IONOSPHERIC NETWORK ADVISORY GROUP (INAG)*

Ionosphere Station Information Bulletin No.21**

* Under the auspices of Commission G Working Group G.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 80302, U.S.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

This issue of the INAG Bulletin is primarily concerned with reporting the INAG Meeting at Lima August 1975.

The proposals for changes in the Handbook discussed in the last three years were all formally accepted at Lima together with a few additions which do not appear to be controversial.

The High Latitude Supplement to the Handbook is expected to be published in October 1975. This contains much of interest to those at lower latitudes and includes a complete (we hope!) set of corrections, clarifications and additions to the Handbook (UAG—23). Please let INAG have your comments on the Supplement as soon as possible, together with any corrections or proposed additions.

It has been decided to add a special section to this Bulletin dealing with particular ionograms which have caused difficulty in interpretation at stations. *Please let INAG have any examples you would like to have discussed.* The success of this section depends on your collaboration - it is not possible for the Chairman to search out such ionograms.

Subject to your collaboration (see section in INAG Bulletin), the future of the Bulletin and thus of INAG appears assured for the next three years. There was much support at Lima for INAG to continue but this is subject to sufficient groups offering to help prove that it is needed by a subscription of $10. U.S. for each set of Bulletins for the next three years. *Urgent action is needed by those who can help in this way.*

The use of the data of the V.I. network is still increasing slowly and it appears likely that a network of roughly the present size will be needed after the IMS. INAG is making inquiries to establish the facts on this. Please collaborate by returning the questionnaire attached to this Bulletin.

If the network is to continue, the replacement of many obsolete ionosondes will become a major problem. A discussion on ionosondes was held at Lima. It is desirable to discover the probable demand for ionosondes of different capacity and cost. *If your ionosonde is wearing out and you are likely to consider a replacement in the next three or four years, please let INAG know.* If the probable demand is sufficient, the cost per unit can be made surprisingly small in each class.

INAG proposes to hold a meeting at Geneva immediately before the C.C.I.R. interim meeting of Study Group 6. This will be confirmed in the next INAG Bulletin. The arrangements at present are to hold a meeting in room T—5 in the C.C.I.R. Tower Building in Geneva on Thursday, February 12, 1976, to be followed by a joint meeting with C.C.I.R. Interim Working Groups 6/1 and 6/3 on the 13th of Feb. Problems involving the use of V.I. data for practical purposes and discussions on the Supplement will form the main items of the Agenda. This is the best opportunity for groups interested in practical problems to have an INAG discussion. If you cannot come yourself, brief your country's representative of C.C.I.R, on the problems you wish to have discussed.

The next task for INAG is to complete the discussion on the detection of magnetospheric phenomena by ionosonde methods and to form a consensus of opinion so that the same techniques can be adopted at all high latitude stations. This is urgent since the IMS starts in 1976. The basis for a consensus is clearly present but needs clarification. The Supplement gives the views of several groups with illustrative ionograms so that difficulties due to misunderstanding of what is seen should be minimized. Chapter 11, section 11.6, pp. 260-270 in the Handbook should also be used in this discussion. (Results from ionosondes in aircraft flying across the auroral oval).

U.R.S.I., Commission III, is now reorganized so as to play a more active part in the solution of problems of practical radio communications. INAG intends to discuss those problems which can be solved using the V.I. network. Amongst other problems it is worth mentioning that the ionosphere has a significant influence on satellite communications up to surprisingly high frequencies and there is much interest in studying these phenomena. Simple beacon experiments using Geostationary Satellite Beacons can be done easily and cheaply, and there is a need for more stations to do this type of work. Ionospheric problems In the Southern Hemisphere also demand greater effort.

INAG hopes that the successful meetings at Lima will promote a further three years of useful and active work resulting in the strengthening of the network and further increases in the use of its data. As in the last three years, this depends on your activity - INAG is only a convenient channel.

II. INAG Meeting at Lima. August 7th to August 19th, 1975

Participants

W.R. Piggott	U.K.	Chairman, INAG	G. Pillet	France	INAG Member
J. V. Lincoln	U.S.A,	Vice-Chairman and Secretary, INAG	A. H. Shapley	U.S.A.	INAG Member
I. Kasuya	Japan	INAG Member	C. McCue	Australia	(Alternate for J. Turner) INAG Member

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0. Awe	Nigeria	R. D. Hunsucker	U.S. (Alaska)	R. G. Rastogi	India
V. Bartra	Peru	I. J. Kantar	Brazil	C. M. Rush	U.S.A.
J. Belrose	Canada	J. W. King	U.K.	C.S.Y. Setty	India
L. A. V. Dias	Brazil	W. G. Mbller	W. Germany	E. V. Thrane	Norway
E. Galdon	Spain	M. G. Morgan	U.S.A.	H.J.A. Vesseur	Netherlands
A. Giraldez	Argentina	J. 0. Oyinoye	Nigeria	R. W. Vice	S. Africa
J. A. Gledhill	So. Africa	A. K. Paul	U.S.A.	S. Westerlund	Sweden
		S. N. Radicella	Argentina	3. W. Wright	U.S.A.

I. Mesterman (Argentina) discussed INAG problems with the chairman before the meeting which he was unable to attend owing to ill health. Written reports were received from A. S. Besprozvannaya and N. V. Mednikova (USSR). J. Turner sent comments via Mr. C. McCue. These contributions were fully discussed at the meetings. Those listed above attended one or more of the six open sessions held before and during the URSI General Assembly at Lima, in all 29 representatives from 17 countries. In addition there were private meetings of the INAG members to discuss membership, make decisions on the Recommendations adopted by Commission III and by INAG and to review and discuss the High Latitude Supplement and corrections to the Handbook. As usual, there were a number of private discussions to clear up particular points.

Votes of thanks.

The INAG working group thanked Dr. A. A. Giesecke N. for the arrangements he made to enable INAG to meet before and during the URSI General Assembly, and also thanked the President of the Sociedad de Ingenieros for the use of rooms in their building for the INAG Meetings on August 7th.

Mr. C. McCue announced that Mr. J. Turner (Australia) wished to retire from his membership of INAG. The meeting passed by acclamation the vote of thanks to Mr. Turner for his help throughout the life of INAG. A note on Mr. Turner will be found elsewhere in this Bulletin.

The Chairman drew attention to the large contribution to the work of INAG made by the WDC-A under the direction of Mr. A. H. Shapley, and Miss J. Virginia Lincoln. This organization has published for the Vertical Incidence Network the Atlas of Ionograms (UAG-1O, 1970), the URSI Handbook (UAG-23, 1972) and has provided both secretarial and financial aid to the publication of the INAG Bulletin. The meeting proposed and carried by acclamation a vote of thanks to those concerned.

Report on meeting.

In order to keep this account short. the main subjects of discussion are published in this Bulletin in the form of summarizing articles.

The Chairman opened the meeting with a short review of INAG organization and tradition and invited those present to contribute to the Agenda. As usual, priority was given to those who could attend one session only.

Major discussions.

Major discussions were held on the Future of the Ionospheric Network, on Ionosondes, on the future of INAG and the INAG Bulletin and on difficulties with particle E conventions. These are reported elsewhere in this Bulletin.

Future of V.I. Network.

The consensus view at Lima was that a VI network of roughly current size will be needed after the INS and that the evidence for this conclusion should be collected by INAG during the next few years.

Ionosondes.

There was much interest in new ionosondes suitable for observatory use. Mr. McCue stated that there would be commercial interest in producing the very cheap Australian ionosonde if there was a market for 25 or more.

Prof. Morgan needed orders in multiples of 3 to justify producing copies of his ionosonde. The USA were interested in producing 12 new ionosondes if money could be raised for this program. INAG requests those interested in buying new ionosondes to make their probable interest known. At present it appears that there may be several levels of cost:

(a)	Cost less than	$ 5,000.	US	(1975 prices)
(b)	Cost approximately	$10,000.	US	
(c)	Cost “	$20,000.	US	
(d)	Cost “	$50,000.	US	
(e)	Cost above	$70,000.	US	

Please indicate which class of ionosonde you might be interested in, noting that this does not commit you in any way.

Future of INAG Bulletin.

There appears to be a widespread need for INAG and the Bulletin to continue. To make this possible it is necessary that a sufficient number of organizations agree to contribute $10. US for each set of INAG Bulletins to be issued in the next three years. The Bulletin will continue to be made available without charge to those who cannot contribute. INAG feels that this charge is sufficiently small to enable a reasonable number of groups to contribute and thus prove that the organization should continue.

Particle E Controversy.

Those present at Lima confirmed the decisions of previous INAG meetings on this problem. However the USSR was not represented and it was felt desirable that a further effort be made to resolve the difficulty so that uniform conventions could be used everywhere.

INAG Meetings.

The last three years has been a period of great activity by INAG. This was started by a very successful INAG meeting at Warsaw, 27-28 August 1972, attended by 42 people from 20 countries (INAG-12, pages 3-14). This was followed by INAG meetings in Boulder, February 9, 1972 (INAG-13, pages 16—18), London, April 6, 1973 (INAG-14, pages 2—5), and Geneva, January 3—4, 1974 (INAG—17, pages 2-11). On the average the latter meetings were attended by 11 people, with little overlap from meeting to meeting, apart from the Chairman and Vice-Chairman.

Future of INAG.

Discussions with URSI Commission III and in the INAG meeting showed that there was wide-spread demand for INAG to continue to operate and for frequent publication of the INAG Bulletin in the future. A Recommendation asking for URSI financial support to INAG was passed unanimously by Commission III. The membership of INAG was reviewed and the changes will be announced when these have been approved by the full INAG membership and by URSI.

Review of INAG Activity.

A major part of the work was concerned with the URSI Handbook of Ionogram Interpretation and Reduction, 2nd Edition, which was published in November, 1972. This has been translated into French, Japanese, Russian and Spanish and portions into Finnish. Many useful comments were received from those translating the Handbook and from its users resulting in the collection of correction and clarification material published in INAG-16, pages 10-20. Further corrections and comments were received at later INAG meetings. All of these have been collected and will be published as an Appendix to the High Latitude Supplement of the Handbook.

The second major activity has been the collection and preparation for publication of material for the High Latitude Supplement to the Handbook. This was reviewed at Lima and is expected to be published by mid-October 1975. As in the case of the Handbook, it is probable that many comments, corrections and clarifications will become desirable when it has been circulated. *You are invited to send such comments to INAG as soon as possible so that they may be discussed in future INAG Bulletins.*

During the three years, nine INAG Bulletins have been published and there has been much discussion of the reduction rules and of interpretation problems. As a result there appears to be a reasonable consensus of opinion on most of the outstanding problems. These were reviewed at Lima. It was agreed to make a new chapter (Chapter 15. Obsolete rules and conventions) of the Handbook to contain obsolete rules and the dates when they were withdrawn, and in future to date changes of rules so that those using old data would know when new rules were adopted.

There is still some tightening up and clarification needed before the network can contribute to the fullest extent to IMS problems but this should be completed within the next six or nine months. Most problems have been successfully solved in the review period.

During the last year notice was received from URSI that it would no longer be possible for URSI to continue to finance the INAG Bulletin. This decision threatened the existence of INAG as an effective organization and the Chairman therefore decided to slow down the publication of INAG Bulletins so that it would be possible to publish a report of the Lima meeting and a report on the High Latitude Supplement with the money available. This action caused appreciable concern amongst the recipients of the Bulletin. As is reported elsewhere in this Bulletin, action was taken at Lima which has resulted in the continuation of the Bulletin and hence of INAG, at least for another three years.

High Latitude Supplement.

The Chairman introduced the master copy of the High Latitude Supplement and stated that it was hoped to publish this early in October. The Supplement would consist of about 200 pages containing over 600 ionograms from 23 stations. These were selected from some 1400 ionograms submitted to the Editor. In some cases networks had provided annotated material in article form. These had been kept as separate chapters. The remaining ionograms were arranged approximately in order of geomagnetic latitude. Some specialized notes on particular high latitude phenomena were included for example, a description of the Slant Es Condition. The Editor had added comments to a large number of ionograms reproduced. Special attention had been given to difficult ionograms and to examples where mistakes in interpretation were very common. Thus corrections to the adopted interpretation should not be considered as indicating low standards for the stations used. The criterion has been that the available ionogram showed the problem most clearly. The second reason for showing the original scaling is that this gives a good guide to past conventions at the station. The Editor has written an introduction drawing attention to a number of problems on which a consensus of opinion has not as yet been reached. *INAG wishes the recipients of the Handbook Supplement to follow up these points and to send their views to INAG as soon as possible so that these problems can be clarified in the next two or three INAG Bulletins.*

It was agreed to collect all Handbook corrections made in the past or at Lima and to add them to the Supplement as an Appendix. This will enable future users of the Handbook and Handbook Supplement to have the corrections in a final form. It is proposed to print about 900 copies of the supplement, of which about one-half will be circulated immediately.

