IONOSPHERIC NETWORK ADVISORY GROUP (INAG)*

IONOSPHERIC STATION INFORMATION BULLETIN No. 34**

*Under the auspices of Commission G. Working Group G1 of the International Union of Radio Science (URSI).

**Issued on behalf of INAG by World Data Centre A for Solar Terrestrial Physics, National oceanic and Atmospheric Administration, Boulder, Colorado 80303, USA. This 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.

1. Introduction

by W. R. Piggott, Chairman

The proposal to close WDC-A, reported in INAG 33, caused much concern about the future of the network and of INAG. However, both the International Community and the National Groups in the USA took action to show support for the WDC and these actions were, in fact, effective. The net result will probably be beneficial with much more attention to the importance of good synoptic monitoring than might otherwise have occurred.

I am happy to be able to report that the future of the Network and of INAG now appears to be good. The meetings held at Edinburgh and Washington showed active interest in VI sounding with much replacement of obsolete ionosondes, and many proposals for new stations and station nets. It is likely that the network will grow significantly in the next three years.

The retirement of our Secretary and Vice-Chairman Miss Virginia Lincoln and the changes at WDC-A have enforced a reconstruction of INAG and in its method of operation in the future. I should like to add my own thanks to the old members of INAG to that expressed by URSI Commission G and I am sure that you would also like to thank them for all their work (see p 11). A list of the members of the reformed INAG and their addresses is given at the end of this Bulletin.

I shall remain your Chairman for the next three years, but will spend more time in visits to stations and groups and less on writing the Bulletin. I hope that most of the Bulletin will be contributed by INAG members and that it will prove possible to issue four Bulletins per year, each rather shorter than recent issues. I shall continue to contribute to Uncle Roy's Column, and to the introduction and will edit the Bulletin. The main work will be done by our new Secretary Mr Alan Rodger and Assistant Secretary, Mr Raymond Conkright, the former producing the manuscript and the latter duplicating and circulating it. There may be some difficulties, at first as the master list of INAG Bulletin distribution has been destroyed. If you are not getting the right, number of copies please inform Mr Conkright. as soon as possible.

For this to continue, it is essential that those groups who are able to contribute $20 for the three years for each set of Bulletins do so. This is only a token payment, the real cost is much greater. The token is needed to show that the Bulletin is valued by you, otherwise the subsidies will be cut off and INAG will cease to exist. An invoice is attached to this Bulletin.

Mr Conkright will take over the work at WDC-A originally done by Miss Virginia Lincoln, issuing letter codes for new stations, copies of the Handbook etc. Please inform him of the latitude and longitude, preferred name and the address of any new stations you may set up, even if they are not contributing regularly to the WDC.

Subject to confirmation, it is proposed that Dr L. F. McNamara will be Vice-Chairman of INAG and will act as Chairman on my retirement in three years time. In the future the Chairmanship will rotate regularly so that more people take a leading part in INAG work. I feel very strongly that it is not good for the Network to have to depend so much on one man - I have been Chairman or URSI VI Consultant for over 21 years so tend to become the final authority!! I hope that the more active role of INAG members will produce an informed Committee who can do the work better than I can. By enlarging the membership it should be possible for several INAG members to attend each INAG meeting and thus provide the continuity which I have provided in the past.

As you will see (p 7) URSI Commission G has adopted many recommendations which originated in INAG, but has shortened them for general use. Copies of the original fuller versions are available to any interested. This reflects the interest of the Commission in the work done on your behalf by INAG.

Intercommission discussions at Washington showed that there was much interest in trying to expand other ionospheric synoptic services, e.g. beacon observations, VLF whistlers, absorption etc, and I was requested to draw the attention of administrations operating VI stations to the desirability of making such measurements.

I would like to take this opportunity to welcome all the new members of INAG and to wish them every success in their work for the VI network.

2. Report of the INAG Meeting held in Edinburgh, UK 3 August 1981

An INAG meeting was held on the 3 August 1981 in Edinburgh, UK, during the 4th Scientific Assembly of the International Association of Geomagnetism and Aeronomy. The meeting was attended by 13 people representing 9 countries.

Participants:

W. R. Piggott (Chairman)
J. V. Lincoln (Secretary)
J. As (Netherlands)
E. Carman (Australia)
J. A, Gledhill (South Africa)
R. D. Hunsucker (USA)
T. Ishimine (Japan)
T. Kelly (Australia)
J. Oksman (Finland)
A. Rodger (United Kingdom)
D. Sabben (Netherlands)
P. Vila (France)
G. 0. Walker (Hong Kong)

Chairman's Introduction

The Chairman outlined the purpose of INAG and introduced a few of the problems discussed below. The importance of the bulletin was emphasised as a forum for ideas and opinions. Over 400 copies of the Bulletin are now circulated.

State of the VI Network

The Chairman reviewed the history of the network stating that 167 stations had operated during the IGY period. From 1960 numbers had varied around the level of about 110 stations with an additional 40-60 operating on an intermittent or campaign basis. During the period 1960-79 about 60 IGY, IGC stations have closed but an additional 60 stations have opened. Present trends suggest that about 130 stations would be operating on a routine basis during the early 1980's. About 15 stations had opened since 1980 and others are planned. Only 8 have closed since 1979. This reflects the upsurge in interest in ionospheric sounding.

IPS-42 ionosondes (or equivalent) are now operated at about 40 stations. The digital receiver, DBD-42, being developed by KEL AEROSPACE has met some production difficulties. However they are developing in parallel an equipment which will use the standard output of the IPS-42 to record the information in digital form.

USA

WDC-A hope to continue to operate the Boulder, Wallops Island and Maui ionosondes under contract. WDC-A will also try to continue to support other stations with which they are involved but this will necessarily be at a reduced level due to financial constraints.

The status of the ionosondes under the control of the Alaska Geophysical Research Institute is given in the table below.

	type	location	status and comments
1.	C3/4	Sheep Creek (10 miles from Fairbanks)	Operating routinely on 15 minute programme for more than 25 years.
2.	C3/4	Sheep Creek	Spare for above - till July 1981 used at Kodiak, Alaska (L=4) for 11 years on 15 min. and hourly programme.
3.	C3/4	Cape Perry	on standby but used on a campaign basis.
4.	C3/4	Sachs Harbour	On standby but used on a campaign basis.
5.	A.I.S. (NOAA Sounder)	Cleary field site 4 miles from Chatinika	operated since July 80 - carried out 6 campaigns. Move to Roberval in March 82 for one year then to Sonderstromfjord.

