IONOSPHERIC NETWORK ADVISORY GROUP

Ionosphere Station Information Bulletin No. 8

(Indicative) TABLE OF CONTENTS

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. 8**

I. Introduction

A successful meeting on Ionogram Interpretation and Prediction was held by INAG in Brussels on 26—27 July. INAG wishes to thank URSI for hospitality on this occasion. The work of INAG was reviewed by our parent body, the URSI/STP Committee, at its meeting on 27—28 July. Those attending the INAG meeting were invited to attend the session of the URSI/STP Committee concerned with Ionospheric Vertical Soundings and associated matters. The URSI/STP Committee expressed its appreciation of the work which has been done. Full reports will be issued in the INAG Bulletin when the minutes of these meetings have been approved. An interim report will be found below.

It is proposed to hold the first meeting of the Ionospheric Network Advisory Group in Warsaw during the XVII General Assembly of URSI 15—31 August 1972. This meeting will be open to all interested in vertical incidence soundings and we hope that as many of you as possible will attend. Even if you cannot come, please make a special effort to let us know your desires:

(a) On the proposed alteration in rules which will be published in the next Bulletin.
(b) On other problems you wish clarified.
(c) On whether the present organization for the VI network is adequate or whether you wish to have a more official, government backed, organization.

You can write direct to INAG members or put your views to your National representative at URSI (particularly to the representative for Commission III). A list of names and addresses of the latter was published in INAG—6, pages 27—28.

The problem of a firmer organizational base for monitoring services was discussed in INAG—6, pages 7—8, 10—14. This is of particular interest to the VI network because we have many special difficulties, e.g. in helping our collaborating stations in developing countries. In contrast with some other disciplines most of our stations are operated directly or indirectly by government supported institutions, nearly a third are operated by Meteorological Institutes, a similar proportion by communications organizations. We have a history of collaboration which has set a pattern for other groups. We should, therefore, ask whether we wish to press for a link of the VI Network with the WMO? The initiative for this rests with those responsible for the operation of the individual stations and we urgently need to know their views both for and against. Very few of our groups are directly represented at the Scientific Meetings where these matters are discussed. The rather limited sample of stations I have visited or whose representatives have raised these matters with me have been strongly in favor of some action on WHO type lines. Is this view general?

The URSI/STP Committee at Brussels has requested INAG to examine the problems of operating stations in developing countries and of the proper local use of data in such cases. The reports to the Committee on the UNESCO visits showed that at least in some cases there was really no local application. If the International community can justify data from such stations, some means of support will have to be organized. INAG has received several letters on these points but needs wider consultation both on needs and the safeguards required to make sure that any international funding would be really justified. It must also be remembered that UNESCO can only support special limited projects, such as the visits of experts. Early discussion is needed if INAG is to make any report on this after its Warsaw meeting.

The C.C.I.R. have requested URSI to consider whether new parameters could be produced to help practical communications or if the rules for old parameters should be modified. URSI has already met the most important weakness by the introduction of fxI. There is an important need to deduce the height of maximum density of the F2 layer for ray tracing problems and the practical developments based on them. This is a very difficult problem to solve synoptically, and attempts to obtain usable data in the past have largely failed. A possible solution is to calibrate the M(3000)F2 factor at

different times of day, season and solar cycle with the aid of ad hoc analysis of a few typical ionograms. Work of this type is being carried out centrally by Dr. W. Becker at Lindau, but much more is required for C.C.I.R. Do you have any other suggestions?

Another point which could help C.C.I.R. would be to adopt the IQSY High Latitude accuracy rules f or D and E at all latitudes. INAG would be glad to hear your reaction to this suggestion. The rules are reproduced below on pages 5—8.

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

II, Notes on the INAG Ionogram Interpretation Meeting at Brussels July 1971

This issue of the Bulletin will be duplicated before the detailed reports of the Brussels meetings are available. We hope to have notes illustrating particular problems raised at Brussels, Leningrad or in correspondence in our next issue and INAG's proposals for meeting these problems.

The proceedings of the Brussels meeting fall into four sections:

(a) Discussion of the Leningrad documents and recommendations.
(b) Discussions, with URSI/STP, of the work of INAG, the future of the network and problems needing solution for the efficient development of the network.
(c) A detailed discussion of the "Lacuna" phenomenon made possible by the abnormally large representation at Brussels of workers who had studied it.
(d) Discussions on particular groups of ionograms mainly high latitude or low frequency and on the problems of their interpretation.

It was agreed that the proposals made at Brussels should be regarded as tentative and published in the INAG Bulletin so as to encourage wider discussion. They will be combined with the Leningrad proposals in due course, modified by discussion, and finally ratified by URSI/STP and URSI Commission III at the URSI General Assembly at Warsaw. It was left to the discretion of the Editors of the URSI Handbook to make any modifications to the text where they felt it desirable, since the Handbook must be in print before the Warsaw meeting.

INAG wishes to thank those who made sample ionograms available; they were valuable at the meeting and will be used in the subsequent studies needed for clear recommendations at Warsaw. Suitable examples from them will be included in the new Handbook or in the Handbook High Latitude supplement.

1. Lacuna phenomena

It was agreed to recommend that the name "Lacuna", Lacune in French, be adopted to describe the gap phenomena seen in high latitude ionograms. A full definition with illustrations will be made available in the next issue of this Bulletin.

By analogue with the use of letter Y to describe broken traces in sporadic E, it is proposed that descriptive letter Y be used to identify the presence of this phenomenon and as a descriptive letter where parameters are influenced or cannot be measured because of its presence.

Researches described at Brussels suggest that the Lacuna is due to strong defocusing of the waves reflected from the ionosphere and that this is caused by horizontal gradients of ionization.

2. Frequency and range spreading

A number of examples of the type of range spreading discussed at Leningrad were produced and discussed. The meeting strongly preferred use of Q as in the USSR for identifying the presence of this phenomenon and for describing parameters affected by it. A number of logical objections to the alternative use of Y for this purpose (Leningrad proposal A.4, INAG—4, p. 4—5) were made. Unless new strong counter arguments are produced, your Chairman now feels that the case for Q rather than Y is overwhelming. Apparently, Y has not been used at low latitudes for many years. The Brussels discussion suggested that the Leningrad claim that this was a distinct phenomenon at high latitudes was justified and that Q would be useful for this. It was not clear whether the use of Q in auroral latitudes would be valuable —— Dr. G.A.M. King's point that range spread can change to frequency spread and vice versa is certainly valid at these latitudes.

3. Use of ionograms from aircraft

The value of ionograms taken in aircraft flying. across high latitude structures was stressed both for scientific and training or interpretation purposes. INAG appeals for suitable sequences for use in the Handbook supplement.

4. Use of h, c, 1 and f types of Es

The widespread use of ionosondes operating down to about 0.2 MHz has destroyed the distinction that normal E is only seen during the day. It is therefore recommended that reference to day and night be removed from the definition of Es types. In the future this means that whenever a thick E layer trace can be observed on the ionograms the appropriate normal Es types will be h, c or 1.

Sequence, or the relative values of h'Es and h'E should be used to provide evidence of whether h, c or 1 is appropriate whenever possible. The current use of f will continue for hours where there is no evidence of a thick E layer on normal ionograms, i.e. for ionosondes starting at about 1 MHz the convention is unaltered but h, c or 1 are used on low frequency ionograms for all hours at which a thick E layer is normally present.

A definition will be prepared by INAG and circulated in the next Bulletin for discussion and approval at Warsaw.

Clarification of night E

Low frequency ionograms show a normal E layer at night fairly regularly when interference is not prohibitive, so that the classical definition of night E is no longer valid. The meeting recommended that INAG put forward a new definition and clarify the appropriate sections of the Leningrad proposals, in particular D (INAG—4, p. 6). The meeting disagreed with Leningrad proposal: D (c) "that the current practice of entering night E in the foE tables be made voluntary" because interest in foE at night was increasing. It was also essential to keep it when both night E and an Es trace were present together. The meeting felt that the proposal could cause confusion at the stations —— it was better to stay with the current rule.

There was a considerable discussion on Leningrad proposal D (b) concerning the identification of night E in tables of foEs, fbEs and h'Es and procedures when foEs is greater than foE (night E). The foEs value, of coarse, takes precedence in this case under the normal Es rules. The identification of night E at hours when normal E is present was considered (low frequency ionosondes or high latitude summer conditions). The Leningrad proposal for an identifying descriptive letter was strongly supported but the discussion confirmed that the Leningrad proposal to use descriptive letter E would cause difficulties.

It was proposed that letter K (obsolete for identification of storm phenomena) be re—introduced and used instead of the Leningrad proposal E. K is readily associated with Kp and hence magnetic activity with which night E is closely correlated.

The question of whether night E could be at a different height to normal E and give two observable layers was raised. No one present had ever seen such a case, and it was believed that it does not occur. If you have ever seen it, please get in touch with INAG by letter.

6. Accuracy rules at high latitudes

There was a discussion on whether the accuracy rules limitation on the use of D and E should be removed so as to allow more numerical data to be obtained. It was clear that many groups were not aware of the change made in the IQSY. [IQSY Instruction Manual No. 4, Ionospheric CIG—IQSY Committee London 1963].

The danger of having no accuracy rule was stressed and accepted by all present, and it was agreed that the IQSY rule (reproduced below on pages 5 to 8) substantially met the difficulty. The discussion then shifted to whether the limits were adequate at low frequencies. The IQSY rule allowed for D or E an uncertainty in one direction of 20% or SA. For foF2 this is 500 kHz up to foF2 of about 2.5 MHz and rises to 2 MHz when foF2 is near 10 MHz. This appears to be adequate. A final decision will be made at Warsaw, The generalization of the high latitude rule to all areas would largely meet the synoptic requirements for more numerical data on foF2 when spread F is present and is proposed for discussion. It is particularly important for stations which do not measure fxI.

7. Representation of oblique traces in f—plots

A proposal was made to the meeting that clearly oblique traces be represented on f—plots by a dashed line whereas those thought to be overhead, be represented by a solid line. Time did not allow a detailed discussion so the proposal was referred to INAG. Proposals of this type have been considered before, by the W.W.S.C. in particular, and rejected because it is difficult to distinguish between broken lines representing broken frequency spread, because the rules needed to tell the operator when to use the broken line are difficult to construct adequately and because the proposals offend the basic principle of an f—plot —— mark what is seen independent of interpretation. The compromise made many years ago was to identify the "clearly oblique trace" by a line on the f—plot with a letter symbol placed at the high and low frequency limits of the trace. This still seems a good compromise, e.g. Q could be used (section 3 above) for this purpose. The need seems real when two structures are present having widely different critical frequencies, the case for which Q was requested. Your comments are invited.

