IONOSPHERIC NETWORK ADVISORY GROUP (INAG)

Ionosphere Station Information Bulletin No. 14

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

* Under the auspices of Commission III Working Group III.1 of the International Union of Radio Science (INAG).

** Issued on behalf of INAG by World Data Center A for Solar—Terrestrial Physics, National Oceanic and Atmospheric Administration, Boulder, Colorado 8O3O2. U.5.A. The bulletin is distributed to stations by the same channels (but in the reverse direction) as their data ultimately flow to WDC—A. Others wishing to be on the .distribution list should notify WDC—A.

I. Introduction

by W. R. Piggott, Chairman

The publication of the Second Edition of the Handbook has resulted in a number of comments, queries, and requests for extension or modification of particular paragraphs and also letters of congratulation. The Editors thank all those who have written.

The Handbook formed a major stem for a meeting of INAG held in London on April 6, 1973 in conjunction with the IUCSTP meeting. This is fully reported in this bulletin. A meeting of station operators to discuss High Latitude Ionograms and their interpretation, and operators' difficulties with the Handbook will be held on May l6th—l7th at Sodankyla, Finland. This will also be attended by your Chairman who will report in the next issue of the Bulletin. INAG hopes that all those who wish to suggest alterations to the Handbook text will inform the Secretary or Chairman as soon as possible so that your comments can be added to those in this Bulletin and be fully discussed by INAG before it issues any amendments and freezes the text at the end of this year.

The Handbook has been made in a form where it can be easily taken apart and rearranged and is published at a low price to encourage groups to obtain several copies and rearrange them to suit local conditions. Thus, for initial training purposes, it may be worthwhile to split it into two volumes. Pages 187—325 are not needed for initial training and a volume of 186 pages is less intimidating than one of 325 pages! Section 5 could also be omitted at this stage and some parts of section 6 if f—plots are not made. However many of the figures of section 6 have been selected to supplement figures in other sections. A further aid in training is to list those sections which should be read first. If any training groups try this type of exercise it would be helpful if they could send a copy of their selection to INAG so that a composite can be prepared for the guidance of individuals who have to train themselves.

Scientists who can see ways in which the data could be made more useful often make their wishes known and are disappointed when they are not acted on immediately. Such proposals, however, usually involve some increase in the training needed. INAG needs to know which proposals are generally acceptable and which seem to you to be complicated and obscure — it is easy for an expert to remember the logical relation involved in an alteration to the rules, but it is not necessarily easy for the operator who has to do it. A balance is needed. Where the scientific value is great and the difficulty small the change should be adopted.

There is at present much discussion on the use of capital or lower case letters to denote Es or spread F types. The central point here is that of training difficulties. The heading of the table or column in which letters appear clearly show whether the letter is qualifying, descriptive or a type. Thus there is no confusion in the final data even when computers are used and all entries are capital letters. As far as possible the meanings of qualifying and descriptive letters are closely similar. For Es types the lower case letters representing the types have completely different meanings. *Is the distinction lower case or capital important in practice when training?* If so, should spread F types be denoted by lower case letters? A similar research applies to qualifying letters. On some occasions when no qualifying letter is needed, more information could be given to the user if certain descriptive letters could be used. This would, however, tend to blur the distinction between qualifying and descriptive letters for the trainee. When first learning the rules, I found this distinction very helpful. *Is it still important?* A typical example might be a lacuna case (letter Y) with weak spread echoes present. YF then shows that some weak spread traces are visible. BR or BK could be similarly used when fmin is at foE though probably ER, EK, EY are more appropriate in this case, cases of multiple causes of doubt where D or E are not necessary could be treated similarly, the descriptive letter in the qualifying space, meaning uncertain value mainly because of reason corresponding to letter used. This is a big departure from past practice and therefore needs widespread comment and criticism before being adopted, and should only be adopted if the consensus feel that the additional information is worthwhile.

With the special electron density profile project led by Dr. Nisbet now involving much effort, it may be that other groups wish to take an interest in electron density profile work. If so please let INAG know what are your main problems so that it can see whether the demand justifies any special INAG effort. Past INAG policy has been to try to put you in touch with the most convenient major N(h) computing group so that you can use their expertise, or else to refer you to the simple procedures given in Chapter 10 of the Handbook which are appropriate when only

limited quantities or types of N(h) data are needed. *Is any further action by INAG desirable?* This is a specialized field in which first class ionograms and computing facilities are essential to provide accurate N(h) data but where approximate data can be obtained fairly easily and have some value, e.g. using a method from the Handbook.

The discussions at London on the International Magnetospheric Survey (IMS) shows that considerable ground based monitoring will be needed in this great international effort and that the monitoring chain will need to be supplemented by selected data from additional stations which do not usually interchange data. *Ionograms provide a cheap and reliable means of monitoring the plasmapause trough position on winter nights for IMS conditions and stations at suitable latitudes should consider the best methods of providing these data for the IMS.* Now is the time to start interpreting ionograms and making subsidiary experiments so that reliable data are available when required.

II. Ad hoc INAG Meeting London April 6, 1973

An ad hoc meeting of INAG was held at the Royal Society, London on April 6, 1973. The following were present:

W. R. Piggott	(Chairman of INAG)	U.K.
A. H. Shapley	(Member)	U.S.A.
J. 0. Cardus	Spain	
D. G. Cole	Australia	
J. A. Gledhill	South Africa	
G. Lange Hesse	W. Germany	
J. K. Olesen	Denmark	
S. M. Radicella	Argentina	
W. Stoffregen	Sweden	
F. F. von Wuthenau	Argentina	

1. Handbook

The Chairman welcomed the representatives, reviewed the current status of the Handbook, the comments so far received on it, and stated that he hoped that all controversial matters could be raised quickly so that the text could be amended and frozen. He described the steps taken in previous meetings to get informed views on the material of the Handbook and stated that be had circulated all INAG members with a questionnaire asking for approval or correction of all major points. While most had been approved unanimously there were requests for reconsideration of certain points, mainly on spread F, letter symbols — K, Q, Y — and possible difficulties in training. The operators do not like frequent minor changes in rules so be proposed allowing until November for discussion and reconsideration and then freezing the correcting text at the end of the year. The meeting approved this suggestion, passed a formal vote of thanks to the Editors of the Handbook and stated that it appeared to be a useful contribution to the efficiency of the network.

Professor Radicella expected that the Spanish version would be available in time to allow a seminar for operators to be held in Argentina later this year.

2. N(h) profiles

A general discussion on the deduction of electron density profiles from ionograms followed. This showed that several groups were interested in this technique and were considering the best ways of proceeding within the limitations imposed by the available ionograms and computers. The question of whether data obtained by different methods would be compatible was raised, and it was agreed to refer this to the appropriate URSI working group.

Since an expert representative was available from Australia, it was agreed to concentrate on Southern Hemisphere problems and, in particular, those of the Australian network. However, most of the problems raised proved to be of general interest.