Gough Island

South Africa intend to open a station on Gough Island in 1983/84. Initially it will be run for two years. International pressure would be required to keep the station open after this time. The proposal for this station has been supported by WWSC and by INAG for many years as it is in a most important position for both scientific and for CCIR purposes.

Papua New Guinea

Operating routine programme.

Equatorial Latitudes

The very limited number of ionospheric observatories operating effectively at equatorial latitudes was a cause for concern. The status of observatories in South America and Africa was not clear.

Needs of Developing Countries

There is a strong desire in many of the developing countries to contribute to the scientific community and also to gain quickly the expertise acquired by others. In particular with ionospheric work, there are problems with training of staff in both running ionosondes and interpreting the ionograms; also problems in using and disseminating the ionospheric data collected. This was discussed at some length by the INAG meeting (see p 13)

Future of INAG

All participants at the meeting thought that INAG fulfilled a very valuable role therefore should continue. The Chairman was very pleased to announce that WDC-A would continue to publish and to circulate the bulletin provided that the editorial work was carried out elsewhere. The Chairman was prepared to continue provided he could have some secretarial help in UK and also provided INAG members played a more active role than in the past.

Proposed Changes

(a) IUWDS International Calendar

Recommendations for changes proposed at the INAG meeting in Geneva were accepted (see INAG 32 p 8).

(b) Guide to Data Exchange

It was noted that virtually no N(h) profiling exchange work was carried out. It was therefore recommended that it should no longer be included.

As costs for reproducing ionograms were so high, the minimum amount of ionogram data which are sent to the WDC's should be Quarterly World Days i.e. 4 days of ionograms per year.

The importance of sending all tabulated data to the data centres was stressed irrespective whether the data were in computer compatible form or not.

(c) Rule Changes

Es The proposal to allow Es types low, cusp, high and flat to be combined into one group to be known as worldwide Es and designated Es-w was supported. Also there was general agreement that Es-a should be allowed to blanket.

fxI Despite the apparent lack of use of fxI by ionospheric predictions groups, most felt it was an important parameter and should continue to be scaled.

High Latitude Problems

At present a network of ionosondes continue to be the best way to monitor high latitude phenomena over a large latitude and time extent. Most of the outstanding problems at high latitudes were raised in INAG 33 but three subjects were given special mention - indentification of the ionogram signatures of the polar cusp precipitation at equinox and in winter, F2 Lacuna and the longitudinal variations in Es and abnormal absorption.

Low Latitude Problems

Low latitude problems were discussed in the report of the Arecibo INAG meeting. The similarities of many high and low latitude problems were stressed and the value of the High Latitude Supplement for use at equatorial stations was emphasised.

Handbooks

(a) Training Handbook

The Japanese Atlas of Ionograms (see INAG 33) was thought to be the only practical way that a suitable manual would be produced. Therefore they should be strongly encouraged to provide an English translation which it may be possible to publish through WDC-A.

(b) High Latitude Supplement

This handbook was thought still to have great value in the identification and interpretation of high latitude phenomena. It was not to be practical or appropriate to revise it at this time, as there was no consensus on names and identification procedure.

3. Resolutions from the 4th IAGA Scientific Assembly Edinburgh

The following IAGA resolutions may be interest to readers of the INAG bulletin.

IAGA, noting that the World Data Centres for Solar-Terrestrial Physics have, in the past, played a vital role in helping to provide IAGA scientists with primary and support data necessary for them to carry out their research effectively and noting that the success of the data analysis phases of the International Magnetospheric Study and the upcoming Middle Atmosphere Program are strongly dependent on the continued availability of the large data archives handled by the World Data Centres, strongly recommends that national agencies which house and support the World Data Centres do all in their power to ensure that the high standards of data archiving and dissemination achieved by these organizations in recent years are maintained and, if possible, upgraded over the coming decade.

IAGA, noting that most meteor radar systems are now automated, considering the need for a more effective geographical distribution of meteor radar stations and recognising the high degree of co-ordination necessary to undertake simultaneous world-wide observations recommends that

(1) IAGA member countries be encouraged to support and extend the meteor radar network.

(2) international co-ordination be undertaken through a Global Meteor Observation System (GLOBMET) and that this co-ordination be effected in the immediate future through the Middle Atmosphere Programme in SCOSTEP

(3) a committee be formed within SCOSTEP with representatives from IAGA, IAMAP and URSI to produce a GLOBMET planning document.

IAGA, recognizing the continuing need for an International Geomagnetic Reference Field, recommends that:

(1) IGRF 1980 be used for the interval 1980 to 1985

(2) DGRF 1965, DGRF 1970, and DGRF 1975 be used, with linear interpolation, for applications requiring definitive values for the interval 1965 to 1975

(3) PGRF 1975 (i.e. DGRF 1975 and IGRF 1980 interpolated linearly) be used for the interval 1975 to 1980 until 1980 is produced.

(4) This pattern be maintained in future updates.

4. INAG Meetings at URSI XX General Assembly August 11 and 18 1981

The resolutions of these meetings are given below, together with a brief note on the network and reorganisation of INAG. The main report on the Washington meeting will be given in the next INAG Bulletin.

Formal INAG meetings were held in Washington on August 11 and 18 1981 and an informal meeting on August 8. There were 27 representatives from 11 countries who attended at least one of the formal occasions.

The attendance was as follows:-

W. R. Piggott	UK	Chairman
R. Conkright	USA	Secretary
J. V. Lincoln	USA	Member
L. McNamara	Australia	Member
J. K. Olesen	Denmark	Member
G. M. Pillet	France	Member
B. W. Reinisch	USA	Member
A. K. Saha	India	Member
A. H. Shapley	USA	Member

D. Baker	South Africa	T. Kelly	Australia
L. W. Barclay	UK	A. K. Paul	USA
K. Bibl	USA	M. P. Peres	Argentina
L. Bossy	Belgium	M. Pitteway	UK
J. Buchau	USA	A. W. V. Poole	South Africa
K. Davies	USA	S. M. Radicella	Argentina
J. R. Dudeney	UK	S. 14estinlund	Sweden
V. N. Jensen	Denmark	J. W. Wright	USA
T., B. Jones	UK	H. Xuequin	People's Republic of China

Network

The Chairman reported on the INAG meeting at Edinburgh (p 2) and summarised the present condition of the network. In addition to the information given at Edinburgh installation of new Chirp and Digital sounders were reported at Washington. Added to replacements already reported in INAG Bulletins it is clear that nearly half the network now has relatively new equipment. The main use of the data from the WDCs involves the median values. Almost all requests for computer compatible data were addressed first to WDC-A, but all data centres were actually using tabular data. There was a significant use of detailed data for particular periods, usually a few days. These analyses were seriously weakened by lack of knowledge of stations which operated, but only reduced data to special requests. Such stations were sometimes known regionally, but not at WDCs. The meeting recommended that administrations be asked to state the name, latitude and longitude of such stations and the name and address to which requests for data should be sent.