8. fxI

Many stations in areas where fxI was recommended as a priority parameter are now measuring fxI and about a third of all stations measure it. There is some demand for an expansion of the rules, with examples, and this has been done in the revised Handbook. The text could be reproduced in the next Bulletin if the demand justifies this.

The circulated data shows that most stations who are measuring fxI do so for every hour and this sometimes discloses unexpected spread F phenomena. INAG suggests that the recommendations with respect to fxI be modified to remove the restriction to hours when spread F is expected, thus removing the need for operators to consider which hours should be tabulated, increasing the value of the tables and conforming with current practice. The restriction was originally made to meet criticisms that the work involved would be too great. This is clearly not true in practice. Please let us know if you object to this alteration.

fxI tabulation when spread F is uncommon

At hours when spread F is uncommon, the median value of fxI is usually identical with fxF2 i.e. to (foF2 + fB/2) so that the completion of the table by adding the fxF2 values does not add significantly to the information available. Several groups felt that rules should be provided so that, in these cases, fxI values were entered only when fxI differed from fxF2. This procedure is always open .o the objection that the fxI values could have altered the median fxI from median fxF2, though the probability of this occurring is small when the count is low. It was pointed out that this concession cannot be allowed unless all cases of spread F are given numerical fxI values. Thus on a winter night, even 0.2 MHz of spread can make fxI significantly different to fxF2. There is then a question of the median value of fxI. This is always the median of the observed values plus the missing fxF2 values, i.e is approximately fxF2, when the count of observed values is low. The question of the maximum allowable count before the fxF2 values are entered and the median calculated correctly can only be found experimentally and depends on season, It is probably between 30% and 40%. Thus a practical rule would be that all fxF2 values must be entered when the number of tabulated fxI values exceeds 10 for any given hour. When the data are sorted by computer, programs can be written to avoid this difficulty by using the foF2 entries. INAG invites comments on this point.

10. Other spread F parameters

There was some discussion of the definitions and status of the spread F parameters, fmI and dfS (INAG—l, p. 10—11). Both fmI and dfS are parameters which are produced voluntarily by interested groups and which are used by sufficient groups to justify providing computer codes. There have never been international discussions to make their definitions unique. As is usual in such cases, the generally accepted definitions are not clear and can cause data from different groups to be incompatible. fmI is defined as the lowest frequency at which frequency spread is seen.

dfS is defined as the frequency spread of the scattered reflections. When large amounts of spread are present these definitions are perfectly adequate though not necessarily logical since the fml is normally an ordinary wave reflection, fxI an extraordinary wave reflection and the differences, fxI —fmI and dfS have a magneto—ionic element of amplitude fB/2. When the spread is less than fB/2 it is not clear whether the operator should record fmI = foF2, dfS = fxI — foF2; fmI = fxF2, dfS = fxI —fxF2; or fmI = foF2, dfS = fxI — foF2, The first of these gives compatible data for all cases. One logical system would be to make fmI always refer to the same magneto—ionic component as fxI, subtracting fB/2 from the total width of spread when both components are present and indistinguishable. Please comment. Note while most groups measure fxI, some measure fmI and others dfS. These give equivalent information if measured using the same rules.

11. Voluntary measurement of spread F when two structures are present

Groups voluntarily measuring fmI or dfS for spread F research purposes find that they would like to measure the spread near foF2 as well as the total spread given by fxI. Examples will be shown in the next Bulletin. This is easily possible for stations using the standard NOAA daily work sheet, Form 7E, using two of the unused F—region columns. Time did not allow a discussion of the nomenclature to be used to identify these parameters or the establishment of rules (the remarks in section 10 apply to these also).

Tentatively we suggest fmF2 for the minimum frequency of spread, ftF2 for the maximum frequency of spread and dfF2 for the interval (if needed) leaving definitions and final proposals to be made by groups directly concerned. The groups undertaking this kind of work are requested to make their preferences known to INAG as soon as possible —— if replies can be received quickly, some reference to these parameters can be made in the Handbook, and codes issued.

12. Changes in the URSI Handbook

The Editors of the Handbook were asked to mark substantial changes in the Handbook so as to draw attention to them. This is easily possible where rules or definitions have been changed but the majority of alterations involve no change in principle but the addition of clarifying examples or phrases. About half the sentences in the Handbook have been modified in this way. The possibility of having the Handbook translated into French, Spanish and Russian were discussed with URSI/STP who made a recommendation on this subject.

13. Ionogram formats

There was a discussion on the formats to be used for ionograms and for the equivalent digital equipments. For conventional ionosondes this involves a compromise between reading accuracy and having enough height range to permit reliable interpretation. Thus it is normally necessary to see at least the main part of the second order trace to determine whether the ionosphere is horizontal or not. Format is also determined by cost and by the interests of the group controlling the station. For these reasons there has been no standardization of frequency scale. However, most stations record with a fixed height scale of 1000 km, or at low latitudes 1400 km. The discussion showed that the 1400 km scale has advantages at high latitudes also, where it simplifies interpretation at a cost of some loss in height accuracy. A few stations use two height scales, one for normal use and interpretation and one for accurate height measurements of E, or E and F heights.

In the case of digital equipments it is relatively cheaper and easier to use multiple soundings with different height and/or frequency scales but it is economical to use certain ratios. Where multiple recording is to be used regularly, the best compromise appears to be 750 km scale for normal analysis accompanied by 1500 km for interpretation and confirmation that the ionosphere is or is not horizontal, with an additional 375 km sounding when the greatest accuracy is required, e.g. for E—layer studies. The meeting therefore proposes these standards, confirming that the old 1000 km standard is usually optimum for ionosondes recording on one fixed height scale and that a greater height range is needed at low and high latitudes,

The advantages of easy interchange of digitized data from different sources was stressed but the meeting as a whole did not feel that there was enough agreement among those developing such equipments to justify international standards at this time. Standards which are not used are worse than useless.

14. Other matters

fbEs

There was a discussion on means to increase the value of fbEs when fbEs exceeds foF2 (INAG—4, p. 4), with opinion split between using foF2 DA and a value based on foEs as modified by the appearance of multiple layers, foEs AA. There was no agreement on practical rules for the latter and the problem was referred back to INAG.

Trough measurements

A multi—station study of the ionosphere over Scandinavia gave naps of foF2 as a function of latitude and LMT which showed great gradients of ionization. Problems arising from the interpretation of the ionograms were discussed.

Stations in difficulties

Letters from stations in difficulties were passed to INAG with a request that it attempt to see if any help can be given. At present such help depends solely on the generosity of the richer administrations.

Participants

K. Bibl	U.S.A.	G. M. Pillet*	France
J. V. Lincoln*	U.S.A.	K. Rawer	Germany
C. M. Minnis	URSI	J. Taagholt	Denmark
J. Oksnan	Finland	T. E. Turunen	Finland
W.	R. Piggott* (Chairman)		U.K. A. H. Shapley*
U.S.A.			

* INAG members

III. Modifications of URSI Handbook Rules Adopted in the IQSY

Many stations have started operations since the IQSY, and some others have not received the IQSY Instruction Manual No. 4 "Ionosphere" [CIG—IQSY Committee 1963, London, but now out of print]. The IQSY changes are reproduced below together with some additional motes.

The Format of f—plots

Existing standards

The standard f—plot form used during the IGY provides a frequency and time grid suitable for plotting quarter—hourly, or in a few cases, 10—minute interval observations. The frequency scale is linear from 0 to 10 MHz and logarithmic from 10 to 25 MHz. Some stations, where the top frequencies never reach these high values, use scales which stop at 15 or 20 MHz.

The standard form uses a scale of 15 mm per MHz from 0 to 10 MHz. At higher frequencies, the ordinate y (in cm) is related to the frequency f(in MHz) by the equation:

$$y = 34.54 \log10(f) — 19.54.$$

This gives a continuous scale at 10 MHz. The standard time scales may vary slightly, most giving between 8 and 9 mm per hour for quarter—hourly recording or about 10 mm per hour for 10—minute recordings. Smaller spacing gives plots which cannot be effectively reproduced.

The frequency scale has heavy rulings at 1 MHz intervals and is subdivided into 0.1 MHz steps below 15 MHz and 0.2 MHz steps above this frequency. The time scale has heavy rulings every hour and is subdivided to give one line per observation, i.e. to give 4 lines per hour for quarter—hourly observations.

A small subsidiary scale is added on or at the top or bottom of the f—plot to show the incidence of Es types. This graph normally contains 5 to 8 horizontal lines spaced about 3 mm apart.

Experience shows that this format is very satisfactory provided care is taken to make any entries, particularly line entries, sufficiently thick to be distinguished from the grid when reproduced. This requirement, which has not been adequately observed at some stations, should be stressed as a considerable fraction of the f—plots produced are unreadable in the published form and are therefore useless.

New f—plot format for stations with extended low frequency bands

It is desirable that the new f—plot sheets should be, if possible, the same size as the existing standard but that the scale below 1 MHz should be more open. Since data are not likely to be obtained, on the average, for more than half the time on frequencies below 1 MHz, it is desirable to make a compromise between convenience of plotting and space required. It is important that the spacing in that part of the f—plot which is used the most (i.e. 2 to 8 MHz) should not be appreciably smaller than that provided at present. This suggests doubling the spacing near 1 MHz and using a geometrically progressing variation starting at a lower frequency than at present. A suitable scale can be constructed in which the spacing between the 0.1 MHz lines decreases geometrically from 3 mm at 0 MHz to 1.5 mm at 1.5 MHz; that is, the spacing between f and (f+0.1) MHz is given by 3×0.955^{10f} mm. The remainder of the f—plot is identical with the standard IGY form except that the highest frequency is restricted to 23 MHz.

A heavy line should be marked on the f—plot at the mean gyrofrequency, f_H, calculated to the nearest 0.1 MHz for a height h = 110 km from the standard equation:

$$= (r_0/(r_0 + h))^3 . (eH_0/mc)$$

where H_0 is the total field (in oersted) at ground level and r_0 is the radius of the earth.

A simpler alternative, which has the disadvantage that the frequency scale is not continuous, is to use 3 mm per 0.1 MHz from 0 to 1 MHz and then the standard scale. If this scale is used a heavy line should be drawn across the chart at 1 MHz. This alternative should only be used if it is not possible to obtain the standard form.

Accuracy Rules at High Latitude Stations

Experience has shown that a strict application of the recommended accuracy rules at high latitude stations results in the production of a large number of non-numerical values during years of low solar activity. This occurs mainly because foF2 is often very low, about 1 MHz, and spread F conditions are common.