The question of whether further ionograms could be added to the Supplement was raised, e.g., SANAE would be able to provide CHIRP ionograms in a few months. The Editor stated that in principle a special INAG Bulletin could be issued containing both corrections to the Supplement, comments on it and new material if sufficient contributions were sent to INAG. The major corrections to the Handbook were given in INAG-16 which thus forms a precedent. The meeting passed a special vote of thanks to all those who had contributed to the Supplement, to the major job of preparing the manuscript and to those responsible for publishing it. In particular the following were thanked:

W. R. Piggott (Editor), A. S. Besprozvannaya, I. Kasuya, J. V. Lincoln and G. Pillet as well as —

Consultants:
Mr. Pat Brown, Canada
Mrs. S. Cartron, France
Dr. D. G. Cole, Australia
Mr. R. 0. Conkright, U.S.A.
Mr. C. Davoust, France
Dr. Alberto Giraldez, Argentina
Mr. Palle Guldager, Greenland
Mrs. L. Hayden, U.S.A.
Dr. Ake Hedberg, Uppsala
Dr. R. Lindquist, Kiruna
Mr. J. K. Olesen, Denmark
Mr. N. Ose, Japan
Mr. Oueklang, Lycksele
Dr. T. J. Shchuka, USSR
Dr. K. Sinno, Japan
Mr. R. Smith, UK
Dr. T. Turunen, Sodankyla

Particular thanks are needed to those who have directly contributed to this Supplement. Wherever possible they have been identified in the introduction to their contribution -- people often do not read Introductions and Acknowledgments! Special mention must be made to Mr. Richard Smith of the Appleton Laboratory, Slough, Bucks, England, who examined all ionograms and comments included in this Report, identified a number of problems on particular ionograms which would interest operators and even on occasion successfully challenged an editorial comment. The INAG Secretary and Vice-Chairman had the unenviable responsibility of translating the Editor's handwritten manuscript and notes into the form reproduced and the finished product would not have been possible without the large amount of detailed editing carried out by Helen E. Coffey and Raymond 0. Conkright. The typing was done by Alice E. McRae and J. May Starr working from the Editor's manuscript as sorted and amended. This work was carried out at the World Data Center A for Solar-Terrestrial Physics and the Editor wishes to thank Mr. A. H. Shapley, Director, National Geophysical and Solar-Terrestrial Data Center, EDS, NOAA, for making this possible. Many users have expressed their appreciation of the Handbook and

and Atlas previously published through the good will of Mr. A. H. Shapley and the WDC—A and your Editor, acting as Chairman of INAG, feels that the operators and users of the World Vertical Sounding Network would wish him to convey these thanks to all concerned.

INAG Bulletin Content.

The Chairman pointed out that the content of the Bulletin had been changed during the last three years in order to meet the request of URSI Comm. III that it would not only serve stations but should also act as a link between the scientists, and the stations. For this reason a number of articles had been added which were primarily of interest to scientists. Professor Gledhill, on behalf of the scientists, stated that these additions had proved very interesting to the scientists but they were criticized by those representing station operators. Mr. NcCue drew attention to the fact that there had been only 14 articles with ionograms in the INAG Bulletin and that it would be very valuable to stations if such articles could be greatly increased. Scientific articles were not suitable for the stations. The general view from contributed letters or the floor was that on the whole the Bulletin was satisfactory but that more ionogram material should be included in the future. The Chairman pointed out that the time needed for him to search out suitable ionograms was prohibitive but that he would welcome ionograms from stations or administrations and would be very willing to annotate and discuss such ionograms if they could be provided. INAG decided to make a special effort to produce such ionograms and it was decided to have a special section of the Bulletin in line with other popular journals who have readers' problems sections. *The Chairman asked that problem ionograms produced at training symposia should be sent to him so as to form the basis for a regular sequence in the future.*
He pointed out the importance of contributions from the stations for showing the INAG Bulletin is really useful.

Difficulties of Isolated Research Groups.

Isolated research groups often have difficulty because they do not have access to good abstracting facilities, do not possess all the desirable periodicals, and seldom receive reprints or preprints. Most do not have the funds to purchase this material. Sample inquiries suggest that the number of active groups in this situation is probably small enough for INAG, with the support of the scientific community, to help alleviate the difficulty. In order to explore this possibility, *INAG requests groups who feel that they have these difficulties to write to the Chairman or Secretary of INAG stating the field in which they are doing active research. INAG also requests the help of the scientific community in identifying review material which would be useful to such groups and asked for volunteers who are willing to send reprints of their work to such organizations.* An attempt will be made to list key review papers in the INAG Bulletin.

Names and Addresses of Users of Ionospheric Data.

INAG circulated the attached memorandum and questionnaire to all National Representatives present at Lima, to those who had attended an INAG meeting and to a selection of other persons. Replies giving 11 addresses were received in the General Assembly period with promises for more when those attending the URSI General Assembly return home.

URSI XVIII General Assembly, Lima 1975
Commission III, Working Group 1, Ionospheric Network Advisory Group

INAG is aware that the data produced by the V.I. ionosonde network is being used by a number of new groups of workers, many of which are not represented at URSI. In order to ascertain the use of data from particular groups so as to advise administrations of the international value of their stations when the future of such stations is being reviewed, INAG wishes to receive names and addresses of groups who use, or expect to use, vertical incidence data. Such groups will be informed of any proposals to close stations which are referred to INAG for advice.

Please return the questionnaire to:

Mr. W. R. Piggott
Chairman of INAG
do Appleton Laboratory
Slough, Bucks, SR3 9JX
England

The main fields in which the data appear to be used are as follows:

Ionospheric research
Application to practical problems (CCIR)
Solar and terrestrial relations

Meteorology (including minor constituents of atmosphere)
Airglow
Magnetospheric problems
Magnetic phenomena

A copy of this questionnaire is attached to the last page of this Bulletin. Please use and return to the above address.

Special Techniques.

The advantage of special techniques both for research and for the interpretation of difficult ionograms was discussed. Mr. McCue mentioned special directional ionograms made at Vanima, June —July 1975 which gave 3° accuracy near vertical incidence. The importance of aircraft observations at high latitudes was stressed and Professor Gledhill stated that S. Africa was flying aircraft to study ionospheric phenomena in the South Atlantic magnetic anomaly zone. The value of aircraft and ship studies of the equatorial anomaly was also stressed.

Ionosonde Measurements of Winter Anomaly in Absorption.

The changes in absorption for the high absorption days during the winter months is sufficiently large to be readily detected by change in fmin or fm2 even when an ionosonde has not been specially controlled for absorption measurements. There is much interest in identifying days of abnormally high absorption during the winter in both hemispheres. *INAG draws attention of all operators of ionosondes in temperate latitude zones to this requirement and in particular to the INAG Recommendation G.*

Proposed New Stations (See URSI Commission III Recommendation A).

The Chairman pointed out that international requests for new stations were seldom effective unless there was a local group interested in the possibility of setting up a new station at one or more of the desirable sites. However such groups often need to know whether there was interest elsewhere in data from the proposed

stations. If such proposals were made to INAG, INAG would be prepared to explore how much interest there was through its contacts and through the INAG Bulletin.
The following stations were mentioned as potential sites for new locations. Scientists interested in data from any or all of these stations are requested to inform INAG with the stations involved:
Easter Island, Gough Island, Ascencion Island, Barter Island, Adak, Anchorage, Sitka or Juneau.

The future of the station at Tsumeb is currently under review. Anyone wishing to make the case for continued observations at this station is requested to inform INAG as soon as possible (see Recommendation C).

Additions to Handbook.

The discussions at Lima brought out a number of points in which the Handbook needed clarification and a decision by INAG to adopt a system of spread F typing. Details will be found elsewhere in this Bulletin.

Training.

During the last three years there have been at least four symposia or international training sessions organized in different countries by INAG members or attended by them. These include:

(a) The second conference of Australian Ionospheric Station Operators, INAG-13, pp. 20-21, 9-10 November, 1972.

(b) The Ionogram Interpretation meeting at Sodankyla, Finland, May 1973, INAG-15, pp. 13—14.

(c) U.K. Training School, for Antarctic Staff, July 1974.

(d) Tashkent Seminar, November 1974.

The discussion of training problems showed that further training seminars are required (URSI Recommendation, 3.17, Warsaw; INAG—12, p. 10 and INAG-15, pp. 14—15).

Mr. McCue stated that an Australian Training Symposium would be held in 1976 and invited other countries to send people to it. Mr. Piggott stated that the U.K. High Latitude Training School is held annually and a few places are available for trainees from other countries. Dr. Westerlund announced that the ionospheric groups in Scandinavia will be holding a meeting in Uppsala during 28 -30 October, 1975, to discuss high latitude problems and the relations between ionosonde measurements and the IMS.

The meeting confirmed the desirability that groups operating training schemes or discussion meetings on ionogram interpretation should notify INAG so that others interested could be informed through the Bulletin. Directly or indirectly, it appears probable that INAG meetings and the training symposia have enabled contact to be made with about 150 station people.

III. URSI Commission III and INAG Recommendations

In view of the urgency for action on the URSI Commission III and INAG Recommendations, these are reproduced below in the form passed at the Business Meetings of these bodies. There may be minor changes in wording and numbers will be given to these in due course. In the event of any significant modification of the Recommendations by the URSI Executive, the changed forms will be published in an INAG Bulletin.

(i) URSI Commission III Recommendations

A. New Stations
URSI Commission 3,

Noting, the active interest in establishing vertical incidence ionosphere sounding stations at Adak, Anchorage, Ascension Island, Barter Island, Easter Island, Gough Island and Sitka or Juneau (Alaska),

Requests that scientists interested in using data from any of these sites inform INAG in the next year of their reasons for needing such data so that suitable priorities can be established, and

Draws attention of Administrations to the interest expressed at the URSI General Assembly at Lima in establishing stations at these sites.

B. Monitoring long term changes in the Ionosphere
URSI Commission 3,

Noting, that many of the ionosphere stations with long sequences (over 20 years) of observations have been closed, and that representations have been made to it requesting that this trend be stopped and if possible some stations be reopened,

Recommends that scientists with interests in long sequences of data evaluate the potential value of maintaining each such station and indicate which closed stations would, if reopened have unusual value to their research and inform INAG of their conclusions.

Note, INAG is unwilling to sponsor any blanket recommendation. Each case must be evaluated separately, showing why a station at its particular position is valuable.

C. Changes in the Ionospheric Network
URSI Commission 3, noting

(a) The decision to set up or close down ionospheric stations is mainly determined by local considerations which are paramount.

(b) That in some cases these decisions can be modified by informed international advice.

(c) That the CCIR has expressed an opinion that INAG should be consulted on the establishment or closure of stations (Opinion 22-2).

(d) That a number of administrations are considering reviewing the future operation of their stations after the I.M.S.

(e) That the number of new users non-affiliated to URSI is growing rapidly and that it is difficult to make contact with these users.

(f) That representations have been made to INAG by scientists who use or expect to use sequences of ionospheric data, that the number of long established stations is dangerously small , and is decreasing, and that stations in important geophysical locations have recently been closed.

Recommends that administrations who intend to review the operation of their stations within next three years inform INAG of the names of the stations involved and whether or not the decision can be influenced by the international importance of the station.

D. Translation of URSI High Latitude Supplement

URSI Commission 3

Noting, that the translation of the second Edition of the URSI Handbook of Ionogram Interpretation and Reduction into French, Japanese, Russian and Spanish (and in part, Finnish) has been very effective in improving the operation of the V.I. network,

and not in that the value of the High Latitude Supplement to the Handbook would be similarly enhanced by translation,

thanks the national organizations responsible for these translations and
recommends that the national organizations make every effort to arrange for the translation of the High Latitude Supplement at least into Japanese, Russian and Spanish.

E. Training Programmes

URSI Commission 3,

Considering that the data from the vertical incidence network is being more extensively used by scientists not connected with network operations and that the importance of uniform and accurate data is therefore increasing, draws the attention of administrators to the need for better training and the existence of special training symposia in several countries, offers the cooperation of INAG in coordinating and guiding such efforts, and recommends that all groups organizing training symposia inform INAG a proposed place and date and report to INAG on difficulties disclosed in the symposium.

F. Jicamarca Observatory

URSI Commission 3

Noting, the distinguished scientific record of the Jicamarca Radio Observatory in studies of the equatorial ionosphere,

Commends the formation of the Jicamarca Users and Sponsors Association (JUSA), and,

Recommends that official members of Commission 3 draw to the attention of their colleagues and administrations the possibilities of undertaking research at Jicamarca on a fees paying basis.

(ii) URSI Commission III Working Group 1 INAG Recommendations

G. Use of fmin and fm2 for absorption monitoring

URSI Commission III W.G.3 has drawn attention to the inadequacy of the absorption measuring network for the delineation of the occurrence and extent of winter anomaly in absorption for use in ionosphere-mesosphere studies and requests the help of the ionosonde network to this end.

INAG Recommends:

1. That stations in the absorption winter anomaly zone take special care to keep ionosonde sensitivity constant near noon during winter months so that fmin can be used as a daily index of absorption.

2. For high sensitivity stations, where fmin is insensitive to absorption changes, a special tabulation of fm2 be made in these months.

3. Special efforts should be made to provide data at least for periods of intensive study chosen by URSI Commission III W.G.3.3.1 for the Northern Hemisphere and S.H.I.S.G. for the Southern Hemisphere.

H. Attendance at INAG Meetings

Considering:

(a) that the vertical incidence network has an important contribution to make for future major international projects and for the synoptic monitoring of the ionosphere,

(b) that it is important to provide expert and informed guidance to the network,

(c) that the development of new applications of network data may involve changes in the parameters or rules,

(d) that INAG proposes to arrange at least one meeting of members and consultants per year on average in conjunction with an appropriate international meeting, in particular with CCIR and IAGA,

(e) that INAG proposes to arrange such a meeting immediately before and during the next URSI General Assembly in Helsinki, 1978,

Recommends that the Administrations send briefed or experienced representatives to these meetings.

IV. Resolutions of IAGA of Interest to INAG

The following resolutions adopted at the 16th IUGG General Assembly by the International Association of Geomagnetism and Aeronomy (IAGA) at Grenoble, August 25 - September 6, 1975, refer to problems of interest to INAG, to the V.I. network, and to the users of ionospheric data:

Resolution 8

IAGA, recognizing the value of high-frequency radio soundings of the ionosphere by ionosondes and other sounding systems (drift, doppler, and angle-of-arrival), and being aware that the world network of ionosonde stations now consist mainly of limited—purpose and aging instruments that are thus inadequate for IMS and aeronomical needs, encourages national plans toward the modernization of ionosondes, particularly to introduce digitization of all relevant echo data and to include new features in the equipment permitting efficient conversion of the data to geophysical parameters.

Resolution 9

IAGA recognizes the support provided by various national governments for the World Data Centers for their necessary services to the scientific community and urges these governments to continue this support.