INAG

The Chairman summarised the work of INAG during the last three years and stressed the need to change the procedure for producing the Bulletin. Only five issues had been made in the period. These were each too long for convenient reading and it was generally agreed that more frequent shorter Bulletins were needed. Eight meetings in association with INAG had been reported in the Bulletin for this period:

(1) Finland Helsinki, August 1978 (Formal INAG Meeting)

(2) USSR Leningrad, October 1978 (Operators Meeting)

(3) Australia Sydney, May 1978 (Operators Meeting)

(4) Australia Canberra, December 1979 (Formal INAG Meeting)

(5) Switzerland Geneva, June 1980

(6) Norway Lillehamar, May 1980

(7) Puerto Rico Aquadillo, July 1980 (Equatorial Aeronomy)

(8) People's Republic of China Peking, March 1980.

The Chairman was involved with 1, 5, 6, 7, and 8. The increasing interest in the VI network, which appears to be partially due to the International Solar Terrestrial Predictions Workshop held in Boulder in April 1979, partly to new interest from Meteorological Institutions and partly to interest in real time forecasting of ionospheric conditions, suggests that an active network will continue for a considerable period and thus there will be a need for an organisation like INAG in the future. In view of this INAG should be reorganised so that it could also continue. Negotiations had been completed with WDC-A and most potential members and it was now possible to make detailed proposals. The guiding principles were:-

a) The Chairman and Secretary should in future be in the same country so as to facilitate the production of regular Bulletins.

b) WDC-A would be able to reproduce and circulate the Bulletin regularly provided:-

i) A fully edited manuscript ready for reproduction was made available and did not exceed about 20 pages.

ii) There was continued support from URSI.

iii) Support from administrations and scientists receiving the Bulletin was sufficient to show that the Bulletin was valued by those of its recipients who were able to contribute $20 per set of issues (invoice on back page).

c) It might be possible to reproduce future INAG documents in the UAG series, but the number of issues per year would be very small, subject to financial limitations and possible delay.

d) It was necessary to maintain long term consistency in INAG advice and yet allow for changes to meet changing circumstances. This could best be attained if the main membership of INAG was kept as constant as possible, but was increased so that several INAG members could be expected to be present at every meeting.

e) It would be advantageous if the especially heavy work of the Chairman and Secretary could be rotated to different countries at regular intervals, e.g. 3 or 6 years.

f) There would be a continuing need to hold INAG meetings in as many countries as possible so as to maintain continuity between different administrations.

g) There would be a continuing major INAG job at WDC-A involving:-

i) The reproduction and circulation of the Bulletin and maintenance of the Bulletin circulation list.

ii) The updating of VI station lists.

iii) Issuing INAG material to new stations.

iv) Providing station codes for new stations.

v) Acting as liaison between INAG and WDC-A.

h) i) The Vice-Chairman's job is regarded primarily as providing experience to take over as Chairman at a later date.

ii) The Vice-Chairman should organise INAG meetings where convenient and represent the Chairman if he is not able to attend a major INAG meeting, e.g. URSI, IAGA or CCIR.

iii) The Vice-Chairman should keep in contact with INAG members, initiating points for discussion and clarifying INAG policy.

i) Full members of INAG should keep in touch with the VI stations in their theatre, bringing problems to the attention of INAG and should try to set up operator discussion meetings. It is important that the problems raised be discussed in the Bulletin also. INAG members should attempt to maintain uniformity of analyses and continuity, remembering that changes are unpopular at stations and can easily cause more harm than good. It takes several years to establish a consensus for a change in parameters or rules.

Station Notes

Yugoslavia

A new station has opened at GROCICA (44°38'N, 20°46'E), address:

The Geomagnetic Institute
11306 Grocica
Yugoslavia

Indonesia

Five new stations have been set up using KEL IPS-42 ionosondes in Indonesia, one at Jakarta and the others forming an East-West chain along Indonesia.

USSR

No changes in the network.

5. URSI Commission G Business and Resolutions

Commission G Working Groups: Commission G decided to have eight working groups of its own in the period 1982-84 and to be involved in one joint URSI/IAGA working group (on Active Experiments; with Comm. H). The two URSI/IAGA working groups on the Structure and Dynamics of the Thermosphere, Ionosphere and Exosphere and on Neutral and Ion Chemistry and Solar Fluxes are recommended to be dissolved.

The Commission G Working Groups and their Terms of Reference are the following:

W.G.G.1 Ionospheric Network Advisory Group (INAG), Chairman: Dr W. R. Piggott (UK); Vice-Chairman: Dr L. F. McNamara (Australia); Terms of Reference:

◦ To monitor, maintain and improve the standards of data produced by the Vertical Incidence (VI) ionosonde network.

◦ To promote the interchange of data through the W.D.C.'s or by direct contact between stations and users.

◦ To produce regularly a Bulletin to further its ends and to provide a link between administrations operating VI stations and the users.

◦ To revise the parameters and associated rules to match the needs of the users.

◦ To evaluate and make recommendations on the international importance of proposed, or existing stations as required.

◦ To encourage the development of new methods of exploiting VI ionosondes output and the use of VI data by the scientific community.

◦ To encourage staff at VI stations by informing them on the use of their data and allied matters.

◦ To inform the VI network of development in techniques which could be usefully deployed at VI ionosondes stations.

◦ To hold meetings to promote these ends in as many countries as possible.

- Southern Hemisphere Atmospheric Studies Group (SHASG), Co-Chairman: Prof. J. A. Gledhill (South Africa); Prof. S. Radicella (Argentina); Terms of Reference:

◦ To maintain exchange of scientific information and to promote and co-ordinate radio observations and studies of the ionosphere in the Southern Hemisphere.