When, on the average, the ionosphere does not allow the accuracy rules to be applied reasonably, it is justifiable to modify the rules but it is essential that degradation of the accuracy limits should only be accepted where absolutely necessary. A note must be made on the published data to show that the accuracies are less than normal. It is recommended that the difficulty be net by increasing the limits for the use of D or E to 20% or 5Δ(p. 23 in Handbook). In general, this appears to increase the median count to a reasonable level, e.g., from about 5 to over 15 in a typical month.

It must be remembered that the accuracy rule limits apply to reasonable doubt, not to absolute certainty. Thus, if an F trace shows some scattered echoes beyond the limit range and is such that it is unlikely that foF2 is really above the limit range, the trace should be treated as if the extended traces were not present. The accuracy rules show the action needed when the estimated uncertainty in the value lies in ranges determined by the allowable percentage error

or a multiple of the reading accuracyΔ, yΔ, whichever is the greater. Note that Δ is determined by the actual reading accuracy available on the normal ionogram as determined by the height or frequency scales in use at the station.

Uncertainty Action: Numerical Value is

less than ± 2% orΔ	unqualified
between ± 2% and ± 5% or ±Δ and ± 2Δ from middle value	middle value qualified by U with descriptive letter which most nearly gives the reason for the uncertainty.
greater than ± 5% or ± 2Δ from middle value but not exceeding + 20% or + 5Δ from lower limit value.	lower limit value qualified by D with descriptive letter
greater than ± 5% or 2Δ from middle value but not exceeding — 20% or —5Δ from upper limit value.	upper limit value qualifed by E with descriptive letter.
exceeds ± 20% or +5Δ	numerical value replaced by descriptive letter.

When either D or E could be used and one limit is more certain than the other, the more certain limit is always adopted. If both are approximately equally uncertain, it is preferable to use the limit which is least likely to widen the separation between first and second medians, e.g. if the middle value is above the likely value for the median prefer D, if below prefer E.

Examples

1. foF2 near 1 MHz, uncertainty determined by yΔ
   Δ = 0.1 MHz, aaa represents numerical value, X appropriate descriptive letter.

Uncertainty	Action
less than ± 0.1 MHz	aaa or aaa —X
between ± 0.1 and ± 0.2 MHz	aaa UX
between + 0.2 MHz and + 0.5 14Hz	aaa DX (lower limit value)
between — 0.2 MHz and — 0.5 MHz	aaa EX (upper limit value)
exceeds ± 0.5 MHz	X

2. foF2 near 10 MHz, uncertainty determined by x%

Uncertainty	Action
less than ± 0.2 MHz	aaa or aaa —X
between ± 0.2 and ± 0.5 MHz	aaa UX
between + 0.5 MHz and + 2.0 MHz	aaa DX (lower limit value)
between — 0.5 MHz and — 2.0 MHz	aaa EX (upper limit value)
exceeds ±2.0 MHz	X

The old rule gave effectively the same total allowable error for D, E and U when the error was determined by x% and not by Δ. The success of the IQSY rule in decreasing the number of values replaced by a descriptive letter at high latitudes suggests that the rule should be adopted everywhere. Experience shows that the removal of all accuracy limits in the size of D or E is very dangerous and can easily result in meaningless data being circulated. Your views on this change are required, particularly your views on the adopted limits of 20% and ± 5Δ. The latter could be too great where low frequency ionograms are available.

Additional rules for frequencies below the gyrofrequency

The following conventions should be used in the frequency band below the gyrofrequency in place of the standard conventions:

- ❜ fmin lowest frequency at which any echoes are observed (no rejection rules);
- -•- fminF except when equal to the critical frequency of a lower layer, when —o— should be used;
- o any ordinary—mode critical frequency or cusp frequency;
- z any z—mode critical frequency;
- x any cusp in a trace attributable to a maximum or a minimum in the ionization profile below the reflecting layer not already denoted by o;
- • foEs.

The distinction between o and x depends on the presence or absence of retardation in the trace of the lower layer. Thus, if both lower and upper traces show retardation at the critical frequency and the upper layer is effectively blanketed by the lower near this frequency, use o. When it is clear from the sequence of events that the cusp is due to the formation of a ledge in the F layer, e.g., near sunrise and sunset, the symbol o is used and the critical frequency tabulated with the values for the appropriate layer. Care is needed to distinguish between foF1 and foE when the ledge first appears in the morning.

When the magneto—ionic modes are closely coupled, additional retardation occurs in the x mode when the working frequency is equal to the plasma frequency. Thus, a complex magneto—ionic wave often shows retardation at frequencies where the underlying ionization has a maximum or a minimum. The symbol x is introduced to denote maxima due to this phenomenon.

Recommendations on the use of the old or new f—plot format and rules

It is recommended that no changes in the standard format or in the f—plot rules be made at stations which are using equipment comparable with that in use during the IGY. For stations with extended low frequency ranges, say down to 200 kHz, the new standard format (given above) should be adopted provided that the quality of the low frequency ionograms and the amount of additional data justify a change. In doubtful cases, it is recommended that the current practice at the station be maintained in order to simplify comparison with IGY data. The existing format (used with the old rules) is adequate for equipment starting near 0.7 MHz. The time taken to make f—plots can be greatly reduced at stations with suitable projection facilities by making the f—plot format exactly match an enlarged projection of the ionogram. With the aid of a set square, the frequencies are transferred from the image directly to the f—plot sheet without first evaluating them numerically. This is both much faster and more accurate than the normal technique provided that the frequency calibrations of the ionogram and f—plot paper are matched. Full details are given in the new edition of the Handbook.

Use of the symbols B and E when foF2 is small

Special care is necessary in years of low solar activity to distinguish between conditions when foF2 is less than the lowest frequency recorded (letter symbol E) and when abnormal absorption is present (letter symbol B). Even in the IGY, when foF2 was relatively large, many cases were found where B had been used incorrectly and E was really more appropriate.

The presence or absence of interference on the ionograms is often a good guide, as is the trend of foF2 near the difficult period. It should be remembered that abnormal absorption is uncommon during magnetically quiet periods. Re—analysis of old ionograms shows that many operators tend to use B despite clear evidence on the ionogram that E was the appropriate letter. Thus, for last solar minimum conditions, there are systematic abnormalities in certain tables and graphs of both foF2 and fmin which repeat for many months over several years, but are spurious.

IV. Notes from INAG Members

Mme. N. Mednikova

There will be a meeting of the representatives of many of the USSR vertical sounding stations at Kaliningrad, August 18—25, 1971. Dr. Besprozvannaya and I will be in charge of instructing on the interpretation and reduction of ionograms; she for high latitude and myself for mid—latitude stations. Some questions concerning the ionosondes will also be discussed. I shall re-read the INAG Bulletins in order to be sure to discuss the main problems and questions which they have raised. At the meeting, material will be prepared which could be considered at a Warsaw INAG meeting, if one is held.

Dr. I. Kasuya

"Ionofax", an electrostatic recording device for ionograms (see INAG—3, p. 13) has been operating at the Tokyo ionospheric observatory since 1969. Ionofax is most useful for monitoring the existing conditions of the ionosphere, since it is able to print the ionograms on paper in real—time without any photo-development processing. Ionofax equipment was sent to Syowa base, Antarctica, last winter, since no serious troubles have arisen in practical use at Tokyo for more than two years. At Syowa, Ionospheric soundings have been carried out by rockets recently as well as by the usual ground based equipment. Recordings by Ionofax should be very useful to decide on periods when the rockets should be launched, specially for times to observe the disturbed ionosphere.

V. Notes from Stations

The Australian Network

The ionosonde at Mawson has been replaced by an IPS Type 3E ionosonde. This should improve the quality of the ionograms from Mawson and make maintenance easier for the operator. All stations in the Australian network except Salisbury are now equipped with one or another version of the Type 3 ionosonde. The Mawson ionosonde is the last of the Type 3 equipments to be manufactured. A new ionosonde has been developed and future replacements will be with this new type.

The stations at Canberra and Hobart are cooperating with stations in the USSR in a conjugate point experiment.

Trevor Stone, who installed and operated the ionosonde at the new Antarctic base at Casey, has now taken over the operation of the station at Vanimo in Papua New Guinea.

Vic Solaga, one of the supervisors of the Australian network, has taken some time off to travel around the world. He has not planned to visit any ionospheric stations during his travels but we hope he will be able to get to one or two of them. Unfortunately, most ionospheric stations have to be located away from the densely populated areas and are naturally difficult to get to.

Cape Town, South Africa

The ionosonde at Cape Town (34°08'S, 18°19'E) was moved to the Hermanus Geomagnetic Observatory (34°25'S, 19°13'E), a distance of approximately 45 miles (90 kilometers) from Cape Town on the 10th of May, 1971, the last recording being made at 0900 hours. The ionosonde started recording data at Hermanus on the 13th of May, 1971 at 1630 hours. The data bulletin for May 1971 will still be designated Johannesburg and Cape Town, but will be designated Johannesburg and Hermanus from June 1971 on.

Swedish Chain of Stations

The following particulars have been received concerning the present organization of the Swedish chain of stations:

Station	Head	Administration	Ionosonde
Kiruna	Lindquist	Defence Research F.0.A.	Lindquist type, 0.2—20MHz, about 20 kW
Lycksele	Hultqvist	Umea University	Stoffregen JS, 0.3 — 21 MHz, 30 kW
Uppsala	Stoffregen	Uppsala Ionospheric Laboratory	as Lycksele
Emmaboda (near H6vby)		Swedish Telegraph Board	D.S.I.R./Union Radio Mark II, 0.65— 20 MHz, about 2 kW

VI, Notes from WDCs

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

Miss J, Virginia Lincoln, while attending the XV General Assembly of IUGG in Moscow, August 1—15, 1971, presented a talk, illustrated by slides, on the operations of WDC—A at a meeting of World Data Center operators. A new data catalog was presented. This Report UAG—15 was issued July 1971 and supersedes all earlier catalog issues. It contains all the holdings in Solar—Terrestrial Physics at both Boulder and Greenbelt.

World Data Center—B2 on Solar—Terrestrial Physics, Molodezhnaya 3, Moscow B—296, USSR

Dr. Golovkov described the activities of his Data Center at the IUGG Assembly. He also showed the facilities of his Data Center to Miss Lincoln of WDC—A, Mr. Cecil Clarke of WDC—Cl, and Dr. I. Kasuya of ‘WDC—C2. Fruitful discussions were held on mutual problems.