Resolution 11

IAGA, recognizing that reports of many expeditions and important collections of older observations have not been adequately distributed, recommends that the preparing institutes or present holders of older archival material of this type be encouraged to provide information concerning their holdings to the World Data Centers, and the World Data Centers be encouraged to maintain bibliographies and catalogues of important monographs.

Resolution 12

IAGA, expresses its thanks to the retiring General Secretary for creating and editing IAGA News, urges the continued publication of IAGA News and recommends its wide distribution to geophysical observatories as well as to research workers.

Resolution 13

IAGA, noting the recent concern for the formulation of a comprehensive program of study of the middle atmosphere, essentially the stratosphere and mesosphere, with the lower ionosphere, and recognizing that the present programs of GARP and IMS are not intended to provide such a study, endorses the concept of the Middle Atmosphere Program (MAP), formerly SESAME (Structure and Energetics of the Stratosphere and Mesosphere), as an interdisciplinary program at present under SCOSTEP, with global scope and the requirements of international cooperation, to which IAGA expects to make substantial scientific contributions.

V. INAG Meeting in Geneva, February 12. 1976

It is proposed to hold a meeting of INAG immediately before the CCIR meeting in February in particular so that people with interest in operational use of ionospheric data can take part in INAG discussions. CCIR Interim Working Party 6/1 will also be holding meetings on February 12 and 13 and IWP 6/3 on February 13. It is therefore proposed to hold an INAG meeting on February 12 since there is not a large overlap with IWP 6/1 membership. Joint meeting of INAG with Interim Working parties 6/1 and 6/3 might be held on February 13. If there is sufficient demand it would be possible in principle to start the INAG meeting on February 11. *Please let INAG know as soon as possible if you wish to have a 2 day INAG meeting.* Unfortunately the Chairman will be unable to attend this meeting as he will be in Antarctica. The Chair will be taken by Mr. C. McCue, supported by our, vice— chairman and secretary, Miss J. Virginia Lincoln. This will be the first chance of discussing the Supplement at an INAG meeting. The Agenda will include a discussion on the desirability or otherwise of changing the international M3000 factor curve. If this is thought worth-while, work should start on evaluating a more representative curve by comparing MUFs deduced by ray tracing techniques applied to standard ionospheric models for different parts of the world, different seasons and different levels of solar activity. It will take about three years to establish a new curve if this is really required. Other subjects which will be discussed will include identification of stations needed for practical prediction and warning problems, use of fxI in practical predictions, deduction of hmF2 from standard ionogram data, whether CCIR needs new parameters and if so which existing parameter could be omitted. (Of course it is also necessary to take note of the interests of the scientific community.) The applications of the intensive high latitude studies during the IMS to CCIR problems also should be discussed. *Your proposals for subjects for the Agenda of this meeting are invited, and should be sent to the Chairman before the beginning of December, 1975.*

INAG wishes to thank the Director of CCIR for the invitation to hold this meeting and for providing room T-5 in the ITU Tower Building for it.

VI. Future of the Network

The factors to be considered which effect the future of the network are:

(a) The need of particular groups for ionosondes for local reasons
(b) The need for long term monitoring of the ionosphere for general scientific purposes.
(c) The particular needs of CCIR for practical application.

(d) The needs of workers in other fields for ionospheric information.

Whereas historically the network was mainly started by groups with interests in practical radio communications only a minority of stations are still operated by such groups. In some countries the stations are regarded as part of a geophysical project and are treated in the same way as solar, magnetic or meteorological observing stations. In some cases the primary interest of the operating group is in rockets or satellites, in extending meteorological expertise to higher altitudes or in associated fields, e.g., airglow, or magnetospheric phenomena. There is renewed interest in the relation between climate and weather and solar phenomena for which ionospheric data may well prove important.

Turning to the use of ionospheric data, this forms one of the most active elements of the World Data Center exchange system, on the average each year there are six requests for each station-month data fed into the World Data Centers. During the last year the radio prediction groups have ceased up-dating their charts annually, a process which used to be the largest single application of the data. Despite this the total usage during the last year has been slightly greater than in the previous year. It is being made up by other scientific users. An investigation by Dr. S. Gilmor shows that the number of papers in ionospheric physics has been increasing at about 2-1/2 times the rate of the number of papers in physics generally, during the last few years. This gives independent support to the findings of the WDCs. Of course, in due course, it will be desirable to up-date the prediction charts but probably at wider intervals of time. Papers given in the URSI symposium showed that the changes since the IGY have already caused significant changes in IGY-based maps of the ionosphere. This is due primarily to the long term changes in the earth's magnetic field, which have resulted in corresponding points at different epochs being shifted by 200 kilometers on the average. The recent analysis of World Data Center activity by the National Academy of Sciences, based on a questionnaire sent to some 500 of the 3000 scientists who obtained data from WDC-A during the last five years, give 251 replies covering all the WDC disciplines. These cited 369 papers involving ionospheric measurements by over 300 individuals. WDC-B reports that it is mostly used by visiting scientists and that the use is similar to that at WDC-A. In general, use at WDC-C Center is less than at A or B. One may conclude that there is good evidence for widespread use of the vertical incidence data.

It is difficult to estimate the actual condition of the Ionospheric monitoring network and different estimates show somewhat different results. For example, should the stations operating

for one to two years be included in the estimate of the strength of the network? Thus, in the IGY there were a considerable number of floating ice island stations, special nets set up along the 75th meridian, and a number of individual stations set up for the IGY-IGC period only. If these are included, the network in 1973 was probably 141 stations as compared with 160 in the IGY. If these are omitted, there are more long period stations operating in 1973 than in the IGY. Proposals to open three new stations were announced at Lima.

Much surprise was expressed at the intensity of the use of ionospheric data by participants at Lima and INAG was requested to make further inquiries to establish the present and probable future use of network data. A report should be prepared and sent to those responsible for operating ionospheric stations. The general consensus of those present was that the network was approximately of the right size and that a serious attempt should be made to maintain it at roughly the present size after the IMS. There were a number of cases where the scientific usefulness could be improved by redeployment of existing stations. However, this was often difficult for the administrators responsible for these stations. Requests were still being received for data from stations which had been closed for more than 15 years, for example, requests for Anchorage and Adak data. There was a serious lack of stations in the southern hemisphere. At WDC-A Huancayo and Maui data were called for most frequently. The general discussion brought out the point that stations with a wide circulation of station books show abnormally small WDC usage, particularly when the distribution of booklets is well monitored. Thus the WDC demands probably significantly underestimate the use of data from such stations, On the other hand, stations which have ceased publishing booklets appear to be more frequently used than one would expect for their position. This suggests that booklets are effective in promoting interest in the data from stations. Mr. McCue stated that because of the IMS all URSI parameters would be scaled at Australian stations beginning in July 1975. INAG requests other groups who have published only part of the international parameters to consider whether they could also measure more parameters during the IMS. The use of foE values for CCIR purposes was stressed. This parameter is now needed for practical purposes.

The Chairman stated that he had received several requests from scientists interested in long term changes in ionospheric phenomena for the maintenance of long established stations. In general there is relatively little local interest in maintaining such stations and they are therefore most at risk for continuing. INAG agreed on a recommendation drawing attention to administration problems and has issued a questionnaire to try to establish how real the need for both these and other ionospheric stations may be. Initial responses to Dr. Dudeney's inquiry re the future of British Antarctic Survey Antarctic stations showed both a surprisingly large number of replies and a general support for them to be continued after the IMS.

Dr. Kasuya stated that the Japanese ionosondes were originally set up for communication purposes but were now predominantly used for geophysical studies. The Chairman pointed out that most new stations during the last 4 or 5 years had been set up to control parameters for non-ionospheric subjects and that the ionospheric network was thus getting closer to the geomagnetic network in the use of its information. Establishing the value of a station to the ionospheric community is a relatively slow process and it is necessary to start making investigations soon since many organizations are likely to wish to review the operation of their stations after the INS. INAG should therefore circulate its questionnaire and recommendations by the ICSU panel at WDCs, to other ICSU unions requesting information on the use of ionospheric data in their specialties, and in particular to CCIR, URSI, IAGA, WMO, ICAO for Civil Aeronautics, and IAU. Inquiries should be made from National Communications Organizations to evaluate the use for shipping, aircraft, expeditions and other purposes. The CCOG (Committee for the Co-ordination of Observations associated with GEOS) has made recommendations for ionosondes to be deployed in Spitzbergen, Bear Island and Iceland. Requests for existing Model C ionosondes have been made from Hong Kong, Ahmedabad, Campbell Island, Sachs Harbor, Cape Parry, San Juan (Argentina), Tahiti, Dakar, Djibuti. Subject to further discussion with INAG, NOAA considers that new ionosondes should be provided for Huancayo, Wallops Islands, Maui, Boulder, Thule (Qanaq), Narssarssuaq, College (Alaska), Godhavn, Anchorage, Barter Island, near Seattle, Adak, Cape Kennedy or Grand Bahamas, White Sands, Taipei, Point Arguello, Manila, Bangkok. Japanese and British Antarctic Survey Stations were reported to be aging.

VII. Future of INAG Bulletin

Alarm and dismay were the reactions by INAG members and observers at the Lima meetings over the prospective loss of token financial support from URSI for printing the INAG Bulletins and thus putting into jeopardy the Bulletin itself. Stretching out the remaining URSI funds by cutting back to a once yearly schedule was deemed a totally unsatisfactory solution; three or four issues a year were considered necessary to maintain the momentum built up in recent years and to accomplish the objectives for which INAG was formed.

The Bulletin was considered key to the continued stimulation and coordination of the worldwide ionosphere network. And it tells "what is going on" to station observers and the users of network data (including the Chairman of URSI Commission III who was vocal on this point at Lima). It is one

of the few international scientific information bulletins which is current, which appears frequently and which is published in the four main languages used by technicians as well as scientists. While the Lima meetings made several suggestions for improvements in the content of the Bulletin, it is very clear that the INAG Bulletin is a success.

Thus very strong representations were made to the URSI Council to continue some support, and this was successful at a reduced rate. INAG decided to try to make up the difference by inviting users to subscribe for a nominal sum.

The annual sum of $650.00 which is attributed to printing the original English language edition of the Bulletin is really only a token of the actual typing, printing and mailing expense. The $650.00 comes to about 50 cents for each issue of 15-20 pages. The remaining costs are covered by WDC-A, with the token money giving assurance that it is a worthwhile activity. Similarly IZMIRAN, CNET, University of Concepcion (and WDC-A) have underwritten the Russian, French and Spanish editions. So the cost of the Bulletin is not by any means fully borne by international resources. INAG considered the sum of $650.00 per year to be a reasonable token of international interest in INAG and the Bulletin.

It was decided to invite users to subscribe to the Bulletin for the nominal sum of $10.00 for the next three years per copy in which time INAG intends to produce 9 to 12 issues. Organizations are further invited to subscribe not only for the copies going to their own stations but for additional copies to be sent to stations which are unable to pay. Organizations which already give indirect support will , of course, not be expected to subscribe. Those stations which have practical problems about subscribing will be continued on the distribution list, in effect being covered by the oversubscribers, or the grant from URSI. Distribution to people whose work will benefit is more important than token payments.

The distribution of the Bulletin is about 450 in all (370 English, the remainder Russian, French and Spanish). If organizations can pay for 100 subscriptions at $10.00 each for the triennium, the necessary token international support of $300.00 per year will have been achieved. Informal indications at the Lima meetings would meet almost half of this goal, when confirmed.

The INAG Bulletin indeed has a future, thanks to the present cooperation of several publishing institutions, and the promised and the hoped—for participation of other organizations, plus continued token support from URSI. The last step in overcoming the crisis is the confirmation of broad international interest through the invited subscriptions. The members of INAG are confident the indications of support will come from all parts of the world.

The invited subscriptions of $10.00 per copy for the three-year period should be sent to World Data Center A, EDS/NOAA, Boulder, Colorado 80302, U.S.A., checks made payable to "Department of Commerce, NOAA/NGSDC".

VIII. New Ionosondes

One meeting of INAG was devoted to a discussion of new ionosondes for network and research purposes. This showed that the equipment could be divided into four different groups:

(a) Equipment in production.
(b) Low cost solid state ionosondes for observatory use.
(c) Second generation ionosondes.
(d) Advanced ionosondes for both observatory and research purposes.

(a) Equipment in production.

Group (a) involve the well-known ionosondes produced commercially.

See	- INAG-3	pages	10-11	INAG.14	page	4
	INAG-4	page	14	INAG—15	pages	15-20
	INAG-6	pages	14—15	INAG-17	page	4
	INAG-7	pages	10-12,16	INAG—18	pages	12—16, 23, 35-36
	INAG-13	page	17	INAG—20	pages	8-10

At Lima, Professor Gledhill reported that he was successfully using VERTICHIRP equipment at SANAE, (see INAG—6, p. 14; INAG-13, p. 17; INAG—14, p. 4) and that it appeared practical to operate this equipment at an observatory provided that a high class oscilloscope was provided for fault finding purposes. This was a problem of identifying a card which was faulty. Faults were normally corrected by inserting a replacement card. Dr. Bossy reported that the digisonde at Dourbes was operating satisfactorily as an observatory instrument (INAG-6, p. 15; INAG-7, pp. 10-12).

In general commercially available ionosondes are too expensive for replacing obsolete equipment in the network or for new stations but several groups have attempted to produce a suitable equipment at a lower price.

(b) Low cost solid state ionosondes for observatory use.

At Lima three new ionosonde projects were discussed and films were shown giving typical ionograms from two of these. They were:

(i) the Australian ionosonde (INAG—18, pp. 35-36). Mr. McCue stated that this ionosonde had now been thoroughly field tested and that the components to construct it could be obtained for approximately U.S. $2,500.00 (camera not included). He believed that this instrument could be assembled commercially for about U.S. $1,000.00. This price was challenged by several present and will be checked. The ionograms shown were of adequate clarity and accuracy for observatory use despite being recorded on 16 mm. film. With suitable projectors it was possible to reduce 16 mm. ionograms with the accuracy called for internationally. The World Data Centers are prepared to accept 16 mm. ionograms.

