Analysis & Applic.

IONOSPHERIC NETWORK ADVISORY GROUP (INAG)*

Ionosphere Station Information Bulletin No. 23 **

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

** 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 gives a report of the INAG Meeting at Geneva, February 12, 1976, which was chaired by Mr. C. G. McCue, in the absence of your Chairman in Antarctica. It also includes some of the first corrections to the Handbook Supplement. If you have further corrections or questions which you would like discussed on this Supplement, please write to the Chairman at his new address:

Atmospheric Sciences Division
British Antarctic Survey
Madingley Road
Cambridge CB3 OET, England

This Bulletin is being written in a hurry in order to try to keep to our normal quarterly publication schedule.

One of the major points raised at Geneva, and before then at the meeting at Uppsala, in October, 1975, (INAG-22, pages 5 - 6), was the question of whether the reduction rules are becoming too complicated. At Geneva it was suggested that this was due to too much pressure from scientists who wished to use the data. However, in fact, normally all of the changes and clarifications have been made at the request of ionogram analysis groups. The more skillful groups have almost unanimously expressed satisfaction at the clarification and amendments made. It would be interesting to have the views of other groups, in particular of groups who feel that the system is getting too complicated. To be useful, points where simplification would be welcome should be mentioned. A possible solution to the difficulty could be to mark rules which apply to few cases with a special symbol in the Handbook so that these could be ignored at stations where the phenomena seldom appeared. Possibly the element which gives rise to the greatest amount of difficulty is the rules for handling sporadic E and in particular storm types of sporadic E at high latitudes. It would be useful to have the views of high latitude groups on whether a simplification is possible or desirable. The greatest uniformity is needed during the IMS, particularly since post mortem analysis showed wide differences in interpretation and methods of tabulation at high latitudes during the IGY.

The decisions on the re-organization of URSI are summarized in this Bulletin together with a list of the new URSI Commissions and the Working Groups of interest to the Vertical Incidence network. In effect this re-organization implies that URSI will cease to be active in geophysical and aeronomical problems and in particular in the physical aspects of the ionosphere. This increases the difficulty for INAG of marrying the producer and the user of the Vertical Incidence data. In future discussions on the use of such data will be the responsibility of IAGA. Your comments on the method of overcoming this difficulty would be most welcome. It appears probable that INAG should collaborate with the appropriate IAGA Working Groups and should invite material of interest to our network from these groups for publication in this Bulletin.

As a result of the re-organization, INAG becomes Working Group G1 of the new Division G of URSI.

II. Report of INAG Meeting, Geneva, Switzerland, February 12-13, 1976

Participants

C. McCue, Australia, Alternate for D. G. Cole, (Chairman for Meeting)

J. V. Lincoln, U.S.A., Vice Chairman and Secretary, INAG

G. Pillet, France, INAG Member

A. M. Bourdila, France

C. Davy, France

P. Vila, France

A. Giraldez, Argentina

H. G. Moeller, German Federal Republic

T. Turunen, Finland

Regrets were received from W. R. Piggott, D. G. Cole, I. Kasuya and A. H. Shapley. A letter of resignation as an INAG member had been received from L. E. Petrie, Canada.

Opening the meeting, the Chairman, Mr. McCue, (a) stressed the need for ionograms to be contributed to Uncle Roy's Column, (b) requested that comments and queries on the High Latitude Supplement, in particular on points raised in the Editor's Introduction, be sent to Mr. Piggott, (c) requested more replies to the questionnaire issued at Lima and reproduced in INAG-21, p. 37, and (d) drew attention to the voluntary ten dollar subscription for a set of issues of the INAG Bulletin for three years and stressed the need for groups who can afford this to make a subscription.

Dr. T. Turunen then gave a brief review of the proceedings of the meeting at Uppsala (INAG-22, p. 5-8). The following Agenda was adopted:-

1. Discussion of Es by Turunen
2. High Latitude Supplement - Report UAG-50
3. General Scaling Problems
4. Training Courses
5. New and Old Ionosondes
6. Status of Network
7. Status of Stations
8. INAG Membership
9. Miscellaneous.

Votes of Thanks

The INAG working group thanked Mr. R. C. Kirby, Director CCIR, for making the room in the ITU Tower available. Special thanks were given to Dr. T. Turunen for his discussions during the meeting. Miss J. Virginia Lincoln was thanked for taking minutes especially to be shared with the INAG Chairman, W. R. Piggott, who was unable to attend because he was visiting British bases in Antarctica.

1. Sporadic E discussion

Dr. Turunen, opening the discussion, stressed the relations between auroral Es or particle activity in the auroral oval, linking these phenomena with substorm, all-sky camera, riometer and micropulsation activity. He claimed that substorm activity could be identified using Es alone.

Effects of Ionosonde

Turning to effects of the ionosonde on the appearance of the ionogram (Supplement, p. 48-58) he stressed the need for observations of other stations to evaluate the effects of gain and dynamic range on the appearance of the ionogram. The modified Sodankyla ionosonde gave a defined dynamic range of 26dB independent of the absorption. With low fixed gain the weaker traces, such as slant Es or boundary reflections, are lost; with high gain, weak scattered echoes confuse the interpretation of the main traces and foEs is frequently given by a weak low Es trace.

With the normal prefixed gain method of operation, the effective signal-to-noise ratio and dynamic range varied with ionospheric absorption, modifying the apparent behavior of gain sensitive parameters.(Comment by Piggott: This is true but its effect can easily be overstressed. In my view it is more important at the average station to get the normal gain right - if too high, as at Kiruna, Supplement p. 32-47, some "normal" = "full" gain ionograms show this, compare with lower gain ionograms also given. In practice if this gain is well chosen, the data from different stations are closely similar. We always have to draw a distinction between what is scientifically desirable and what is possible at the average station manned by the average trained operator. This discussion adds weight to the case made by A. H. Shapley and J. W. Wright at Lima (INAG-21, p. 13-15) for ionosondes which record on magnetic tape and therefore have the facility of enhancing the effective gain and dynamic range at the analysis stage. T. Turunen's solution is, of course, much cheaper where the necessary skill to modify the ionosonde is available.)

Spread E

Turunen then discussed the distinction between Spread E, spread near the foE and auroral Es and stressed the scientific importance of the distinction.

Piggott. I concur with the scientific importance of this point but feel that it is definitely one where we have to decide between complexity in teaching and accuracy of interpretation. *INAG would like further discussion on this point.* Some details are given below:

At Sodankyla (Supplement p. 55-57, Figs. 2.19 - 2.21) and probably at least some other stations, spread traces are often present near foE at high effective gain giving a pattern which is closely similar to auroral Es (Handbook, p. 115, Fig. 4.29, top); Supplement p. 21, Fig. 1.47 g; p. 29, Fig. 1.67, d, e, g, h; p. 52, Fig. 2.15; p. 77, Fig. 2.38; p. 85, Fig. 2.44; p. 170, Fig. 6.3.

Weak Traces

Turunen states that Slant Es is always a weak trace, sensitive to noise conditions, and disappears when the ionosonde is operated to cut off at 26dB below normal echoes. At gain levels which show Slant Es he always sees weak low diffuse Es traces, whose top frequency normally exceeds those of the normal Es types. Dr. Moeller suggested that such low reflection co-efficient Es may be important for propagation and asked whether the Secant Law could be used with it. Mlle. Pillett and Mr. McCue stated that for communication the type of Es could be important and perhaps the weak low type Es was not effective. The Australians found fxEs x Sec I gave an oblique Es MUF when low type Es was not present. (Note by Piggott: Loran observations near 2 MHz show that weak boundary type reflections can be of great importance at oblique incidence, even when not detectable at vertical incidence. These badly need a systematic scientific study and appear more important for propagation than the boundary low Es seen on ionograms.)

Comments on High Latitude Supplement

The meeting felt that the Supplement was generally helpful and informative and congratulated the Editor and those helping in its production. Mr. McCue stated that IPS (Australia) would like to question some of the scaling and would send comments to INAG. *INAG wishes to receive similar comments from as many groups as possible.*

The Chairman (Mr. McCue) made the following comments to help further discussion. Mr. Piggott's views are also added.

(a) The description of fmin by R when close to foE. This is new to IPS, who have always scaled the lowest frequency as unqualified. Is this rule referenced anywhere?

Piggott. This has been common practice for many years amongst the rather few people who have used fmin as an absorption index and is a natural use of R - the non-deviative absorption is increased by deviative absorption near a critical frequency. An inspection of f-plots at temperate latitude stations will show that fmin shows a step when it approaches foE, being too high relative to a smooth curve when approaching foE from lower frequencies and (less marked) too low when approaching foE from higher frequencies. This point has also been raised by a few VI operators who have noticed the discontinuity in fmin near foE. With the increased use of fmin and fm2 (to which the same rule applies) for studies of the morphology of the winter anomaly in absorption it appears timely to make the use of R more widespread. Similar effects occasionally occur on fm2 when fm2 approaches foF1 and the convention could be applied in this case also--though only experts would normally worry about this. The use of R with fmin is a case where very little trouble appreciably increases the value of the data to the users of the data and should probably be recommended by INAG. *What are the views of other operators and users?* As in several other cases, the Editor has given the best possible use of the letter symbols in the examples in the Supplement, leaving it open to discussion whether these should be widely adopted or not.

(b) The IPS use of E(fmin)B for foE at night time will cease, thus alleviating the problem of giving conventional types of Es. This practice began about 3 years ago (Antarctic Stations only) in order to circumvent inaccuracies in sunrise/sunset observations (Supplement, p. 138).

Piggott. A note to this effect will be added to page 138 when all corrections to the Supplement have been received.

(c) The use of the cusp of the c-type Es to give an accurate numerical value of foE (Supplement p. 202).

IPS feel foE can sometimes be greater than the cusp frequency by more than accuracy limits and should therefore be qualified.

Piggott. This point is accepted. It is dealt with in detail in the Handbook, p. 32, section 2.4 and is shown in Fig. 2.2. It is essential that the operator is taught the extrapolation rules. My own practice is to have a typical normal E-trace overlay available so as to be able to check doubtful cases. This problem is raised at roughly 6 yearly periods mainly because the relative position of Es and E vary with geographic position and time of day, season and solar cycle. When examined, some stations find the majority of cases need no qualification, some that a significant number of cases need U or D, and this varies seasonally. Probably for the world as a whole the majority of cases should be unqualified so the simplest use is to take foE at the cusp - this is the standard practice.

(d) The diagrams given as Figures 4.32 and 4.33 in the Supplement appendix (pages 275 and 277) are especially useful and it is recommended that more use of such scaled figures be made in the INAG Bulletin.

Piggott. These diagrams were prepared by R. Smith of the Appleton Laboratory to help in the teaching of B.A.S. Antarctic Station Staff. *INAG would like to receive similar material from other groups which appears to be useful for training.* If such diagrams are submitted, published in the INAG Bulletin and, as in this case, raise wide interest they can also be added to the Handbook when next revised.

Mlle. Pillet stated that Terre Adelie comments on slant Es and G condition will be sent later.