World Data Center—Cl, Radio and Space Research Station, Ditton Park, Slough, Bucks, England

We apologise for the fact that no ionospheric catalogue has been issued since June 1970. The delay has arisen because the next catalogue is being produced by computer printout, and it has taken considerable effort to check all the entries to insure their accuracy.

The format of the new catalogue will be changed such that daily—hourly values, ionograms and f—plots are on the same pages, but the stations are still listed alphabetically, year by year, showing the months for which data are held. However, in the summary showing in much briefer form whether data are available, the stations could be listed in latitude order if users of the catalogue prefer this presentation. The WDC would, therefore, like to have views on which presentation is most useful. We would also like to widen the circulation of the catalogue and welcome requests from any readers of the INAG Bulletin who would like to go on the circulation list.

The catalogue would increase its usefulness if it gave listings of data available at any particular station although not necessarily held in the WDC. Stations making measurements in any of the disciplines for which WDC—C1 is responsible are, therefore, asked to inform the Center of such measurements so that their existence may be more widely publicized. Finally, the catalogue will be published as before, at 6 monthly intervals, but not necessarily in June and December as in the past.

World Data Center—C2 for Ionosphere, Radio Research Laboratories, Tokyo, Japan

The following report was given by Dr. I. Kasuya at the IUGG Assembly:

1. General Information on WDC
   1. Operating Institution: Radio Research Laboratories, Ministry of Posts and Telecommunications.
   2. Funds: Government.
   3. Staff: Dr. I. Kasuya (Director of WDC—C2 for Ionosphere) F. Ochi, C. Watanabe, Miss T. Miyazaki and temporary assistants.
   4. Premises dimensions: 300 m^2
   5. Equipment for copying: Xerox (in common use) 2
      Readerprinter (for 35 mm film or microfiche) 1
      Electrostatic copying machine 1
      Order on commercial basis.
   6. Possibility for expansion: Uncertain.

2. Data Sent to WDC
   1. Type of data: Ionosphere. (vertical sounding, topside sounding, absorption, drift, field intensity, etc.)
   2. Directly received: 10%
      Through the WDCs: 90%
   3. Connection: Exchange basis.
   4. STP NOTES No. 6: Reexamine the geographic coordinates of stations and show the present status of stations (active or inactive).

3. Notifications from Centers
   1. Materials: Data from Australia.
   2. Notifications: Yes, we received them.
   3. Data Catalogue: Yes, observations are included.

4. Exchange of Data with Other WDCs
   I. Guide: We have mostly followed the recommendations.
   2. Claims or wishes: Please indicate the name of the Station on every sheet or film strip.

5. WDC Data Service for Scientific Institutions and Private Scientists
   1. Institutions served: 9
   2. Scientists: 193
   3. Requests: 5,279
   4. Foreign scientists served: Few
   5. The latest catalogue of data (up to 1970) is now in press.

6. Non—utilized data
   1. Use of data: The original ionograms are used less than the tabulated ionospheric data.

VII. F Region Disturbance Index

by
W. R. Piggott

A description of the F—region disturbance index was given in INAG—3, pp. 2—4. The value for each day is published as part of the Calendar Record Notes in:

IQSY Notes;	Solar—Geophysical Data (Formerly CRPL—F part B);
SYP NOTES;	Upper Atmosphere Geophysics Report UAG—4;

and can be obtained from WDC—A, Upper Atmosphere Geophysics, NOAA, Boulder, Colorado 80302, U.S.A.

It is informative to see whether exceptional conditions at your station were exceptional worldwide, so the indices for 1969 and 1970 are reproduced below for your use. The numbers signify:

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

1969	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	5	4	4	5	4	4	6	2	2	8	5	5
2	4	8	2	5	5	2	4	2	1	8	6	4
3	1	9	1	5	6	4	1	6	2	7	6	2
4	4	7	2	4	3	1	2	6	2	6	5	6
5	0	6	4	4	4	1	1	6	6	4	4	8
6	2	5	4	2	2	1	2	4	7	6	4	7
7	6	4	5	5	1	5	4	5	6	4	6	6
8	5	5	4	4	0	6	5	5	7	0	6	5
9	2	1	2	6	4	6	6	6	5	2	8	5
10	2	5	1	4	4	5	5	6	4	8	8	5
11	2	8	4	5	2	4	4	2	6	6	6	5
12	6	7	7	3	3	7	6	7	4	5	4	5
13	4	5	4	7	8	8	7	4	1	2	2	4
14	5	4	2	7	8	8	6	3	5	1	1	2
15	7	7	7	6	9	7	4	0	8	1	2	4
16	5	5	6	4	8	8	5	2	5	2	3	6
17	7	2	7	5	8	7	5	5	5	4	0	4
18	7	1	5	5	7	1	1	5	6	4	4	4
19	6	2	6	1	5	2	1	6	4	5	5	3
20	5	5	8	2	4	5	0	6	4	2	4	4
21	2	4	7	3	7	1	4	5	2	4	3	2
22	1	4	7	5	5	1	5	4	2	4	5	5
23	1	6	7	3	4	1	5	4	4	1	4	7
24	6	5	9	4	2	5	2	1	4	5	4	6
25	8	6	8	1	2	5	2	0	4	5	5	6
26	8	7	5	2	1	4	7	4	2	4	6	6
27	7	8	4	6	1	2	8	8	1	5	8	6
28	4	8	4	8	2	1	6	5	8	6	7	4
29	4		7	7	3	0	2	3	8	2	7	1
30	4		5	8	4	0	2	3	8	2	7	0
31	4		4		6		5	4		4		1

1970	Jan	Feb	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	5	5	7	5	6	7	5	4	8	4	3	1
2	8	7	7	2	5	7	4	1	7	5	3	2
3	5	6	6	4	2	5	6	1	7	5	5	2
4	2	6	6	1	4	5	7	1	6	7	6	2
5	2	5	7	4	4	1	4	0	2	4	5	5
6	3	4	8	5	4	0	6	2	1	2	7	6
7	3	1	8	4	1	4	1	5	1	4	8	7
8	6	0	8	4	2	6	5	8	5	0	6	8
9	5	0	8	5	3	4	8	6	2	0	4	5
10	4	1	4	4	1	1	8	4	5	3	6	3
11	3	4	2	5	1	0	5	4	4	8	7	4
12	4	3	4	4	5	1	6	4	5	6	6	5
13	4	1	1	1	5	6	4	1	8	5	5	5
14	4	6	1	2	5	4	1	0	8	1	2	8
15	6	5	1	3	5	7	1	4	6	2	2	7
16	8	6	1	5	1	6	0	4	4	8	4	5
17	7	6	2	7	4	6	2	8	4	8	3	2
18	5	6	4	6	4	8	2	8	5	8	5	2
19	5	5	2	7	4	7	1	7	7	5	7	3
20	6	4	0	6	7	8	2	4	7	4	4	6
21	6	2	0	8	6	8	5	1	7	2	7	4
22	2	0	1	8	5	2	5	2	6	6	8	4
23	4	2	1	5	1	0	5	5	4	8	7	4
24	5	5	3	7	2	2	7	2	4	7	7	6
25	1	5	2	5	5	4	8	7	4	5	4	5
26	1	8	2	4	4	7	7	7	4	4	4	4
27	2	7	5	4	7	8	4	6	6	4	4	4
28	4	7	7	4	8	6	4	5	4	6	4	7
29	5		7	4	8	0	8	4	2	6	1	6
30	6		7	5	5	4	5	4	5	5	2	6
31	5		8		5		6	5		4		

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

A Circular Letter RWC—123 (June 1, 1971) is available from Miss J. Virginia Lincoln, IUWDS Deputy Secretary, NOAA, Boulder, Colorado 80302, U.S.A., describing the new solar and geophysical information (as of July 1, 1971) given by voice in the English language on NBS Radio Station WWV at 18 minutes after the hour and on NBS Radio Station WWVH at 45 minutes after the hour. The information is provided by the Space Environment Services Center of the Space Environment Laboratory, National Oceanic and Atmospheric Administration, in their role as the World Warning Agency of the International Ursigram and World Days Service. This prompt information provides both current observations of solar and geophysical events and predictions for the next day or so.

IX. "Ionospheric Data"

This monthly bulletin collects the summary monthly data from the worldwide network of observatory ionospheric vertical sounding stations as reported to World Data Center—A, Upper Atmosphere Geophysics, Boulder, Colorado 80302, U.S.A. The data tables give the monthly median and other statistics for each hour of the day for the principal characteristics derived from ionograms. "Ionospheric Data" is available on a data exchange basis upon request to WDC—A. It is also for sale through the

Superintendent of Documents, Government Printing Office, Washington, D. C. 20402, Catalog Order Number C55.218, annual subscription $10.00 with additional $2.50 for foreign mailing ($9.60 additional for U.S. airmail, foreign airmail quoted on request). It has been published continuously since 1944.

It is hoped to bring the publication of the medians up-to-date within about a year's time. When the rate of publication matches the rate of data flow to WDC—A, it will be appropriate to consider changes to the contents of the "Ionospheric Data" bulletins. Therefore, suggestions are solicited as to what data would be most useful to publish, or in what groupings the data should be published. Possible suggestions include only presenting median foF2 and M3000F2, or presenting only solstice or equinox data, or presenting the daily/hourly values from a set of key stations, or grouping the data by time period, etc. Please comment.

X. The International Computer Code for VI Stations

The general principles of the station computer—code were published in the URSI Handbook of Ionogram Interpretation and Reduction, p. 72—80. The code has been modified and has grown with the growth. of the network. Some confusion has also arisen because all computers do not read the same symbol in the same way! The following notes will help you to read the computer station codes. Each station is identified by a three symbol code (on punched cards in columns 3, 4, 5).

The first symbol denotes longitude range.

The second and third symbols denote actual geographic latitude in degrees.

The third symbol may be modified arbitrarily where necessary to identify different stations in the same longitude band and at the same latitude. No two stations can have the same code.