- International Reference Ionosphere (IRI) (jointly with COSPAR), Chairman: Prof. K. Rawer (FRG); Vice-Chairman: Dr. A.D. Danilov, (USSR; represents COSPAR); URSI members: Dr P. Bradley (UK) Dr N. Matsuura (Japan), Dr E. Kazimirovsky (USSR), Dr V. Wickwar (USA), and Dr D. Alcayde (France); Terms of Reference for the period 1982-84:

◦ Improve existing IRI, in particular:
  - New adaptive formula for subpeak plasma density (to be compared with true height, total electron content and inc. scatter data);
  - New formula for electron temperature taking account of relation with electron density and of height (and, possibly, seasonal) influence;
  - Better ion composition description based on larger data base, from rockets and satellites in particular;
  - Describe lowest ionosphere cluster and negative ions;

◦ Widen height range by modelling at altitudes above 2000 km and in plasmasphere.

◦ Discuss limitations, high latitude conditions, perturbations.

◦ Start empirical modelling of ionospheric drift data.

◦ Co-operate with CCIR-IPW 6/3 for improvement of world-wide mapping of peak data.

◦ Prepare IRI sessions (2) at 1982 (Ottawa) COSPAR meeting.

◦ Prepare subsequent third edition of IRI (probably 1983).

- Ionospheric Knowledge Needed to Improve Radiocommunication, Chairman: Dr C. M. Rush (USA); Vice-Chairman: Dr B. M. Reedy (USA) and Dr E. Throne (Norway); Terms of Reference:

◦ Modelling the ionosphere for applications to radio systems and performance prediction.

- Incoherent Scatter, Chairman- Dr M. J. Baron (USA); Vice Chairman: Dr M. M. Blanc (France); Terms of Reference:

◦ To foster communication, Co-ordination and Co-operation among workers in the field of incoherent scatter;

◦ To foster interaction and Co-operation between the incoherent scatter community and the general upper atmospheric science community.

- International Digital Ionosonde Group (IDIG), Chairman: Dr J. R. Dudeen (UK); Vice-Chairman: Dr K. Bibl (USA), Dr J. W. Wright (USA); Terms of Reference:

◦ To act as a forum and channel of communication for individuals and administrations interested in the design, construction and application of digital ionospheric sounders.

◦ To stimulate international support of the digital sounding community's interests within the Scientific Unions.

◦ To promote standards for data acquisition, interchange and archiving where a user need is identified.

◦ Assist in the interchange of appropriate system specifications and software for data acquisition and analysis.

◦ To facilitate the planning of Co-operative research campaigns.

◦ To encourage theoretical studies relevant to the design, development and application of digital sounding techniques.

- Panel on Southern Hemisphere Incoherent Scatter Facility (SHISCAT), Chairman: Prof. J. A. Gledhill (South Africa); Terms of Reference:

◦ To plan a Southern Hemisphere Incoherent Scatter facility.

- Use of Beacon Satellite Transmissions, Chairman: Dr. R. Leitinger (Austria); Vice-Chairman: Dr L. Kersley(UK), Dr J. A. Klobuchar (USA); Terms of Reference:

◦ To further the international co-operation between scientists engaged in beacon satellite observations of e ionized environment of the earth or in the interpretation of data from such observations and scientists as well as engineers who need information on propagation errors for definition of system parameters and for error specification and correction.

Proposed Symposia and Workshops for 1982-84

URSI main sponsor for the following symposia:

- Radio probing of the high latitude ionosphere and atmosphere: New techniques and new results, at Fairbanks, Alaska on 9-16th August 1982. Convener: Prof. Hunsucker (USA).

- Beacon satellite studies of the earth's atmosphere, at New Delhi, November 1982, Convener: Dr. Leitinger (Austria).

- The equatorial aeronomy symposium, in Kenya, probably in 1983.

URSI Sponsored Workshops Intended to Serve Developing Countries in Particular:

- Workshop on Ionospheric Modelling for Propagation Problems, in Africa in 1982 or 1983, Convener: Dr. Reddy.

- Workshop on the Use of Beacon Satellite Transmissions, in New Delhi; 1982, in connection with the above-mentioned beacon satellite symposium; conveners: Drs. Leitinger and Tyagi.

Co-Sponsored Symposia

- The STP symposium in Ottawa, May 1982 (URSI representative in the programme committee is Prof. Hultqvist).
- Symposium on Ionospheric Modification at IUGG General Assembly in Hawburg, August 1982 (Dr Stubbe is suggested to be URSI representative on the programme committee).
- Symposium on the Electrodynamics of the Polar Ionosphere and Magnetosphere, at IUGG General Assembly in Hamburg, August 1982 (Prof. Hunsucker is suggested to be URSI representative in the programme committee).

Representative of Commission G on MONSEE

Commission G decided to recommend Dr D. G. Cole (Australia) to replace Mme. Pillet (France) as Commission G representative in MONSEE.

Resolutions of URSI Council and URSI Commission G at Washington

Commission G recommends that the URSI Council adopt the following resolutions (if any of them is not accepted by the Council they will be Commission G resolutions):

(1) URSI,

being aware of the recent difficulties in continuing the full programme of the STP Data Centre at Boulder MCA), and

recognizing the very great importance of the services of this Data Centre for the worldwide scientific activities within several of the URSI Commissions,

urges the US authorities to continue and develop the WDCA services through the t980's.

(2) URSI,

having considered the report of the Commission G Panel on a Southern Hemisphere Incoherent Scatter Facility,

endorses the proposal that a feasibility study of a transportable incoherent scatter facility be undertaken, and

requests the Panel to investigate possible arrangements for the financing of the study, and to proceed with the study, as soon as possible.

(3) URSI,

being aware that the production of the Zurich Relative Sunspot number has been discontinued,

commends the Sunspot Index Data Centre (SIDC) for its willingness to provide a sunspot index and urges that it be prepared in a manner that makes it consistent with the earlier Zurich series.

(4) URSI,

recognizing the value of long term trans-ionospheric and propagation studies for modelling and application purposes,

recommends that governmental and intergovernmental agencies be urged to provide satellite beacons in the HF-UHF range.

(5) In view of the importance of multi-technique campaigns for investigations of the ionized environment of the earth, URSI,

recommends that the organizations planning multi-technique campaigns distribute information about the goals of the campaigns and required or desired facilities or techniques to make possible a full use of available equipment on an international basis.