Several present did not agree with fxI arguments in UAG-50, p. 74, since part of x trace visible (see Handbook, p. 85, for rules).

Piggott. This is a very difficult set of Figures, particularly the 2000 Figure, to which the note referred. fmin is high so the interpretation depends on the significance of the weak trace near 035 MHz. fxF2 would be expected about 029 and it is probable that the lower edge of the scattered trace is due to the x-mode. In making the comments I do not expect the weak trace to reproduce and it is clear that the foI is not less than 028 which would have given the same value of fxI as that actually recorded on the Figure. With the x-mode showing as clearly as it is here I concur with the arguments given at Geneva and would recommend reading from the x-trace.

Turunen objected to the interpretation in Figure 2.26, Supplement, p. 62, on the grounds that if the main Es type is blanketing there should not be a slanting trace.

Piggott. I put in this Figure, even though it is a very rare type of ionogram, because it indicates a way in which the argument should go and I expected controversy. We note at 0000 totally blanketing Es type f. At 0030, the controversial ionogram, the second order flat trace is clearly evident, ending close to fbEs as given by the F layer. The top frequency of this Es, 035, is higher than the top frequency of the Es-a trace so that foEs is given as shown by the flat trace. The a trace shows the characteristic of auroral Es, it is a dense trace, which is stronger than the slant. There is no reason when flat Es is varying rapidly with position, why an auroral Es should not be seen below fbEs for the flat trace. This is confirmed by the sequence where foEs has fallen greatly since 0000, probably 5 minutes later foEs should have fallen below 2 MHz. I do not concur with Turunen's objection. This is an extreme case of a very common phenomenon where classical temperate latitude Es types h, c, ℓ, f, are simultaneously present with typical oblique high latitude types a or r.

3. General Scaling Problems

It was felt that the complexity of the scaling rules has increased substantially over the last few years. While this is partly due to a more detailed knowledge of the ionosphere, it is also due in part to scientific lobbying for certain specific data dictated by research interests. If this trend continues it will become extremely difficult to train new operators. The original idea of being able to build up the original ionogram trace from the simply scaled data is being lost. If the scaling becomes too complex it will lose some of its accuracy and consistency. Some thought should perhaps be given to scaling particular types of events for specific periods when required.

Piggott.

(a) The real additions to the work at stations are due to the introduction and working out of the rules for fxI, lacuna, and spread F typing. In all three cases the rules have grown with time and are possibly not in the best form for training new staff. In my view there have also been many cases where the words for a simple but inaccurate rule have been replaced by a more complicated but more exact form. This has been valuable to well trained operators but a disadvantage to new operators. Probably the best solution would be to mark the basic rules so as to distinguish them from those less often seen. Unfortunately this solution cannot be unique as the behavior of the ionosphere changes with position and solar cycle. *I would like to have a meeting of those who are responsible for training new staff at fairly regular intervals since such people have the clearest views of the difficulties which are common to most new staff.*

(b) It appears to me that we may need to note the dates and times when particular types of phenomena are seen rather than describe them fully, e.g., trough, lacuna, slant Es phenomena.

(c) The suggestion that particular classes of phenomena should be stressed for specific periods could be a valuable method of getting uniform interpretation. *I would like to have other views on this point.* The work involved is clearly considerable so it would only be worth doing if widely supported. We could have, for example, an equinox or solstice month in which all groups were asked to do a spread F classification and were invited to contribute their problems for discussion. *Does anyone want such a program and has anyone alternative suggestions?*

(d) There are some cases in which I feel that the rules are not in the simplest form or where we may be trying to do too much. *I would like to receive other views stressing particular points.*

Turunen stressed that interpretation and science must be done hand in hand. Where the probability of occurrence was less than 3%, events could not be handled statistically and the rules should not be complicated to look after such rare events. *He believes that replacement letters R, S and B present problems which should be discussed further.*

4. Training Courses

(See also Training Course notice on page 21.)

Mr. McCue described the training course for Australian Station Operators which included training in the operation and maintenance of the IPS 4A ionosonde, scaling and interpretation of ionograms, with special reference to the High Latitude Supplement, and discussion of current problems raised by IPS Operators. For Australian stations, the operator is trained in Sydney for up to one year, and is sent into the field for a three weeks test before being assigned to a station. If the new trainee has adequate knowledge of electronics it takes 6 - 8 weeks to provide adequate training to run a one man station.

Dr. Giraldez reported that a short training course was given in Argentina in the summer of 1975. At LIARA two persons scale the data from three stations but the data from Antarctica were not too good.

At NOAA, Boulder, Colorado, a training course on video-tape is being considered. Other countries have indicated interest in obtaining the tape if it materializes.

The French do preliminary scaling in the field but all ionograms are re-scaled at Lannion before publication.

5. New and Old Ionosondes

Three prototypes of the Finnish sounder IS-14 (see INAG-22, p. 13, 19-20) are in production. The first is expected to be ready for Sodankyla in the fall of 1976. The receiver is the most important component. Cost will be about $40,000 (U.S.).

The construction of a prototype for a monitoring digital ionosonde is proceeding at NOAA, Boulder, Colorado. *A. H. Shapley invited letters recommending the best places for locating a dozen such ionosondes throughout the next decade.* Attention is also called to URSI Commission 3 Recommendation III.3 (this Bulletin p. 12).

Turunen again pointed out danger for scientific work using gain sensitive parameters due to an AGC based on noise level as used in both the Australian and Dartmouth ionosondes. Mr. McCue, however, replied that one gets good movies useful for engineering purposes at $3112 (Australian) including the camera.

Piggott. The situation is that we have a wide range of ionosondes operating at different gain levels. The general rule that the gain should be adjusted to give the optimum analysis of the standard parameters in fact makes many gain sensitive parameters comparable. As has been shown by Turunen, e.g., as given in Sodankyla Geophysical Observatory Report No. 17. "On the gain dependence of ionospheric parameters in High Latitude ionospheric soundings", a change in the mode of operation causes a change in the statistics so that the statistics given by an ionosonde with noise controlled AGC will differ from those given by a conventional or preset gain ionosonde. Further tests are needed. My feeling is that the noise controlled AGC system behaves more like the absorption controlled system advocated by Turunen than like the conventional system - decrease in noise level has been used for many years as an indication of high absorption conditions.

New Australian ionosondes are planned for Australian Weapons Establishment, Port Moresby, and British Antarctic Survey. The latter are investigating the use of the ionosonde as an observatory instrument. McCue was planning to build a total of twelve, but not planning to build commercially. Anyone was welcome to go to Australia to learn how to build their own ionosonde to this design.

Giraldez stated that the ASHAY ionosonde has died. Peru and Argentina were unable to do their part of the plan.

Turunen suggested that the method of operation of old ionosondes could be estimated by slant Es and letter Z. If slant Es measurements or z-components were often seen, these operate at very high gain.

Piggott. True at high latitudes but not at low.

If too rapid differentiation is used, spread traces occur more frequently than should be expected.

6. Status of Network

Dr. Moeller reported that there was danger that Breisach and Lindau might be closed at the end of 1976. He requested INAG to utilize replies to Lima URSI questionnaire (INAG-21, p. 6, p. 37) to sound out ionospheric community as to the effect of such station closures. Those present at the meeting felt that closing Lindau would be a great loss since it is a long term station and has been operated in a most efficient way.

New Australian ionosondes (IPS Type 4A) will next be sent to Mawson, Canberra and Hobart. Latter two are conjugate locations to USSR experiments under G. Bukin of IZMIRAN.

7. Status of Stations (see also Station notes).

The following were reported at Geneva:

Casey in Antarctica was closed December 31, 1975 by Australia. Port Moresby is to reopen. Perhaps within two years Darwin will reopen.

Dr. Giraldez announced that Ushuaia has reopened. Belgrano reopened a year ago. Trelew is to reopen.

Miss Lincoln said that the first new NOAA digital ionosonde will probably be installed at Chatanika. The Maynard station closed in July 1975.

Mlle. Pillet said that there would be no problems for French stations through the IMS. The French GRI (Groupe Recherche Ionospherique) no longer exists but all ionospheric work is now at MIR, Lannion.

Okinawa will stop on April 1, 1976, to end of year, in order to move the station to a new site a few kilometers southeast of the present one.

8. INAG Membership

At Lima it was decided that alternates should be nominated by INAG members so as to increase the representation at INAG meetings, help INAG members to contribute to the INAG Bulletin and give younger people some experience in the type of work done by INAG. Many members of INAG had been active in the field for many years and are now approaching retirement age. As in the past, membership of INAG is in a personal capacity, new members being selected by INAG and appointed by URSI Commission G.

Mr. Piggott's alternate is Dr. J. Dudeney.

Mlle. Pillet announced Mme. C. Davy from Lannion as her alternate.

D. G. Cole's alternate is G. Robinson of IPS.

Miss J. V. Lincoln's alternate is R. O. Conkright of WDC-A.

The Canadians have requested a letter from the INAG Chairman in order to state whether they should suggest a replacement for L. E. Petrie.

The group present felt it would be desirable to propose R. G. Rastogi as a member to represent the equatorial ionosphere even if it might mean an overall increase of one. He should be in contact with the Indian communications groups to keep the proper balance in his recommendations.

I. Mesterman continues as a member sponsored by the Argentinian URSI committee.

Turunen said more station people should attend INAG meetings. McCue commented that it was unlikely that actual station operators would ever be nominated to attend INAG meetings held in conjunction with CCIR, URSI or IAGA. These are attended by professional scientists and engineers and there is much competition for support funds which are limited.

Note by Piggott. I concur. It has always been my hope that INAG members and alternates would fill this gap by organizing suitable meetings of operators or attending those arranged by other organizations, e.g., I held a discussion of ionogram problems at Grahamstown, South Africa, during March 1976, and attended the meeting at Uppsala on behalf of INAG.

9. Miscellaneous

Translations

LIARA will translate the High Latitude Supplement into Spanish. The French plan to translate the new Chapter and Appendix giving corrections to Handbook, but not planning to do rest of High Latitude Supplement since data from French Antarctic stations are scaled at Lannion by staff who understand English. In the USSR the INAG Bulletins continue to be translated into Russian.

INAG Bulletin Notes

Miss J. V. Lincoln reminded everyone to react to the *italics* in the INAG Bulletins. They are points requesting action. *Send any objections or corrections to the High Latitude Supplement to W. R. Piggott. If "Uncle Roy's Column" is to continue, examples of ionograms and questions must be sent to Piggott.*

Attention was called to URSI Information Bulletin No. 195, September 1975, which contains the URSI Recommendations from Commission III and INAG. (The appropriate material is reproduced in this Bulletin).

III. INAG Meeting with CCIR Study Group 6 Interim Working Parties 6/1 "Sky-Wave Field Strength and Transmission Loss at Frequencies Above 1.5 MHZ" and 6/3 "Basic Long-Term Ionospheric Predictions"

February 12, 1976

McCue reminded the Group that URSI will now adopt problems that are basic to the engineering problems of CCIR. Of course, the CCIR requests will come from the Director of CCIR to URSI, and where appropriate, would be referred to INAG for assistance.