To show whether the station is in the South or North hemisphere an "eleven punch" is put over the last digit for South hemisphere stations, This converts the numerical code into a letter code. The conversion for the Southern hemisphere (third symbol) is:

0 1 2 3 4 5 6 7 8 9
(Symbol depends J K L M N 0 (letter) P Q
R
on computer)

There are twelve longitude bands listed below:

Band	East	Actual	Code
0	345°-15°	15^0W-15^0E	0
1	15°-45°	15^0E-45^0E	1
2	45°-75°	45^0E-75^0E	2
3	75°-105°	75^0E-105^0E	3
4	105°-135°	105^0E-135^0E	4
5	135°-165°	135^0E-165^0E	5
6	165°-195°	165^0E-165^0W	6
7	195°-225°	165^0W-135^0W	7
8	225°-255°	135^0W-105^0W	8
9	255°-285°	105^0W-75^0W	9
10	285°-315°	75^0W-45^0W	J
11	315°-345°	45^0W-15^0W	A

The code of characteristics, Table 6.1, p. 75. in the Handbook has also been extended and, in a few cases, modified. Many of the new characteristics included are voluntary (c.f. INAG—l, p. 11); in general codes are provided for any parameters measured at several stations so as to prevent confusion when interchanging computerized data. The current code is reproduced below:

Code of Characteristics January 1970

Characteristic Codes Used for Ionospheric Measurements

Code of Characteristics January 1970

Characteristic Codes Used for Ionospheric Measurements

		FREQUENCIES			PARAMETERS	HEIGHTS					
CARD COL 13 / CARD COL 12 / LAYER		0	1	2	3	4	5	6	7	8	9
F2	0	00 foF2*	01 fxF2	02 fzF2	03 M(3000)F2*	04 h'F2*	05 hpF2	06 h'Ox	07 MUF(3000)F2	08 hc	09 qc
F1	1	10 foF1*	11 fxF1		13 M(3000)F1*	14 h'F1		16 h'F*	17 MUF(3000)F1		
E	2	20 foE*		22 FoE2		24 h'E*		26 h'E2			
Es	3	30 foEs*	31 fxEs	32 fbEs*	33 fEs	34 h'Es*		36 Type Es*			
Other	4	40 foF1.5		42 f min*	43 M(3000)F1.5	44 h'F1.5			47 fm2	48 fm3	
Spread F and Obliques	5	50 foI	51 fxI*	52 fmI	53 M(3000)I	54 h'I			57 dfS		

Characteristics normally interchanged are marked with an asterisk (*).

XI. Ionospheric Data in Computer Format

At WDC—A Upper Atmosphere Geophysics in Boulder, Colorado there **i5** a considerable amount of vertical incidence data on punched cards or magnetic tape. See tables below:

BA IONOSPHERE VERTICAL SOUNDINGS

AT BOULDER

VERTICAL SOUNDINGS DAILY-HOURLY TABULATIONS ON MAGNETIC TAPE

STATION	COMPUTER CODE NO	BEGIN		END DATE		DATE
ADAK	651	1/1957	—	12/1965	+	MAGNETIC TAPE
ALERT	J82	1/1957	—	12/1958		MAGNETIC TAPE
ANCHORAGE	761	1/1957	—	12/1965	t	MAGNETIC TAPE
BARROW	771	7/1957	—	11/1965		MAGNETIC TAPE
BOGOTA	JO5	1/1966	—	6/1967		PUNCHED CARDS
BOGOTA	J05	4/1962	—	5/1962		MAGNETIC TAPE
BOGOTA	JO5	7/1957	—	12/1959	+	MAGNETIC TAPE
BOGOTA	J05	8/1960	—			MAGNETIC TAPE
BOGOTA	JO5	10/1962		12/1965		MAGNETIC TAPE
* BOULDER	840	1/1966	—	3/1969	+	PUNCHED CARDS
BOULDER	840	5/1963	—	12/1965		MAGNETIC TAPE
BOULDER	840	7/1970	—	4/1971		MAGNETIC TAPE
BRISBANE	52P	1/1966	—	12/1967		MAGNETIC TAPE
BYRD STATION	80—	1/1964	—	2/1967		PUNCHED CARDS
BYRD STATION	88—	10/1964		2/1967	+	PUNCHED CARDS
BYRD STATION	88—	5/1964	-	12/1964	+	MAGNETIC TAPE
BYRD STATION	88—	7/1957	—	12/1963	+	MAGNETIC TAPE
CANBERRA	53N	1/1966	—	12/1967		MAGNETIC TAPE
CAPE KENNEDY	929	3/1958	—	12/1958		MAGNETIC TAPE
CAPE KENNEDY	929	5/1964	—			MAGNETIC TAPE
CHICLAYD	90P	7/1957	—	12/1958		MAGNETIC TAPE
CHIMBOTE	90R	7/1957	-	5/1959	+	MAGNETIC TAPE
CHURCHILL	958	1/1943	—	12/1960		MAGNETIC TAPE
CHURCHILL	958	1/1963	—	12/1964		MAGNETIC TAPE
CHURCHILL	958	10/1965	—	6/1970		MAGNETIC TAPE
* COLLEGE	764	1/1957	—	12/1965		MAGNETIC TAPE
COLLEGE	764	1/1966	—	±2/1967	•	PUNCHED CARDS
*CONCEPCION	J30	1/1966	—	11/1966	+	PUNCHED CARDS
CDNCEPCION	J30	10/1957	—	2/1962		MAGNETIC TAPE
CONCEPCION	J30	12/1962	—	4/1965		MAGNETIC TAPE
CONCEPCION	J30	12/1967	—	12/1968		PUNCHED CARDS
ELLS WORTH	A7P	7/1957	—	12/1958		MAGNETIC TAPE
EUREKA	980	1/1957	—	12/1959		MAGNETIC TAPE
FLETCHERS ICE	982	7/1957	—	12/1958		MAGNETIC TAPE
FROBISHER BAY	J63	1/1957	—	12/1959		MAGNETIC TAPE
FT MONMOUTH	J40	7/1957	-	12/1965	+	MAGNETIC TAPE
GARCHY	042	1/1961	—	1/1966	+	MAGNETIC TAPE
*GODHAVN	J69	1/1965	—	9/1970		PUNCHED CARDS
GODHAVN	J69	7/1957	—	12/1965	+	MAGNETIC TAPE

GRAND BAHAMA	926	1/1966	-	6/1966		PUNCHED CARDS
GRAND BAHAMA	926	1/1967	—	3/1967	+	PUNCHED CARDS
GRAND BAHAMA	926	6/1957	—	6/1961	+	MAGNETIC TAPE
GRAND BAHAMA	926	10/1961	—	12/1965		MAGNETIC TAPE
HOBART	54K	1/1966	—	12/1967		MAGNETIC TAPE
*HUANCAYO	91K	1/1957	—	12/1965	+	MAGNETIC TAPE
HUANCAYO	91K	1/1966	—	8/1970	+	PUNCHED CARDS
ILO	J1P	2/1959	—	5/1959		MAGNETIC TAPE
JULIACA	J1N	4/1959	—	5/1959		MAGNETIC TAPE
KENORA	948	10/1965	—	6/1970		MAGNETIC TAPE
KIRUNA	167	1/1965	-	8/1966		MAGNETIC TAPE
LA PAZ	J10	1/1964	—	8/1965		MAGNETIC TAPE
LA PAZ	J10	2/1961	-	3/1961		MAGNETIC TAPE
LA PAZ	J10	7/1961	—	12/1961		MAGNETIC TAPE
LA PAZ	J10	10/1957	—	12/1960		MAGNETIC TAPE
LA PAZ	J10	10/1962	—	8/1963		MAGNETIC TAPE
LITTLE AMERICA	77Q	7/1957	—	12/1958		MAGNETIC TAPE
LYCKSELE	164	1/1965	—	8/1966		MAGNETIC TAPE
*MAUI	720	1/1957	—	12/1965	+	MAGNETIC TAPE
MAUI	720	1/1966	-	12/1970		PUNCHED CARDS
MAWSON	26P	1/1966	—	12/1966		MAGNETIC TAPE
MEANOOK	855	1/1957	-	12/1959		MAGNETIC TAPE
MUNDARING	43K	7/1967	-	9/1967		MAGNETIC TAPE
*NARSSARSSUAQ	J61	1/1966	—	5/1970	+	PUNCHED CARDS
NARSSARSSUAQ	JB1	8/1957	-	12/1958		MAGNETIC TAPE
NARSSARSSUAQ	J61	8/1959	—	12/1964	+	MAGNETIC TAPE
NATAL	AON	3/1958	—	1/1959		MAGNETIC TAPE
NATAL	AON	10/1959	—	12/1959		MAGNETIC TAPE
NORFOLK ISLAND	63—	1/1966	-	12/1967		MAGNETIC TAPE
*OKINAWA	426	1/1957	-	2/1960	+	MAGNETIC TAPE
OKINAWA	426	1/1961	—	12/1965	+	MAGNETIC TAPE
OKINAWA	426	1/1966	—	12/1968	+	PUNCHED CARDS
OKINAWA	426	3/1969	-			PUNCHED CARDS
OKINAWA		12/1969	—	6/1970	+	PUNCHED CARDS

B1 **IONOSPHERE VERTICAL SOUNDINGS** (Continued)

<u>AT BOULDER</u>

VERTICAL SOUNDINGS DAILY—HOURLY TABULATIONS ON MAGNETIC TAPE

STATION	COMPUTER CODE NO	BEGIN DATE		END DATE	
OTTAWA	945	10/1965	—	6/1970	MAGNETIC TAPE
PANAMA	909	7/1957	-	12/1958	MAGNETIC TAPE
PORT MORESBY	SOR	1/1966	—	12/±967	MAGNETIC TAPE
PUERTO RICO	418	1/1957	—	10/1957	MAGNETIC TAPE
PUERTO RICO	J18	1/1958	—	±2/1958	MAGNETIC TAPE
PUERTO RICO	418	6/1959	—	9/1959	MAGNETIC TAPE