3. Circulation of INAG Material

Professor Radicella stated that there was difficulty in obtaining an adequate circulation of the INAG Bulletin and the Handbook in South America. He suggested that ten copies be sent to a center and distributed locally, The difficulties of financing the Spanish version of the Bulletin were discussed and the Spanish speaking representatives agreed to investigate whether any funds could be allocated. They felt that perhaps $200 to $300 might be available and that it might be possible to organize the reproduction of the Bulletin in South America in the future. Mr. Shapley welcomed these statements.

4. Australian convention for qualifying and descriptive letters

Mr. Cole pointed out that the Australian network still used the original WWSC layout of qualifying and descriptive letters, before and after the numerical value respectively, and requested that this be legalized. The Chairman stated that this had been discouraged owing to the difficulties in punching data accurately, but that as the Australians punched their own data and would circulate it in punched form there was no objection in this case. It was agreed to legalize the use of the old form where data were punched locally and made available, in particular in the Australian network, though still stressing the disadvantage for general use.

5. Distinction between qualifying letters A and E

The need for qualifying letter A and its distinction from qualifying letter E was not clear to many present. The Chairman explained that the difference lay in the median rules.

Letter E implied a limit value which was less than the numerical value and that these values had to be moved to the bottom of the distribution when forming the second median.

Letter A also implied a less than limit value but this value was expected to be abnormally large and hence should not be moved to the bottom of the distribution when forming the second median. The connotation “less than” is thus ignored in forming the medians.

6. Use of lower case symbols

Two problems were raised:—

(a) Computers do not have lower case symbols so that parameters such as foF2, fbEs, fmin, h’F and the Es types must be reproduced as capitals FOF2, FBES, FMIN, H’F, etc. *Should the international symbols be altered accordingly?* The meeting was split on this problem, the majority feeling that a change should be made in the future when use of computer data is more widespread and people have got used to the computer form. It was agreed to add a new section to the Handbook to be drafted by the Editor. (See below).

“Draft 1.9. Computer Output

Parameters reproduced in computer form are usually identified by the standard characteristic codes given in section 7.3 of the Handbook. These may be supplemented or replaced if desired by the corresponding parameters in computer printout form, e.g. FOF2 for foF2, FMIN for fmin, etc. All lower case symbols are replaced by capitals for computer reproduction and are regarded as equivalent to the international conventions."

(b) The lower case symbols for Es types are difficult to read, and also they must be changed to capitals for computer purposes.

The complaint of illegibility is widespread and appears to be justified. Originally lower case symbols were devised for Es types so as to avoid confusion with letter symbols which have quite different meanings. This is important to trainees but not important to fully trained operators who easily recognize the different context. The same problem is arising with the proposed spread F types which possibly should also have lower case symbols. *INAG requests comments from other groups* — would the user prefer capitals for Es and spread F types. Would this change cause confusion to operators?

7. Extending use of qualifying letters

The advantages and disadvantages of introducing more qualifying letters was discussed. In general those using the data for scientific purposes were greatly in favor of some extension when an existing qualifying letter was not needed, e.g. when replacement letters are being used. The disadvantage is again that it could complicate the training of operators, and the views of trainees and those responsible for training are needed. INAG has to try to hold a balance between value to user and difficulty in obtaining data — this often really involves training.

8. D— and E—region stratifications

The complexity of the D and E region part of the ionograms usually increases in solar minimum activity years and thus the question of what should be analyzed becomes more important. Unfortunately there is little guidance from scientists on these problems. Pending such guidance, INAG must try to keep the conventions uniform at as many stations as possible and also try to promote more studies of the phenomena at individual stations. At the higher latitudes low traces are often due to z—mode reflection which has less retardation than the corresponding o—mode trace. There are some interesting problems which could be studied but it is not worthwhile to attempt international conventions until the correct interpretations have been established and it is clear that the information would be valuable.

9. Chirp sounders

Professor Gledhill stated that a Chirp sounder had been successfully operated at Grahamstown and that problems were not anticipated when it was moved to SANAE because the staff were skilled and well trained. INAG wishes to receive comments on the use of this technique by other groups. It has considerable technical merit, but the question of whether it can be run successfully by the relatively unskilled staff and limited test equipment generally available at observatory type stations needs to be established.

10. Commercially produced sounders

The Chairman stated that contributions in the Atlas of Ionograms, Handbook and INAG Bulletin involving or describing commercially available equipment do not imply any recommendation or approval of such equipment by U.R.S.I. or INAG and that these contributions should not be quoted for commercial purposes. It is desirable that INAG draws attention to new techniques or new equipment which may be of interest to the network but it does not have the facilities either to discover all available equipments or to evaluate their capacities. INAG depends on collaboration for this type of information; if you feel your equipment merits a comment please inform INAG.

11. Future of network

Mr. Shapley stated that the VI network data had the biggest user demand of any network contributing to the World Data Center Organization. Last year 65,000 station months of data were requested from WDC—A. This is consistent with the increasing demand for clarification of VI data from groups who have not used it in the past.

Mr. Shapley stated that it is becoming more and more difficult to provide spares for the National Bureau of Standards (now NOAA) type C ionosondes and that this may soon prove impossible. At present about 40 type C's are in use, half in observatory stations. The deployment will be reviewed to make sure that optimum use of equipment is made.

Mr. Cole drew attention to a new Australian ionosonde costing about £5000 ($12,000). The cost of component parts is about half of this sum. Professor Radicella stated that Argentina was also making some sounders to local design.

12. Australian data

Mr. Cole stated that all Australian data 1957—1972 is now available on magnetic tape and that he would be glad to exchange these data for data from other stations in computer usable form.

13. Use of fEs

The question of the value of the Australian fEs data was raised. The Chairman pointed out that scientists tend to avoid using these data since they do not know when they are fxEs **(** foEs + fB/2) and when a mixture of fxEs and foEs. Where the variability of the data is comparable with or less than fB/2 this causes significantly more dispersion and some systematic error in use of the data. Provided such data is clearly marked fEs it is acceptable, but its value internationally is less than foEs or fxEs data.

14. Use of IF2

Mr. Shapley inquired about the use of IF2 since there is some doubt about the future of three IF2 stations: Huancayo, College (Alaska), and Slough. *INAG would like to have more views on this subject.* For IF2 purposes it would be possible to continue using Jicamarca instead of Huancayo if the former station was made a synoptic station, and to replace Slough by one of the nearby European stations.

15. MONSEE

The possibility of using h'I to measure the position of the polar edge of the plasmapause trough was discussed. This appears to be a useful technique in zones where much ground—based work will be active in the I.M.S. The Australian techniques for measuring the direction of oblique traces could be simplified for use at observatory stations, particularly for calibrating the site. The possibility of using changes of Es type as a method of monitoring movement of particle precipitation was mentioned.