(6) URSI,

recognizing that there is strong evidence for long-term variation in the earth's magnetic field, which affect the ionosphere and in the relations between solar activities and ionospheric phenomena, that monitoring of these changes is essential and that the value of data for these purposes increases rapidly with the length and homogeneity of the sequence available,

stresses the need to maintain stations with long sequences of data or, where this is not possible, to provide sufficient overlap with replacement stations.

(7) URSI,

recognizing that the monitoring of the ionosphere on a global scale using ionosondes continues to be of

major interest and involves a large number of institutions around the world;

draws attention to the desirability for these institutions to maintain an effective research effort in parallel with the monitoring activities, aimed at improving the value and availability of the data bases so obtained, and developing new methods to meet these needs.

Commission G adopted the resolutions listed below:

(8) URSI Commission G,

considering
a) the most valuable services rendered by the International Ursigram and World Days Service (IUWDS) to the international scientific community by ensuring the speedy transmission of information on phenomena of interests to radio scientists, geophysicists and astronomers;
b) the major contribution being made by this body for the implementation of international co-operative research programmes such as the Solar Maximum Year, the International Magnetospheric Study and the Middle Atmosphere Programme;

expresses its appreciation of the excellent work done by this Service;

view with great concern the uncertainties regarding the future financing of the Service; and

urges URSI, IAU and IUGG to jointly approach ICSU and UNESCO asking these organisations to make every effort to provide adequate financial support for the continuing full operation of IUWDS.

(9) URSI Commission G,

recognizing that there is a continuing interest in the maintenance of a Vertical Incidence ionospheric network, that a considerable number of new ionosondes have recently been produced and deployed, some in developing countries, and that INAG has made adequate arrangements for the future production of the Bulletin,

appreciating that significant financial support will continue to be provided by WDCA and some national administrations,

recommends that URSI continue to support the publication of the INAG Bulletin for the next three years.

(10) URSI Commission G,

recognizing
(1) the increasing interest in systematic radio measurement of the terrestrial environment, including those of the sea surface, the lower neutral atmosphere, the mesosphere, and the ionosphere;
(2) that the utility of these measurements is increased where they are co-located;
(3) that these diverse measurements may share similar resources, such as radio transmitters, receivers, antennas, data processing facilities, and observing staff;

recommends that national administrations should attempt to develop multi-purpose geophysical observatories including appropriate portions of the existing ionosonde network.

(11) URSI Commission G, in view of the increasing use of ionospheric channel probing by oblique sounding for the purpose of improving HF communications,

encourages the exchange of oblique sounding data and ionospheric properties derived therefrom, and

urges that an evaluation be made at many geographical locations of the potential for ionospheric assessment on a global and synoptic basis by this technique.

(12) URSI Commission G,

noting the potential importance of a vertical incidence ionosonde on Gough Island for URSI and CCIR programmes,

recommends strongly a vertical incidence sounding station be established at this site.

(13) URSI Commission G,

recognizing that high accuracy N(h) profiles are required for testing of the International Reference Ionosphere,

noting that adequate techniques exist,

recommends that agencies with suitable facilities produce accurate profiles and carry out such tests

(14) URSI Commission G,

expresses its appreciation of the preparation in Japan of a simplified training handbook based on the URSI Handbook of Ionogram Interpretation and Reduction, and

recommends that an English version be produced for international use.

Vote of Thanks to INAG Members

Commission G of URSI noting that the membership of INAG would be changed during the General Assembly, passed a vote of thanks to all past INAG members as listed below and in particular to the retiring Secretary and Vice Chairman Miss J. V. Lincoln.

Past INAG members:

J. V. Lincoln
D. G. Cole
G. A. M. King
R. I. Mesterman
V. A. Padula Pintas
A. H. Shapley
J. Turner
A. S. Besprozvannaya
I. Kasuya
N. V. Mednikova
G. Pillet
L. E. Petrie
G. M. Stanley

6. INAG Membership and Resolutions

Membership of WG G1 - INAG

Officers: W. R. Piggott (UK) Chairman
L. McNamara (AUS) Vice Chairman
A. S. Rodger (UK) Secretary
R. 0. Conkright. (USA) Assistant Secretary

Members: A. S. Besprozvannya (USSR)
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Honorary Members: N. V. Mednikova (USSR)
A. H. Shapley (USA)

A list of addresses appears at the back of this bulletin.

INAG Recommendations

Changes in International Rules and Parameters

INAG recommends that the following changes in parameters and rules be adopted by the VI stations and that the associated, additional texts be used where necessary in place of the rules given in the Handbook.

(1) Descriptive and qualifying letter symbols M and T will no longer be used.

(2) Values of foEs for k-type, sporadic E will no longer be recorded in the foE table.

(3) No distinction will in future be made between auroral Es traces seen at oblique incidence and overhead. Remove statements that Es-a cannot blanket. (See full instructions).

(4) World-type Es, Es-w: (see full instructions).

Where desired locally, distinctions between the standard temperate latitude types of Es, Es-f, Es-1, Es-c, Es-h may be ignored and traces of these types be classified as Es-w (world type). Es-1 traces with foEs and fbEs equal to or less than foE are ignored together with all weak Es-1 traces.

(5) When Es-k or Es-r is totally blanketing, it is denoted as Es-k (see full instructions).

Administrations who wish to continue using the old rules are encouraged to do so since the changes are designed mainly to enable analysis to be simplified where this is desired without destroying the

continuity of the data sequences. Full instructions will be given in a future INAG Bulletin.

INAG Resolution: List of Synoptic Stations who do not contribute data to W.D.C.'s

There is much scientific interest in studying special events on a worldwide or regional basis for which it is important to obtain the maximum coverage possible.

There are many administrations who make regular soundings so as to cover such events but who only analyze the data to special request. Such stations do not appear in W.D.C. lists showing active stations and so are usually overlooked.

INAG draws attention to the urgent need to provide an up-to-date list of such stations giving, for each station the name and address to which requests for data should be sent.

INAG requests help in preparing such a. list and in particular requests all administrations operating stations in this mode, who have not informed INAG of this fact within the last three years, to provide the requested information to the INAG Chairman or to the local W.D.C. INAG further requests the W.D.C.'s to maintain such lists for the future.

INAG Resolution: Assistance to New Stations in Developing Countries

The Staff at new stations in developing countries often have difficulties with the construction of overlays for analysis and with technical problems with their ionosondes.