RESOLUTE BAY	974	1/1963 —	12/1964		MAGNETIC TAPE
RESOLUTE BAY	974	10/1965 —	6/1970		MAGNETIC TAPE
REYKJAVIK	A64	1/1964 —	12/1964		MAGNETIC TAPE
REYKJAVIK	A64	2/1957 -	12/1961	+	MAGNETIC TAPE
SAN FRANCISCO	837	1/1957 —	1/1959		MAGNETIC TAPE
SAN SALVADOR	424	12/1958 —	12/1959	+	MAGNETIC TAPE
SOUTH POLE	09	— 1/1966 -	12/1966		PUNCHEDCARDS
SOUTH POLE	09	— 2/1964 —	3/1964		PUNCHEDCARDS
SOUTH POLE	09	— 6/1965 —			PUNCHEDCARDS
SOUTH POLE	09	— 9/1964 —	11/1964	+	PUNCHEDCARDS
SOUTH POLE	09	— 7/1957 —	12/1964	+	MAGNETIC TAPE
ST JOHNS	447	7/1957 —	5/1959		MAGNETIC TAPE
ST JOHNS	J47	10/1965 —	6/1970		MAGNETIC TAPE
TALARA	90M	1/1957 —	12/1965	+	MAGNETIC TAPE
TAMANRASSET	022	1/1961 —	1/1966	+	MAGNETIC TAPE
* THULE	J76	1/1966 —	6/1966		PUNCHEDCARDS
THULE	J76	7/1957 —	12/1965		MAGNETIC TAPE
TOWNSVILLE	SIR	1/1966 —	12/1967		MAGNETIC TAPE
UPPSALA	158	1/1965 —	6/1966		MAGNETIC TAPE
VICTORIA	848	1/1957 —	12/1959		MAGNETIC TAPE
*WALLOPS	937	6/1969 —	6/1969		PUNCHEDCARDS
WALLOPS	937	1/1970 —	1/1970		PUNCHEDCARDS
WALLOPS	937	7/1970 -	1/1971	+	PUNCHEDCARDS
WASHINGTON	938	1/1957 —	12/1965		MAGNETIC TAPE
WASHINGTON	938	1/1966 —	9/1968	+	PUNCHEDCARDS
*WHITE SANDS	832	1/1966 -	10/1970	+	PUNCHEDCARDS
WHITE SANDS	832	7/1957 —	12/1965		MAGNETIC

					TAPE
WILKES	**460**	**8/1957 -**	**1/1959**	**+**	**MAGNETIC TAPE**
YELLOWKNIFE	**862**	**1/1957 —**	**12/1959**		**MAGNETIC TAPE**

+ DATA NOT CONTINUOUS - LESS THAN 6 MONTHS MISSING

The asterisks (*) indicate the stations whose data are routinely computerized by WDC—A.

At WDC—Cl, Slough, U.K., the daily/hourly values of all parameters are prepared in computer f or— mat for Argentine Island, Halley Bay, South Georgia, Port Stanley, Singapore, Slough, and Cape Zevgari. In addition, for all stations in the world from May 1967 through April 1968 the daily/hourly foF2 and M3000F2 have been punched, but without the letter symbols.

The data of the eight G.R.I. stations of France are mow computerized as was reported in INAG—4, p. 16.

The data from the 14 Australian stations are on magnetic tape and although their service is mainly limited to users in Australia, their tapes have also been made available to WDC—A.

The Canadians are currently preparing their data on magnetic tape for Churchill, Kenora, Ottawa, Resolute Bay and St. John’s.

It would be of interest to know of the availability of other vertical incidence ionospheric data in computerized format. Please report to the INAG Secretary any such holdings you would be willing to make available to the scientific community.

XII. January 1972 Winter Anomaly Program

This is primarily a program for D—region rocket experimenters at Wallops Island. The experimental period is to start on January 15, 1972 and not extend beyond February 15. The criteria for this experiment were discussed at a recent international symposium and a panel consisting of L. C. Hale, R. A. Goldberg and M. A. Geller met to discuss the details. It was decided that the University of Illinois partial—reflection experiment should be used to detect days of high and low electron density in the 70—80 km region and that these measurements should be supplemented by an absorption experiment (either Al or A3 at about 2 MHz). The objective would then be to fire the rockets on two days of quite different ionization in the 70—90 km range when no apparent solar effects are present or were immediately preceding. The information on energetic particles would be inferred from LF propagation, satellite information, and possibly N~ airglow emissions.

It was also suggested that we attempt to find the more unusual day first, be it lightly or heavily ionized. This would be determined from a previous long data run of the ground—based experiments at Wallops. It was pointed out that there should be a set of reduced criteria in the event the primary case does not materialize in a reasonable interval of time.

It has been suggested that ground—based stations in northern, middle and high latitudes may want to intensify their observations or analyses at the time of this program for studies of the geographical extent of winter anomaly phenomena. If possible, the selected dates will be promptly notified to the IUWDS Regional Warning Centers from whom individual stations can get the information. Further information on the January 1972 Winter Anomaly Program nay be obtained from Dr. C. F. Sechrist, Jr., Aeronony Laboratory, Department of Electrical Engineering, University of Illinois, Urbana, Illinois 61801.

XIII. Third ESLAB/ESRIN Symposium on Intercorrelated Satellite Observations Related to Solar Events

The proceedings of the symposium sponsored by ESLAB/ESRIN at Noordwijk, September 1969, have been published by D. Reidel Publishing Company, Dordrecht, Holland, price $32.20.

The first part of the book consists of up—to—date review lectures given by leading international space scientists on interrelated phenomena seen on the sun, in interplanetary space, in the magnetosphere and right down to the earth's ionosphere. The second part presents papers describing results obtained from the three ESRO satellites and the American Vela satellites during the 25 February 1969 solar event (some very relevant Russian Venera V and Venera VI results for this period are given in the review lectures).

The review lectures should provide much that is interesting and new even for scientists working in some branch of solar—terrestrial physics. It is hoped that the presentation of many results for one short interval of time around 25 February 1969 will encourage further study of that event and similar cooperative assaults on the data in the future.

XIV. Abstracts of Current Publications from VI Station Groups

It is very helpful to your colleagues to know the main interests of particular groups, especially when arranging regional collaborations. INAG wishes to encourage you to send abstracts of published papers to the Bulletin for this purpose.

In this issue we include some Abstracts showing the use of your data as collected in the W.D.C's by the Aeronomy Group at Ahmedabad, India. We wish to thank Professor R. G. Rastogi for providing these abstracts.

RASTOGI, R. G. In Press Solar Cycle Variation of foF2 and hpF2 at Low Latitudes, Nature.

Solar cycle effects in the daily variation of foF2 and hpF2 at stations of same longitude i.e. KODAIKANAL/THUNBA (equatorial trough region), AHMEDABAD (peak foF2 region) and KOKUBUNJI (beyond equatorial anomaly region) are described. At KOKUBUNJI the ratio of foF2 1958/ foF2 1964 and hpF2 1958 — hpF2 1964 are almost constant at any solar hour. At KODAIKANAL the solar cycle effects and foF2 and hpF2 are opposite to each other. At ARMEDABAD also the solar cycle effects in foF2 are least when effects in hpF2 are maximum. Solar diurnal component of foF2 and hpF2 have been determined for different Rz values. AHMEDABAD behaves like KOKUBUNJI for Rz <50 and like KODAIKANAL for Rz >50.

(Thumba 1965—68, Kodaikanal 1956—68, Ahnedabad 1953—68 and Kokubunji 1952—67)

CHANDRA, H. and R. G. RASTOGI In Press General Features of the Ionosphere at Thumba, J. Inst. Telecomm. Engrs.

Some characteristics of the ionosphere at THUMBA are described partly studied from the ionograms and partly from the published data. Broad features of the equatorial ionosphere at THUMBA like seasonal differences in the midday bite—out in foF2, daily variation of the different ionospheric parameters, the seasonal and solar activity control of different ionospheric F-region parameters are shown. F—region parameters at THUMBA are compared to similar parameters at neighboring station KODAIKANAL which shows shift of foF2 equator with season. Special features at THUMBA like occurrence of spread—F, absence of ionospheric echo in the presunrise hours in low sunspot years, occurrence of high multiples are also discussed.

(Thunba Nov. 1964 to Dec. 1968 and Kodaikanal Nov. 1964 to Dec. 1968)

SHARMA, R. P. and R. G. RASTOGI 1969 Some Studies of the Phase Reversal of Lunar Semi—monthly Oscillations in Midday foF2, Jour. Ins. Telecom. Engrs., 15, 581.

Lunar tides in midday critical frequency of the F2 layer, foF2, have been studied for all the available stations between $l_{6\sim}$ and 250 dip. It is shown that the phase reversal of the lunar tide in midday *If* oF2 takes place very close to 2O~ dip and from the presently available data, no definite conclusion can be drawn about the seasonal shift of the region of the phase reversal.

(Bunia 1957-60, Hyderahad 1963—65 and Dakar 1961—62)

SHARMA, R~ P. and R. G. RASTOGI 1970 Lunar Tides in the Structure of the F2 Region and in H at Puerto Rico, Ann. Geophys., 25, 807.

The lunar daily (L) and lunar monthly (M) tides in N_{max} F2, h_{max} F2 and N_t at Puerto Rico, and in H at San Juan have been computed. It is shown that the tide in the structure of the F2 region at Puerto Rico is not controlled by the tides in H at the same place. Evidences are seen which show that lunar tidal oscillations in N_{max} at Puerto Rico are governed by the corresponding variations in H at Huancayo.

(Puerto Rico 1959—61)

SHARMA, R. P. and R. G. RASTOGI 1970 Lunar Perturbations in Geomagnetic Field and in the Characteristics of F—region over Huancayo, Pure. App. Geophys. (formerly Geof is. Pure Appl.) Italy (in press)

The lunar daily (L) and lunar monthly (M) variation in horizontal magnetic field (H), maximum electron density (N_{max}) height of peak ionization (h_{max}), semi—thickness (Y_m) of the F2 layer and total electron content (N_t) at Huancayo for the period January 1960 and December 1961 are described. The lunar tidal variations in h_{max} follow sympathetically the variations in H such that an increase of magnetic field causes the raising of height of peak ionization. Lunar tides in N_{max} are opposite in phase to that of h_{max} with a delay of about 1—2 hours, suggesting that an increase of height causes a decrease in maximum electron density. The lunar tides in semi—thickness are very similar in phase to that in h_{max} The lunar tidal effects in any parameter are largest in D—months and least in J-months The amplitude of lunar tides in N_{max} seems to increase with increasing height whereas the phase seems to be constant with height. It is concluded that lunar tides in the ionospheric parameters at magnetic equator are greatly controlled by the corresponding geomagnetic variations.

(Huancayo 1960—61)

RASTOGI, R. G. and R. K. MISRA 1969 Solar Cycle Variations of the Noon Critical Frequency of E—layer, Presented at 3rd International Symposium on Equatorial Aeronomy, January 1969.

Solar cycle variations of foE during 18th and 19th solar cycles (1944—54 and 1954—64) are studied for a number of stations over the world and it is found that the values of foE for the same sunspot number is larger during the rising part of the cycle 18 compared to the falling part. For the

19th solar cycle however, the effect is reversed and the values of foE are lower during the rising part of the cycle. A comparison between the Zurich sunspot number and the 10.7 cm flux is also made for 19th cycle, which also shows a similar kind of hysteresis effect as is noticed between foE and Rz. It is thus concluded that 10.7 cm radiation is much better index for defining the ionization of E—region.

(Slough, Washington, Tokyo, Maui, Ahnedabad, Christchurch, Watheroo)

CIIANDRA, H. and R. G. RASTOGI 1970 Solar Cycle and Seasonal Variation of Spread—F near the Magnetic Equator, J. Atmosph. Terrest. Phys., 32, 439.