It is essential that the MONSEE lists of synoptic stations be supplemented by lists of stations who record but do not analyze their data without special reason, and by lists of stations who are will4ng to collaborate in particular ad hoc experiments. These will be greatly needed for I.M.S. studies. *Those willing to be included in either list are requested to inform INAG or MONSEE.*

16. A number of specific ionogram problems including polar spurs, lacuna, night E were also discussed.

III. Comments on Handbook and INAG Bulletin Discussions from J. K. Olesen, Director of the Danish Group of Stations and Ionospheric Laboratory, Lyngby

INAG is very pleased to be able to publish the letter reproduced below and hopes that other groups will also send similar comments. *Your Chairman's comments on Mr. Olesen's suggestions have been inserted after each point and denoted by Comment. INAG would like to know whether you support or object to any of the points raised in the letter or comments.*

"I should like to thank you and your INAG colleagues for your valuable work and express my gratitude by reacting on your request for comments.

Since several of my comments deal with scaling conventions, it might be suitable that I first state some general basic viewpoints that I have on the subject of new or revised scaling conventions and which I prefer to utilize when evaluating these:

A: Well established scaling conventions must be kept unchanged if at all possible."

Comment

Concur fully.

"B: If additional information is needed in the scaling sheets, e.g. because our knowledge is increased, or because we want to use the data for both propagation and research purposes the extra information must be given as additional symbols, not by new symbols, if at all possible. Especially we must aim at avoiding the use of different symbols for different subgroups of the same phenomenon. Additional symbols may be introduced in these cases, but the well—established symbols must be kept if at all possible even if their exact meaning is altered slightly by the additional symbol."

Comment

The use of additional symbols has some serious practical difficulties from the international point of view. This has always been allowed as a local rule and a few stations use three letter entries for local studies of which only the first two (qualifying letter and priority descriptive letter) are interchanged internationally. The adoption of an additional descriptive letter category implies not only redesigning the daily work sheets, but also the rewriting of the computer programs used to handle the data. This is not a trivial operation, in fact, some stations have stated that they would find it too expensive to tabulate fxI because it means altering their computer formats. Thus the scientific justification has to be great enough to make it reasonably sure that the majority of stations would accept the change.

On past performance and statements made by station representatives this seems unlikely, but INAG is prepared to publish letters or articles showing the scientific advantage and to inquire from time— to—time whether a positive response would be effective! It is because your Editors felt that only minor alterations to rules and parameters would be acceptable that an attempt has been made to modify existing symbols only slightly and to introduce the minimum of new ones needed to help current research.

The use of different symbols for different subgroups of the same phenomenon is clearly undesirable, and there is still time to alter any such cases which come to light. However, no practical set of rules can be entirely free of this criticism. INAG has already asked for comments, and any desirable clarifications or alterations which can be agreed by it before November 1973 will be incorporated in the next INAG Bulletin after that date and formally frozen by INAG.

It might be possible to introduce additional qualifying type symbols to particularly meet this need. This is discussed elsewhere in this Bulletin.

"C: Basic scaling symbols and conventions must be as simple as possible. If specialized groups want symbols, which are not easily understood and used, these symbols must be given on a voluntary basis. It must be remembered that on many field stations the scaling work is a limited part of the total work (about 2 hours a day?) and the personnel changes maybe each year."

Comment

Concur. Most of the changes made are in response to inquiries by operators or representatives at INAG meetings. It as difficult for the Handbook Editors to hold a good balance between the requirements of the best

trained and least trained operators — clarifications which help the former may confuse the latter! *Your comments and criticisms are invited.* INAG hopes to get to grips with this problem by encouraging regional training seminars and by articles dealing with training points.

"It might be that the above viewpoints seem self—evident, however, I find that some of the Handbook conventions and some of the proposals seen, seem to overlook these facts. These 3 "fundamental laws" are the basis for some of my comments below.

Lacuna (or Slant E Condition)

I have already at several occasions expressed my viewpoints on this subject and I am ready to live with the Handbook compromise, as it is now. However, with reference to the planned High Latitude Supplement and as an example on my point B above I should like to repeat my question in my June 16, 1972 letter, whether it would have been possible to use Y for the Lacuna (or Slant E Condition) as a Oualifying Letter (or an additional Descriptive Letter) added to the old symbols R, F, G even if there is no numerical value. YR would indicate the Lacuna—gap in connection with SEC, and I realize that the old R—meaning might have been changed a little through the addition of Y. I personally had preferred this instead of a quite new symbol, — you might not agree? F and G would have same meaning as before when written YF and YG, the only change being that these phenomena are here seen in connection with Lacuna (SEC) indicated by qualifying Y.

The use of Y for tilts I am personally not quite happy with, since I would have preferred to keep Y as "clean" as possible for Lacuna—SEC."

Comment

Several members of INAG are not satisfied with the Handbook treatment of Lacuna and use of Letter Y and have suggested substituting this text as given in INAG—12, p. 10—14. We are awaiting further comments before INAG makes any modifications and formally confirms and freezes these rules. We are inclined to agree with Mr. Olesen's point that the use of Y for such tilt, p. 78 (b) and Fig. 3.34, may cause some confusion. It might have been better to extend the meaning of H to cover this point. However, the representatives at INAG meetings did not like this alternative and asked for a special letter for this case. Such expressed opinions (unless clearly impractical) have been given priority in writing the Handbook. A search through WDC ionograms suggested that the severe tilt case and Lacuna case seldom, if ever, occur in the same region so that there is probably not much dilution of the identification of Lacuna.

Mr. Olesen's proposal for extending the use of qualifying letters could be important and merits detailed discussion. It was discussed at the London meeting in April. An initial contribution is provided elsewhere in this bulletin. The Editors wished to avoid making big changes in the Handbook without wide discussion and were unwilling to delay publication despite some remaining controversial points. It seemed that most of the required information was available comparing parameters where Y appeared, the main exception being weak lacuna cases where spread traces were present. Thus lacuna cutting off the top of the E trace would be shown by a descriptive letter Y entry in the foE table, affecting the Fl trace by entries in the h'F and/or foF1 tables, affecting the F2 by entries in the h'F2 and foF2 tables. More information can be included using Mr. Olesen's proposal at, of course, the cost of an additional rule. The suggested use of YR, however, seems illogical as the missing F trace near the critical frequency is not due to retardation effects but to lacuna (SEC). (Rules A, B above), — we do not substitute R for A when Es blankets the cusp.

"Spread F index

In a limited preliminary study of spread F at Thule, Godhavn and Narssarssuaq we used as an index of frequency spread the total width in MHz of the spreadiness along the vertical part of the foF2—fxF2 upturns. When there was a separation between the two upturns, we added the width of the two individual spread traces together. Our report was published in AGARDograph 95, 1966, ed. P. Newman (J. K. Olesen and S. Bak Jepsen: Some characteristics of Spread F in very high latitudes)."

Comment

Apart from a suggestion to clarify the spread F indices by using only fmI and fxI with suitable definitions, this is the only comment INAG has received. It appears that there is little use at present of spread F parameters (other than spread F types) so no further action will be taken until the need arises.

"Olesen's Comments on INAG—13:

An INAG—meeting in London April 1973 at STP—conference is desirable.

I agree with the 4 Kaliningrad recommendations.

