated perturbations are typically of order ± 1 to ± 3%, and their phase varies with height. The periods of the observed oscillations are roughly 20 min. The disturbances are also seen on ionograms taken simultaneously. A theoretical argument is advanced to the effect that the ionospheric manifestation of a neutral wave packet differs near the magnetic equator from that at temperate latitudes.

(Huancayo)

PARK, CHUNG G.	1971	Westward Electric Fields as the Cause of Nighttime Enhancements in Electron Concentrations in Midlatitude F Region, J. Geophys. Res., 76, No. 19, 4560-4568.

Large enhancements in electron concentrations are frequently observed in the midlatitude nighttime F region. These enhancements are explained in terms of enhanced downward diffusion flux from the protonosphere induced by substorm-associated electric fields in the ionosphere. A mechanism is proposed by which a westward electric field enhances downward flux from the protonosphere while lowering the F layer. (An eastward electric field has opposite effects.) This mechanism plus height variations of recombination loss can explain the observed behavior of the nighttime F layer during substorms. Crude estimates of electric fields and protonospheric fluxes are made from ionospheric parameters observed during a substorm. Under favorable conditions ground-based ionosonde records may be used to infer spatial and temporal variations of electric fields in the ionosphere during substorms. The results of this study suggest that in middle latitudes the nighttime ionosphere is controlled by vertical drifts and fluxes from the protonosphere.

(Wallops Island)

PURKAIT, N. N. and 5, K. DATTA	1971	Absorption at 2.2 MHz in the Presence of a Cusp-Type Sporadic-E Layer, J. Geophys. Res., 76, No. 13, 3149-3151.

Absorption of a 2.2-MHz signal in the presence of a cusp-type Es layer is studied. The magnitude of the absorption is found to be decreased by about 25% of its value for days without any sporadic ionization. The cos X index of absorption is also increased from a value of 0.72 to 1.2. Detailed analysis of the data shows that the absorption is mostly nondeviative in the presence of cusp-type Es layer.

(Haringhata)

BAGGALEY, W. J.	1971	Solar Cycle Variations in Daytime Ionospheric Es Parameters in the South Pacific Area, J. Geophys. Res., 76, No. 19, 4674-4678.

Daytime occurrence frequencies of foFs and fbEs are presented for stations Rarotonga and Christchurch for a period of two solar cycles and for Scott Base for a period of one cycle. Although foEs shows little association with sunspot activity, fbEs shows a strong positive correlation with both sunspot number and with noon foE. The data also indicate the presence of a 4-month time lag of fbEs peaks after sunspot maximums.

(Rarotonga, Christchurch, Scott Base)

DAVIS, JOHN R.	1971	Decameter and Meter Wavelength Radar Studies of Artificial Plasma Clouds in the Lower Ionosphere, 2, Unstable Evolution in the Lower ELayer and Some Implications Regarding Sporadic E, J. Geophys. Res., 76, No. 22, 5292-5315.

Radio frequency scattering experiments have indicated that irregular fluid motions of tens of meters spatial scale and tenths of seconds temporal scale occur in the E region. It has been suggested that there can also occur in this region a dissipative plasma instability (similar to what has been termed the gradient-drift or E x B instability in previous work) that displays these spatial and temporal scales and that may be of importance in the evolution of sporadic E. This paper describes an attempt to study the circumstances under which such an instability might appear by injecting alkali plasma clouds in the lower E region and observing them with decameter and meter wavelength, coherent-pulse-Doppler radar. After an initial blast-wave-driven expansion phase, an alkali plasma cloud undergoes a period of irregular behavior, in which a number of discrete echoes from seemingly coherent, large, short-lived reflectors appear superimposed on the generally diffuse plasma cloud radar echo. Their large apparent size and spectral discreteness indicate that they may arise from an ordered, possibly wavelike structure, which must involve the entire plasma cloud. Comparison of the observed growth rates and probable spatial scales of the instabilities in the alkali plasma clouds with order-of-magnitude calculations of these quantities based on linear instability analysis confirms that the postulated plasma instability can indeed explain the observed behavior. In one phase of plasma cloud evolution a reflecting layer similar to sporadic E is formed, which permits decameter wavelength radiation, incident obliquely on the cloud, to be reflected back to earth in much the same manner as sky-wave transmission is achieved via sporadic E. The similarity in behavior of an artificial sporadic E patch to the natural variety is evident. Also, a nonlinear, two-dimensional plasma instability analysis is capable of explaining the spectral appearance and temporal variation of the decameter radar data from the alkali plasma cloud. An association is suggested between these results and the mechanism by which temperate latitude sporadic E is formed,

(Wallops Island)

MUGGLETON, L. M. 1971 Effect of Sun—Earth distance on E—region ionization, J. Atmos. and Terr. Phys., 33, 1299—1305