Analysis of spread—F at equatorial stations over a solar cycle from published foF2 data has shown an increase of spread—F with solar activity at stations Djibouti, Ibadan and Kodaikanal. However, at station Huancayo in American zone opposite trend is seen. Similarly there is a vast longitudinal effect in the seasonal variations also. While Huancayo shows maximum spread in D—months with practically no spread in J—months, stations in African zone show maximum in J—months and minimum in D—months. At Indian zone stations there is little seasonal variation having weak maxima in J—months. The amount of variation is maximum in American zone and least in Indian zone.

(Kodaikanal 1956—66, Djibouti 1953—64, Ibadan 1955—66, Huancayo 1947—1966, Natal 1958—62,
Christmas Islands 1945—46 and Nha Trang 1951—52, 1955)

CHAKRAVARTY, S. C. and R. C. RASTOGI 1970 Lunar Tide in D—region of the Ionosphere near the Magnetic Equator, J. Atnoaph. Ierr. Phys., 32, 945—948.

The phase of the lunar tide in the ionospheric absorption at Colombo does not change appreciably with season during low sunspot years but has a semi—annual variation during the maximum sunspot years. Lunar tide in f_{min} for any particular season of the period IGY/IGC has a phase identical to that of absorption; the amplitude does not show any marked enhancement close to the magnetic equator.

(Colombo, Huancayo, Chimbote and Talara)

CHAKRAVARTY, S. C. and R. G. RASTOGI 1969 Lunar Oscillations in the D—region Absorption at Singapore, Nature, 223, 939—940.

The phase of the lunar tide in the D—region absorption at Singapore is opposite to that of the lunar tide in foF2. This suggests that the phase reversal of the lunar tide in the D—region may be taking place at a slightly lower latitude compared to those in the F—region.

(Singapore)

RAJARAI4, GIRIJA and R. G. RASTOGI 1970 North—south Asymmetry of Ionospheric Storms — Depend—ence on Longitude and Season, J. of Atmos. and Terres. Physics, 32, 113—118.

The study of ionospheric storms at pairs of north and south mid—latitude stations in different longitude zones, individually for each season, has shown asymmetry in their behaviour, most significantly in the Pacific zone, to some extent in the Asian and American zones. The decrease of foF2 which is found to occur during geomagnetic storms in summer months is conspicuously absent at Rarotonga. This suggests that ionospheric storm variations are greatly affected by horizontal and vertical movements of ionization, which are controlled by the asymmetric magnetic field of the earth.

(Akita, Brisbane, Puerto Rico, Port Stanley, Buenos Aires, Maui, Rarotonga, 1957—1961)

RAJARAM, GIRIJA and R. C.. RASTOGI 1970 F—region Disturbances in the Australasian Zone during IGY—IGC, Indian Journal of Pure and Applied Physics, 8, 551—554.

A study of foF2 in the Australasian zone during magnetically disturbed conditions shows the existence of some asymmetry between the northern and southern hemispheres. During the daytime hours of the winter months, there is a prominent increase in D/Q (foF2), the ratio of disturbed to quiet values of foF2, between 40^0N and 70^0N dip. Similar but rather a flatter hump is observed in the southern hemisphere in the daytime in the local winter months. These humps seem to get stronger during the night hours of the local winter months. The Dst (foF2) variations show an unexpected positive phase at the Japanese stations together with the region of reduced disturbed foF2 values around 300 dip. The effects of storms on foF2 seem more enhanced in the northern hemisphere than in the southern hemisphere. Within ± **4Q0** dip the disturbance effects in foF2 are associated with the normal solar daily variation of foF2, which in turn is controlled by the equatorial electrojet current.

(Singapore, Townsville, Brisbane, Canberra, Watheroo, Hobart, Scott Base, 1957—1959)

ARAM, GIRIJA and R. G. RASTOGI 1969 A Synoptic Study of the Disturbed Ionosphere during ICY—ICC — (1) the Asian zone, Annales de Ceophysique, 25, 795—805.

A systematic study of the solar daily variation SD(foF2) and the storm—time disturbance variation Dst(foF2) has been made for stations in the Asian zone for different seasons of the IGY—IGC period. The latitude of change—over of the equatorial to the high—latitude type of ionospheric storm varies with season. During local winter months, all the stations in the Asian zone, except those between 100 and 200 dip latitude, and above 600 dip latitude have positive type of ionospheric disturbances. It is suggested that the ionospheric storm effects at stations within **00** — 200 dip are due to the modification of the diurnal development of the equatorial anomaly, caused by geomagnetic disturbance. The mid—latitudes are affected by the combined effect of disturbances arising at the equator as well as at the high latitudes.

(Trivandrum, Kodaikanal, Tiruchi, Madras, Baguio, Ahmedabad, Okinawa, Delhi, Yamagawa, Kokubunji, Akita, Wakkanai, Alma Ata, Irkutsk, Tomsk, Yakutsk, Salekhard, Tixie Bay, 1957—1959)

XV. Literature Citations

SUKHORUKOVA, E. V. 1970 Temporal and Cyclic Changes in Ionization in Semitrans-parent Sporadic Layers, Kompleksnvve Issledovaniva Polv-arnoy lonosfery, 95-102.

A study was made of the temporal and cyclic changes in the parameters of semitransparent sporadic layers which are formed at nighttime in the high latitudes. The parameters of the sporadic layers were determined from ionograms for the Murmansk ionospheric station. The distribution of screening frequencies (fbFs) and critical frequencies (fbEs) during different phases of the solar cycle reveals that fbEs has a clearer dependence on solar activity.

(Murmanak)

BEN'KOVA, N. P., 1970 Correlation Between Disturbances in the Lower Ionosphere
G. V. BUKIN, and Type Pil Geomagnetic Pulsations as Observed in Ark-
A. L. KALISHER and hangel'skaya Oblast in March 1968, Geomagnetizm i Aero-
V. A. TROITSKAYA nomiya, Vol. X, No. 5, 842-846.

This paper gives the results of a comparison of sporadic layers of polar types and irregular magnetic pulsations of the Pil type based on observations made in Arkhangel'skaya Oblast in March 1968. Irregular Pil pulsations, excited for the most part near the auroral zone and then sometimes propagating to the middle latitudes during strong magnetic disturbances, are of three types: Sip, "noise bursts," and auroral agitation AA. Visual comparison of Esr, Esa, and all three types of Pil revealed that despite the fact that observations of these phenomena were made in different places separated by a distance of about 400 km they usually coincided, although the beginning and end of appearance of Pil and Es frequently differ somewhat. It was found that in the latitude zone 62.5-64.5' the magnetic and ionospheric disturbances usually begin and end simultaneously. The cross section of the flux in a meridional direction is not less than **20,** or 200 km. In the distribution of the cases of nonsimultaneous commencements and endings there is an asymmetry indicating that in most cases magnetic disturbances begin earlier and end later than ionospheric disturbances. A good correspondence between lower ionosphere disturbances and the appearance of Pil is expressed not only in an agreement in the periods of the appearances, but also in a high correlation of the intensity of these phenomena. Ionization density and Pil intensity are directly proportional to the intensity of the flux responsible for both these phenomena. It is concluded that it is not so much the energy composition as the flux density which determines the conditions favorable or unfavorable for Pil generation.

(Arkhangel' skaya Oblast)

SHCHEPKIN, L. A. 1970 Seasonal Change in the Probability of Appearance of the Fl Layer at Identical Solar Altitudes, Issledovaniva **P0** Geomagnetizmu. Aeronomii i Fiziki Solntsa. No. 7. "Nau-ka", 80-83.

This paper gives the results of a detailed analysis of data for the years of maximum (1959), intermediate (1961-1962) and low (1964-1965) solar activity, using a new method, for observations at Irkutsk and Moscow, The analysis was made for studying the seasonal change in the probability of appearance of the Fl layer for identical solar altitudes above the horizon. It is shown that the conditions for formation of the Fl layer are most difficult during the winter and equinoctial months, that is, the Fl layer is formed with a lesser probability during the season of the year when the seasonal anomaly in the F2 layer is most clearly expressed, being manifested in an increase in the electron concentration at its maximum in comparison with the summer.

(Irkutsk and Moscow)

YELIZAR'YEV, YU. N. 1970 Dependence of Parameters of the Ionospheric F2 Region on Solar Wave Radiation at Tomsk During the IQSY Period, Tomsk, Trudy Sibirakogo Fiz. -Tekhn. Instituta pri Tom-skom Universitete, No. 53, 23-68.

Observational data registered at the Tomsk Ionospheric Station during the years 1963—1965 were used in analyzing the correlation between the parameters of ionization of the F2 layer and solar zenith distance and the level of solar wave radiation. The following parameters were analyzed:

foF²max, foF²min, A foF2 (diurnal increment), fOF2max/fOF2min, h'F²min. The author computed the correlation coefficients characterizing the relationship between these parameters and solar zenith distance. and the receipts of solar energy in the earth's atmosphere (r = 0.80-0.96). The appendix gives tables of the median hourly values of ionospheric parameters for 1963-1965.

(Tomsk)

YEVLASI-IIN, L, S. and Z.I. NEKLYUDOVA 1970 Nature of the Correlation Between Auroras and lonospher-Ic Disturbances During the Solar Activity Cycle, Kompleksnyye Issledovaniya Polyarnoy lonosfery, "Nauka", 28-35.

This paper gives the results of a study for comparing visual observations of auroras and ionospheric data obtained by vertical sounding at Murinanak station during 1957-1966. The authors computed the correlation coefficients between the numbers of cases of the appearance of total absorption and for the sporadic Es layer and auroras for all observation seasons. It was found that the values of the correlation coefficients are related to solar activity. The conclusion is drawn that there is a change in the energy spectrum of particles responsible for auroras in the cycle. A study was made of the correlation between different types of auroras and the parameters *If* the disturbed ionosphere. It was established that the nature of this correlation did not 'Lange from the years of the maximum to the years of the minimum of solar activity.

(Murinansk)

ZASENKO, V. Y. 1970 Effect of the Ionosphere on a Wide-Band Signal, Issledovaniva **P0** Geomagnetizmu. Aeronomii i Fiziki Solntsa, No 7. "Nauka", 121-131.

The use of wide-band signals with good correlation properties for sounding the ionosphere makes it possible to broaden the possibilities of the vertical sounding method. The use of wide-band signals will favor a more detailed investigation of the fine structure of the ionosphere and study of change in dispersion of the medium with time.