Question 1: I agree that the new rules for D— and F—limits will be of help in increasing the number of numerical values from polar ionograms. However, also I agree on the desire, also in other cases than the one mentioned, to have symbols that enable one to scale an upper or lower limit to parameters without having to guarantee a corresponding 20% lower and higher limit, respectively. Am I wrong when I feel that in median calculation, for example, an exclusively "upward limited" value (without a lower limit) is much better than just a symbol, especially for hours when you might not have more than very few exact numerical values? I should prefer some addition to the D— and B—rules introducing the unlimiting feature discussed here, e.g. by expanding the meaning of BE, DD, which are already unlimited, to cover the cases too which are not equipment—limited, although this means omitting the relevant descriptive symbol in these cases. If you don't like this, what about UE, UD? (My points (A) and (B))."

Comment

The main objection to unlimited extrapolation is that it can easily lead to meaningless data, particularly at stations where the training is inadequate. If there is a widespread demand for a strictly limited use of unlimited data, a suitable convention could be devised, but the critical question is whether this would add sufficient meaningful information to be worthwhile (Point C). See also discussion in INAG—13, p.3, section (1). *INAG would like to receive other comments.* With regard to the example suggested, it would be possible to make U a descriptive letter for this case, e.g., DU, EU. The qualifying letter must be D or B as appropriate as otherwise the limit value will not be included in the medians correctly.

"2a. Night E: I do not understand the "Comment" of INAG — it seems to assume that Kaliningrad proposed Night E scaled in normal E column, which is not the case. I should have preferred Night E scaled exactly analog to normal E on sheets and f—plots. I am afraid I don't understand how it can be proved that an E layer seen during night is a normal E. Isn't that a question of pure definition? What is the physics behind? Could you show an ionogram example?"

Comment

The established practice (rule A) has always been to tabulate night F in the foE (normal F) tables. The Kaliningrad proposal (INAG—13, p. 3, (2a)) was to cease to do this, keeping night F only in the Es tables. Thus past practice, and the new practice advocated in the Handbook are identical so far as tabulating night E in foE and on f—plots is concerned. The new feature is the proposal to describe recognized cases of night B by descriptive letter K. There were several reasons for this proposal, the main being

(a) Unless K is used there is danger that users of the data will believe that foE entries due to night E refer to the normal F layer.
(b) The incidence of K draws attention to whether the median value is mainly determined by normal F or night E and simplifies reanalyses where only one of these is required.

The question of proving whether a given trace is night E or normal E in marginal cases is very difficult and probably impossible. Fortunately such cases are very rare, so in practice the difficulty seldom, if ever, appears.

When it does, the distinction is not important, and it is simplest to assume that such cases are normal E. The definition of night E agreed at the various symposia and INAG meetings is based on this principle. If foE for normal F is not seen at a given hour any foE value found must be night E. This covers nearly all cases. When normal E is seen, e.g. with low frequency ionosondes or in summer at high latitudes, it is readily recognized by its smooth diurnal variation and day—to—day consistency. foE values which are significantly higher than the values given by these trends are defined as due to night F. The remaining possible cause of confusion is the intermittent presence of E2 reflections. Such traces are very unlikely to be night F traces (I have never seen such a case) and should be classified as E2 unless local research can show that they are probably night E.

"Couldn't the problem with two E layers during night be solved by symbol "H" in the E column of the sheets and by two open circles on the f—plot, exactly as we normally do during the day to the normal E? If this is impossible I prefer Night E scaled only as an Es in the sheets — not as both E and Es. foE night indicated on f—plot by —o— is in this case satisfactory to me although, according to my statements above, I do not see why the horizontal line is necessary."

Comment

The H proposal to denote two thick E layers at night appears acceptable. No such case has as yet been drawn to our attention, and it seemed preferable not to include it when writing the Handbook. Although not spelled out explicitly for this case, the f—plot general rules state that two open circles should be used in this case. The object of the open circle with line was to draw attention to blanketing by a thick night E layer when particle activity was present. It usually shows clearly that the blanketing frequency rises and falls rapidly at the ends of an event. For practiced f—plot readers it is not needed but it helps non—expert users of f—plots. Strictly speaking it is superfluous, an open circle with no fbEs symbol at higher frequencies always implies blanketing at the thick layer critical frequency.

"2b. Certain and uncertain classification of Es type:

I should like to have this feature introduced in general for high latitude scaling. I feel it is of help both for the scaler and for the scientist according to my experience, e.g. with Ess— SEC—Lacuna scaling. (In some special studies we have even defined a third category: a small dot for "extremely doubtful". — In some cases I feel this category comprises the "border area" where new scientific achievements might be obtained)."

Comment

This is another example of a possible improvement in available information at the cost of a change in or addition to the rules. I presume that this proposal is intended to apply only to the f—plot representation. Logically a possible technique would be to change the Es—type rules on the f—plot, Handbook, p. 152, section 6.6 by adding the sentence: "Where the appropriate type is uncertain because it is borderline, the open circle should be replaced by a solid dot. This should be restricted so that the usual entry is denoted as certain." This would involve some change in the operation of stations which at present represent Es types by a solid dot. *INAG invites comments from other groups on this point.*

"I strongly recommend that the Es—type letters be printed — all of them at the left end of the Es—type—table on the sheets. It is very often impossible to read the hand—written letters on the sheets."

Comment

The original distinction between capitals for descriptive and qualifying letters and lower case for Es types was intended to assist in training. There is no connection between A, a; C, c; D, d; H, h; L, l; R, r; S, s, and it was generally felt that using the same style could cause confusion. (The same point has arisen on spread F types — should these be made compatible with descriptive letters or also be lower case)?

Mr. Olesen's point on legibility has been raised by others, particularly users of the data and punched card operators who have to put Es types into computer format. Of necessity tables printed by computer reproduce the types as capitals.

INAG would like more views on whether a change to capitals would involve training difficulties before deciding whether the proposal should be accepted.

"Totally blanketing Es layer: I have no objection to (foF2) DA but I do not intend to use it.
I prefer the Handbook rules: fbEs = (foEs) AA on sheets and —V— on f—plots. Isn't here again a case where Handbook uses F without the 20% limit? — ref. my comments above on the needs for am "unlimited" symbol."

Comment

The general view now appears to favor dropping the alternative fbEs = (foF2) DA though when the Handbook was prepared some groups wanted to keep it. This is an unlimited case though the additional guidance on comparison between orders should in practice keep the limit within 20% (section 4.6, p. 108, Handbook).

"f_tEs: I agree on the Handbook text and find it all—right that scaling is voluntary for some time."

Comment

In practice only a very few stations use ftEs or fEs and most scientists avoid using these data unless essential. The average scientist prefers foEs or fxEs and uses fEs only when the variability of the data are clearly much greater than fB/2.

"Accuracy rules: I prefer Handbook alternative — deviation from most probable value — since this is what I would use at the scaling table. I should for similar reasons have preferred deviation limits stated not as percentages but as fixed MHz— and km—values (probably different for different frequency and height intervals). I cannot imagine that anybody at the scaling table is calculating these percentages for each reading, so why not take the consequence of this fact. This point is an illustration of my point C above.

Comment

The accuracy rules alternatives are exactly equivalent and either can be used according to the wishes of the individual operators. Both are being formally adopted by INAG.