Bradley, Chairman of IWP 6/1, stated that their field strength predictions method depended on ionospheric mapping, ray tracings, ionospheric models, absorption, winter anomaly, auroral absorption, longitudinal effects, solar cycle effects, foE in auroral regions, polarization, prediction of Es, and there were special problems between 1.5 to 3 MHz.

Leftin, Chairman of IWP 6/3, stated that there was a mapping group in URSI under Charles Rush. There have been U.K. criticisms of deficiencies of CCIR mapping. CCIR has never claimed to be perfect, merely used all of the data that were available and are considering whether to remap this current solar cycle. At one time CCIR was criticized for not using merely the zenith angle dependence of foE. It has been known for a long time that particle E is present up to 90% of the time at some high latitude stations. CCIR needs help on how to use fbEs and foEs for propagation.

McCue--help is needed for the transmission qualities of the lower ionosphere, even for the higher ionospheric layers there are gaps in the Southern Hemisphere. Bradley said that theory could help understand propagation at frequencies above MUF and resolve the question of side scatter. Errors in estimating Hmax from the M(3000) factor need to be considered. There seemed to be a feeling that there should be some adjustment in present M(3000) factors. INAG could perhaps help in this regard.

IV. XVIII General Assembly of URSI, Lima, 11-19 August 1975

Important reorganizations of the work of URSI were agreed at its General Assembly at Lima and those of most interest to readers of the INAG Bulletin are summarized below: The main effects are the replacement of the old Commissions, in particular Commissions III on the Ionosphere and IV on the Magnetosphere, by new Commissions having different terms of reference.

In order to simplify the relations with other Unions, in particular with the I.U.G.G. URSI will cease to be active in the Geophysical and Aeronomical problems. This produces serious problems for INAG as those producing ionospheric and magnetospheric data by radio means remain in URSI whilst those using the data do not. The gap between producer and user of our data, which already gives us great trouble, will be increased. Clearly in future we shall have to look to IAGA for information on the current and future use of our data and should invite comments from IAGA Working Groups.

The change in emphasis will also mean that we are likely to have more contact with the type of practical problem dealt with by the C.C.I.R. in the future and that this Bulletin will become a natural vehicle for discussions on C.C.I.R. problems. *INAG would like to have your views on these developments so that it can continue to serve your interests in the future.*

The two new Commissions most closely concerned with our work are Commission G and Commission H, and INAG officially becomes Working Group 1 of Commission G.

Commission G. - Ionospheric Radio and Propagation.

Chairman:	Dr. J. W. King, Appleton Laboratory, Ditton Park, Slough SL3 9JX, United Kingdom.
Vice-Chairman:	Dr. A. P. Mitra, National Physical Laboratory, Hillside Road, New Delhi, 120012, India.

Commission H - Waves in Plasmas.

Chairman:	Dr. R. Gendrin, CNET, 38 rue du General Leclerc, F-92131 Issy-les-Moulineaux, France.
Vice-Chairman:	Dr. F. W. Crawford, Institute of Plasma Research, Stanford University, Stanford, California 94305, U.S.A.

C.1. — Reorganisation of URSI

The URSI Council, (Resolution C1)

has resolved, inter alii,

1. that the following be added to the Objects of URSI as listed in Art. 1 of the Statutes :

"(*c*) to stimulate and to coordinate studies of the scientific aspects of "telecommunications using electromagnetic waves, guided and unguided";

2. that the activities of URSI be concentrated on the topics listed in Annex 1 and that this list be reviewed at each General Assembly;

3. that the Commission structure shown in Annex 2 be adopted.

Annex 1. — *Recommended Topics*

(*a*) Electromagnetic measurement methods, including radio standards and biological interactions.

(*b*) Electromagnetic theory, including antennae and waveguides.

(*c*) Scientific developments in devices for telecommunications, including radioelectronics and microwave sources.

(*d*) Information theory, statistical fluctuation problems, signal processing and computer methods.

(*e*) Communications systems and system theory, including circuits.

(*f*) The electromagnetic noise and interference environment.

(*g*) Remote sensing.

(*h*) Radioastronomy.

(*i*) Wave phenomena in non-ionized media, including radiometeorology and radio-oceanography.

(*j*) Wave phenomena in ionized media, particularly in the Earth's ionized environment, including ionospheric soundings and radio communications (as far as the geophysics of ionized media is concerned, those aspects which do not closely relate to wave phenomena should be excluded).

(*k*) The application of telecommunications science to problems of ITU, through the channels of CCIR and CCITT.

(*l*) The teaching of the science of telecommunications (theory and practice).

V. URSI Council Resolutions of interest to INAG.

C.7. — STANDING COMMITTEE ON URSI MEMBERSHIP

The URSI Council,

considering that it is desirable to encourage the adherence of new Member Committees to URSI;

resolves

1. to establish a Standing Committee on Membership consisting of the following :

Prof. O. Awe (Nigeria) : Africa,
Prof. K. Géher (Hungary) : Europe,
Dr. A. Giesecke (Peru) : Latin America,
Prof. S. Okamura (Japan) : Asia;

2. to request the Committee to propose ways of bringing URSI to the attention of radio scientists in territories which have not yet decided to adhere to URSI and to send its recommendations to the URSI Board of Officers.

C.8. — URSI-ITU COMMITTEE

The URSI Council,

considering

(*a*) that the reorganisation of URSI will result in a reorientation of the activities of the Union and in the need to give increased attention to radiocommunications;

(*b*) that closer relations between URSI and ITU are desirable;

requests the Board of Officers to consult ITU regarding the possibility of forming a joint URSI-ITU Committee in which the Chairmen of appropriate URSI Commissions and CCIR and CCITT Study Groups would be members.

ANNEX 2. — *URSI Commissions*

Identification Letter	*Title*
A	*Electromagnetic Metrology* (including radio standards and biological interactions)
B	*Fields and Waves.* Electromagnetic theory and practice (including antennae and waveguides)
C	*Signals and Systems.* Communications systems and system theory (including circuits); information theory and signal processing (including fluctuation problems)
D	*Physical Electronics* and devices
E	Electromagnetic *Interference Environment*
F	*Wave Phenomena in Non-ionized Media* (including radio-meteorology, radio-oceanography and remote sensing of non-ionized media)
G	*Ionospheric Radio and Propagation* (including ionospheric communications and remote sensing of ionized media)
H	*Waves in Plasmas*
J	*Radioastronomy* (including remote sensing of celestial objects).

Notes :

(1) Commissions A, D, E, F and J correspond, respectively, to Commissions I, VII, VIII, II and V, usually with some broadening of the area of interest.

(2) Commissions B and C cover the area of interest of Commission VI.

(3) Commissions G and H cover the present areas of interest of Commissions III and IV. The theoretical aspects of wave propagation in ionized media are covered in Commission H, while communications aspects are covered in Commission G.

(4) It was not considered appropriate to create a Commission to deal with ITU (CCIR and CCITT) matters or with the teaching of telecommunications science since each of these subjects is of interest to several Commissions. It was agreed instead to recommend the formation of :

(*a*) a joint URSI-ITU Committee (including representatives of CCIR and CCITT Study Groups) whose tasks would be to ensure the maximum cooperation between URSI and ITU;

(*b*) an URSI Committee to deal with the teaching of electromagnetics and telecommunications science.

(5) Radio interactions with biological tissues are of interest to several Commissions.

C.15. — International Reference Ionosphere

The URSI Council,

noting

(*a*) that Prof. K. Rawer was asked to organise the specification of an International Reference Ionosphere (IRI);

(*b*) that a report entitled "Preliminary Reference Profiles proposed for the International Reference Ionosphere" has been prepared by K. Rawer, S. Ramakrishnan and D. Bilitza (Scientific Report WB2 of the Institut für Physikalische Weltraumforschung, Freiburg, F.R. Germany, July 1975);

resolves

1. to congratulate Prof. Rawer and all those who cooperated with him on the completion of this difficult task;

2. to authorise the Board of Officers to arrange for the publication of certain parts of the Report mentioned above.

C.16. — UNESCO Subvention

The URSI Council,

considering that the annual subvention received from UNESCO via ICSU represents a valuable support of the scientific activities of URSI, in particular for the organisation of international scientific symposia and other meetings of scientists and the issue of publications;

resolves to convey to UNESCO the thanks and appreciation of the Union for these subventions.

C.17. — Peruvian URSI Committee

The URSI Council,

noting

(*a*) the arrangements made in Lima for the scientific and administrative sessions of the XVIII General Assembly of URSI;

(*b*) the hospitality shown to the delegates and their families during the Assembly;

resolves to transmit its warmest thanks to the URSI Committee in Peru for the invitation to hold the Assembly in Lima, and for the first time in Latin America, and to the members of the Organising Committee who were concerned with the detailed arrangements and who spared no effort to ensure the success of the Assembly.

C.18. — XIX General Assembly of URSI

The URSI Council,

considering

(*a*) the invitations for the XIX General Assembly submitted by the Member Committees in Brazil, Finland, France, Israel and USSR;

(*b*) the result of the ballot;

resolves

1. to accept the invitation of the URSI Committee in Finland to hold the XIX General Assembly in Helsinki in 1978;

2. to express to all the Committees its appreciation of their kind invitations.

VI. URSI Commission III Recommendations

The revised form of URSI Commission III Recommendations given in INAG 21, p. 8-10, are given below together with their official numbers. There are some significant changes in wording though the general sense and purpose remains the same.

III.1. — Changes in the Network of Ionospheric Stations

Commission III,

considering

(*a*) that the decision to set up or close down an ionospheric stations is mainly determined by national considerations which are paramount;

(*b*) that in some cases these decisions can be modified in the light of informed international advice;

(*c*) that the CCIR has expressed the opinion that the Ionospheric Network Advisory Group (INAG) should be consulted on the establishment or closure of stations (Opinion 22-2);

(*d*) that several administrations are considering the need for continued operation of their stations after the IMS (1976-1978);

(*e*) that it is difficult to make contact with the rapidly growing number of users of long sequences of ionospheric data, many of whom are not in touch with URSI;

(*f*) that some scientists have expressed concern about the small and decreasing number of long-established stations and the recent closure of stations in important locations for geophysical studies;

recommends that administrations which intend to review the operation of their ionospheric stations before 1978 be invited to inform INAG of the names of the stations involved and to say whether or not any decisions can be influenced by the international importance of the stations.

III.2. — Monitoring of Long-term Changes in the Ionosphere

Commission III,

considering

(*a*) that many of the ionosphere stations which have made long sequences (over 20 years) of observations have been closed;

(*b*) that representations have been made to URSI (INAG) requesting that this trend be stopped and, if possible, that some stations be reopened;

recommends that scientists who are interested in long sequences of ionospheric data be invited (i) to evaluate the potential value of maintaining each such station; (ii) to indicate which of the closed stations would, if reopened, be of unusual value to their research; (iii) to inform URSI (INAG) of their conclusions.

Note. — Each station must be evaluated separately, and the conclusions must indicate why a station at its particular location is valuable. INAG is unable to accept recommendations concerning groups of stations.