VUGMEYSTER, B, 0. and V. D, KOKOTJROV 1970 Continuous Registry of Ionospheric Parameters, Issledovaniva **PO** Geomagnetizmu, Aeronomii i Fiziki Solntsa, No 7. "Nauka", 132-134.

A new method is described for the continuous registry of the F2-layer critical frequency. The functional diagram of an apparatus for checking the method is described. The results are discussed.

KOLOSOV, N. A,, N, A. SAVICH, M, B. VASIL'YEV, I. V. VORONIN, A. S. VYSHOV, A. I. SIDORENKO, C. I. TEREKHIN and D. YA. SHTERN 1970 Measuring Ionospheric Characteristics Using Coherent Radio Signals of the "Luna-14" Satellite, Kosmicheskive Issledovaniva, Vol VIII. No 5, 735-739.

A two-frequency dispersion interferometer, whose transmitter was carried aboard the "Luna-14" satellite, was used in measuring variations in the total electron concentration in the ionosphere. The receiver was at the earth's surface. The satellite-borne transmitter operated in the decimeter and centimeter ranges. Both absolute and differential measurements were possible. The antenna system picked up both ranges. Measurements to a distance of several hundred million kilometers were possible. The maximum total electron concentrations were-~6.9.10^9 cm^{-2} sec^{-1}. It is shown that in interpreting the results the nonstationary nature of the ionosphere must be taken into account. The fluctuations registered for the integral characteristics during most of the measurements are caused by large-scale inhomogeneities. The exact scale of the latter could not be determined due to the brevity of the observations, but their characteristic dimension is tens of kilometers (assuming the velocity of horizontal movement to be ~100 m/sec).

KORSUNOVA, L. P. 1971 Effect of Universal Time in foE Variations at Large Solar Zenith Angles, Geomagnetizin I Aeronomiva, Vol XI, Nol, 154-157.

The author studied the effect of evening-morning asymmetry in variations of the critical frequency of the E region for large Z◎. It was discovered that a new phenomenon can be detected in the behavior of foE which is associated with this effect. If the changes in foE are studied for Z◎ = const at different stations situated at close geomagnetic latitudes one can determine a pattern in foE variations with UT. Graphs of foE(UT) were constructed for Z◎ = 83° during different seasons during the period of minimum solar activity 1963-1964. The foE values were averaged for three-five measurements for the same Z◎ during several days during the middle of the month. The geomagnetic field was quiet (Kp ≤3). The article gives examples of the distributions for June, December and March. The following conclusions are drawn concerning foE variations with UT for ø = 45-50^0N: 1) there is a definite foE maximum during the period ~0800 UT which exists independently of season, 2) there is an opposite change in foE in sunnier and winter in other periods of UT. Quantitative estimates of the intensity of the additional source in the E region obtained using data on me from rocket experiments are confirmed by the results of ground foE measurements at large solar zenith angles. At altitudes 100-130 km in the middle latitudes there is an additional ionization source whose intensity at twilight is not dependent on Z◎ but changes with UT and season.

VERGASOVA, G. V., S. G. SIDOROVA and N. A. CHERNOBROVKINA 1970 Moving Disturbances at Irkutak, Issledovaniva po Geomagnetizmu, Aeronomii i Fiz. Solntsa, No 13, 81-96.

A study was made of moving disturbances responsible for double reflections on ionograms registered at Irkutsk station, Analysis of the N(h) profiles revealed that the direct factor responsible for such reflections is the curvature of isoelectronic ionospheric surfaces at the altitudes of the F region. The passage of moving disturbances is accompanied by an increase of the F layer and accordingly a decrease in the electron concentration. It is postulated that curvature of the isosurface occurs under the influence of internal atmospheric gravitational waves.

(Irkutsk)

MAMRUKOV, A. P., A. 14. UVAROVSKIY, V. 14. FILIPPOV and L. D. FILIPPOV 1970 Experimental Investigations of Radio Wave Propagation in the Subauroral Ionosphere at Yakutsk, Issledovaniva **PO** Geonagnetizmu, Aeronomii i Fiz. Solntsa, No 13, 117-124.

Investigations of the subauroral ionosphere and radio wave propagation were made at four ionospheric stations situated along a latitudinal cross section of the subauroral zone and three experimental radio paths. The measurement method is described. The paper presents the results of a preliminary analysis of the data. It was found that the diurnal variation in field strength is influenced by brief anomalous phenomena: intensive Es and absorption bursts. Computations of field strength by the Kazantsev method in the subauroral zone give exaggerated values. However, on the basis of continuous registry of the field level, vertical sounding data, and slant sounding observations it was possible to determine the values of the attenuation factor by the Kazantsev method, taking into account the influence of anomalous phenomena in the subauroral ionosphere on the propagation of short waves.

LIKHTER, YA. I. and YA, P. SOLOLEV — 1971 — Some Morphological Characteristics of the Spectra of Whistlers and the Nature of Ionization Inhomogeneities in the Outer Ionosphere, Geomagnetizin i Aeronomiya, Vol XI, Nol, 165-167.

Two types of dynamic spectra of whistlers can be distinguished: multicomponent and diffuse. There is a relationship between the characteristics of whistlers and the presence of scattered reflections in the ionospheric F2 region. When F-scattering is observed, the registry of completely diffuse whistlers is most common. However, whistlers having discrete tracks with considerable diffusivity are also registered in the absence of scattered reflections in the F region below the ionization maximum; this is probably determined by the complex nature of ionization distribution above the F region. Comparison of F scattering registered at ground stations and by satellites revealed that in approximately half the cases when the F region was sounded from below by ground stations and above from satellites the inhomogeneities were situated above the F2 layer maximum and absent below it, On the other hand, there was not a single case when F scattering was observed below the ionization maximum of the F region and was not registered in the outer ionosphere. Thus, in the outer ionosphere there are two types of ionization inhomogeneities oriented along the geomagnetic field: a) discrete, leading to the observation of multicomponent whistlers, b) inhomogeneities of a more complex structure, leading to the formation of diffuse whistlers. Discrete ionization inhomogeneities can exist during both the daytime and nighttime. Inhomogeneities responsible for diffuse whistlers are detected only at nighttime. There is a relationship between the observation of completely diffuse whistlers and the phenomenon of scattered reflections in the ionosphere. These conclusions apply to the region of the magnetosphere below L = 3. Other conditions may exist in the region of the plasmapause.

VAN ZANDT, T. E., V. L. PETERSON and A. R. LAIRD — 1971 — Electromagnetic Drift of the Midlatitude F2 Layer during a Storm, J. Geophys. Res., 76, No. 1, 278-281.

In this paper we report a middle-latitude nighttime F2-layer event during a moderate magnetic storm that almost certainly was caused by electromagnetic drift of the ionospheric plasma. The storm occurred on October 23, 1965.

(College, Anchorage, Churchill, Adak, Winnipeg, St. Johns, Ottawa, Urbana, Fort Monmouth, Boulder, Belvoir, San Francisco, Wallops Island, Point Arguello, White Sands, Cape Kennedy, Grand Bahama, Maui, Mexico City)

MAYRI H, G. and K. K. MAHAJAN — 1971 — Seasonal Variation in the F2 Region, J. Geophvs. Res., 76, No. 4, 1017-1027.

Semiannual and annual variations in the F2 region are examined by using foF2 and hm data during the descending phase of solar activity (1958-1965). The semiannual effect appears as a persistent feature of the ionosphere which, demonstrably, is not related to fluctuations in the 10.7 cm noise or the EUV radiation. This gives support to theories that attribute the semiannual effect to variations in the lower atmosphere. Although theoretically predicted temperature variations [Volland, 1969] could quantitatively account for the observed semiannual variations in the height of the F2 peak, the variations in NmF2 require additionally significant variations in the neutral composition at lower heights. Evidence for this is found in rocket-borne [0]/ [02] measurements at 120 km, which show maxima during equinox and a maximum to minimum ratio of 2 consistent with the ionospheric behavior. The annual variation in the ionosphere, showing a winter to sunnier enhancement in the F2 peak density at low latitudes and during low solar activity, can be explained by meridional winds at ionospheric heights. These winds also have a significant effect on the height of the F2 peak and appear to be effective throughout the solar cycle as evident from the ionosonde and the radar backscatter observations at Puerto Rico, which show the peak at higher altitudes in summer than in winter. This is consistent with the observations of King et al, [1968], pointing out that the electron density in the topside ionosphere is persistently higher in the summer hemisphere than in the winter hemisphere thus suggesting that in the upper ionosphere the wind effect on the height of the F2 maximum masks the processes responsible for the winter anomaly in Nm.

(Puerto Rico, Huancayo, Kodaikanal, Bogota, El Cerillo, Grand Bahamas, Ft. Belvoir)

NISBET, J. 5. 1971 On the Construction and Use of a Simple Ionospheric Model,
Radio Science, 6, 437-464.

The parameters controlling the development of a simple model of the E and F regions of the ionosphere are discussed. Uses of such models in scientific investigations and engineering applications are given. A computer model is described that will provide estimates of the electron and ion densities in middle latitudes as a function of latitude, longitude, altitude, season, time, and solar activity. Statistical parameters for midlatitude blanketing sporadic E are presented. An analytic expression is used for the CIRA 1965 neutral atmospheric models. The Fl region is treated using a photoequilibrium model with three ionic constituents and 62 ionizing radiation groups. The F2 layer uses theoretical models arranged to fit boundary conditions of NmF2, HmF2 and the electron density at 1000 km. Values of NmF2 are obtained by using the CCIR atlas of ionospheric characteristics. The midlatitude sporadic E layer is treated by presenting three parameters of the layer: the probability of observing sporadic E with a blanketing frequency greater than 0.5 MHz, the average peak electron density when sporadic E is observed, and the standard deviation (assuming log normal distributions for the peak electron density). The restrictions on the model and the availability of data on suitable boundary conditions are discussed. Suggestions for further development of models of the ionosphere are given.

(Grand Bahamas, Puerto Rico, Ft. Monmouth, White Sands, St. John's, Panama, Talara, Huancayo)

DU CHARME, E. D. 1971 A Method of Predicting the F1 Layer Critical Frequency,
L. E, PETRIE and Radio Science, 6, 369-378.
R. EYFRIG

The development of a method for predicting monthly median values of the F1 layer penetration frequency (foF1) at any location and time is described. The expressions derived for predicting the monthly median foF1 are functions of the zenith angle of the sun, the ionospheric index IF2 and the geomagnetic latitude.

(39 stations 1954-1966 from Resolute Bay in north to Halley in south)

1500MM - VRL