(ii) The Dartmouth College lonosonde. (INAG-20, pp. 9, 10). Professor Morgan stressed the reliability of this ionosonde and showed a typical week of recording at the rate of one ionogram every two minutes. The quality was again quite adequate for observatory use. Professor Morgan stated that the lowest frequency of the ionosonde could be changed to about 1 MHz (the film shown started at about 1.7 MHz). This equipment could be produced for U.S. $10,000.00 and two inquiries had been received in the short time since INAG—20 Bulletin was produced. (Word has been received that this ionosonde is no longer available.)

(iii) Professor Gledhill gave a brief description of the SHISH ionosonde (INAG-18, p. 32). The prototype should be available by the end of 1976. The expected cost would be about U.S. $20,000.00.

(c) Second generation ionosondes.

A. H. Shapley introduced the NOAA proposals for upgrading the NOAA ionospheric sounding network and explained the philosophy underlying these proposals. Essentially, the classical type of ionosonde does not utilize modern data handling techniques so that considerable improvements in both quality of data available and in the problems of handling and reducing these data can be obtained by using modern techniques. The second generation ionosondes should be designed so that the final data are available in computer compatible digital form. The United States proposed, subject to finance being made available, to produce a simplified ionosonde suitable for observatory use based on the NOAA dynasonde prototype. The instruments would be based on a small general purpose computer which would carry out some initial analysis and produce the output in digital form on magnetic tape. Virtual height amplitude and phase of the o and x components could be obtained. It would be made in modular form to simplify servicing.

When this had been produced and tested a constructor would be selected to produce additional instruments specifically for updating the NOAA network and to open new stations on scientifically important sites. The new instruments should yield electron density profiles 10 times more accurately than present instruments and the improvement in data handling will enable short term changes in the ionosphere to be studied without prohibitive data handling problems. The computer compatible digital output will permit retention of information contained in the reflected signal which is totally lost in the analogue only film recordings. Modular design will enable additional recording or analysis modules to be added at a later date if so desired. Full digital control of the instrument permits flexibility of programs, not possible in conventional ionosondes, e.g., a given ionogram can be reproduced for analysis at a number of different gain settings or with different frequency or height scales. Centralized analysis of the ionograms is both convenient and efficient with this type of ionosonde. It was hoped to produce initially 12 instruments at a cost of between U.S. $60-70,000.00 per ionosonde.

(d) The advanced ionosonde.

Mr. J. W. Wright introduced the concept of the advanced ionosonde and pointed out that a network of 40 such instruments could give all the information at present available from the world network, plus much additional data. The instrument was fundamentally capable of producing many different types of data, the fundamental limitation being the cost and the number of people available to study the data obtained. It was more economical to combine all these facilities in one machine than to produce special equipment for each purpose. A full description of the equipment and its possibilities has been produced in NOAA, ERL/SEL, preprint 206, July 1975, copies of which were circulated to interested participants. In many ways the instrument described by Mr. Wright resembles incoherent

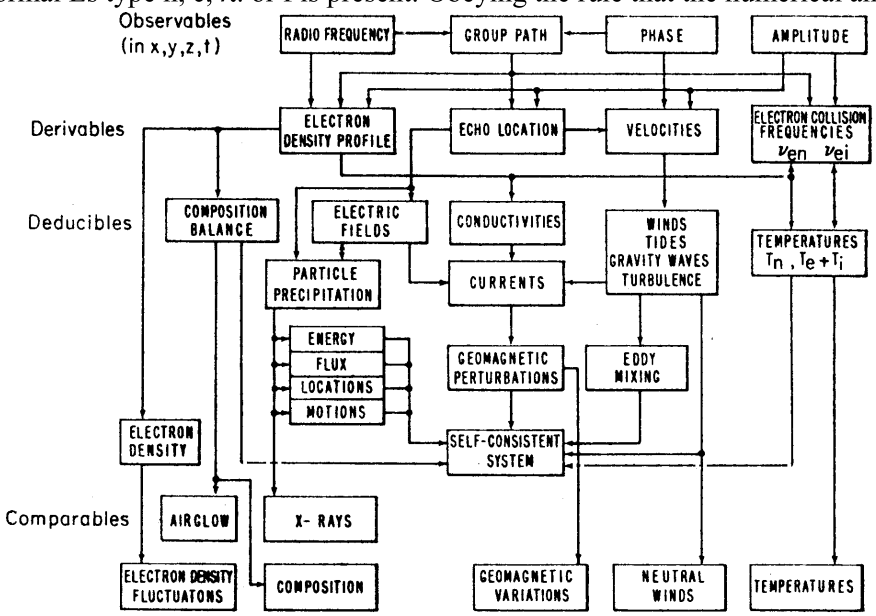
scatter instruments. Both are capable of giving a wide range of physical parameters, and can be readily linked with observations using other techniques, e.g., magnetometer, photometer, all-sky camera, incoherent scatter, balloon, rocket, satellite observations. However, the relatively high cost of the instrument, implies that it is really only economical when used in a research establishment with sufficient staff to take advantage of the very wide range of experiments which are possible. It should be considered seriously by any group proposing to set up a geophysical research centre.

The Chairman pointed out that the network is not a centrally planned organization with equipment deployed according to recognized scientific needs. It is, in fact, a free association of a large number of independent groups, each of which have their own reasons for operating the ionosonde, but who are willing to cooperate in making their data sufficiently uniform and easily available for world-wide studies. The technique gives a large amount of scientifically interesting data relatively cheaply. In geophysics it is necessary to know whether and when particular phenomena occur as well as how and why they occur. As new phenomena or interrelations between phenomena are identified these problems have renewed importance. Thus, it appears probable that a network will be needed in the future comparable with that available at present and this means that sources of cheap observatory ionosondes will become necessary. Where staff are expensive the U.S. approach appears likely to be the most economical available, but where staff expenses are not so great, a cheap reliable conventional ionosonde may well prove the most economical solution.

GEOPHYSICAL FUNCTIONS OF A DIGITAL IONOSONDE

IX. Problems in Measurement of foE in Presence of Ladder or Tilted Types of Es

There is some disagreement on the measurement of foEs in the ladder or tilted types of Es-a especially when a normal Es type h, c, λ. or f is present. Obeying the rule that the numerical analysis represents the ionosphere most nearly overhead means that all auroral traces which are clearly at oblique incidence are ignored for numerical analysis in favor of traces with lower values of foEs which are more nearly overhead. Obeying the rule that the trace with the highest value of foEs is used for analysis gives trouble when this is clearly oblique, e.g., if there is an Es-a structure near 100 km and another clearly separated near 200 km with (as is usual) higher foEs, is the latter measured and if so is hEs 200 km? This is clearly an acceptable interpretation and logical but gives difficulty with fbEs which only has meaning for vertical reflection. We need guidance from the scientists as to whether, in auroral conditions, the ionosphere overhead is more important than the maximum Es structure seeable from the ionosonde -- which may be several hundred km away. When the Es is moving rapidly, as is usually the case, it frequently happens that an ionogram taken at a slightly different time shows that the Es has moved nearly overhead giving foEs values corresponding to the maximum seen. However at some stations this seldom happens, the dense Es is always some distance away. The problem only occurs at certain stations with appropriate position relative to the auroral oval but probably deserves further discussion.



X. Spread F Typing

After p 48 new section to Handbook.

2.8 Spread F types

2.80. Historical: After considerable discussion INAG decided at Lima 1975 to adopt a simplified form of spread F typing and to recommend it for general use. The original proposals in section 12.34 were used as a basis. Many examples of spread F typing are given in the High Latitude Supplement published in 1975 by

World Data Center A (WDC-A) for Solar-Terrestrial Physics, NOAA, Boulder, Colorado, USA, *(Report UAG-50).*

While all agreed that the ideal solution would be to provide a spread F-type table similar to the Es-type table section 4.8, it was felt that this would cause too much work at stations for general use. INAG recommends that a separate spread F-type table be produced where possible, section 2.82.

In order to obtain widespread use and avoid additional work at the stations a compromise scheme was developed, see sections 2.83, 2.84.

2.81. Definition of spread F types:

(a) Frequency spread; letter symbol F.

The traces near the critical frequencies are broadened in frequency and may show additional traces similar to a normal critical frequency trace. This is the most common type of spread F. Figure 2.19. Other examples are shown in Figures 2.11, 2.17 trace 2, 2.18, 3.8, 3.11, 3.12, 3.14, 3.28, 3.35, 3.39 a,b, 3.40 a,c,d; and for f-plot presentation 6.4, 6.5, 6.6, 6.7, 6.8. Frequency spread from a tilted F layer, Figure 2.20 is also included in this classification. (See also 6.10e). Letter F should be used whenever the frequency range of the spread exceeds 0.3 MHz (accuracy rule for $\pm\Delta$, total range 2Δ for unqualified result.)

(b) Range spread; letter symbol Q.

The traces away from the critical frequency show broadening in range or the presence of satellite traces or both Figure 2.21. Other examples are show in Figures 2.14, 2.16, 2.17 trace 1, 3.13, 6.10. For uniformity Q is used when the range spread exceeds 30 km in virtual height. When broad pulses are used so that the normal trace is wider than this limit use Q when the additional broadening of the trace exceeds 15 km.

(c) Mixed spread; letter symbol L.

The traces are broadened in both range and frequency and do not show the presence of distinct F and Q types. Figure 2.22. This classification shows a physical phenomenon distinct from those given by F and Q and INAG wishes to encourage its use on a voluntary basis.

(d) Spur (historically polar spur, equatorial spur); letter symbol P.

This class includes all types of spread F not classifiable under F, Q or L. It indicates the presence of traces from an oblique reflecting region which usually reflects to a considerably higher frequency than the F layer nearest overhead. When the structure moves in time it may move overhead in which case the classification changes to F or Q as appropriate. Figure 2.23. Other examples are shown in Figures 3.39 c, 6.10 c,d.

2.82. Rules for use with a spread F type table.

When a spread F type table is made the following rules should be used.

(a) First entry — Spread F type used to give fxI.
(b) Second entry — Spread F type present at expected value of foF2.
(c) Third entry — Range spread if present.

Note in most cases fxI is given by a frequency spread trace type F or by a range spread trace from near overhead, type Q, and only one entry is needed.

(d) When L is not used mixed type should be shown by entries of F, Q.

(e) Possible entries are:

Single entry F; Q; L,

Double entry F, Q; P, F; P. L.

Treble entry P, F, Q; P, L, Q.

(f) X may be used to show the absence of spread F at times when it would normally be expected in the spread F type table.

2.83. Rules for typing spread F in standard parameter tables.

Where a separate spread F table is not used spread F types should be shown in the numerical tables using the following rules.

(a) Descriptive letters representing spread F types F, L, P, Q take priority over descriptive letters showing doubt in the tables to which they apply only. Do not use these letters in other tables, e.g. M(3000).

(b) The type of spread F used to evaluate fxI is shown in the fxI table. Absence of spread is shown by descriptive letter X (see fxI rules section 3.3).

(c) Frequency spread, F, is shown in the foF2 table. If fxI is also given by F and has been tabulated in the fxI table letter symbols denoting reason for doubt may be used in preference to F in the foF2 table.

(d) Range spread, Q, is shown in the h'F table,

(e) When frequency spread or spur are absent and fxI is determined by a range spread trace Q is used in the fxI table.

(f) Mixed spread, L, is shown in both h'F and foF2 tables unless structured traces Q or F are also present in which case these take priority in their appropriate tables.

(g) When L is not used mixed type traces are shown by F in the foF2 table, Q in the h'f table.

Typical Cases

Present	fxI	foF2	h'F
No spread	X	-	-
Spur, F	P	F	-
F Q	F	(F)	Q
L	L	(L)	L

P F Q	P	F	Q

( ) without priority.

2.84. Rules when fxI tables are not available.

(a) Descriptive letters representing spread F types take priority over descriptive letters showing doubt in the tables to which they only apply. Do not use these letters in other tables, e.g. M(3000).

(b) The type of spread F which would be used to evaluate fxI (see fxI rules section 3.3) is denoted by its descriptive letter symbol in the foF2 table (possible symbols F, P, Q or L).

(c) The presence of range spread is shown in the h'F table (possible symbols Q, L), Note in this case it is impossible to fully describe the ionogram and a priority system has to be used. In this fxI greater than fxF2 is more important than denoting frequency spread.

(d) Structured traces of types F or Q are always shown in preference to L when superposed.

2.85. Difficulties.

The main difficulty in practice is to distinguish between spur traces and Es-a traces seen at very oblique incidence. When a close sequence is available, e.g. three gain ionograms at the hour, it will be seen that the Es traces vary considerably in a space of a minute whereas spurs change more slowly. Spurs and high Es-a traces tend to occur together so possibly a unique solution is not essential. Spur patterns tend to recur on different nights at similar levels of magnetic activity showing similar patterns whenever Es-a is less regular.

Certain types of spur appear to identify the movement of the auroral oval over the station (see High Latitude Supplement, *Report UAG—50.*

Corrections to Existing Handbook Sections.

The corrections are identified as follows:

(a) page number as given on bottom of page
(b) section number
(c) (i) paragraph number (in brackets) from top of page if section starts on an earlier page
(ii) paragraph number (in brackets) in section if section starts on the page
(d) line in paragraph

Displayed equations are regarded as part of the preceding paragraph when counting. Otherwise, a blank line implies a new paragraph.

p 64 3.2 letter F At end insert:

"When F is used to denote spread F—type frequency spread in foF2 or fxI tables it takes precedence over all other descriptive letters (see section 2.76, p. 49).