III.3. — New Ionosphere Stations

Commission III,

considering that there is an active interest in establishing vertical incidence ionosphere sounding stations at Adak (Alaska), Anchorage (Alaska), Ascension Island, Barter Island (Alaska), Easter Island, Gough Island (South Atlantic) and either Sitka or Juneau (Alaska);

resolves

1. to invite scientists interested in using data from any of these locations to inform INAG during 1976 of their reasons for needing such data so that suitable priorities can be established;

2. to draw the attention of national administrations to the interest expressed at the URSI General Assembly in 1975 in the establishment of stations at these locations.

III.4. — URSI Handbook of Ionogram Interpretation and Reduction (High Latitude Supplement)

Commission III,

considering

(*a*) that the translation, in whole or in part, of the second edition of the *URSI Handbook of Ionogram Interpretation and Reduction* into the French, Finnish, Japanese, Russian and Spanish languages has been very effective in improving the operation of the network of vertical incidence sounding stations;

(*b*) that the value of the High Latitude Supplement to the Handbook would be similarly enhanced by translation;

resolves

1. to express its thanks to the national organisations responsible for these translations;

2. to recommend that the national organisations be invited to make every effort to arrange for the translation of the High Latitude Supplement at least into Japanese, Russian and Spanish.

III.5. — Training Programme

Commission III,

considering

(*a*) that the data from the network of vertical incidence ionosphere stations are being more extensively used by scientists not connected with the network as such;

(*b*) that the importance of uniform and accurate data is, therefore, increasing;

resolves

1. to draw the attention of administrators to the need for better training of the staff responsible for the operation of ionosphere stations and to the existence of special training symposia in several countries;

2. to offer the cooperation of INAG in coordinating and guiding such efforts;

3. to invite all groups organising training symposia to inform INAG about the proposed place and date, and about any difficulties disclosed during the symposium.

III.6. — Jicamarca Observatory

Commission III,

considering the distinguished scientific record of the Jicamarca Radio Observatory, in Peru, in studies of the equatorial ionosphere;

resolves

1. to commend the formation of the Jicamarca Users and Sponsors Association (JUSA), and

2. to invite Official Members of URSI Commission G to draw the attention of their colleagues and national administrations to the possibilities of undertaking research at Jicamarca on a fee-paying basis.

III.7. — Incoherent Scatter Sounding in Asia

Commission III,

considering

(*a*) that important parameters describing the ionosphere and the atmosphere can be obtained by using the incoherent scatter sounding technique;

(*b*) that there is no such sounder in the Asian region;

(*c*) that such a sounder would help to improve our understanding of the Earth's environment, and especially of the structure and dynamics of the middle and upper atmosphere;

resolves to urge scientists in the Asian sector to investigate the possibility of constructing an incoherent scatter sounding station in their region.

III.8. — Middle Atmosphere Programme

Commission III,

considering

(*a*) that the SCOSTEP programme on the Structure and Energetics of the Stratosphere and Mesosphere is being reformulated as the Middle Atmosphere Programme;

(*b*) that there will be a strong emphasis on remote sensing techniques when these have been fully developed;

recommends that URSI Commission G participate in the formulation of the new programme in collaboration with other interested bodies in ICSU.

III.9. — Indices for Predictions of Ionospheric Propagation

Commission III,

considering

(*a*) that in 1962 the ionospheric index IF_2 was recommended by CCIR for use in making ionospheric predictions;

(*b*) that this index necessitates the use of monthly mean values of foF_2 from 11 vertical incidence stations;

(*c*) that the reasons given in 1962 for preferring IF_2 to the solar noise flux (ø) at 2,800 MHz are no longer valid;

(*d*) that absolute measurements of ø can now be made with sufficient accuracy at one station located anywhere;

resolves

1. to draw the attention of CCIR Study Group 6 to the advances made in this field since 1962;

2. to recommend that consideration be given to the substitution of ø for IF_2.

VII. Commission G

III.10. — Working Groups

Commission III,

recommends that the following Working Groups be constituted or reconstituted, as appropriate, within Commission G :

G.1. *Ionospheric Network Advisory Group* (INAG).

Chairman : W.R. Piggott (UK); Vice-Chairman : J.V. Lincoln (USA).

To assist the ionosonde network stations and to serve as a means of communication between them and the scientific community.

G.2. *Ionospheric Drift Observations.*

Chairman : K. Sprenger (GDR); Vice-Chairman : A. Spizzichino (France).

To co-ordinate measurements of horizontal movements in the ionosphere.

G.3. *Ionospheric Absorption Measurements.*

Chairman : H. Schwentek (FRG); Vice-Chairman : K.M. Kotadia (India).

To co-ordinate measurements of ionospheric absorption.

G.4. *Data Processing in Ionospheric Research.*

Chairman : J.W. Wright (USA); Vice-Chairman : A. Haug (Norway).

To promote the exchange of information and international agreement on the optimum processing and exchange of ionospheric data.

G.5. *Southern Hemisphere Ionospheric Studies Group* (SHISG).

Co-Chairmen : J.A. Gledhill (South Africa), S.M. Radicella (Argentina).

To encourage and coordinate studies of the ionosphere and ionospheric communications in the southern hemisphere.

G.6. *Morphological Models of the Ionosphere.*

Chairman : K. Rawer (FRG).

To coordinate the development of numerical and analytical models of electron density and related parameters of the ionosphere.

G.6.1. *International Reference Ionosphere* (IRI).

Chairman : K. Rawer (FRG).

To develop, jointly with COSPAR, reference models of the vertical structure of the ionosphere.

G.6.2. *Complete Electron Density Profiles.*

Chairman : L.F. NcNamara (Australia).

To investigate methods of deriving complete electron density profiles.

G.6.3. *Ionospheric Mapping.*

Chairman : C.M. Rush (USA).

To investigate methods of constructing global maps of selected ionospheric parameters.

G.7. *Artificial Ionospheric Heating.*

Chairman : W.E. Gordon (USA); Vice-Chairman : W.F. Utlaut (USA).

To promote studies of the effects of artificial heating of the ionosphere and its communication aspects.

G.8. *Incoherent Scatter.*

Chairman : P. Bauer (France); Vice-Chairman : J.V. Evans (USA).

To exchange experimental and theoretical information on, and plan programmes using, the technique of incoherent scatter.

G.9. *Influence of the Ionosphere on Radio Systems.*

Chairman : J.W. King (UK).

G.9.1. *Propagation below 300 kHz as affected by the Ionosphere.*

Co-Chairmen : H.G. Booker (USA); T.B.Jones (UK).

To study all aspects of radio wave propagation at frequencies below 300 kHz which involve the ionosphere.

G.9.2. *Normal ionospheric propagation at frequencies above 300 kHz.*

Chairman : H.G. Moeller (FRG); Vice-Chairman : J.M. Kelso (USA).

To study all aspects of ground-to-ground ionospheric propagation by means of the normal layers at MF and HF.

G.9.3. *Abnormal ionospheric propagation associated with special ionospheric features.*

Chairman : C.G. McCue (Australia); Vice-Chairmen : I. Kasuya (Japan) and E.K. Smith (USA).

To study the effects of temporal and spatial features (e.g. sporadic-E, spread-F, electrojets, disturbances) on ground-to-ground propagation at frequencies above 300 kHz.

G.10. *Ionospheric Scattering and Scintillation.*

Chairman : J. Aarons (USA); Vice-Chairman : E.J. Fremouw (USA).

To study experimental and theoretical aspects of the scattering and diffraction of radio waves by irregularities.

III.11. — URSI/IUGG (IAGA) Inter-Union Working Groups

Commission III,

recommends that the following URSI/IUGG (IAGA) Inter-Union Working Groups be maintained, subject to the approval of IUGG (IAGA) :

1. *Structure and Dynamics of the Thermosphere, Ionosphere and Exosphere.*

Chairman : H. Rishbeth (UK); Vice-Chairmen : G. Kockarts (Belgium) and H. Kohl (FRG).

2. *Neutral and Ion Chemistry and Solar Fluxes.*

Chairman : L. Thomas (UK); Vice-Chairmen : A.D. Danilov (USSR) and T. Tohmatsu (Japan).

3. *Stratosphere-Mesosphere-Ionosphere Interactions.*

Chairman : J.B. Gregory (Canada); Vice-Chairmen : M. Ackerman (Belgium) and C.F. Sechrist (USA).

VIII. Commission H Terms of Reference and Working Groups

IV.1. — Terms of Reference of Commission H

Commission IV,

noting and approving the reorganisation of URSI as decided by the URSI Council, and the title "Waves in plasmas" proposed for Commission H;

considering that it is desirable to distinguish clearly between those parts of the study of wave phenomena in natural plasmas associated on the one hand with geophysics, and on the other with radiophysics;

recommends that Commission H take immediate steps to define its terms of reference in relation to the study of the specific characteristics of wave phenomena in plasmas.

Commission H Internal Working Groups

Five internal Working Groups have been created, among which four are joint with other Commissions :

H1. Plasma instabilities (joint with Commission G) :

Chairman : J. A. Fejer (Commission H).
Vice-Chairman : D. T. Farley (Commission G).

H2. Antennae in plasmas (joint with Commission B) :

Chairman : R. W. Fredricks (Commission H).
Vice-Chairman : not yet designated (Commission B).

H3. Wave analysis (joint with Commission C) :

Co-chairmen : D. Jones and J. L. Lacoume (Commission H).
Vice-Chairman : not yet designated (Commission C).

H4. Radiofrequency plasma devices (joint with Commission D) :

Chairman : F. W. Perkins (Commission H).
Co-chairman : not yet designated (Commission D).

H5. Active wave experiments :

Chairman : C. T. Russell.

This list is only tentative, and will probably be subject to slight modifications during the coming year. A short note on the terms of reference of each Working Group is available on request. Anyone wishing to participate is encouraged to notify the Chairmen or Vice-Chairmen.

IX. Corrections to URSI Handbook of Ionogram Interpretation and Reduction

The following amendments have been prepared by the Japanese Ionogram Scaling Group and forwarded through our INAG member, Dr. I. Kasuya. A few suggested amendments require further discussion and these are given separately below. Most of the changes are of an editorial type.

Page iv. Contents. Add:

Page vi Contents. Add:

Page 9 Section 1.04, equation 1.2 $(N/cm^{-3})^{\frac{1}{2}}$ should be replaced by $(N/m^{-3})^{\frac{1}{2}}$.

Page 9 Section 1.04, equation 1.5 should be exact, not approximate as shown.

Page 16 Section 1.08, equation 1.9 and 1.10 add F2 after M(3000).

Page 45 Section 2.73, first paragraph, line 10, 71 should be 17.

Page 46 Figure 2.15, reverse arrow: → POLE. Delete "decreasing", insert "increasing".

Page 47 Figure 2.17, on Figure, 2 to read 1, 1 to read 2.

High Latitude Supplement correction:

Page 255 Correction for Section 2.81, paragraph (a), line 4, replace trace z by trace 1.
paragraph (b), line 3, replace trace 1 by trace 2.

INAG-16 correction:

Page 14 (given in correct form in Supplement, page 251).
At end of replacement text 2.75 in INAG-16, replace (see Figure 1, page 12) by (see Figure 2.18).