Most stations use logarithmic frequency laws for their ionograms for which a fixed percentage is a fixed distance along the frequency axis of the ionogram. Thus, if the operators are given a ruler with the percentage limits marked on it very uniform analysis is obtained at all frequencies. For non—logarithmic ionograms a table is most convenient.

"E2, FO.5, F1.5: I agree on the rules in Handbook, also that they are voluntary. I hope it is acceptable that I would routinely scale FO.5 and F1.5 with use of symbol "H" added to F1 (or F2). Also in some cases I might interpret an apparent E2—trace as a stratification in F."

Comment

Concur. The use of H is generally necessary but special cases can occur where fO.5, f1.5 (appear to be due to) regular layers which are present for long periods. The question of E2— and F—layer stratification needs further consideration and the policy should be determined by the needs of the scientists. Unfortunately clear guidance on what is really physically most significant has not been provided so that the best that INAG can do is to try to keep the analysis consistent between different stations.

IV. Abstracts from Letters from INAG Members

1. From Professor V. Padula — Pintos, Argentina

—Second edition of URSI Handbook of Ionogram Interpretation and Reduction is being translated to Spanish. It is a little early to mention a date, but I hope it will be published before July.

—The Third Technical Symposium of the Argentine Program of Ionosphere and Radiopropagation (PNIR) is planned to be held at Tucuman University next July. During the Second, held last year at the Instituto Tecnologico de Buenos Aires, some 50 reports were presented by workers belonging to the 11 institutions involved in this joint Program. We now think to organize this meeting in a different way, so as to have more time to discuss on fewer subjects. We also intend to invite some scientists from other South American countries.

—If the Spanish Edition of the URSI Handbook is ready, as we hope, the PNIR will try to organize a meeting of regional sounding stations people, (if possible, also in July in Tucuman), to discuss reduction rules and requirements, as recommended by URSI. We expect to have visitors from most, if not all, stations in South America.

I must add that the PNIR is an effort involving all active working groups in the field, belonging to different universities and institutions, geographically apart but trying to coordinate their activities, discuss results together and make the best possible use of the facilities available.

2. J. Turner, Australia

We are now manufacturing a new ionosonde which has quite a few novel features. It is a stepped frequency device, i.e., sounds on a number of fixed frequencies, it makes three soundings on each frequency step thus eliminating a considerable amount of random noise, before making a sweep the received noise is sampled and the receiver adjusted to give the best gain for the existing conditions. This means that gain runs are meaningless. It also makes gain sensitive parameters rather difficult to measure. We intend to operate the new sounder at 15 minute intervals as at present but with only one sounding on the hour. As far as I can see apart from the problem of gain sensitive parameters no alterations to the rules will be involved.

Other points raised were dealt with in the Report of the London meeting.

3. N. V. Mednikova, U.S.S.R.

On programs and data interchange problems, after discussing these questions with my colleagues in IZMIRAN, we all think that the preferred program of synoptic ionospheric observations is to obtain ionograms every 15 minutes. This eases considerably the interpretation of ionograms and provides the reliability of published data (hourly values).

It is very desirable to record ionograms at the hours at three different gain levels. Unfortunately not all the stations do so now.

The 15—minute program enables one to make f—plots which are, as it is well known, a primary tool for investigating the changes in the ionosphere.

During eclipses and at times when rapid changes are occurring it is necessary to have more rapid recording.

All the ionospheric stations of the USSR, which send their data to WDC, work according to the 15—minute program, and during magnetic—ionospheric storms, eclipses, etc., to a more rapid one.

Our colleagues completely agree with section 9.2 of the new URSI Handbook.

As to the data interchange, our colleagues consider this question is quite clearly described in sections 9.1, 9.3, and 9.4. in the new URSI Handbook, and it seems to us that no changes or supplements are needed now.

I would like only to attract attention to the section 9.14. I feel it would be better to write more strongly that WDCs are not responsible for reliability, that is, the accuracy and quality of data in their possession. Perhaps it would be better for this to write in the first line of this paragraph "WDCs are not responsible for accuracy of data . . . " instead of "WDCs are not generally responsible . . .

4. A. S. Besprozvannaya, U.S.S.R.

I have carefully studied those problems which you wanted us to comment upon.

1. On the use of URSI in the title I completely rely on your decision and my view of the text is as follows:

3.2 (letter 0) — I feel that introduction of this letter should be in agreement with 12.34 where spread—F echoes are treated and letter R is introduced for range spread in 3.2.

4.83 (letter K) — I am not that certain that it is necessary to duplicate night F in all four parameters foE; foEs; fbEs and add type K, moreover, classifying night F into a special class of Es as shown by our long—term practice is rather complicated and subjective, while it does not provide the comparability in the scaling of these phenomena. I believe the Recommendations of Leningrad Seminar are simpler and more convenient for usage.

12.34 — In general I concur with your classification of spread—F echoes, except that type — Y and polar spur associated with the trough are combined. So I suggest to separate spread F of type — *Y* marking it with letter 5, while the polar spur should be indicated by letter P. In addition, I want you to consider my suggestion sent to you earlier for the INAG Bulletin (and which was not published). I thought it more appropriate to classify only those echoes for which fxI is being scaled. We did likewise for Dixon Island ionograms covering two winter months. It appeared that in different hours of the day fxI was scaled by quite different spread echoes, while on the ionogram there were simultaneously several types of spread F. If we classify all the types of F spread on the ionogram, then I doubt that we can obtain a distinct diurnal variation of F—spread echoes. So I am afraid this point should be given some additional consideration.

On the station program: all Soviet high—latitude stations (with the exception of North Pole drifting stations) make observations in accordance with the recommended program and make soundings every 15 minutes, while North Pole drifting stations every 30 minutes and on WORLD DAYS they also make observations in 15—minute intervals.

Summing up I would like once more to express my sincere admiration at the amount of work you and Dr. Rawer have handled to make this Handbook. It is extremely useful for the geophysicists. The Handbook not only deals with ionogram interpretation and scaling, but it explains also a lot of physical and technical aspects, which are very useful and which should be treated in one way or another while analyzing the vertical sounding data. I have found in the Handbook nothing that would seem unnecessary. I even felt that it might be desirable to dwell on some aspects associated with the calculation of Sun's altitude (the time of Sunrise and that of Sunset), magnetic conjugates (Vestine's map), penetration ability of corpuscular emission (in the sense it is treated by Bailey and Rees). My congratulations on the work accomplished!

Comments on this letter will be included in the next INAG Bulletin.

5. J. Virginia Lincoln, U.S.A.

INAG—13, p. 4 (your item (a)) in plotting complete blanketing prefer use of value of foEs with -v-.

INAG—13, p. 5 U.S. stations microfilm all monthly 7Gs and Equipment Logs. This microfilm is spliced to any ionograms which are copied upon request. We think this is necessary for the user to interpret the ionograms as correctly as possible.

1.22 Prefer to use fmI and fxI rather than dfS. It is easier to visualize dfS from fmI and fxI parameters, and in addition dfS alone does not give the relative frequency boundaries.