Letter F must be used whenever the frequency spread is equal to or exceeds 0.3 MHz and should not be used when it is less than this value. This rule enables the presence of spread F to be compared at different stations."

p 72 3.2 letter L At end of description add:

"Letter L is used to denote the presence of spread F type mixed and is used in spread F type, foF2 or fxI tables only (see section 2.3, p. 32). The identification of spread F by L is voluntary but recommended by INAG as being valuable scientifically. When L is used in the foF2 or fxI tables for this purpose it takes precedence over all other descriptive letters."

p 73 3.2 Before letter Q Insert:

"P - Man-made perturbation of parameters - Presence of polar spur traces.

P is used to show that the ionosphere has been modified by man—made phenomena. e.g., heating experiment, injection of foreign substances.

Spread F types. P shows the presence of spur type spread F. When used for this purpose in fxI tables P takes precedence over all other descriptive letters.

p 77 3.2 letter X Add to paragraph:

"Letter X is used in fxI tables to show that no spread was present, i.e., fxI = fxF2. When more than half of the values are described by X the median of fxI must be described by X."

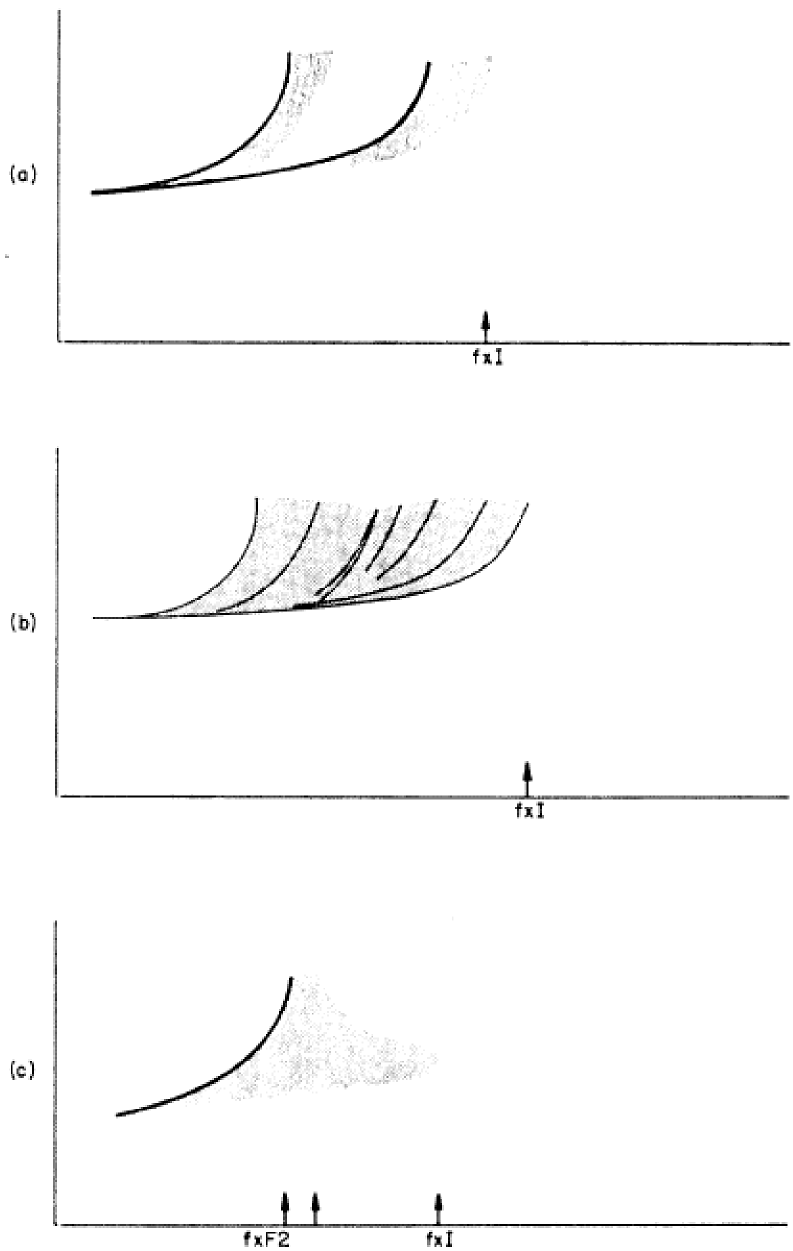


Fig. 3.20. Frequency spread. Type F

Note: In logic fxI should be read at the middle arrow but the standard fxI rule (read the highest frequency of spread visible) is easier and more useful.

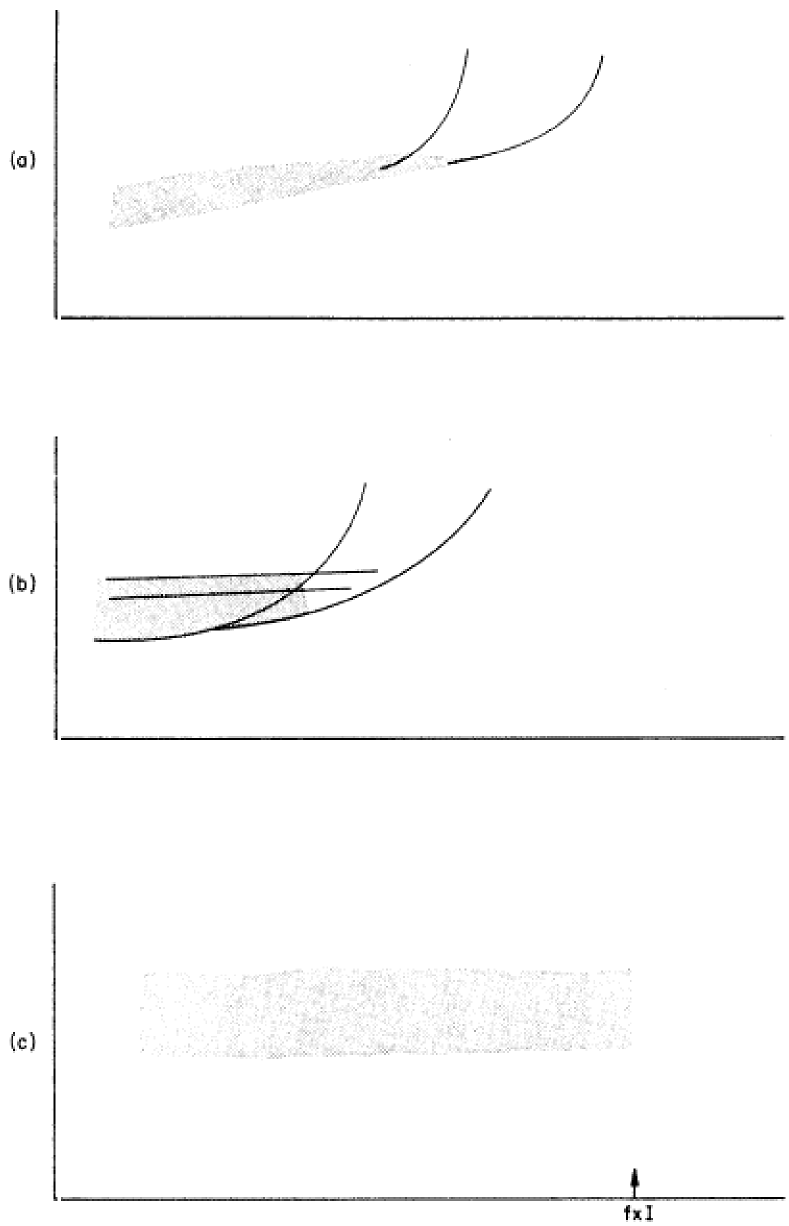


Fig. 3.21 Range spread. Type Q

(a) Shows an unresolved range spread Q in h'F table.
(b) Shows resolved range spread Q in h'f table.
(c) Shows fxI determined by a range spread pattern Q in h'f and fxI (or foF2 table).

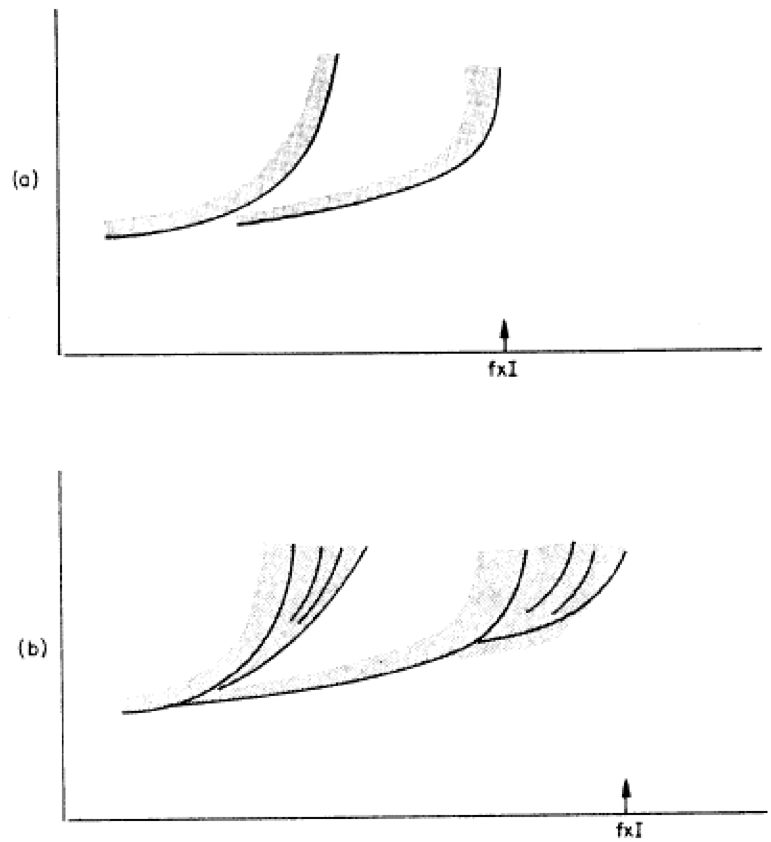


Fig. 3.22 Typical mixed. Type L

Note no structure in horizontal parts of trace. Usually no structure in frequency spread as in (a).

Structural frequency spread (b) superposed on pattern (a): Use F in fxI, L in h'F to give exact description. (Voluntary.)

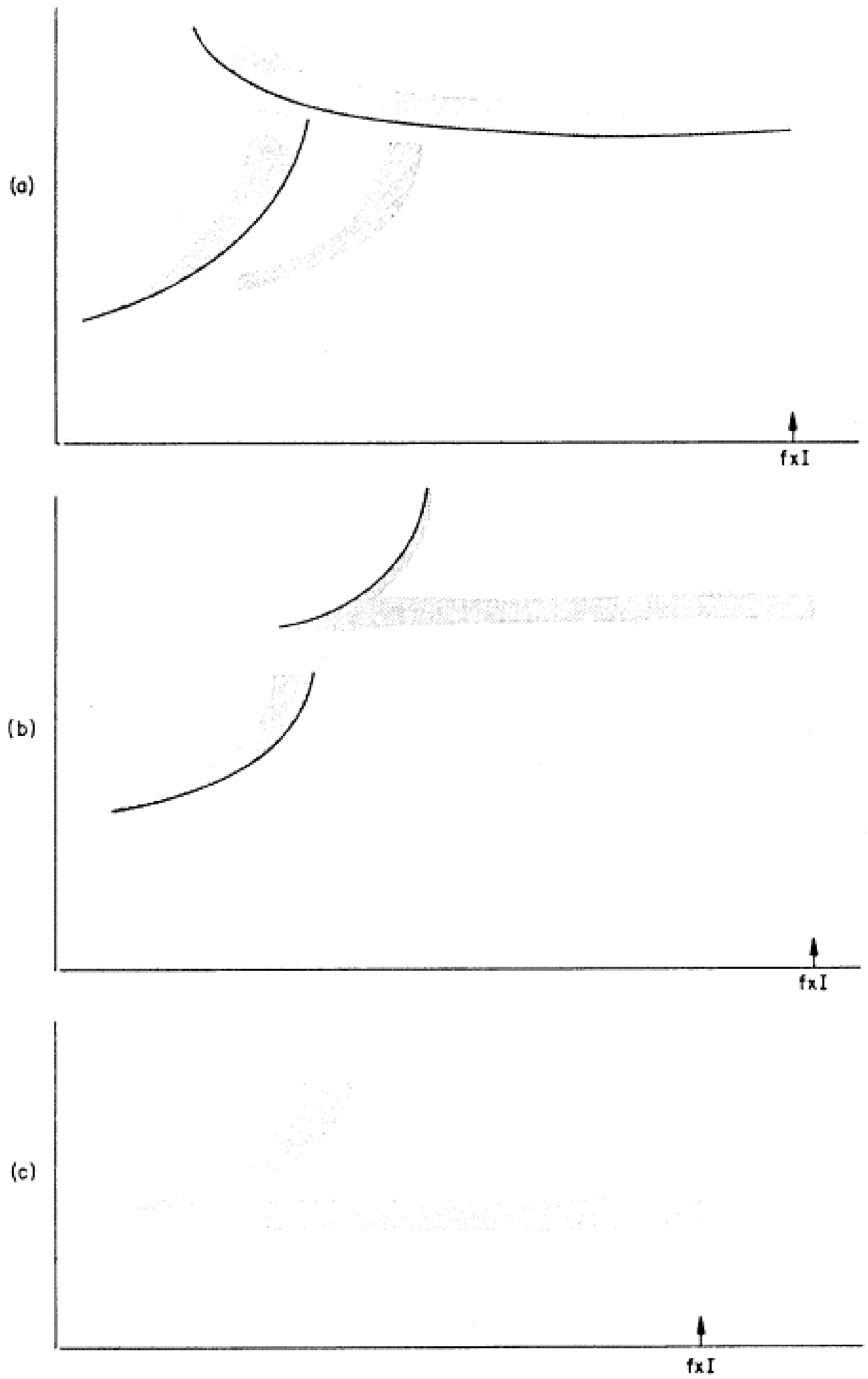


Fig. 3.23 Spur. Type P

Note the P traces may be alone or below the main traces and may start at lower or higher frequencies than shown.