INAG requests administrations who have developed and operated new ionosondes for synoptic purposes to send copies of their overlays (e.g. MUF factor curve) to INAG c/o W. D. C. A. and, if possible, to the manufacturers.

Any administration which is prepared to provide some technical training with their new ionosonde is requested to inform the Chairman of INAG stating type of ionosonde involved.

7. INAG Advice on the Future of the VI Network

W. R. Piggott, Chairman

At the second INAG meeting in Washington several participants, particularly from IDIG, expressed the view that INAG should take a lead in encouraging the formation of a logically based network for synoptic soundings, noting that the present network is very uneven, with large numbers of stations in some areas and none in others. These problems were last considered by the joint URSI-IAGA Working Group "Needs for Ionosondes in the 1980s", August 1977, INAG 26 page 7-14 (see also comments INAG 28 page 5, INAG 29 page 7).

This would represent a major change in INAG responsibilities which, in the past, have been restricted to drawing attention to the international value of threatened stations and to gaps where there was active interest in obtaining data with some chance of the gap being filled. At present INAG exists to serve the VI network and the scientists using its data and the official INAG view is that the decision to set up or maintain a station is primarily that of the sponsoring organisation who will make their decisions mainly according to local needs, but with some weight given to international needs. Thus INAG can collect opinions to help guide such decisions on request, but refers the sponsors to the 1977 Report for general principles.

It has been claimed that the 1977 report is now out of date and better criteria could now be established if INAG would take a lead. This note is being published to give you a chance to agree or disagree, I am rather doubtful whether it is true.

To start discussion my own views would be that it is possible, and might be useful, to request INAG members and collaborators to state what would be the criteria for an ideal network. This might at last draw attention to areas where new stations might be deployed effectively or special care be taken to keep old stations operating. INAG could then publish the results, leaving the administrations, as at present, to decide whether action is possible and desirable, This may seem rather a negative approach, but is probably the only one which will not do more harm than good - it is impossible for anyone to weigh up all the local practical and research needs which may be incompatible with setting up a 'most efficient' world network.

One major problem is to foresee what will be important research in the future, e.g. there have been epochs in the past when there was considerable support for trying to move stations to high or low latitudes, where ionospheric conditions vary rapidly with latitude and longitude and time. For CCIR mapping, on the other hand, a more or less uniform spacing of stations would probably be near optimum - the mapping process smooths out the greater gradients so that close networks are not necessarily effective. For the scientist ridges and troughs are particularly interesting, but often require chains of stations for proper analysis.

Recently, J. W. Wright and A. K. Paul have published a report entitled "Towards Global Monitoring of the Ionosphere in Real Time by a Modern Ionosonde Network" (NOAA, SEL, Boulder, Colorado 80303, USA, July 1981) which attempts to solve the CCIR problem using 88 stations and taking into account limitations due to oceans and deserts. In a scheme of this type, the choice of land stations is often arbitrary - anywhere within a 500 km radius of the nominated station would be equally good. It is probable that many more stations would be needed in zones, where the ionosphere changes rapidly with position unless the complex mixture of VI and oblique sounding using

-advanced equipment was available at all nominated stations. This study has, however, identified a number of key locations which could contribute significantly if occupied. Unfortunately, many of these are difficult logistically, but might become practical if reliable unmanned equipment could be developed and deployed.

Adak	Galapagos Island
Ascension Island	Guam Island
Azores	Camp Heurtin
Bouvet Island	Marion Island
Christmas Island	Marquesas Island
Diego Garcia Island	Muscat (Oman)
Easter Island	Pitcairn Island
Fiji	San Ambrosio Island
Fort Archambault	Tristan da Cunha

8. Needs of Developing Countries

Note to INAG meeting Edinburgh 1981 contributed by T. Kelly

Developing countries currently appear to have a very real need for help from INAG. The Administrations within these countries are usually eager to establish capabilities in many areas of science which they consider relevant to their immediate stage of development. Communications, particularly HF communications, is one area which usually attracts much interest. The establishment of peer relationships with other scientists throughout the world is also considered important.

The acquisition of ionospheric data in networks in developing countries provides a very effective base upon which to build the following:-

(1) A greater understanding of HF propagation.

(2) An increased potential for future real time frequency management and effective utilization of the available HF spectrum.

(3) An excellent possibility for the establishment of working relationships with peer groups of scientists throughout the world

These activities can obviously then be further developed to include participation in other areas of solar terrestrial physics in the future.

To the administrators of new ionospheric monitoring facilities INAG now represents that group of potential peer scientists. The new members' needs specifically are for:-

(1) Hardware - Ionosondes. These appear to be fairly easily available now.

(2) Training in Equipment Operation and Maintenance. This can be arranged for by equipment manufacturers, but additional training at stations with similar equipment could be invaluable.

(3) Training in Scaling Techniques. INAG needs to address itself to this problem with regard to developing countries.

(4) Training in Administration Techniques. The typical question in a developing country can be "What do we do with our ionograms and data?" The person in charge of the operation of a new ionospheric monitoring installation in a developing country will usually appreciate guidance based on the experiences of a group such as INAG in the following areas of administration:-

(a) The "Internal" structuring of his group which includes the establishment of his scientific group "within" his particular developing country. He needs to be shown the value of his scientific observations with regard to the many other departments within his country who can use his data. Such other departments can include Communications, Military, Geophysical and Educational authorities, as well as possibly some independent commercial organizations. The experiences of established INAG members can be valuable in this area.

(b) The "External" structuring of the relationships of his group with various international scientific organizations. INAG already has the mechanism for accepting new members and for sending out new handbooks, bulletins etc. It is suggested, however, that special emphasis could still be given to the particular problems of new developing countries that may become active in INAG. As well as exchanging data internationally there is a need for developing countries to quickly become active in co-operative projects which are matched to their early capabilities. INAG can possibly serve as an introductory medium in this regard. This can be a very important factor in ensuring the on-going success of new ionospheric monitoring facilities.

(c) Finally, the internal management of the actual station or stations (network) within the developing country can also be a task in which the administrator can benefit from INAG guidance and experiences. This matter can cover part of point (3), above, but it particularly refers to the basic management techniques of running a station or network on a day-to-day and year-to-year basis, as distinct from

the scientific techniques of actually scaling ionograms. INAG could help for example by providing suggestions for the organization of regular operators' conferences for a new network and could possibly arrange for supply of much of the technical data required for such an occasion.