3.2 letter Y: This new symbol is probably going to result in some confusion. In the text and illustrations on large and small tilts "Y" and "H" are both used and new scalers may be confused. On p. 43 shouldn't statement under Fig. 2.12 for foF2 be changed to following parenthetical statement "(If x trace badly distorted tabulate (foF2) FY.)". Also, you seem to prefer "H" over "Y" for F1— region stratifications due to tilts. Is this correct?

V. Some Comments to fmin Parameter Application for the Estimation of Radiowave Absorption in the Ionosphere

by

Z. Ts. Rapoport, USSR, IZMIRAN

A list of recommendations by Ionosonde Network Sub—group of IUCSTP is presented in [1], concerning the work of ionospheric stations. In particular, WG. Rec. 15 refers to the observation of ionospheric radiowave absorption by means of ionosonde. In this connection I would like to express some comments.

I. Parameter fmin may indicate the state of the lower ionosphere if its value varies regularly and noticeably with the changes in conditions in the lower ionosphere (absorption). The use of powerful transmitters and highly efficient antennas leads to value fmin not changing during the day. Naturally, in this case fmin cannot be a representative characteristic of the lower ionosphere state. According to WG. Rec. 15 in this case fm2 parameter should be used. We, however, think that this parameter for a number of cases (in particular with ionosphere slopes over ionosondes) may mislead. It should be more expedient to select the amplification of the receiver for each

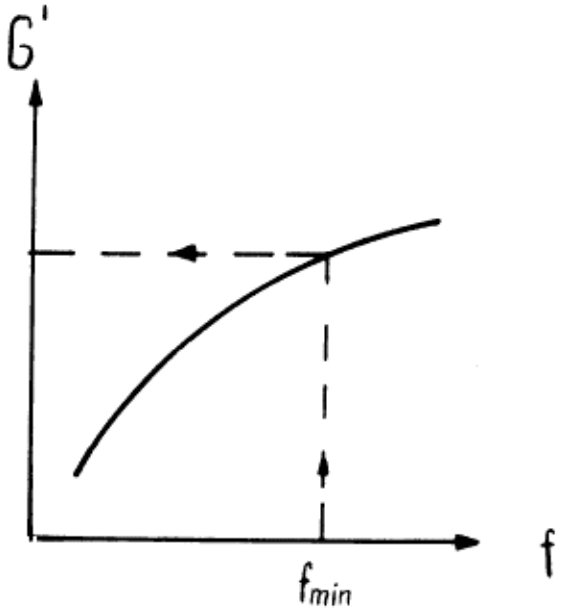

Fig. 1

12

station in such a way that fmin values vary noticeably during the day (i.e. follow the regular variation of absorption) and with this amplification to register an additional ionogram for each hour, especially for determination fmin value. The amplification of the receiver selected in such a way (as well as other ionosonde parameters, including the ray brightness of the cathode — ray tube) should be controlled and maintained invariably as long as possible. There are no peculiar difficulties as to technical fulfilment of this operation.

The value of fmin determined as mean or median for 15—min period of observations will be, of course, more representative than that of fmin determined by an individual ionogram.

2. We would like to pay our attention to the possibility of using fmin parameter for quantitative estimation of absorption. As is known from [2], absorption L by method A1 is determined by formula

$$L = 20\log G - 20\log I - 20\log h' \quad (1)$$

where G is the calibration constant,
I is the amplitude of the first — order echo,
h' is the virtual height of the pulse reflection.

Each term of the equation (1) is a function of a frequency on which the measurements are performed,

$$L(f) = 20\log G(f) - 20\log I(f) - 20\log h'(f). \quad (2)$$

Of course, this expression will be valid for the frequency fmin,

$$L(f_{min}) = 20\log G(f_{min}) - 20\log I_{min}(f_{min}) - 20\log h'(f_{min}). \quad (3)$$

Imin (fmin) is the smallest amplitude of the echo which could be detected with selected parameters of the ionosonde (frequency characteristic of ionosonde sensitivity). Dependencies Imin(f) and G(f) are functions of apparatus parameters; therefore, let us note

$$G(f)/I_{min}(f) = G'(f), \quad (4)$$

where G'(f) is a new calibration constant. The dependence (4) may be plotted (Fig. 1). So

$$L(f_{min}) = 20\log G'(f_{min}) - 20\log h'(f_{min}). \quad (5)$$

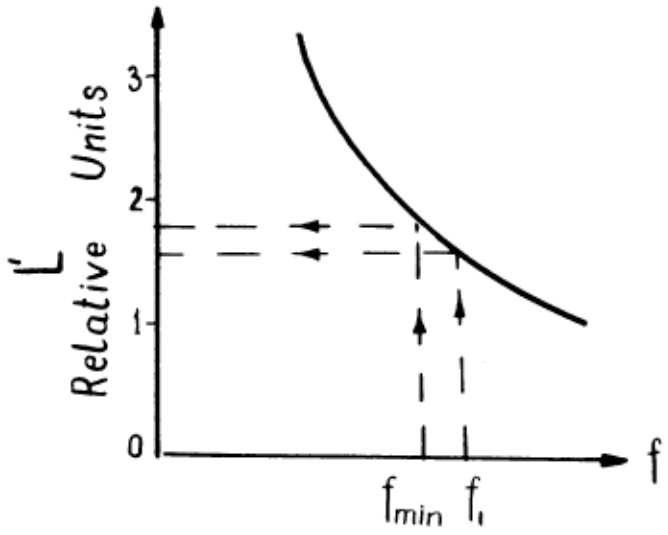

Fig. 2

Having the dependence of radiowave absorption on frequency (here is convenient to use L(f) in relative units — L'(f) — Fig. 2) we by using fmin may determine the absorption at any frequency. At first from the plot of the Fig. 1 the corresponding value of G' is determined by fmin value; then from the plot of the Fig. 2 the value L' is determined by the same value of fmin. And, further, from the same plot (Fig. 2) the value L' is determined corresponding to f = fI at which it is desirable to determine L(fI). The value L(fI) may be calculated from the ratio I

$$L(f_I) = (L'(f_I)/L'(fmin)).L(fmin). \quad (6)$$

The ionosonde on which it is desirable to obtain fmin parameter which may be used for quantitative estimation of the absorption should satisfy the same requests of stability as other usual apparatus designed for absorption measuring by method Al. Evidently, automatic sensitivity control system for this ionogram registration should be disconnected in the receiver; it is desirable to have a step attenuator (it is of importance for determination of calibration constant). Value G may be determined the same as in the case of method Al. Taking into consideration that the calibration constant should be determined on number of frequencies G(f) it is more convenient to use Briggs' method [3], in particular, indications of R(f) and h'(f) types.