Handbook (UAG-23) corrections:

Page 53 Section 3.2, letter A, in paragraph before (a), 7 lines up, replace "first order E" by "first order Es".

Page 60 Figure 3.10 (a) f-min values between T2 and T3 should be v not ●.

Note: Practice here is mixed. Some groups prefer v some ●. v is more logical but slightly more trouble. *Do you have views on this point?*

Page 64 Section 3.2. F, paragraph (d), line 2, replace paragraph (c) by paragraph (d).

Page 75 Figure 3.27 (b), delete "h'F given by (h'F)Es", insert "h'F replaced by S" as no original ray trace is visible.

Page 77 Section 3.2, paragraph 3, replace "the qualifying letter D" by "the qualifying letter".

Page 77 Caption of Figure 3.30, line 4. Delete "qualifying", insert "to be described".

Page 80 Figure 3.34, fxEs should be replaced by foEs in Figure 3.34.

Page 89 Section 4.0, paragraph 3, line 4. Delete "first F echo", insert "first higher echo".

Page 152 Section 6.6, paragraph 1, line 1. After "filled circles", insert "(sometimes open circles, see below)".

Page 152 Section 6.6, paragraph 3, line 1, delete "the F layer trace", insert "the higher layer trace above Es".

INAG wishes to thank those responsible for this careful reading of the Handbook, for their corrections.

The Group also raised three controversial points:

(a) Whether descriptive letter R should be used rather than descriptive letter B when fxI is influenced by absorption. They feel that letter R is more appropriate than B on page 87 (b) and (c). While it is true that B is normally associated with non-deviative absorption which is the main absorption in the vicinity of f min, and R is associated with deviative absorption, or attenuation in the vicinity of the critical frequency, spread F is normally weakened or missing because of high non-deviative absorption. Thus, although the traces are often close to a critical frequency, it would be wrong to suggest that they are missing because of a deviative type of attenuation. *In my view* B *is much preferable to* R *in these cases but would invite further discussion.*

(b) It is suggested that the symbol for fbEs when fbEs is caused by a thick layer should be an open circle with a line right through it, rather than the convention as used. Since most f-plots are reduced before reproduction, and are often not easy to read, the open circle without a line through it is more clearly different from a closed circle symbol for a thin layer fbEs. I do not feel that the suggestion would in fact make f-plots more easy to interpret, but would like to receive other views on this point.

(c) It has been suggested that additions be made to the list of cases where oblique traces are not ignored, paragraph (d) of section 2.0, page 27, of the Handbook. I concur with the spirit of this suggestion but feel that it should be more fully discussed before we change a basic rule which has been in use for many years. The suggestion made is that we should add "rule (d) does not apply to:

(iv) a range spread trace
(v) auroral type Es"

I suggest for discussion:

(iv) when no trace is present from overhead, parameters for the nearest vertical trace are measured
(v) auroral and retardation types of Es (these are always to a larger or smaller extent, non-vertical).

Your comments are requested.

X. High Latitude Supplement Corrections

The following typing or editorial errors have been brought to the attention of your Chairman by A. Rodger and R. Smith:

Page 7 Throughout table where "J" in "qualif" column replace "X" in "descrip" column by "A" (revised rule).

Page 8 Bottom of page add "Note: If the spread F parameters had been tabulated in the normal table of entries, table 2, descriptive letter F in the height tables should have been replaced by Q."

Page 15 Figure 1.26 should read foF1 at closed circle; fF2 at open circle should read foF2.

Page 36 Figure 2.4, 2030, fbEs = 040AA not 040JA.

Page 37 Figure 2.5, 1900, fbEs = 040-K not 035AA. F parameters - replace G by A (revised rule). h'Es = 110-K, h'E = 110-K. 1720 F parameters - replace G by A. h'Es = 205-K.

Page 38 Figure 2.6, 0330, add to Editor's Note: "If foE was observable at this time as indicated by the foE entry, foE = A. The Es type must be ℓ3 not f3. If Es type f3 is appropriate the foE entry should be blank."

Page 39 Figure 2.7, 2230, F parameters A not G. h'Es = 105-K, h'E = 105-K.

Page 40 Figure 2.8, 0330, fbEs = 017-G.

Page 54 Figure 2.17, 0600, fbEs = ...EG.

Page 59 Figure 2.23, Editor's Note: insert 1830.

Page 62 Figure 2.26, 0000, foEs insert JA.

Page 70 Figure 2.32 (b), In Editor's Note, line 2, delete fBEs, insert fbEs.

Page 73 Figure 2.34, 1900, add "The spread above foF2 extends at least to fxF2. fxI = (foI + fB/2)OC is best evaluation, confirmed by 2000 record."

Page 76 Figure 2.37, the trace with critical frequency near 0.5 MHz could be the z component corresponding to foF2.

Page 84 3 lines from bottom, Greenland.

Page 90 Figure 2.49, 0855, foEs = 025. Delete DY. Editor's Note: On original, Es low screening upper part of E trace. foE could be replaced by Y or A.

Page 91 Figure 2.49, 0955, foE = 280DY.

Page 92 Figure 2.51, 0614, foF1 = 250-F.

Page 92 Note, preferable to use h'FUQ rather than h'FUH or UF.

Page 94 Figure 2.53, 1914, h'F = 260UQ.

Page 96 Figure 2.55, 2214, add "presence of spurs at 2214 should be noted on daily work sheet."

Page 98 Figure 2.57, 0557, foE = 530-K.

Page 107 Figure 3.1, 1021, add: "foF2-Y preferable to foF2-H when spurs with oblique patterns present, as here, since tilt must be severe."

Page 132 1300, fbEs = 010ES.

Page 136 Incorrect format for foF1 and foF0.5. 042 should read 420 etc. throughout.

Page 138 Add. As agreed at the INAG Meeting at Geneva, INAG 23 p. 3, the IPS use of E(f min)B for foE at night time will cease, thus alleviating the problem of giving conventional types to Es. This practice began about 3 years ago (Antarctic stations only) in order to circumvent inaccuracies in sunrise/sunset observations.

Page 143 Figure 5.5, foF1 = 360, not 036 in observations.

Page 151 Figure 5.13, add: "Note typical gradient reflection at about 97 km."

Page 158 Figure 5.20, fbEs A088A.

Page 159 Figure 5.21, add: "Accuracy rules would allow foF1 = 380-H."

Page 161 Figure 5.23, second line from bottom, foEs = 012.

Page 162 Figure 5.24, foEs = J56A.

Page 162 Figure 5.25, Editor's Note: "The presence of 2 Es type a structures could be shown by the type entry a, a."

Page 164 Figure 5.26, add Editor's Note: "As foE is present foEs and fbEs should be E(foE)G. G takes precedence when the thick E layer is present. In this case foE = 350."

Page 170 Figure 6.3, foE 150-K, add k to type Es.

Page 174 Figure 7.2, Editor's Note: "As foE = 190UR the Es type cannot be flat. foEs is 18G since foE is greater than foEs."

Page 175 Figure 7.3, Editor's Note: "As foE is given Es is most likely to be a type c."

Page 187 Figure 9.1, fbEs 016EG, Editor's Note: "foE = 160UA or 160EA probably preferable."

Page 189 Figure 9.6, add Editor's Note: "Comparison with Figure 9.5 above suggests apparent value of foFl quite misleading. Prefer replacement letter Y."

Page 193 Figure 9.13, foEs = 033. fbEs = 031-K.

Page 193 Figure 9.14, h'Es = 105-K.

Page 197 Editor's Note: "The comments made refer to the original entries many of which have unfortunately been corrected to the preferred values. Values in heavy script have been changed."

Page 203 Last line, delete all after "record". See note by Editor on page 197.

Page 205 h'F 210EA. fxI 045DX.

Page 210 Figure 10.13, add to Editor's Note: "f-plot representation is consistent with the original foE doubtful value. This is a case where putting in all of the cusps on the f-plot would be valuable."

Page 213 Last line, for "040--" read "0.4 MHz."

Page 215 Editor's Note: "This appears to be an Es type c rather than h, with the conventional foE=220-A. The accuracy rules would have allowed 250UA for an foE scale with the non-standard analysis method.

Page 219 Second line from bottom should read: The value 240EA is just acceptable....

Page 222 Figure 11.4, fxI = 069-P.

Page 222 Figure 11.6, add: "d-type Es present".

Additions to the Handbook, Chapter 15

Insert section 15.1 after paragraph 3 of Chapter 15 (Supplement, page 287).

15.1. Pre IGY Symbol Differences

The meanings of certain ionospheric symbols were changed at the beginning of the IGY in 1957. For the convenience of those using pre-IGY data they are summarized below:

Symbol	Post 1957	Pre 1957
fEs	The highest frequency at which a mainly continuous Es trace is observed. (Note this may be either an o- or x-mode trace.)	Highest frequency on which echoes of the sporadic type are observed from the lower part of the E region using the extraordinary trace when both ordinary and extraordinary Es traces are observed.
fE2s	Abandoned	Highest frequency on which echoes of the sporadic type are observed from the upper part of the E layer using the extraordinary trace when both ordinary and extraordinary Es traces are observed.
fbEs	The blanketing frequency of an Es layer, i.e. the lowest ordinary-wave frequency at which the Es layer begins to become transparent. This is usually determined from the minimum frequency at which ordinary-wave reflections of the first order are observed from a layer at greater heights. foEs, fbEs and h'Es must all be scaled using the same Es trace.	That frequency below which reflections from higher layers are blanketed by Es.
h'F1	Abandoned, h'F used instead.	Minimum virtual height of the F1 layer.
h'F2	Minimum virtual height of the highest stable stratification observed in the F region (only scaled when stratification is present).	Minimum virtual height of the F2 layer.

Symbol	Post 1957	Pre 1957
h'F	The minimum virtual height of the ordinary wave F trace taken as a whole.	
h'Es	Minimum virtual height of the trace used to give foEs.	Minimum virtual height of Es echoes.
h'E2s	Abandoned	Minimum virtual height of E2s echoes.
hpF1 hpF2	hpF1 abandoned. hpF2 discouraged.	Virtual height of the F1 and F2 layers respectively measured on the ordinary wave trace at a frequency equal to 0.834 foF1 and 0.834 foF2.
ypF2	Abandoned	Difference between hpF2 and the virtual height of the F2 layer, measured on the ordinary-wave trace at a frequency equal to 0.968 foF2.

Insert 15.2, Changes since December 1973, before paragraph 5 (Supplement, p. 287).

XI. Further Discussion of the High Latitude Supplement

Ionograms, page 36, Figure 2.4, 2100. Blanketing auroral Es

The high gain ionograms suggest the presence of Es types r and k as well as Es type a. This would be consistent with the screening of the F2 layer shown by the F entries.