A situation now exists in Indonesia, where two separate groups have purchased a number of IPS-42 ionosondes for monitoring along an extensive East-West chain throughout Indonesia. The two groups are LAPAN, and the Department of Meteorology. These departments are currently gaining a thorough appreciation of the operation of their equipment. They are also now very eager to further develop their ionospheric capabilities and they need to develop relationships with more advanced groups of ionospheric physicists throughout the world. They would appreciate assistance in the training of scaling personnel and they appear to be most interested in receiving co-operation from more developed groups in the design and implementation of actual monitoring projects and experiments. For more information on the possibility of co-operation with the Indonesian networks please write to one or both of the following:-

LAPAN
P 0 Box 26
Bandung
Indonesia

Attn. Mr Sugijo

Dept. Meteorology and Geophysics
JL.A.R. Achman Hakin 3
Jakarta
Indonesia

Attn. Mr Sutrisno or Mr Susanto

9. Some Problems in the Scaling of fmin

by A. S. Rodger, British Antarctic Survey

In this note, some problems concerning the scaling of fmin, which frequently raise questions during our annual ionospherics training programme at BAS, are discussed.

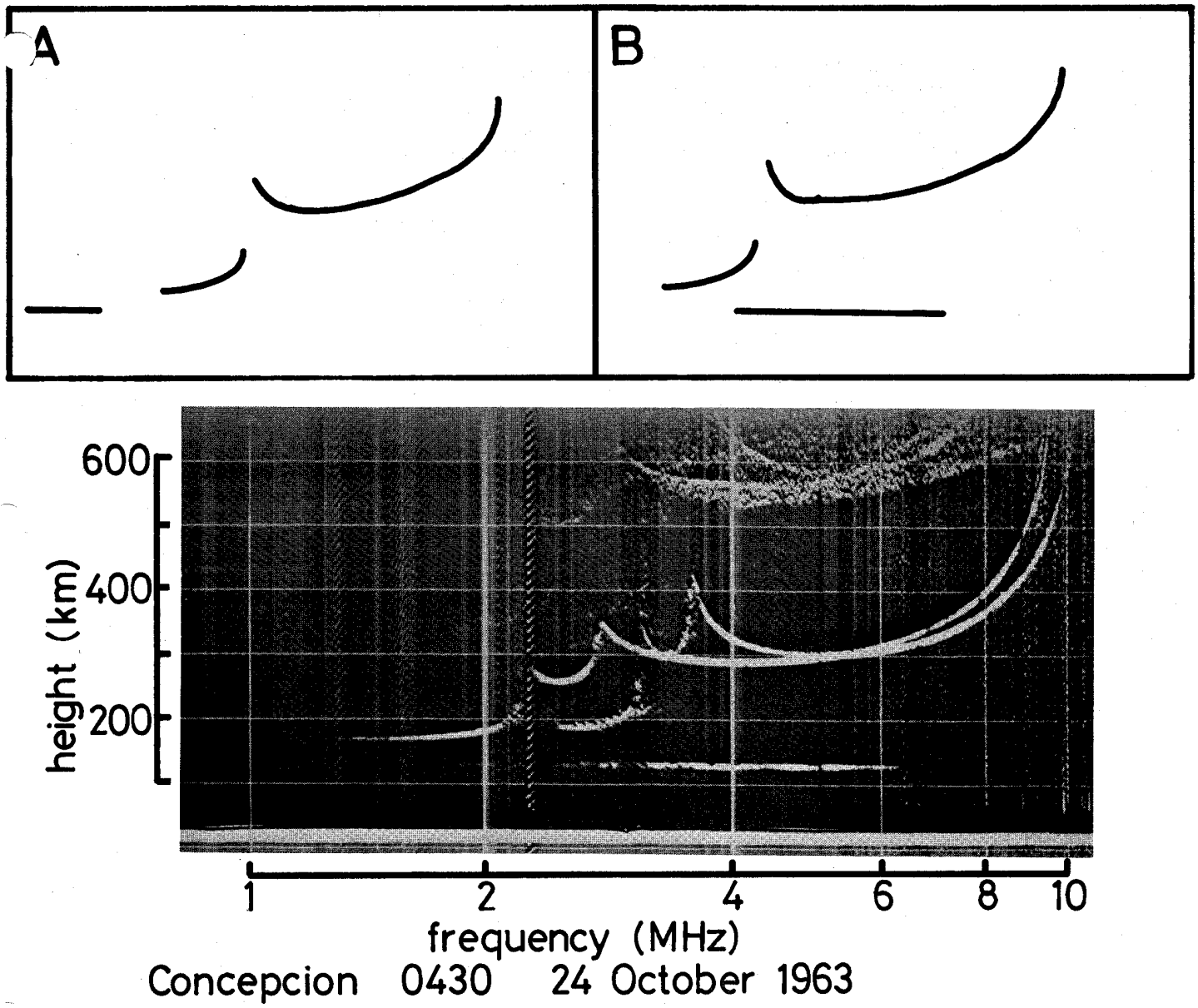
Basically, in Section 1.19 of UAG-23A, fmin is defined as the lowest frequency at which echo traces are observed on the ionogram. Problems arise when oblique, weak and transient traces are observed at the low frequency end of the ionogram. Guidance on how to recognise these cases and instructions on the way these examples should be scaled are given in Section 2.0 of UAG-23A. Difficulties also are caused when both o- and z-mode reflections are observed.

Strictly fmin should be deduced using an o-mode trace, but this is often replaced at the lower frequencies by z-mode reflections, particularly at stations where the magnetic dip angle exceeds about 65°. This is most common when fmin is less than the electron gyrofrequency, f_B, as explained in UAG-23A Section 1.04 (see Figures 1.4, 1.5 and 1.6) and also in summer daytime when the lowest part of the E trace is reflected near or below the coupling level (see Section 1.05 of UAG-23A). The rules in Section 1.19 allows the separation of o- and z-mode traces to be ignored in these circumstances as their identification is often difficult. This raises difficulties with trainees when the distinction between o- and z-mode traces is clear which is a fairly common occurrence at higher latitudes, Many examples are given in the High latitude Supplement (see UAG-50 index z-mode traces).