REFERENCES

1. 1970 INAG Bulletin, No. I, 12 — 13
2. 1957 Annals of the IGY. Vol. III, Pt. II. IGY Instruction Manual. The Ionosphere. The Measurement of Ionospheric Absorption. Pergamon Press. London — New York — Paris
3. 1951 Proc. Roy. Soc., 64B, 255 — 274

Note by W. R. Piggott on Comments by Z. T. Rapoport on fmin and fm2

The operation of an ionosonde usually involves a compromise between the needs for different types of data from the same ionogram, operating conditions which are best for one type of analysis are often poor for another. In particular measurement of absorption changes using fmin and determination of N(h) profiles are mutually conflicting, the latter needs echo traces over the widest possible frequency range. In some parts of the world accurate values of standard parameters can only be obtained if the gain is adjusted to optimize these measurements. Thus it is not possible to make fmin determination of absorption a major priority everywhere.

The comment on the effects of tilt and curvature on fm2 appears to be due to a misunderstanding. Accurate measurements on echo amplitude for different orders of reflection shows that these effects are, on the average, almost identical for the first two orders but are usually uncorrelated between them. However the absorption loss in decibels is twice as large for the second order as for the first so that the error in a single value is, roughly, halved, when expressed as an error in the absorption indicated. The main disadvantages of fm2 in practice are (i) that it is often perturbed by deviative absorption near to B and (ii) that mode changes from F to F trace are more common than for the first order, thus introducing some extra scatter due to different spatial attenuation and different upper limits to the height range over which the absorption is measured.

At stations where it is desired to measure absorption using fmin considerable increase in accuracy can be obtained by adopting the high latitude three gain technique. This gives three values for fmin at each hour which can be sufficiently spread in frequency to minimize effects due to focus fading and layer tilt. The Australians have extended this idea by having a switched attenuator which enables the attenuation needed to keep fmin constant to be measured directly. However, for those who do not wish to make the additional instrumental complications a judicial use of fmin and/or fm2 seems to offer the simplest solution. In the UK network, when we want to make accurate estimates of absorption using fmin or fm2 (we usually use both unless fm2 is near foE) we calibrate the ionosonde by making a series of ionograms at different gain settings (or with an aerial attenuator) so as to see how fmin varies with inserted loss. This has proved successful.

VI. A Check of the Bradley—Dudeney Method of Calculating hmax by

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A technique for rapidly calculating the height of maximum electron density and the semithickness of the F2 layer from regular synoptic ionosphere parameters was described by P. A. Bradley and J. R. Dudeney in INAG—13, January 1973. Given the values of foF2, foE, and M(3000)F2, the value of hmax can be computed.

Fifty ionograms made at Wallops Island in April 1969, and in February, March, and July 1972, were used to compare values of hmax obtained by the Bradley—Dudeney method with those computed by the NOAA true—height reduction program currently in use at the NGSDC in Boulder.

About half of the ionograms used were for nighttime, when no foE could be scaled from the ionogram. Although Bradley and Dudeney do not give a procedure for this case, we decided to assume nighttime values of foE. For 14 ionograms taken at night in February and March, 1972, foE was assumed as 0.3 MHz, and for nine ionograms taken on one night in July, 1972, it was assumed as 0.5 MHz; both of these estimates may be a little small.

Table 1 gives the times, the number of ionograms used, and the average differences between the hmax calculated by the two methods. The positive sign means that the Bradley—Dudeney method gave values higher than the NOAA values. The differences tended to be greater at night than during the day. The individual daytime values ranged from —12.2 to +20.3 km with a median value of +0.7. The nighttime values ranged from —8.0 to +19.8, but the median value was +9.8. The standard deviation from the mean was 8.1 km for the daytime and 7.4 km for the night. There did not seem to be any significant seasonal trend.

Table 1

Differences in hmax: values calculated by Bradley—Dudeney method less those calculated by NOAA method

TIME	MONTH	NUMBER OF IONOGRAMS	AVERAGE DIFFERENCE (km)
Night	Feb. 1972	7	+7.6
	March 1972	7	+14.6
	July 1972	9	+8.0
Day	April 1969	5	+9.1
	July	17	+1.4
Sunrise	April 1969	5	—3.8

VII. Beacon Satellite Activities — COSPAR Satellite Groups

Those interested in making Beacon Measurements are invited to join the COSPAR Beacon Satellite Group *(COSPAR Information Bulletin No.* 63, September 1972). Circulars are issued periodically by Dr. R. Leitinger, Institut fur Meteorologie und Geophysik, Universitat, A8010, Graz, Austria giving details on programs, new

satellites, sources of equipment and other information useful in planning Beacon experiments. Beacons enable total electron content to be measured, a quantity which has both theoretical interest and practical applications to problems of satellite communications. INAG invites groups starting in this field to notify WDC—A so that computer codes can be issued to them (see Handbook Second Edition, p. 164—174).

The Beacon Satellite Group Circular issued 2 February 1973 deals in particular with conventions for circulating beacon data, computer card formats, progress report on ATS—F, status of the INTASAT satellite and frequencies used by it. Please note that the mailing list is being revised to omit stations which appear not to be active.

VIII. NOAA *Ionospheric Data* Publication January 1973

Starting with NOAA ISPDA FA 341 January 1973 the format of the well known NOAA *Ionospheric Data* publication has been changed to conform with requests put forward by those using it. Instead of data being published as it comes available, data will be published at annual intervals according to Month. Thus data not previously published for any January will in future be found in the January issue and similarly for other months. Thus issue FA341 contains monthly median data from 71 stations for January 1972, 1 in 1971, 2 in 1967, 3 in 1965, 1 in 1964, 1 in 1963, 1 in 1958, and a list of issues for all previous January data. In addition, detailed data for Wallops for January 1972 with f—plots for RWDs and monthly median N(h) contours as a function of height and LMT. The result of this change is that in future it will not be necessary to search all copies of the FA series to collect data for a particular month but only those issues for that month — an enormous reduction in search work. If you are not receiving this publication and would like to, please send your request to the INAG secretary. For those wanting current data quickly a list is given of data received up to the date where the text is frozen, in this case data received during November 1972 at WDC—A for Solar—Terrestrial Physics. These data are obtainable from your WDC.

IX. Retrospective World Intervals

The National Geophysical and Solar—Terrestrial Data Center, which is responsible for *Ionospheric Data* has requested (p. 5 of FA341) the advice of INAG on the publication of selected data for Retrospective World Intervals. It proposes that, for the selected dates, all of the foF2 data will be tabulated together with the corresponding monthly median values. These data will be organized in four longitude zones to be determined by your requests. *INAG invites your comments.* Remembering that RWIs are normally based on periods involving RWDs or Alert periods where quarter—hourly data should be available from a considerable number of stations and that economy is important, at least the following points should be considered:

(1) Should the tabulated data be restricted to hourly values only and quarter—hourly data published in f—plot form only?

(2) Should f—plots be preferred to tabulated data in the publication?

(3) Should special efforts be made to get as much as possible of RWI data in computer form? If so should this include quarter—hourly or 5—minute data or be restricted to hourly data?

(4) Should a height index be included, e.g. M(3000)F2? If so, is it more important than detailed quarter—hourly, 10 or five—minute data of foF2? Which index is preferred?