XI. Additions to- Handbook Corrections

p 17 1.15 Replace existing paragraph by:

"1.15 Particle E: The ionogram shows the presence of a thick layer In the E region with a critical frequency significantly greater than that of normal E (1.14). In most cases particle E can be attributed to direct or indirect ionization by particle activity. Traditionally this trace was called night E as the critical frequency of the normal E was below the lowest recordable frequency at night. Fortunately, on almost all practical cases, the difference between the critical frequency of the particle E and of normal E is large —- much larger than the differences between foE and foE2 (1.16). Thus at night when foE for normal E is between 300 kHz and 500 kHz particle E usually gives foE above 1 MHz -- often up to about 5 MHz. Particle E is often preceded or followed by retardation type Es (Es-r) or auroral type Es (Es-a), in such cases foE usually varies rapidly with time. When particle E is present, as indicated by retardation of the traces from higher layers or by the character of the E trace (see section 3.2 letter K and section 4.24) it is identified in the tabulations by descriptive letter K (foE, foEs, fbEs, h'E, h'Es and Es type tables). Note retardation of a higher trace is enough to identify particle E (foE)—K if it obeys the definition given above. Particle E normally blankets normal E but is sometimes seen at heights up to about 170 km."

p 32 2.4 5 lines from bottom Insert:

"The extrapolation rule is that the range of uncertainty extends from the end of the observed trace to the deduced value of the critical frequency. This has the merits of simplicity and long use. However this rule restricts the number of numerical values allowed by the accuracy rules. The convention shown in Fig. 2.2b is also permitted. This can be stated: The ranges of uncertainty allowed by the accuracy rules are to be compared with the ranges between the least and largest value of critical frequency permitted by the extrapolation process.

P 32 Add Figure 2.2b:

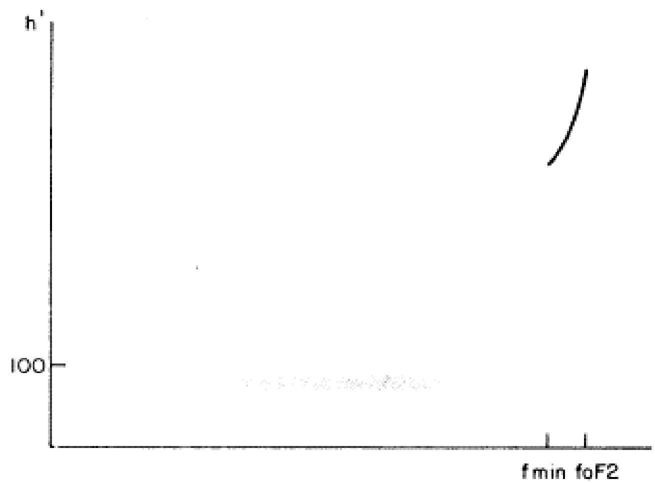


Fig. 2.2b Range of uncertainty when extrapolating to a critical frequency.

The observed trace ends at frequency 1.
The most probable trace gives a critical frequency at frequency 3.
The least possible value of the critical frequency is 2
The greatest possible value of the critical frequency is 4

when the frequency difference 2-3 or 3-4 is Δ.
The range of uncertainty to be used when applying the accuracy rules (section 2.2) is then ±Δ, or if total range rules are used, 2Δ.
Note that the range of uncertainty is usually less than the range of extrapolation given by the difference 1-3.

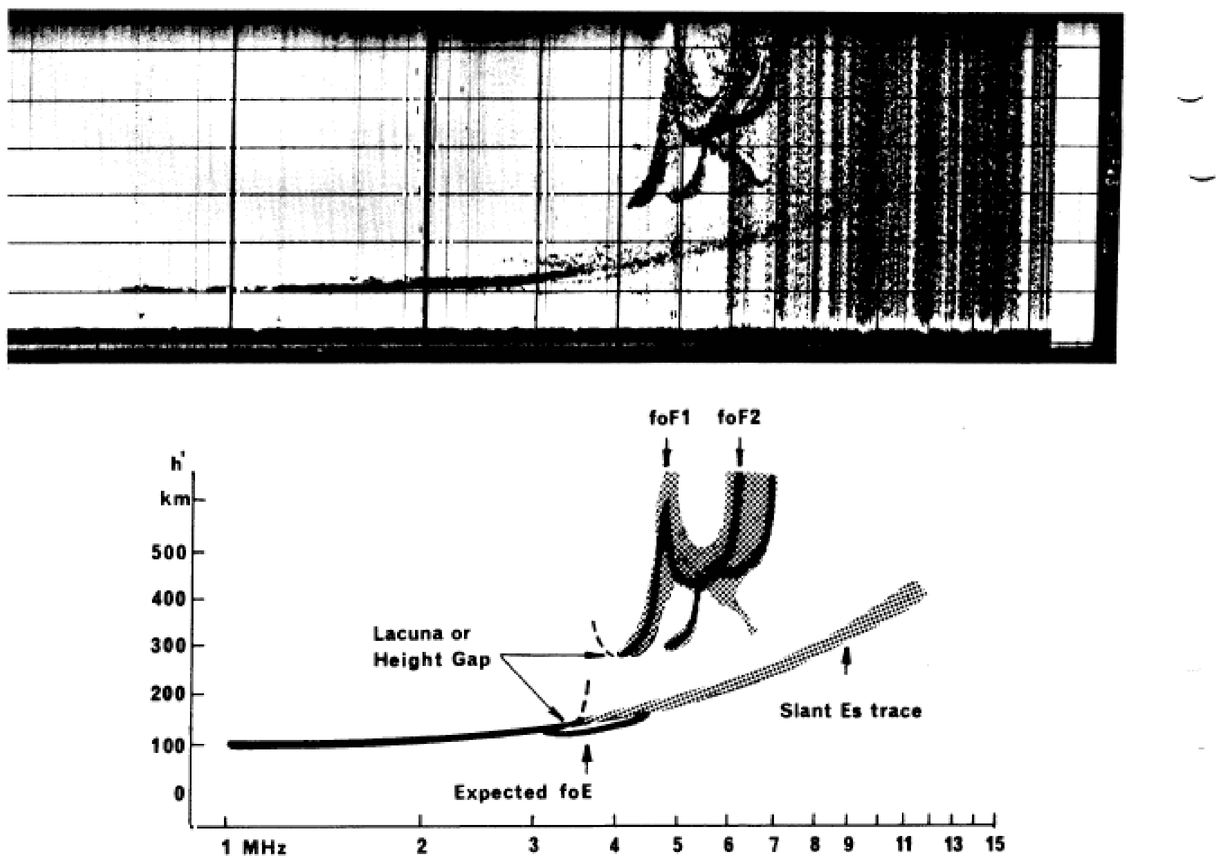
p 48 2.76 Insert after page 48:

"2.76. Slant Es Condition (SEC): In practice Lacuna is most frequently associated with Slant Es, the two phenomena being due to intense plasma instability. This is believed to be associated with the two stream mechanism, and most probably indicates occasions when the local electric field in the E and lower F region exceeds a critical limit. The phenomena are thus important for studying magneto-spheric phenomena at high latitude. Figure 2.18(b) shows a fairly typical example of an ionogram with both Lacuna and Slant E present. Many examples of these phenomena are given in the High Latitude Supplement. Very often the Slant Es is visible before the Lacuna appears and it can also be seen after the Lacuna disappears. It appears that the Slant Es shows the presence of intense turbulence in the E region up to several hundred kilometers from the station whereas a Lacuna shows the presence of this intense turbulence overhead. As a Slant Es trace is a relatively weak trace it can readily be screened by absorption and its apparent frequency of occurrence depends on the sensitivity of the ionosonde."

Fig. 2.18b Typical day time ionogram with Slant Es phenomenon at an auroral zone station illustrating the main characteristics: Slant Es trace, Lacuna or Height Gap, F-spreadiness even in low part of F1-trace, and obliques. Narssarssuaq, June 15, 1969 at 1559 hr. LT.

p 54 3.2 letter A Insert above Fig. 3.1:

"A special case occurs when particle E, Es—k, completely blankets the F trace. Logically this would imply the use of G but such use would cause difficulties with the F-layer medians. Also the distinction Es-r, Es-k is often difficult in this case. For simplicity, particle E is regarded as an Es type for this purpose and the



value of foF2 should be replaced by letter A. It is impossible to know whether foF2 was normal or not so the accuracy rules do not allow E to be used. Thus total blanketing by Es or particle E are treated alike, use replacement letter A."

p 78 3.2 letter Y Add after first paragraph:

"The accuracy rules are, as usual, followed, use replacement letter Y, DY, EY, UY or -Y as given by the rules. This holds for all cases where Y is used, both Lacuna and severe layer tilt cases."

P 78 3.2 letter Y (6)10 Replace "h'F1" by "h'F".

p 78 3.2 Severe layer Delete line 2. Insert:

tilts present
para (a)2

"as in Fig. 4.22 use accuracy rules to give appropriate use of Y. When in doubt use replacement letter Y."

p 78	3.2	last para. (b) 1	Replace "F layer" by "F2 layer"
p 78	3.2	(1)18	In (iii) replace "value of fmin" by "value of fm2".
p 78	3.2	letter Y	Insert before letter H rule:

"G. (a) When the ionograms before and after the Lacuna event show G conditions for the F2 layer, G should be used in preference to Y.

(b) When the ionogram sequence shows an F2 layer before and after the Lacuna event and this trace disappears in the event, F2 parameters are replaced by Y."

p 78	3.2	letter Y	Insert after letter H rule:

"Note in most cases Lacuna is accompanied by Es—s and this is also often seen when the Lacuna is about to develop or is dying away. The presence of slant Es is a clear distinction between layer tilt and plasma instability causes of Lacuna phenomena.

When Lacuna is present with Es—s the two phenomena are treated independently for scaling (see section 4). Es-s can arise from a normal E trace, a particle E trace (Es-k), or from a blanketing Es trace (usually f, but h, c, λ. also possible). For convenience the rules are summarized below:

(a) foEs is deduced from the top frequency of the Es pattern from which the slant Es rises, foE is deduced ignoring the slant trace.

(b) Slant Es cannot blanket.

(c) If the Es trace is of a blanketing type and there are good reasons to believe that blanketing is effective in screening the upper level, characteristics below the estimated value of fbEs should be replaced by A, or for Es-k by G.

(d) If the F1 trace is seen but the F2 trace is missing, the F2 parameters are treated as G cases (foF2 less than foF1). It is quite possible for a G condition to occur during or after a Lacuna event, see general rules use of G above.

(e) If parts of the F1 trace are missing, the missing F1 parameters are replaced by Y. (See accuracy rule note.)

(f) If both F1 and F2 traces are missing, use G rules given above.

(g) If the E region trace is Es, the problem of whether Y should be used depends on whether foEs is likely to be influenced by the Lacuna phenomenon. For low, flat or auroral types of Es this is improbable. For particle E (night E) or retardation Es the appearance of the ionogram sequence will suggest when Y is needed, i.e., when the nose of the trace is missing. If there is no evidence suggesting that foEs is affected by the Lacuna, it would appear best not to use Y

—- we know Lacuna is present from the F—layer tables. However, this point should be discussed more fully in the Bulletin and at INAG meetings.

(h) Although slant Es frequently accompanies Lacuna and is usually present at some stage in a Lacuna sequence, its presence is not essential on a particular ionogram. If the F traces are missing, Y should be used for the missing parameters except where G above applies."

p 80 3.2 Fig. 3.34 Replace "(foF2 + fB/2)OY" by "(foF2 + fB/2)EY".
p 80 3.2 Fig. 3.34 Replace "N-S or E-W" by "E-W or N-S".
p 81 3.2 letter Y Add new paragraph at end:

"Note the use of Y to identify severe layer tilts is restricted to tilts in the F2 layer for physical reasons. Tilts near F1 are better described by H. Only tilts giving the type of ionogram illustrated in Fig. 3.34 should be identified by Y. H is more appropriate in other cases."

p 86 3.32 after (d) Insert:

"(e) When the spread F structure is not gain stable the value of fxI from the normal gain ionogram is recorded.

At some stations spread is found on the 0-trace but not on the x-trace even when absorption is low. This is due to the fact that the two traces are reflected at different points separated by typically about 50 km in the magnetic meridian plane. A small movement of the station would, therefore, cause this situation to change. As fxI is intended primarily to show the existence of spread F near the station it is preferable to deduce the value from foI, fxI = (foI + fB/2)OF (F, if spread F typing is in use, otherwise X). This also makes the analysis simple —- always look at the o—trace if the x—trace is clean and deduce fxI from it. If in doubt between B and X prefer B."

p 109 4.83 (1)5 Replace "night" by "particle".
p 109 4.83 (2.)2 Replace "night" by "particle".

p 110 4.83 (d)1 Replace "A weak" by "A weak diffuse"

p 110 4.83 (k) After paragraph "k", add:

Note: (I) Es-r and Es—a type traces can be present with normal E or particle E, Es-k. In these cases the retardation at the low frequency end is ignored in deciding the type.

(ii) It is common for Es—f, Es—h, Es-c to be superposed on Es-a, occasionally on Es-r also. In these cases f, h or c is given priority over a, r for the second entry."

p 144 6.3 after (i) Insert new subsection:

6.32. Representation of range spread and polar spur traces on f-plot.

(a) Range spread and polar spur traces should be represented by a line with letter q at the upper and lower frequency ends of the line, Fig. 6.10. This line should never be allowed to confuse the representation of frequency spread 6.31(e) or fmin 6.31(f).