Line drawings for two common problems are given in Figure 1. In the first example, A, there is a considerable gap between the top frequency of the Es-1 layer and the minimum frequency of the layer above. As drawn in the figure, the upper trace is from a normal E layer, but at night it is often an F-layer trace. Some examples are shown in UAG-50 p 79 and on p 135 0145 ionogram. This problem can also be discussed using the ionograms in INAG 29 pp 18-22 when the traces below 0.5 MHz at heights near 100 km are clearly z-mode reflections. Can they be neglected under the weak trace rule? As the ionosonde sensitivity is normally low at these frequencies and the observed traces are as solid as would be expected from a normal reflection at 0.5 MHz, this is not allowed. Should fmin be scaled from the low frequency end of the o-trace of the E layer in these examples?

In all the examples quoted, it is very probably that the Es-1 type trace is really a z-mode reflection. Broadcast band interference has not contributed significantly to the difficulties in interpretation. Logically, in Case A and the examples, fmin should be scaled from the low frequency end of the normal E trace.

In example B, problems arise when it is not clear which traces are more nearly overhead. This can be illustrated using the ionogram from Concepcion kindly supplied by Richard Smith from WDC-C1 at Slough. Further examples are given in the High Latitude Supplement on p 154 at 1945.and 2045, p 161 and p 163. The ionogram from Concepcion shows a weak second order trace of the major stratification between the E and F layers and a relatively strong, if diffuse, second order F trace such that 2h'F=h'2F. In contrast, the Es layer near 120 km shows no multiple traces. Thus, the evidence strongly suggests that the Es layer is oblique and should be neglected for scaling purposes and fmin should be scaled from the normal E layer. In this case, the Es trace was probably due to a trail of ionisation caused by the passage of a meteor. In addition, this Concepcion ionogram shows a good example of ground backscatter from the second order trace (see UAG-23A p 99 for a full explanation).



A final cause for debate is the case when fmin can be given either by the lowest frequency of d-type trace or a higher frequency from a normal E or F layer trace. There are two classes, the classical high absorption case where the difference in fmin is very large, and the Es-d reported by Rodger and Boteler in INAG 27 p 32-33 (see ionograms p 33). The Es-d trace is often weak and can then be ignored under the weak trace rule, but sometimes it is clearly stronger than the normal trace! In Figure la, p 33 the Es-d trace is certainly not weak at the lowest frequencies whereas in Figure 1c it is clearly weaker than the main traces. These have been interpreted as gradient reflections, implying that they are relatively weak. Is this sufficient to rule that they should be ignored? Section 4.83, on Es types, type d states that this trace "should never be used to determine values of fmin, foEs or h'Es". Thus, fmin in case la apparently should be given by the normal trace if the Es-1 is of the d class.

Chairman's Comments

General

In INAG, we always have the difficulty of trying to balance two incompatible points of view. On the one hand there is the user and particularly the specialist in any field who want the greatest possible accuracy in the data; on the other hand the administrators have difficulty in training their reduction staff who often find it difficult to learn complex rules. Once analysis staff have reached a high level of expertise and are interested and knowledgeable in the ionosphere, they want to be more accurate and logical - but this implies more complexity and often involves more time in analysis at the stations. Thus a balance has to be found, weighing the increase in value of the data against the extra cost of training and in analysis time. This varies with the amount of use of the data which can change in time. In the past, for example, interest in foF2 and Es have resulted in the tightening of the rules. Also, the use of lacuna at high latitudes for magnetospheric studies has made it worthwhile to give fuller instructions for its analysis. At present, the decrease in the interest in Es types would justify some simplification of the rules.

fmin Difficulties

fmin is a crude, but useful, measure of the sensitivity and performance of the ionosonde. Also for many equipments, variations in fmin can reflect variations in ionospheric absorption. Many difficulties arise because the signals near fmin (except in the EE and ES cases) are normally weak and thus the traces must look like weak echo traces. Thus we always stress finding the lowest frequency on which an echo is seen, whether continuous or intermittent, when measuring fmin. Alan Rodger is correct in drawing attention to some of the difficulties with fmin so that they can be debated.

Previous discussions in INAG gave a consensus view that the distinction z- and o-modes was too difficult for the average operator and that the gain in accuracy in making it was not worth the effort. Thus the INAG rule is that this case is ignored and treated as an o-mode. It should be noted that the z-mode when totally reflected is always less absorbed than the corresponding o- mode trace.

In general, partial reflection mode, e.g. a gradient reflection, will give a signal which is much weaker than the normal trace. Thus fmin for a partial reflection trace is normally greater than fmin for a normal trace.

The exception occurs when the normal trace is more heavily absorbed than the partial reflection, because the gradient of electron density with height is small for the main trace, as near a critical frequency or because the partial reflection is occurring below the main part of the D-region where most absorption occurs.

When the absorption does not vary rapidly in space, as is normally the case outside the auroral zones, oblique traces are more absorbed than vertical traces so that the lowest value of fmin is normally representative of the absorption present - hence the rule as given in the Handbook. At high latitudes, the absorption overhead may be much larger than that at oblique incidence since the particle precipitation is often very localised. In this case fmin from oblique traces is physically misleading. However, such localised precipitation moves about rapidly and there is no evidence that it is worthwhile to worry about this possibility.

There is a very real difficulty with Es-d and Es-1 traces, which can be either gradient or z-mode traces or both and may be used to define fmin. The distinction is often clear, but borderline cases need complicated rules for uniformity in interpretation as we have found with Es-typing. I am rather doubtful whether the gain in logic and accuracy is worthwhile, but would like to hear this discussed so as to see whether many groups have these problems. When it is clear that an o-trace and separated z-trace are present continuously)*Id logic would suggest using the o-trace for fmin. When it is reasonably certain that fmin is given by a z-mode trace this should be indicated with descriptive letter z, but it is unlikely that it is worthwhile to classify difficult cases accurately.

10. Future Meetings

In addition to the scientific meetings given on pages 8 and 9 of this bulletin others which may be of interest to INAG bulletin readers is given below. It may be possible to arrange an INAG meeting during some of these conferences if there is sufficient interest expressed to your Chairman.

Dates	Location	Remarks
9-13 August 1982	Fairbanks, Alaska	Radio Probing of the High Latitude Ionosphere and Atmosphere - sponsored by URSI.
23-27 August 1982	Leeds, UK	9th European Geophysical Society meeting.
16-26 August 1983	Hamburg, West Germany	5th Scientific Assembly of International Association of Geomagnetism and Aeronomy.

11. Names and Addresses of Members of URSI Working Group G1 - Ionospheric Network Advisory Group

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12. Invoice for INAG Bulletin Subscriptions

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