The effect of the Earth's orbital eccentricity on $(N_m)E$ has been investigated. Values of $(foE)^2_{noon}$ at some 20 observatories, averaged over a solar cycle and stripped of seasonal effects, noon have provided the basic data. By combining the data from mirror—image months the scatter has been reduced. It has been found that Sun—Earth distance control of a Chapman—like model of the E— region is describable by the relationship

$$(N_m)\,E\ \alpha (foE)^2\ \alpha\ d^{-1.2} = d^{-2m}$$

where d is the ratio of the Sun—Earth distance at the time of interest to the yearly average of the distance. Noting that,
for the same model, $(foE)^2\ \alpha\ \cos^n X$, some significance is attached to the fact that both m and n have been found to be equal to
about 0.6 instead of 0.5, the value applicable to a recombination law for the electron—loss mechanism.

DAVIS, JOHN R. and DONALD R. UFFELMAN 1971 Detonation-Wave Effects on Decameter-Wavelength Radio Waves in the Lower Ionosphere, J. Geophys. Res., 76, No. 25, 6172-6184.

Three high-explosive charges were placed by rocket in the lower E layer to study the effects of detonation waves on this region of the ionosphere. Observations made by coherent-pulse-Doppler high-frequency radar and an ionosonde indicated that three types of radar targets were discerned: (1) Shock-wave excitation of atmospheric constituents and compression of existing ionization created an overdense reflecting surface, with a probable small additional contribution due to partial reflections, that traveled radially outward quite rapidly and was observed for a few tenths of a second. (2) Shock-induced ionization created as a result of the high temperatures achieved in the region between the first shock wave and the contact surface between the explosion products and the atmospheric fluid persisted as a nearly stationary radar target for several minutes. (3) Sonic waves propagating outward from the detonation were observed to perturb sky-wave transmission paths that passed through the ionosphere many tens of kilometers from the explosion. These effects were detected several minutes after the explosion. It is concluded that explosive thermal excitation of the lower E layer is adequate to produce radar reflections of decameter wavelengths by compression of existing ionization and shock excitation of additional ionization and to deposit by this means long-lasting ionization, which may appear as an artificial sporadic-E layer of several minutes duration. This layer is probably composed of the long-lived ions of alkali metal atoms, which exist continuously in the lower E region and form a detectable persistent radar target when they are excited by a shock wave. This result and other workers' independent evidence for atmospheric acoustic-wave effects in the lower E region indicate that such phenomena may be involved in the growth of naturally occurring sporadic-E layers. The sonic wave created by the explosion also perturbs existing ionospheric regions several tens of kilometers from the burst point, and this perturbation is readily detectable as a phase-path modulation in decameter-wavelength earth backscatter.

(Wallops Island)

PIKE, C. P. 1971 A Comparison of the North— and South—Polar F Layers, J. Geophys. Res., 76, No. 28, 6875—6882.

Monthly median ionosonde data were used to investigate the north—polar F layer. The dependence of the north—polar F layer on universal tine and on corrected geomagnetic latitude is clearly established, and the results are compared with the results of a previous study of the south— polar F layer so that similarities and differences between the F—layer features of the plasma ring and the polar cavity can be pointed out. The energy input into the zone of soft—electron precipitation is sufficient to produce the electron—density level of the plasma ring, whereas the energy input poleward of the soft zone is insufficient to produce the electron—density level that is observed in the polar F—layer cavity. Calculations, based on median levels of the wintertime polar F—layer peak electron density, indicate that an energy input of between 4 and 5 x 10^{21} ergs day^{-1} is required to produce the wintertime polar F layer.

(Alert, Resolute, Eureka, Thule, Barrow, Tixie, Tikhaya, Godhaven, Longyearbyen, Murmansk, Dixon, Tromsd, Artica I and Artica II)

THOME, C. D. and L. S. WAGNER 1971 Electron Density Enhancements in the E and F Regions of Ionosphere during Solar Flares, J. Geophys. Res., 76, No. 28, 6883-6895.

Using the method of Thomson scatter, it has been possible to observe detailed ionospheric effects due to solar flares. Observations have been limited to four 2B flares, and two of these events have been examined intensively. The two events that have been studied exhibit very similar characteristics, i.e., a strong and long—lasting E—region electron density enhancement, a moderate and shorter duration F_1—region enhancement, and a moderate F_2—regiom enhancement characterized by a long—duration "tail". Flare X—ray data, available in the 2— to 12—angstrom band, shows excellent agreement with electron density fluctuations in the lower E region. The F_1—region enhancement is believed to follow the time history of the EUV ionizing radiations. The F_2— region tail is attributed to the much smaller recombination rate at these heights. Plasma—line observations, permitting unequivocal measurement of electron density, have been possible within a limited height range. Comparison of electron density, as deduced from the plasma lines, with backscattered power measurements corrected for the effects of absorption, has resulted in estimates of flare—associated changes in the ratio of electron to ion temperature.

(Arecibo)