(5) On what principle should the data be selected for publication, e.g. representative data from widely spaced stations, more complete data from chains of stations? *This depends on your views of how you want to use these data so it is essential that you comment. Otherwise INAG should state that the effort to make a fairly quick circulation is not worthwhile.*

X. Future of the Ionosonde Station at RSRS Slough, England

The ionosonde at Slough is mainly operated to provide service to groups in the U.K. who wish to know about the condition of the ionosphere on a short time basis though its tabulated data are widely distributed. It is now a considerable time since any local research has been undertaken using its ionograms, the active ionospheric research at R.S.R.S. mainly uses data from stations in other parts of the world. There appears to be much research using ionograms proceding at stations which are geophysically almost equivalent to Slough, e.g. in France and Germany. From the point of view of providing data for C.C.I.R. to construct the 1F2 index, Slough data could be replaced by Lindau data without significant discontinuity. There is a serious shortage of posts at R.S.R.S. for ionospheric research and therefore the question of closing the sounding station and diverting the posts involved to research has to be considered. *The purpose of this note is to draw attention to the possibility that the station may be closed and to allow opportunity to any who need it to continue to make representations so that their requirements can be taken into account.*

XI. Digitization of Ionograms

Carl Robinson reports that Canadian vertical incidence ionograms have for some time been reduced by a digitizing technique, that is, the data reduction technician moves a cursor to the various points of an ionogram and a machine generates 8—digit groups describing the points indicated in terms of x— and y—position. The 8—digit notation is processed by a computer which generates the values of height, frequency and M factor. The computer then prints out the monthly tables of hourly values with the synoptic values which it has determined.

The reduction process has recently been extended to produce a digital representation of hourly ionograms useful for machine processing of such values as electron density profiles. The technician follows the ionogram trace with the cursor from the first definite increase in the ordinary trace height through the greatest meaningful virtual height of the F2 ordinary trace at foF2, and then moves the cursor horizontally to the fxF2 cusp and follows it down in frequency until it becomes indistinguishable from the F2 ordinary trace.

Each set of digits is stored on a magnetic disk with the related station identifier, date, hour, minute, calibration indicators, and a record length statement. At the end of each month the stored data are run through a program which converts the digital representation of the log/linear ionogram into a linear/linear representation in correct height and frequency units so that calibration points are no longer required. The digital string begins with ‘99’ (the designator for digital representation), followed by the notation indicating the record length (4 digits), followed by the standard representation of station, year, hour and minute, and then 8-digit groups. The first 4 digits of each group represent frequency multiplied by 100, the second set of 4 digits indicate height multiplied by 10. This system cannot indicate frequencies below 1 MHz. Only Ottawa ionograms are being digitized at the present time.

XII. Note on the Federation of Astronomical and Geophysical Services (FAGS)

A number of the geophysical parameters which are in common use by ionospheric scientists are produced by one of the permanent services of FAGS. A useful review of the history, objectives and organization of FAGS, a list of its publications and the addresses of its permanent services are given in *U.R.S.I. Information Bulletin No. 185* (Dec. 1972) pp. 23—40.

Table 1 gives the names, abbreviations and date of creation of the permanent services of FAGS and Table 2 the publications and addresses of those most often used by ionospheric scientists.

TABLE 1

International Polar Motion Service	IPMS	1895
Bureau International de l'Heure	BIH	1911
Central Seismological Bureau	BCIS	1904
International Gravity Bureau	BGI	1953
Permanent Service of Earth Tides	SPMT	1960
Permanent Service on Mean Sea Level	PSMSL	1933
Permanent Service on Geomagnetic Indices	PSGI	1932
Solar Particles and Radiations Monitoring Organization	SPARMO	1961
Quarterly Bulletin on Solar Activity	QESA	1928
International Ursigram and World Days Service	IUWDS	1962
Permanent Service on the Fluctuations of Glaciers	PSFG	1967

TABLE 2

(1) Permanent Service for Geomagnetic Indices — PSGI
Royal Netherlands Meteorological Institute
de Bilt, Netherlands.
(a) Tables of planetary indices Kp (fortnightly)
(b) Monthly bulletins of international character figures Ci, etc.
(c) Quarterly bulletins of magnetic indices, etc.
(d) IAGA Bulletin series 12 (annual through 1969), series 32 (annual from 1970)

(2) Quarterly Bulletin on Solar Activity — QBSA
Eidgenossische Sternwarte
Schmelzbergstrasse 25, CH—8006 Zurich
SWITZERLAND
(a) Quarterly Bulletin on Solar Activity

(3) Solar Particles and Radiation Monitoring Organization — SPARMO
Observatoire du Parc Saint—Maur
4 Avenue Neptune
F94 Saint—Maur—des—Fosses
FRANCE
(a) SPABMO Bulletin (several per year)

(4) International Ursigram and World Days Service — IUWDS
Observatoire de Paris
Section d 'As trophysique
F-92 Meudon
FRANCE
(a) Ursigrams (telegrams, telex, etc. daily)
(b) Spacewarn Bulletin (fortnightly)
(c) International Geophysical Calendar (annual)
(d) Calendar Records of Solar and Geophysical events (irregularly)
(e) Synoptic Codes for Solar and Geophysical Data (Triennial)

XIII. Station Indicators and Computer Coding

1. At the request of the Japanese the two letter code for Wakkanai is to be changed from KK to WK, effective July 1, 1973. This will allow the World Data Centers time to convert their records as necessary.

2. For the Fuji icebreaker the two letter code XN has been assigned.

3. For punched card entries for "ym", the semi thickness of a parabolic layer, the characteristic code assigned for card columns 12 and 13 is "19".

XIV. Literature Citations

The summary below will give the journal, volume number, page number and list of stations used in the publications as evidence of the use of the V.I. network.

Indian J. of Radio and Space Physics, 1972, 1, 119, (Huancayo, Kodaikanal, Ahmedabad, Tirachirapalli, Kokubunji, Thumba, Trivandrum, Madras, Delhi, Guam, Kwajalein, Christmas Island, Bogota, Singapore, Ibadan, Taipei, Baguio, Nairobi, Puerto Rico)

JATP, 1972, 34, 2045, (Wallops Island and "Ionospheric Data" 1968—1970) 1973, 35, 193, (Ahmedabad, Thumba);
291, (Slough);
363, (Scott Base, College);
367, (Huancayo).

JGR, 1973, 78, 320, (Haringhata); 1167, (Jicamarca)

J. Radio Res. Lab. (Japan), 1972, 19, 109, (Lindau);
139, (Thule, Godhavn, Narssarssuaq, Reykjavik, St. John's);
175, (Nanila).

Nature, 1972, 237, 73 (Huancayo, Ft. Archamboult)

Radio Science, 1972, 7, 1085, (Grand Bahama Islands, San Salvado~e, Puerto Rico, Panama, Paramaribo, Bogota, Talara, Chiclayo, Chimbote, Huancayo, Natal, La Paz, La Quiaca, Tucuman, Sao Paulo, Buenos Aires, Concepcion, Trelew, Port Stanley, Wakkanai, Akita, Kokubunji, Yamagawa, Okinawa, Taipei, Macau, Baguio, Singapore, Hollandia, Tahiti, Rarotonga, Towneville, Brisbane, Kodaikanal) 1973, 39, (Arecibo)