These ionograms draw attention to a point on which current practice at different stations is widely different. It appears that stations at which Es-a type traces are associated with retardation Es, particle E , or flat Es, Es types r, k or f, often show blanketing of higher layers when the Es-a type trace is seen. At these stations screening of F-layer parameters, replacement letter A has been used without drawing attention to the type of screening layer present. There is thus conflict between simplicity of reduction and the logic of the interpretation of the ionogram. Strictly, an auroral Es pattern is due to reflection from Es structures at oblique incidence, though in practice it may include overhead structure which, of course, can cause blanketing of higher layers. The latter structure is normally an Es type k, an Es type f or one of the temperate latitude types h, c or ℓ. *INAG would like to have your views on whether it is preferable to be logical in these cases and regard blanketing Es-a as a mixture of Es-a and an overhead Es type or whether the Es-a rule should be simplified to include the case of the mixed pattern.* The latter simplifies the job of the reducing staff. The Supplement contains many examples where the distinction has been made, so that all groups can see clearly what is involved. This point was discussed at Uppsala and Geneva.

Sunrise E layer critical frequency

p. 59, Figure 2.23 of Supplement. At sunrise there are frequently no real troughs between the E and the F layer and the value of foE is therefore very ill-defined. Physically the most significant value is that of the densest sub-stratification as shown in Figure 2.23, page 59 of the Supplement. However, this is not always consistent with the international rule, e.g., at 1830 the international rule would be foE = 230-H, the gain value 250-H. At 0630 both rules give essentially the same answer. At 0700 continuity with 0630 shows that 210-H is the correct value. An example where this approach would be wrong is given in Uncle Roy's Column. The real need is for some discussion of foE near sunrise and sunset in the scientific literature.

Use of N when interpretation is doubtful

Historically, the qualifying letter U has been used in two manners: (a) to show that observation is doubtful within limits set by the accuracy rules (section 2.2 of Handbook), and (b) to denote uncertainty in the interpretation of a trace.

With the stress on the use of accuracy rules since the IGY, the second use has tended to decrease--many stations do not use it at all. *INAG would like to inquire how many groups still wish to use U in sense (b) so as to decide whether this use should be discontinued.* A possible method of keeping the information would be to use descriptive letter N when the interpretation is doubtful, restricting U to errors obeying the accuracy rules only. *Your views on these points are requested.*

The problem of blanketing at high latitudes

fbEs is a very important parameter at high latitude stations as it indicates the critical frequency of the E-region ionization which is overhead. It is now common practice at high latitude stations to include an fbEs value in every scaled ionogram. Some readers appear to have had difficulty with the rule that fbEs should be taken from the same trace as foEs. They see a logical difficulty when the trace is in fact due to the super-position of different types of sporadic E, e.g., f or k. In practice fbEs is always determined by the lowest frequency at which an echo trace appears at a greater vertical height. In the case of non-blanketing Es type c or h when foE is present, fbEs is numerically equal to foE. The high latitude case is an exact analog. The comment raised at Uppsala, INAG-22, page 7, section VI, fbEs determined by foE or particle E applies direction to this case--strictly EG is superfluous. In the thick layer case K has the same implications as G.

XII. Ionogram Interpretation Meeting, Uppsala, October 1975

Dr. A. Hedberg states that the full report on the Uppsala meeting is now published (INAG-22, p.5 and 6) and copies can be obtained from Dr. A. Hedberg, Uppsala Ionospheric Observatory, S-755, 90 Uppsala 1, Sweden.

Some of the material presented by Dr. Tauno Turunen at Uppsala and at the INAG meeting at Geneva, February 1976, exists in the form of Reports from the Sodankyla Geophysical Observatory, Sodankyla, Finland and copies are obtainable from Dr. Turunen at that address. This material falls into two main groups:

(a) Studies of gain effects on the apparent values of gain sensitive ionospheric parameters and their statistics.

(b) Studies of the relations between ionospheric parameters, solar or magnetic activity and their long term changes at this auroral station.

The Chairman of INAG wishes to draw attention to the fact that the long term variation of the Earth's magnetic field since the IGY has already caused significant changes in the behavior of the ionosphere above stations placed where ionospheric conditions vary rapidly with position, in particular stations near the auroral zone and equatorial anomaly. It is quite time that these changes were studied, either by local studies at individual stations or by a multistation investigation. These changes form one of the larger sources of error in the use of ionospheric data for ionospheric radio frequency propagation.

XIII. ICSU World Data Centre Panel Meeting, Grenoble, 27th August 1975

About 50 people attended the open meeting of the World Data Centre Panel at Grenoble. It was reported that the WDCs are, on the whole, well used, sending out as much data as they receive. In the past, agreements on WDC rules have been reached easily since the contributors and users were mainly the same people. This is now changing; some new projects, such as GATE produced large quantities of data of interest to relatively few specialized groups. The problem of matching cost of producing data and sending them to the WDCs, and their value needs continual monitoring.

The discussion showed close parallels with the problems of the use of V.I. data and of the V.I. network and it is probable that with the aid of the INAG Bulletin, the V.I. Network and its users could work out a technique for maximizing the efficiency of the network which would provide a good guide for the general development of the WDC system. *INAG would like to solicit comments on this type of problem. In particular, on:*

(a) the size of the network needed after the IMS,

(b) the types and quantity of data which should be sent to the WDCs,

(c) how to monitor the use of the data by the scientific community and to, if necessary, change the network operation to meet future needs,

(d) to consider whether a change in the method of storing the data is desirable and could improve its usage,

(e) can any past data be thrown away? e.g. because it is not sufficiently accurate or is incompatible with later data, or because its storage decreases the efficiency with which more important data can be used.

The question of useful pre-IGY data was raised. With the possible exception of sporadic E data, most pre-IGY data are compatible with later data and there appears to be a good case to try to get pre-IGY V.I. data into WDCs.*

*World Data Center A for Solar-Terrestrial Physics, Report UAG-54, *Catalog of Ionospheric Vertical Incidence Sounding Data*, includes the pre-IGY holdings at WDC-A.

Both the sources and the extent of the data available are now difficult to ascertain and in some cases it is known that irreplaceable data have been destroyed when local interest in it decreased. *If you hold any pre-IGY data for your stations please inform INAG so that the possibility of copying it for the WDCs can be explored.* Your chairman has become aware that several new workers on long sequences of data, e.g. for ionosphere meteorological relations, are completely unaware of data which were widely circulated before the war, e.g. The Carnegie Institute books of V.I. data from Washington, College, Alaska, Huancayo and Watheroo.

Another point of special interest to the V.I. network was that many scientists using WDC data do not make suitable acknowledgement in their publications or reprints of the organizations generating the data. Thus most stations are unaware of the extent to which their data are used. This also applies to the use of the data booklets published by many stations whose use through the WDC is thereby decreased. *The problem that some stations cannot afford to send their data to the WDC system was raised. INAG would like to hear from V.I. stations which are having this difficulty. Please inform the Chairman or Secretary.*

XIV. Training

Australian Operators' Conference

The Australian Ionospheric Prediction Service will be holding an Operators' Conference for Australian station operators during 18, 19, 20 August 1976. This is the week before the International Symposium on Equatorial Aeronomy to be held at Townsville, Queensland, thereby allowing any interested visitors from overseas the chance to participate if they wish. The program will include training in the operation and maintenance of the IPS 4A ionosonde, scaling and interpretation of ionograms with reference to the High Latitude Supplement, and discussion of current problems among the IPS operators. The conference is intended for Australian station operators but anyone else who is interested is welcome to attend provided they give prior notice to Dr. D. C. Cole.

U.K. Training Program

Dr. J. Dudeney states that the annual training for new operators for the B.A.S. Antarctic stations will be held at Cambridge, England, starting July 5, 1976. Applications from other groups to join in part or all of this course should be made to Dr. J. Dudeney, British Antarctic Survey, Madingley Road, Cambridge CB3 OET, England.

XV. Station News

Adak

Dr. N. K. Andrews, New Zealand, has written supporting the reopening of the station at Adak, which is needed for conjugate point studies in New Zealand. He states:

> "Our particular interest is whistler-mode transmissions from the northern hemisphere; strong whistler-mode signals from NLK in Seattle usually seem to have entered the ionosphere in our conjugate region. We have developed a technique which measures rate of change of both phase and group paths of ducted signals, from which we can deduce ionosphere-magnetosphere coupling fluxes and magnetospheric electric fields. However, we need to correct for the ionospheric portion of the path. At present we use Adak median data from the previous solar cycle, but new data would be preferable."

Okinawa

Dr. I. Kasuya states:

> "The Okinawa Radio Wave Observatory is scheduled to stop the vertical soundings of the ionosphere from April 1 to the end of 1976 due to move from the present position to a new site few kilometers southeast and construction of the new station building and ionospheric sounding facilities.
>
> Accordingly, the ionospheric data of Okinawa will not be available during the period.
>
> Further information about new Okinawa ionospheric sounding station will be delivered later."

Argentine Islands, Halley Bay, South Georgia

The Chairman of the INAG visited the B.A.S. Stations at Argentine Islands, Halley Bay and South Georgia and discussed difficulties in the operation of the stations and the interpretation of the data. He congratulated the group at Argentine Islands on their remarkable success in obtaining complete sequences of quarter-hourly data despite the fact that their ionosonde was over 20 years old. In each of the last two years over 99.7% of the desired quarter-hourly ionograms were obtained successfully with good technical quality. Halley Bay also had considerable success with a similar old ionosonde, 97.8% of the desired quarter-hourly ionograms were obtained. An apparent loss of sensitivity near 3.0 MHz previously ascribed to antenna problems was identified as due to strong interference from a ray reflected from the bottom of the ice shelf.

A thorough overhaul of the ionosonde at South Georgia has been started and it is expected that the data from this station will be greatly improved.

Closure of Casey Ionospheric Station

Operation of the Casey ionosonde ceased in December 1975. This station was formerly located at Wilkes and was operated by the U.S.A. until January 1959 when it was handed over to Australia. Wilkes was closed in January 1969 when it was replaced by the new station at Casey (geog. lat. 66.28°S, long. 110.53°E). The station was operated by the Australian Ionospheric Prediction Service and information about the station and data can be obtained from:

Assistant Secretary.
Ionospheric Prediction Service,
P.O. Box 702,
Darlinghurst, N.S.W. 2010, Australia.

Tsumeb

The responsibility for maintaining ionospheric observations at Tsumeb has been taken over by D. C. Baker and D. K. Hartnagel, NITR, P. O. Box 3718, Johannesburg 2000, to whom inquiries for data should be directed. Regular observations will be maintained, but at present only skeleton analysis will be done. Full data will be analyzed only upon special request.

Sanae

The Chirp ionosonde was successfully installed and has operated for a year giving both V.I. data at Sanae and oblique ionograms (Sanae received at Grahamstown, South Africa).

Grahamstown

A new lightweight ionosonde is being developed for use in aircraft. This uses a psuedo-random code system to improve the signal-to-noise ratio so that useful ionograms can be obtained below 3 MHz even when using a short aircraft antenna.

Druzhnayo (77°54'S, 40°13'W).

Some ionospheric measurements are being made during the summer 1975-76 by a group from the D.D.R. (East Germany) at the USSR summer base at Druzhnayo. This is expected to be reoccupied next year.