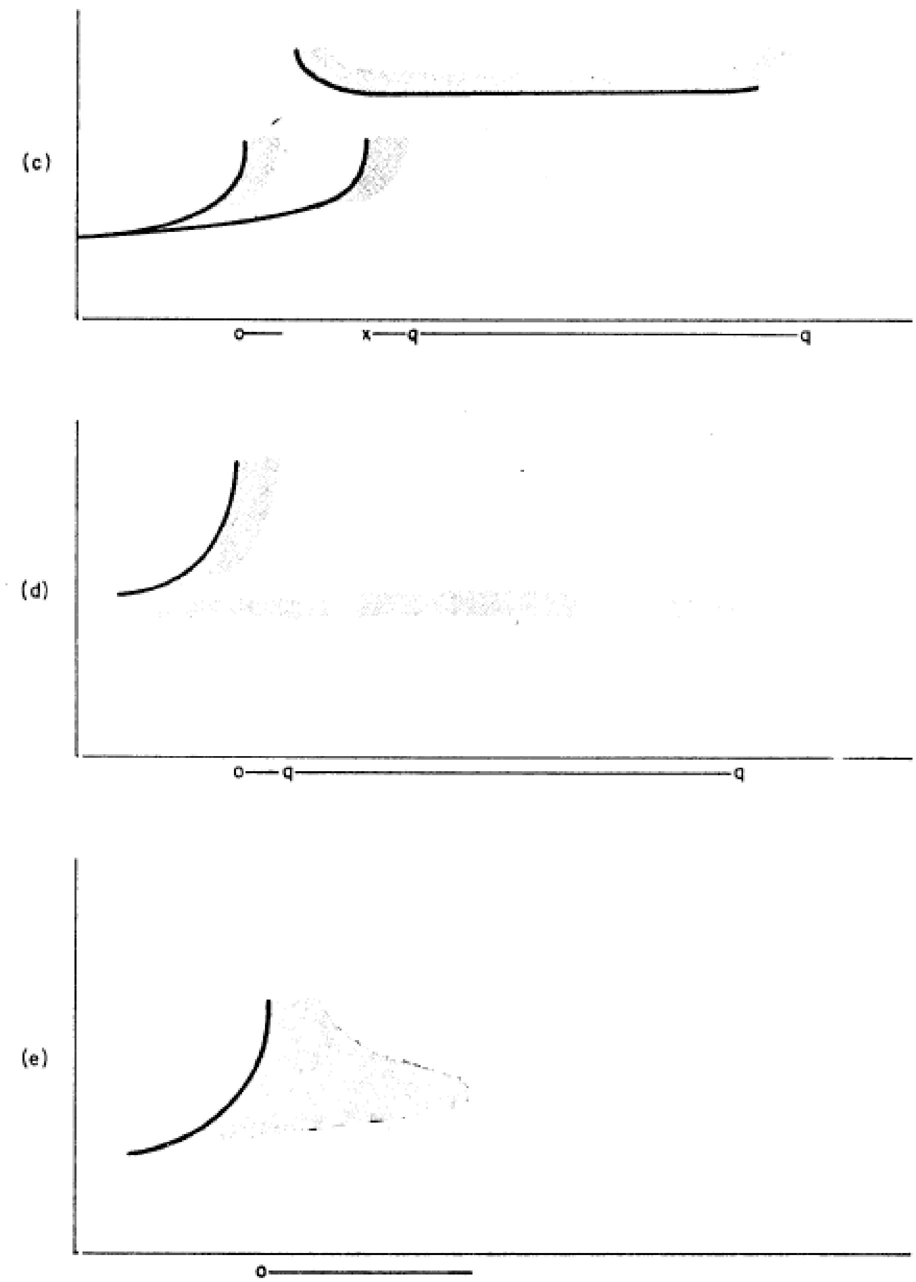
(b) When range spread and polar spur traces extend below the upper frequency of frequency spread traces, q is placed between the upper limit of frequency spread and the lower frequency end of the line representing the oblique trace, Fig. 6.10 (c), (d).

(c) When all traces are oblique that nearest overhead is treated as an F--layer trace, 6.31 (a), (b), (c), (d), (e), (f).

(d) The nose type of trace representing frequency spread F in a tilted F layer is treated as a frequency spread trace, Fig. 6.10 (e)."

Fig. 6.10. f-plot convention when spread is present

(c)(d) Use of q, spread F type P



(e) Nose type trace treated as frequency spread type F

XII. New Handbook Chapter

15. LIST OF OBSOLETE RULES REMOVED FROM HANDBOOK

For those using data from early years it is convenient to know when rules were changed and what rules were in use before the change. The earliest references are given in section 0.01 this Handbook.

The first widely used manual was the IGY Instruction Manual for the Ionosphere, Annals of the IGY, Vol. III, Part 1 which is still useful for the large number of ionograms published in it. The rules were revised and clarified for station use in the First Edition of this Handbook.

As a result of many discussions the rules were clarified, extended and changed at the meeting of INAG held at the XVII URSI General Assembly at Warsaw, August 1972. These changes were incorporated in the Second Edition of the Handbook as published in August 1972. Almost immediately, however, additional clarifications were found to be needed and new problems suggested new rules.

Starting with the changes adopted at Lima, August 1975, modified rules will show the date at which they were formally adopted and the obsolete rules will be transferred to this Chapter, again with the date of formal statement of obsolescence. Minor clarifications or additions which should have little effect on the data are not dated.

Corrections and amendments to the Handbook were published in INAG 16, December 1973.

(i) December 1973. X changed A.

Old rule. When an Es trace is such that foEs cannot be distinguished and must be deduced from fxEs, X is used, foEs = (fxEs — fB/2)JX.

p 53 section 3.2
p 102 section 4.42
p 178 section 8.2

(ii) December 1973. Use of descriptive letter A in (foF2)DA when total blanketing present.
Old rule. No longer allowed.

(c) When rules (a) (b) cannot be used, the best estimates of foF2 give fbEs, fbEs = (foF2)DA. This should be found from the sequence of foF2 values near the time involved or from corresponding values on other days.

p 53 section 3.2 letter A
p 108 section 4.6

(iii) December 1973. Median rules for B; G, Es; and G, M(3000),

(b) Values of parameters replaced by the following letters are treated as shown below:

B —For fmin, count as greater than the median.

Note: B is often used when fmin is greater than the normal value of the characteristics In this case it does not contribute to the median. The logical form (fmin)EB adds little or no real information and involves proceeding to a second median. For foEs, fbEs the full form, (fmin)EB, should be used when (fmin) is numerical and determines these characteristics.

G — For foEs and fbEs, count as equal to or less than median foE. When foEs or fbEs are less than foE, which may occur when low type Es is the dominant Es type, the numerical values are described by G and treated as equal to or less than foE.

G — For M(3000) and MUF (3000), count as equal to or less than the median.

p 180 section 8.33, (b)

(iv) March 1974. Change of name, Night E to Particle E. p 17 section 1.15

(v) March 1974. Y — Intermittent trace or trace missing due to defocussing.

p 32 section 2.3

(vi) March 1974. Change of letter symbols for spread F classification.

12.34. INAG proposals for spread F classification: At the time of going to press, the general view of INAG members and consultants was that Penndorf's scheme should be greatly amplified. The proposal for initial study is to divide the phenomenon into four types:

(i) Frequency spread, proposed letter symbol F:
All cases where the spread shows frequency structure and not range structure (see section 2.70, 2.72) (Penndorf Fig. 12.1, α1, α2, α3, α4; β2, β3, β4).

(ii) Range spread, proposed letter symbol R:
All cases where the spread shows spread in range but not frequency structure (see section 2.74) (Penndorf Fig. 12.1, δ1, δ2, ε1).

(iii) Mixed spread, proposed letter symbol M:
Patterns which show a range spread at lower frequencies changing to frequency spread at higher frequencies, the lower edge of the range spread trace being continuous with the lower edge of the frequency spread trace. (e.g., Penndorf 12.1, β3, δ3, δ4). Cases where the limitation is not true are treated as superposed independent F and R traces and are tabulated F,R. Thus cases where a range spread trace is seen either above or below the trace giving the frequency spread are tabulated separately.

Note: One of the purposes of the classification is to show when an oblique structure becomes overhead by entry F,R being replaced by M. Also the sequences of F turning to R or R to F may represent different situations to F,R turning to M.

(iv) Spur (historically polar spur) proposed letter symbol S:
This includes the range of patterns found when the ionosphere is very tilted or a second reflecting structure is visible at oblique incidence, There are two main groups:

(a) Spurs or noses superposed on a normal F or M pattern (Penndorf type γ).

(b) A spread trace at a different apparent virtual height to the normal traces and with considerably different top frequency (Fig, 3,39 (c) and (d)). These have been called polar spurs as they often show group retardation near foF2 and are closely associated with the plasmapause trough in years of large solar activity. This type is usually present at the same time as type F or M; sometimes with F,R, so that it is possible to have entries:
single type present F; R; M; S.
two types present F,R; F,S; M,S; R,S; R,M.
three types present F,R,S; M,R,S.

It is suggested that, until more experience has been obtained, no attempt be made to make the tabulation more complex.

Note that if these proposals obtain general approval, the definitions and detailed rules are likely to be refined in the future and published in the INAG Bulletin, p 282 section 12,34

(vii) August 1975. Range spread.

(g) There are some cases where the F trace is replaced by a range spread pattern which does not show frequency spread. This can be represented by a line extending over the range of frequencies showing spread provided that letter q is used at both ends of the line. Occasionally frequency spread can be detected at the upper frequency end of the range spread pattern. In this case the line is broken between the range spread section and the frequency spread section with q in the break. q is not used where a main trace is visible or when it may confuse the interpretation of frequency spread, Fig. 6.10 (a) (b).

p 144 section 6.3 (g)

(viii) August 1975. Definition of night E changed to that for particle E.

1.15 Night E: The ionogram pattern corresponding to night E is very similar to that for normal E. The difference is that the critical frequency is significantly larger than would be expected for normal E at the time involved and varies rapidly with time. Night E is often preceded or followed by retardation type Es or auroral type Es and is due to particle bombardment causing excess ionization in the E region. Thus at night when foE for normal E is between 300 kHz and 500 kHz, night E often shows values of foE between 1 MHz and 5 MHz. When night E is present, as shown by group retardation in the

E or higher traces, the critical frequency of this layer is included in the foE tabulation. Normal E is not seen in these conditions,

P 17 section 1.15

(ix) August 1975. Use of q on f—plots.

The old rule 6.3 (g) stated q is not used when a main trace is visible or when it may confuse the interpretation of frequency spread. This was a rule devised for equatorial stations where range spread develops from a normal pattern in order to enable a sharp distinction to be made. q can now be used more freely.

p 144 section 6,3 (g)

(x) August 1975. Use of G with night E.

The same conventions apply when foE is equal to or greater than foF2, foF2 = (foE)EG (usually a night E case). This is withdrawn in favor of A as this use of EG causes difficulties with foF2 medians.

p 64 section 3,2, 0

(xi) August 1975, Spread F typing and limit rules for the use of descriptive letters F,Q will change the apparent incidence of spread F.

(xii) August 1975. f plot.

Delete p 152, 6.6, line 2, “which are attributable to the same Es trace.”

XIII. Mr. J. Turner - Member of INAG

It is with much regret that INAG has received the resignation of Mr. J. Turner (Australia). Mr. J. Turner was one of the original members of the World Wide Soundings Committee and a founder member of INAG. He has contributed regularly to the work of both organizations and also helped our Chairman during the years in which he was URSI Vertical Incidence Consultant. Thus he has been active in working on behalf of the network for more than 20 years. Mr. Turner has had much influence not only on the details of WWSC and INAG projects but also has greatly influenced policy by his common sense comments. He will be greatly missed, INAG, on behalf of the world network, wishes to express appreciation and thanks for a long and effective service. We hope that Mr. Turner will feel free to continue to contribute to the INAG Bulletin and send him our best wishes for the future.

XIV. Solar-Terrestrial Physics and Meteorology: A Working Document

The purpose of this note is to draw attention to a most valuable document prepared by A. H. Shapley, H. W. Kroehl and J. H. Allen and at WDC-A for Solar-Terrestrial Physics, Boulder, and issued by SCOSTEP, 2101 Constitution Avenue, Washington, D. C., 20418, U.S.A. The object of the document is to encourage studies in Solar-Terrestrial Physics (STP) and Meteorology. It makes readily available a bibliography of over 800 references divided conveniently into three groups:
STP - weather, STP - climate, STP - atmosphere (combined weather and climate papers) and subdivided into pre—1958, 1958-1969, 1970-1975 periods. References are given to the major pre-1958 compilations of references, giving access to more than 1000 additional papers. This is supplemented by a list of addresses of active members (where known) for the period 1970-75.

The next section is valuable not only for studies of STP and Meteorology but also for studies in STP or with ionospheric data. It consists of nine tables summarizing the most important key dates needed in such work.

1. 40 isolated solar flares 1957-59 (Schuurmans).
2. 105 type IV proton solar flare events 1956-71 (Zeretos).
3. 545 solar sector boundary crossings 1957-1975 (Svalgaard) (with sign and rotation date).
4. Most important geomagnetically disturbed days 1884-1970 (Shapiro). On average about 8 days per year.
5. Geomagnetic disturbances 1950—71 (Roberts and Olson) (days when Ap both exceeded 15 and exceeded previous days value of Ap) 797 entries.
6. Major magnetic disturbances 1932—1914 (Allen and Dunham). Periods when average Ap was equal to or exceeded 40 in a 24-hour period determined by time of greatest activity. In general this starts with time when Ap is first large. 780 cases.
7. Recurrent magnetic disturbances 1890-1974 (Mustel). 228 cases.
8. Isolated magnetic disturbances 1890-1972 (Mustel).258 cases.
9. Annual mean sunspot numbers 1700-1974 (Waldmeier).