Future of German stations at Lindau and Freiburg (Breisach)*

The stations at Lindau and Freiburg have been financed to the end of 1976 while their future is under review. Both of these stations have operated with high efficiency for many years giving valuable sequences of observations. The decision of whether either should close or remain open after the end of 1976 depends on the balance of their cost and the extent of use of their data. *INAG requests that any groups having good reason to wish that these stations should continue should write to the Chairman of INAG at his new address, British Antarctic Survey, Madingley Road, Cambridge CB3 OET, U.K., giving their reasons.* Any letters received will be sent to the appropriate authorities for consideration. In the past, requests of this type have disclosed that the use of the data from a station was considerably more than expected by the responsible authorities and has had significant effects on the policy adopted by them (e.g. INAG-16, p. 4). This request is additional to the more general problem of post IMS operation raised in previous Bulletins (INAG-17, p. 3, INAG-20, p.7, INAG-21 p.3 and 11-12).

The purpose of this note is to draw attention to the probability that these stations will be closed at the end of 1976 and to allow opportunity to any who need the observations to continue to make representations so that their needs can be taken into account.

*WDC-A has not had time to analyze data usage for the individual stations; however, demand for ionospheric data has remained at a high level during the past year amounting to about 18,000 station months.

Canadian Stations (see footnote page 22)

B. W. Currie, Canadian IMS Coordinator, sends word that discussions are now proceeding concerning the continued operation of Canadian ionosonde stations at Resolute Bay, Fort Churchill, Kenora, Ottawa and St. John's. IMS researchers or others anticipating need of data from these stations, campaign or otherwise, should write B. W. Currie, Canadian IMS Coordinator, University of Saskatchewan, Saskatoon Canada S7N OWO.

XVI. Advanced Ionosonde, Re: INAG-21, pages 14-15

Chairman's note: The following letter has been received from Mr. J. W. Wright, in extension of the information given in INAG-21. In view of the widespread interest in new ionosondes at present, INAG is hoping to publish comments which may be useful to those planning to update or extend their station or network.

Mr. Wright states:

"I note in INAG #21 a summary of the Lima session of the working group at which I described, by your request, our digital ionosonde concepts. The summary includes some remarks which the reader would reasonably attribute to me, but which I did not make, and which do not reflect my views. The present letter is intended to correct these impressions.

Regarding costs, I emphasized that it is wrong and even irresponsible to judge ionosondes by hardware acquisition cost alone. Those planning observatory facilities must consider, in addition,

a) The latent costs of misleading or incomplete information, when hardware compromises deny the user access to needed echo properties. For example, the distinctions between foEs and fbEs could have been put on a firm physical basis years ago, with echo angle-of-arrival information. High-latitude phenomena (cleft and particle-precipitation structures) also require this information; without it, ionograms merely provoke unnecessary controversy among a small class of 'ionogram experts', without benefit to other scientists.

b) The often prohibitive costs of data processing. While we may take pride in the long climatology of the upper atmosphere which our technique has captured and (we are confident) retained for us in the $\sim 10^8$ ionograms rolled up in the WDC vaults, it is clear that we have inherited a major problem as well. It is simply too expensive to extract from these ionograms very much of what they have to tell us.

c) The high cost of archiving uncompressed raw data. We do not hesitate, today, to justify the ionosonde as a geophysical instrument; radio propagation parameters are secondary or even irrelevant motives. On an attached sheet, also distributed at Lima, the 'data processing economics' of our technique is briefly summarized. It is to be noted that in-the-field data processing provides orders of magnitude compression of wanted information.

d) Some general-purpose cost-benefits of a sensible approach to the modern ionosonde. In the \$70-\$120,000 cost of the instrument I advocate, there is \$20-\$40,000 of general-purpose, modern, high-quality, data processing hardware: minicomputer, teletype or CRT terminal(s), magnetic tape, disk units, etc. The spread of costs can reflect such factors as: existing comparable devices at an institution, adjustments to local (and remote) levels of activity, future expansion, and multiplicity of users. Even the minimal digital ionosonde today includes a minicomputer with 8K of core, a TTY, disk, and mag tape. With an observing schedule five times that of the traditional ionosonde (e.g. one N(h) profile, etc., each 3 minutes) these computing facilities can still be available for other activities 75% of the time.

I agree that 'the number of people available to study the data' can be viewed as an economic question bearing on the justification of the systems but this is to put the matter backwards. Administrations must have the courage to lead, not lag. The ionosonde has stood long enough at the church door, hoping that her underlying beauty and virtuous character would attract the fervant admirations of the dashing modern geophysicist. Incoherent scatter and satellite data have attracted 'available people' once the advocates of those techniques made the data itself available.

It is also true that the Geophysical Functions of a Digital Ionosonde, as displayed in Figure 15 of SEL Preprint #206 and reproduced in INAG #21, suggest comparisons with incoherent scatter instruments. However, the relevant similarities (and differences) are not really those between the instruments, but between the information content of coherent and incoherent scatter, respectively. The workers who developed incoherent scatter worked directly, almost single-mindedly, to develop systems which could exhaust the information content of their received signals. Ionosonde developers, alas, have not seemed to consider it their business to do so, but have aimed mainly at h'(f), instead.

The differences between coherent and incoherent scatter merit some mention: your paragraph cites 'the relatively high cost of the (digital ionosonde) instrument', referring, presumably to the spread of costs listed on p. 4 of INAG #21. I sincerely doubt that an ionosonde can be produced today for $20,000. $30-$50,000 is more likely, even for heavily-compromised instruments which will incur latent costs (a, b, c, d, above) and then inevitably attract further criticism of the technique itself. Thus $70-$120,000 for a fully competent, modern instrument, does not seem unreasonable. And this is, at worst, only 5% to 10% of the cost of an incoherent scatter facility."

XVII. IMS Newsletter

IMS Newsletters giving the IMS program plans are issued monthly from: Joe H. Allen, Head, Temporary IMS Central Information Exchange Office, World Data Center A for STP, D64 NOAA, Boulder, Colorado 80302, U.S.A. If you wish to receive these newsletters, please write to the above address and if you have special programs of observations which could be of interest to other groups, please inform Joe H. Allen so that these program plans can be included in the newsletter.

The IMS ground-based program plans are largely concerned with rocket, aircraft and balloon flights; special sequences of magnetic pulsations, aurora, backscatter-radar, VLF observations, etc., and special ground-based observations in conjunction with satellites.

The special IMS periods for satellite studies are listed by the IMS Satellite Situation Center at World Data Center-A for Rockets and Satellites, Code 601, Goddard Space Flight Center, Greenbelt, Maryland 20771, U.S.A.

XVIII. Antarctic and Southern Hemisphere Aeronomy Year

Details of stations and groups collaborating in ASHAY can be obtained from the ASHAY data coordinators:

W.G.1 Aeronomic effects in the South Atlantic Anomaly,
Mr. R. Haggard,
Department of Physics,
Rhodes University
Grahamstown, South Africa.

W.G.2 Low magnetic latitude F-region study,
Ing. F. F. von Wuthenau,
Centro Nacional de Luminiscencia,
Av. Benavidez 8175 Oeste,
Marquesade, San Juan, Argentina

W.G.3 Auroral and sub-auroral aeronomy,
Mr. C. G. McCue,
Ionospheric Prediction Service,
162-166 Goulburn Street,
Darlinghurst, N.S.W. 2010, Australia.

The ASHAY periods of intensive study in 1976 are:

21 March	to	3 April
17 June	to	30 June
15 September	to	29 September
8 December	to	23 December.

XIX. aa and Ci Magnetic Indices

The IAGA-Assembly (Grenoble, 1975) recommends the replacement of the traditional Ci-index by a new index aa, which can be determined in a more objective way than the Ci-index. The aa index was introduced by Mayaud some years ago and has since then been published regularly by the Institut de Physique du Globe, Paris and for recent years also in *Solar-Geophysical Data* from NOAA-EDS, Boulder. For the years 1868-1967 they have been published in a special IAGA-Bulletin No. 33 (A hundred years series of geomagnetic data, by P. N. Mayaud, IUGG-Publ. Office, 1973) which also gives a complete explanation of the aa-indices. The aa-indices will appear in the ISGI bulletin, starting from 1 January 1976, as well as in the yearly IAGA-Bulletin No. 32, where they will replace Ci.

<u>Short description of the aa-indices</u>

The aa-indices are derived from the K-indices of two approximately "antipodal" stations in England and Australia. The K-indices from these stations are converted into three hourly amplitudes (in gammas and reduced to magnetic latitude 50°N and 50°S). The table gives the daily mean values of these amplitudes (N and S). The two values in the column M are 12 hour mean values of these amplitudes, averaged over North and South.

The letter symbols C (or K) behind the indices denote that the day is quiet according to the criterium: mean aa ≤ 13. The symbol in the first column pertains to the Greenwich day, the symbol in the second column to the period of 48 hours, centered at Greenwich noon. If individual three-hour intervals are relatively disturbed (although the mean value of aa is ≤ 13), then K is given instead of C.

XX. Review of Radio Science

In 1969 the XVI URSI General Assembly decided, in the interest of economy, not to reprint the extensive triennial reports, prepared by Member Committees of the Union which had formerly appeared in the Proceedings. Instead, arrangements were made to issue a review of recent advances over the whole field of radio science covered by the eight Scientific Commissions of URSI. This field includes not only fundamental scientific research relating to radiocommunication systems (measurements, wave propagation, information theory, electronic devices, etc.) but also the applications of radio methods in other branches of science such as astronomy and geophysics (radio studies of astronomical objects, radio probing of the lower and upper atmosphere, radio sensing of the earth resources, etc.).

Two such volumes were prepared and published by URSI for the General Assemblies in 1972 and 1975, each covering the 3-year period preceding the Assembly:

1. *Review of Radio Science 1969-1971*. Ed. C. M. Minnis and Y. Bogitch (ix--423 International Union of Radio Science, Brussels 1972);

2. *Review of Radio Science 1972-1974*. Ed. S. A. Bowhill (x--133 International Union of Radio Science, Brussels 1975).

In both volumes each chapter deals with the field covered by one Commission. Although the Chairmen of Commissions were responsible for their respective Chapters, many other individual scientists assisted with the collection and editing of the material under the supervision of the General Editors.

The text is generally very concise in style but the inclusion of numerous references to published and unpublished material permits the specialist reader to pursue further particular topics in which he has a special interest.

Copies of both volumes are available at U.S. $7.50 (including surface postage) from:

for 1969-1971 and 1972-1974:

URSI Secretariat, until 31 January 1976, Place Emile Danco 7, B-1180 Brussels, Belgium; from 1 February 1976, rue de Nieuwenhove 81, B-1180 Brussels, Belgium.

for 1972-1974 only:

Aeronomy Laboratory, Department of Electrical Engineering, University of Illinois, Urbana, IL 61801, U.S.A.

XXI. International Ursigram and World Days Service

At its recent meeting in Grenoble, during the General Assembly of IUGG, the Steering Committee of the International Ursigram and World Days Service (IUWDS) adopted the following resolution:

IUWDS,

recognising the importance of the daily interchange messages, especially during the International Magnetospheric Survey (IMS),

urges that all Regional Warning Centres or Associate Regional Warning Centres operate, if possible, on a seven days per week basis in order to provide the requested information.