The book also includes reprints of the modern reviews by J. W. King, “Sun—Weather Relationships” (reprinted from Aeronautics and Astronautics, Vol. 13, No. 4, pp. 10—19, April 1975) with details of papers referred to in the review and by J. M. Wilcox, “Solar Activity and the Weather” (reprinted from J. Atmos. and Terr. Phys. 1975, Vol. 37, pp. 237-256) with sector boundary list updated in Table 3 listed above.

It is suggestive that the largest meteorological effects occur in winter when, as is well known, the ionosphere is also abnormal and both disciplines show systematic changes in behavior with the sign of the interplanetary magnetic field.

This document should be available at all laboratories in which ionospheric research is active.

XV. STP Notes No. 13, August 1975

STP Notes No. 13 has now been published and copies can be obtained from:

SCOSTEP Secretariat
National Academy of Sciences
2101 Constitution Ave., N.W.
Washington, DC 20418, U.S.A.

This issue contains summaries of the numerous planning meetings and symposia which have been held to formulate the programs for the IMS.

Of special interest to the network are the reports of MONSEE, MONSEE Bulletins (also obtainable separately from the above address), SCAR program for IMS, SHISG/ASHAY program, National Programs and Condensed Calendar Records.

Station Notes.

The following V.I. station notes have been abstracted from the STP Notes No. 13 – National Reports:

Brisbane, Australia (Dr. J. D. Whitehead)

The Phase Ionosonde. The vertical height of radio waves reflected from the ionosphere will be measured with an accuracy of 10m. Not yet operational.

Melbourne, Australia (Prof. K. D. Cole)

Phase path ionosonde. A phase path ionosonde is being constructed to measure sporadic E- and F-region irregularities giving group range accuracy of 1OOm, and discrimination in range of 0.5 Km.

Digital Ionosonde A digital ionosonde Is being developed incorporating angle of arrival measurements or studies of the effect of the Sq current on the E layer and to study F-region irregularities.

Hong Kong (Prof. A. J. Lyon)

Bottomside soundings of ionosphere using a C2/4 ionosonde, taken every 15 minutes, have been obtained since January 1969. (Due to age of machine the ionograms are not of very high quality -it is hoped that it will be possible to replace the ionosonde soon.) Note: This ionosonde was replaced by a refurbished C2/4 in August 1974.

From the ionograms the following data are obtained: foF2, M(3000)F2, foE, foEs, fmin, h'F, h'E and $h'E_5$. (Only on the hour.)

Monthly bulletins are produced of these data. From January 1971 the data analysis is being computerized and the computer output tables will be off-set printed in the bulletin. Reduced data from January 1971 will be available on magnetic tape. Copies of all Ionograms taken from January 1969 are being lodged in World Data Center A.

India

The following stations are in operation:

Place Name of Site	Geographic N Lat Coordinates (°)	E Long	Status x-exists p=plan'd	Particip. Organi-zation
ATMOSPHERE				
Ionosonde				
New Delhi	28.65	77.22	x	NPL
Ahmedabad	23.01	72.60	x	PRL
Haringatta (Calcutta)	23.00	83.60	x	IRPE
Bombay	19.00	72.80	x	AIR
Hyderabad	17.40	78.45	x	DLRL
Madras	13.10	80.30	x	AIR
Tiruchirapalli	10.80	78.70	x	AIR
Kodaikanal	10.20	77.50	x	IIA
Thumba	8.60	76.90	x	VSSC

List of Participating Organizations and Their Abbreviations

National Physical Laboratory, New Delhi	NPL
Physical Research Laboratory, Ahmedabad	PRL
Vikaram Sarabhai Space Centre, Trivandrum	VSSC
Institute of Radio Physics & Electronics, Calcutta	IRPE
All India Radio, New Delhi	AIR
Indian Institute of Astrophysics, Kodaikanal	IIA
Defence Electronics Research Laboratory, Hyderabad	DLRL
Bhabha Atomic Research Centre, Bombay	BARC
Indian Institute of Science, Bangalore	IIS
Uttar Pradesh State Observatory, Nainital	UPSO
Andhra University, Waltair	AU
Indian Institute of Technology, Madras	IIT
Poona University, Poona	PU
Kurukshetra University, Kurukshetra	KU
Indian Institute of Geomagnetism, Colaba, Bombay	IIG

(Chairman's Note: Not all of these stations appear to be giving adequate data.)

Tehran, Iran (Dr. H. K. Atshan)

New Ionosonde Model 1005 W (Magnetic AB).

Since the older ionosonde which the Institute has been operating began to suffer operational and maintenance difficulties, a new system has been installed and is now being adjusted and used.

This ionosonde and recorder Model No. 1005 W, manufactured by the Magnetic Aktienbolaget (AB), Stockholm, is based on a completely different design for transmission and reception; it operates with a log-periodic and a dipole antenna system No. 1906 originally designed by Bureau of Standards, Washington. A recording camera is equipped to photograph satellites as they pass near the zenith, and ionograms can be obtained simultaneously.

The Ionosonde has the following specifications:

-- Frequency range: 0.25 - 20.25 MHz
-- Frequency scale: logarithmic
-- Frequency markers: every 0.25 MHz in the range 0.25 - 20 MHz;
every 1 MHz in the range 3 - 30 MHz;
at band edges 2.25 and 20.25 MHz with an accuracy of 0.1%

Transmitters:
-- Peak pulse power output: 25 kW at 600 ohms (reduced to 10 kW)
-- External trigger: 25 Hz - 60 Hz
-- Pulse width: 70 - 100 microsec.

Receiver:
-- First IF, Bands I, II and IV: 4 MHz; Band III: 8 MHz
-- Second IF: 455 kHz
-- Tangential sensitivity: 2 microV
-- Selectable IF bandwidth: 10, 20, 35, & 75 kHz
-- Video differentiation: 10, 20, 50 & 100 microsec

Recording system: high & low speeds
Height Measurement Features

-- Height ranges: 0 - 250 km, 0 - 1000 km, and 0 - 2000 km, adjustable ± 25%
-- Height scale: linear
-- Height markers: 100 km and 200 km, with an accuracy of ± 0.5%

Cameras: 35mm and 16mm. Power consumption: 2 kW

South Africa (0. A. van der Westhuysen, Secretary SANCGASS)

The South African National Committee for Geomagnetism, Aeronomy and Space Sciences (SANCGASS) have agreed that national participation in the IMS be aimed at a number of specific problems within the framework of the IMS program. These specific problems are listed in the schedule below and an indication is given of how existing and planned observations will contribute to their solution, In the rest of the document each of the scientific problems is discussed in more detail. (See also 1973 Report in STP Notes 12, which lists the Universities and research institutions involved.)

Angle of arrival at SANAE under consideration.

ANALYSIS OF PLANNED SOUTH AFRICAN PARTICIPATION IN THE INTERNATIONAL MAGNETOSPHERIC STUDY
Vertical Incidence Ionosphere Sounding

List of stations	Lat.	Long.	L	Topics 1	2	3	4	5	6	7	I	Status
Marion Island	—46.85	37.87	2.71	.	0	0	.	.	x	.	.	A
Johannesburg	-26.20	28.03	1.57	.	0	0	.	.	0	.	.	A
Hermanus	-34.42	19.22	1.84	.	0	0	.	.	0		.	A
Grahamstown	-33.28	26.48	1.84	0	0	0	.	x	x	.	.	A
Sanae	-70.31	357.64	3.93	0	0	0	.	x	x		.	A

List of topics
1. Monitoring of plasmapause and plasmasphere
2. Large storm effects and motion of auroral oval
3. Propagation of auroral energy towards the equator
5. Effects of the South Atlantic Anomaly
6. Particle precipitation and its effects

List of symbols used in table above
X indicates that the investigation is regarded as a major contribution to the topic at the head of the column.
0 indicates an incidental contribution.
A indicates existing observations.

B indicates intended observations.
C indicates observations under consideration.

XVI. Study of Travelling Interplanetary Phenomena — STIP

SCOSTEP has set up a working party to study the Solar Wind phenomenon with

Convener:	Dr. M. Dryer Space Environment Laboratory NOAAERL Boulder, Colorado 80302, U.S.A.	and Secretary:	Miss M. A. Shea AFCRL Space Physics Laboratory Hanscoin Air Force Base Bedford, MA 01731, U.S.A.

The first newsletter of this working party has now been published giving inter alia the addresses of the interested scientists, proposals for programs, list of satellite launch dates, paper titles of open meeting held at Varna, Bulgaria, June 4, 1975 and comments by scientists.

Anyone who wishes to receive this publication is requested to write to the Convener or Secretary giving name and address.

Special Observational Intervals for the Study of Travelling Interplanetary Phenomena

At their meeting in Varna, Bulgaria (during the 18th Meeting of COSPAR) SCOSTEPs group for the Study of Travelling Interplanetary Phenomena (STIP) proposed three intervals for intensified observations. These intervals were later endorsed by COSPAR Working Group 2 and COSPAR itself, the SCOSTEP Steering Committee for Solar and Interplanetary Programs, and the SCOSTEP Bureau.

These periods, listed below, were selected on the basis of the positions of interplanetary spacecraft relative to each other and to the earth-sun line, as shown in each case.

Interval I: September - October 1975, with special emphasis on the shorter interval 8-25 September during which time

Helios A and Pioneer 9 will be aligned (10 September);
Helios A and Pioneer 8 will be aligned (16 September); and
Helios A and Pioneer 5 will be aligned (23 September).

Interval II: February - March 1976, during which interval Helios A and B will be close, if Helios B is launched in early December 1975 as expected. (This interval may be shifted somewhat depending on the actual launch date of Helios B.)

Interval III: November 1977 - January 1978; that is to say, about the first three months after the launch of ISEE A/B (now expected in October 1977). The attention of University stations and those operating for special projects only is drawn to these periods. Please try to have your ionosondes operating during them and notify either your WDC or INAG of the existence of your observations so that this information can be sent to scientists using the satellite data.

XVII. Riometer Equipment

The solid state riometer described below is available from La Jolla Sciences, Inc. If interested, please contact Dr. H.J.A. Chivers, Dept. of Applied Physics and Information Science, University of California San Diego, La Jolla, CA, 92037, U.S.A.

LA JOLLA SCIENCES RIOMETER
Standard Specifications

Operating Frequency:	30 MHz ±0.01%. Others available, 20 to 100 MHz.
Receiver Bandwidth:	3 dB 150 kHz. Crystal filters available. 60 dB 4.0 MHz
Time constant:	0.25 sec. or more (Factory adjusted, specify value)
Intermediate frequency:	10.7 MHz, Image rejection: >60 dB
Input impedance:	50Ω
R.F. switch loss:	<1 dB, R.F. switch isolation: >40 dB
Calibrations:	Internally generated for 56 sec. each hour from crystal controlled clock. Four levels are used, one each hour, to cover the expected signal range.
Data output:	0 - 5V for digital interface or chart recording.
Time marks:	Hourly from calibration sequence, accurate to ±0.001%
Operating temperature:	-25°C to +30°C
Size:	10.1 cm x 12.7 cm x 17.8 cm
Weight:	1.8 kg, including cast aluminum case.
Power drain:	0.8W at 12V DC
Power input:	11OV AC, 220V AC, 12V DC or 28V DC
Operating mode:	All calibrations and time marks generated internally eliminating the need for external adjustments or controls.
Maintenance:	Not required under normal conditions. An auxiliary switch and test unit which controls the riometer functions is available and recommended for isolating faults.

* ** ** ** * * ** *

Prices:	Standard riometer	$1450.00
	Auxiliary switch and test unit	325.00
	Air shippable antenna kit	200.00

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Delivery: 90 days after receipt of order.
Terms: Net 30 days, 1.5% per month added to past-due accounts.

Prices effective January 1, 1975
f.o.b. La Jolla, California

XVIII. World Data Centers

World Data Center A for Solar-Terrestrial Physics, NOAA, Boulder, CO. 80302, U.S.A.
Activities for July 1, 1974 - June 30, 1975.

1. VI Data disseminated:

Type	No. of Requests	No. of Station Months
Ionograms	64	799
f—plots	22	1,281
Daily hourly values	83	9,349
Electron density profiles	30	257

2. In addition, 132 issues of *Ionospheric Data* containing median values were distributed.

3. A catalog including all of the ionospheric data available at WDC-A is nearing completion. This will include pre-IGY holdings. The formats in which the data are held will be included, especially those in computer compatible form.

World Data Center C2 for Ionosphere, Radio Research Laboratories. Japan

Activities for the period April 1974 — March 1975.

1. Data received from WDCs A, B2, C1 and Ionospheric Stations:

   Booklets and Sheets: 2100

   Microfilms: 51 rolls of 1000 feet each 47 " " 100

2. Data sent and lent to users:

To	Other Centers	Domestic	Foreign Researchers	Total Researchers
Booklets and Sheets	553	1035	1	1589
Microfilm (roll)	124	857	14	995

3. Adjustment and compilation of microfilm data in office:

Microfilm from WDC-A	Ionograms	16 reels	1000 feet each	
	Others	1 "	100	
Microfilm from WDC-B2	Ionograms	19 "	1000	
	Others	18 "	100	

Microfilm from WDC-C1	Ionograms	23	"	100
	Others	1	"	100

4. WDC-C2 Catalogue of Data for Ionosphere:

   Cumulative catalogue of ionosphere data for the period 1 July 1957 - 31 March 1975 will be available in August 1975.

5. Daily hourly values of Japanese ionospheric data are stored on magnetic tape from June 1968 onward.

World Data Centre C1 for Ionosphere, Appleton Laboratory. Ditton Park, Slough 5L3 9JX, England

The 21st Catalogue of Ionospheric Data, including data received through April 1975, was issued in August 1975. It includes concise summaries of years for which data are available and detailed lists by month and year.

URSI COMMISSION III WORKING GROUP 1. INAG QUESTIONNAIRE

Names and addresses of groups using vertical sounding data:

a) Known to be active — Field
   Name and address

b) Believed to be active — Field
   Name and address

c) Further in9uiries should be directed to the following: — Field

   Name and address