XXII. Uncle Roy's Column

Several groups of ionograms have been submitted for inclusion in this column and we hope that other groups will be encouraged to contribute. At Lima the view was strongly expressed that we do not have enough ionogram discussion in the INAG Bulletin. *It is up to you to provide material.*

1. The Gyro Frequency Trace

Since the presence of significant amounts of D-and E-region absorption normally suppress the Gyro frequency trace, at most stations it is more often seen during years of low rather than of high solar activity. Thus, many operators are seeing this trace for the first time. Some examples of it were shown in the High Latitude Supplement, pages 68, 223 and 224 and there appears to be a general interest in discussing more examples.

The phenomenon is rare at most stations, is normally restricted to night hours, but when it occurs is often present for a number of hours during a given night.

There do not appear to have been any systematic collections of Gyro trace ionograms in the past though in my experience the Gyro trace is frequently associated with a partially blanketing Es trace near 110 km - almost all published examples show this association. Historically this trace was much discussed before the war in connection with the controversy of the presence or absence of the Lorenz term in the magneto-ionic dispersion equation. It is often observed to stop at a frequency appreciably below fB as would have been expected if the Lorenz term (Hartree equation) was applicable. This interpretation is no longer accepted though the true explanation of the shape of this trace remains obscure.

The three examples shown below differ from those in the High Latitude Supplement in that they show both the retardation of the x-trace near fB as in Fig. 1.3, p. 8, of the Handbook and multiple orders of the Gyro trace. Such cases are relatively uncommon. Multiple orders of the Gyro trace are only seen on nights of exceptionally low absorption, e.g., when echoes can be seen round the time base (delays of more than the pulse recurrent period).

The following three ionograms were submitted by Mrs. L. S. Hayden, WDC-A, Boulder.

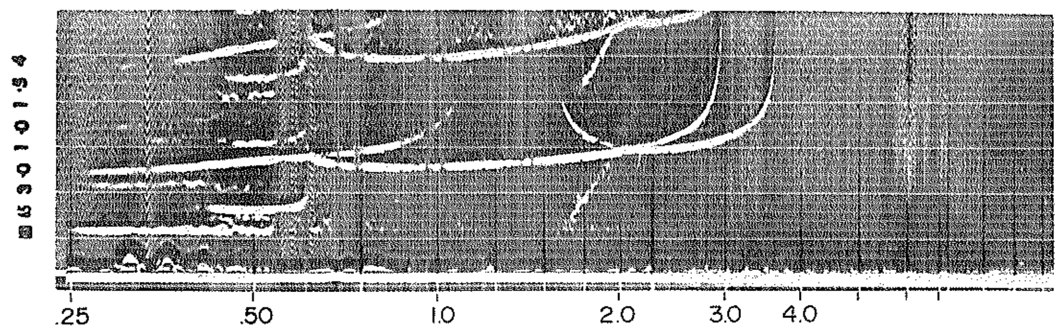


Figure 1. Point Arguello, 35.6 N 239.4 E, March 1, 1965, 0154, fB = 1.25MHz. The mean value of Kp was 1.5 for this night. An interesting additional feature of the ionogram is the presence of a high thick E layer with h'E equal to 150 km, above the typical blanketing sporadic E trace. This appears to be an example of particle E at night on a very quiet day with foE = foEs = fbEs; the value is 0.6 MHz with descriptive letter K. A number of examples of the presence of this high layer have been reported recently. It is probable that the retardation due to this layer is the main cause for the x-trace retardation seen just above the fB in the ionogram.

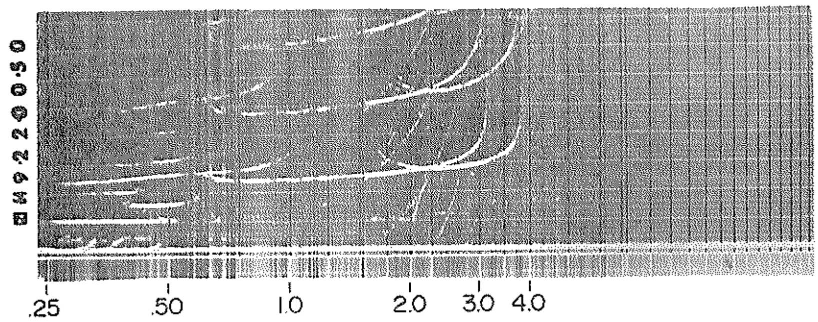


Figure 2. Point Arguello, September 22, 1964, 0050, fB = 1.25 MHz, shows the same phenomena, again on a night of exceptional quiet. A severe storm started shortly after these records were taken. Again a thick particle E type layer is present with foE = 060-K and multiples of the Gyro trace can be seen. Round the time base traces corresponding to the 8th, 9th, 10th, 11th, 12th and 13th order are visible at the high frequency end of the pattern.

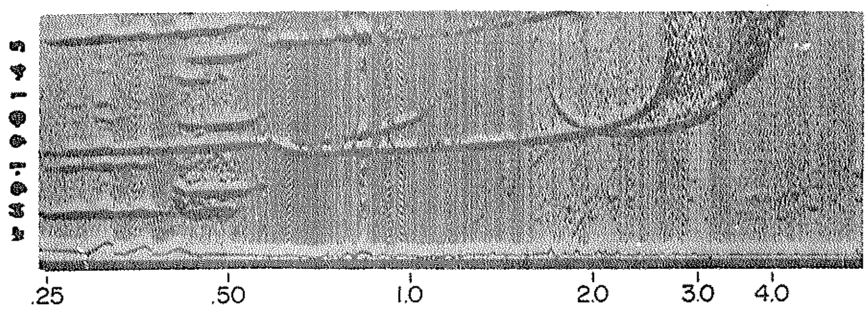


Figure 3. Wallops Island, 37.9N 239.4E, fB = 1.42, September 19, 1964, 0145 shows a similar pattern. Again the absorption is very low, other patterns in the sequence showing orders up to the 14th. Once again the thick E layer with foE = 060-K and with h'E near 160 km is present. It would be interesting to find out whether these three remarkably similar cases are due to an accidental coincidence or a characteristic of Gyro patterns in sunspot minimum years.

A further example of a Gyro-trace is given in Figure 6 below.

If you see any of these types of pattern please send either a note stating the date, time and whether flat or particle E patterns were present, or, if possible, a print from the ionogram.

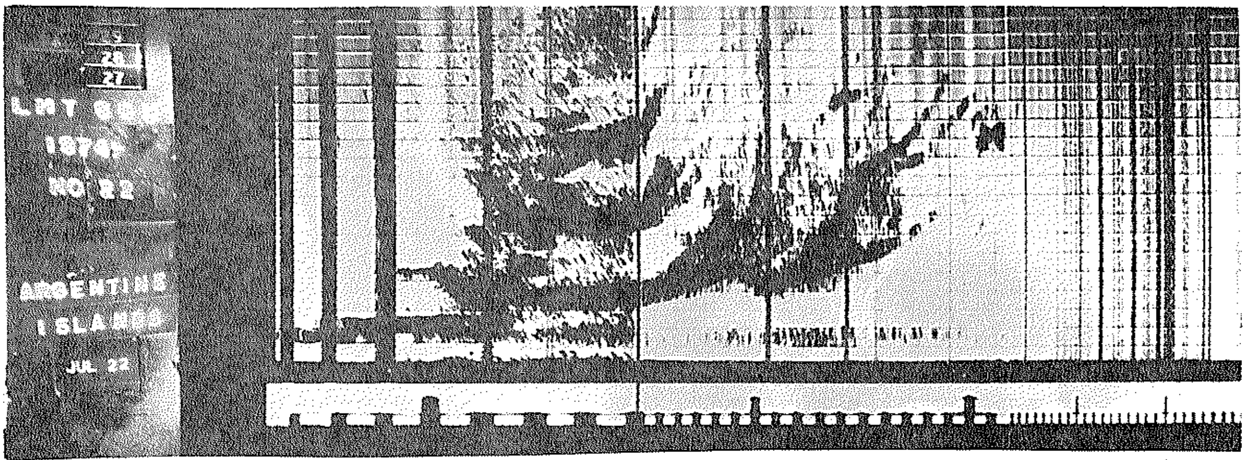
2. The Sunrise sequence at Argentine Islands (Lat. 65.2S, Long. 295.8E)

A sequence of three ionograms on July 22, 1974, at 0830, 0845 and 0900 has been submitted by Mr. A. Rodger, British Antarctic Survey, and are reproduced below in Figures 4, 5 and 6.

The main objectives of this sequence are to show a phenomenon which is fairly common at Argentine Islands and at the same time to show an example of a situation where the highest critical frequency in the E region near sun-rise is definitely not the normal E layer. This may be compared with the High Latitude Supplement patterns on page 59 for Sodankyla. At these times of day, the classical values of foE at this station would be expected to be near 1 MHz at 0830 and 1.3 MHz at 0900.

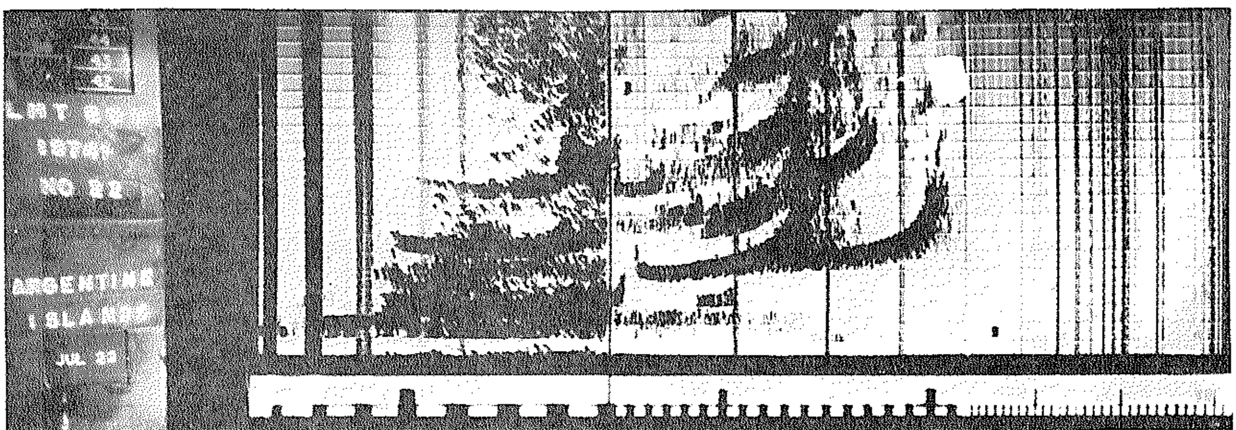
In the first ionogram the normal E is screened by an Es trace but the retardation in the F trace can be clearly seen. foE = 095UA. h'F is at 200 km and the multiples below 1.4 MHz are overhead. The first order F trace shows the typical complexity present when the critical frequency is varying very rapidly with position. Note that the multiples show an apparent critical frequency near 1.5 MHz. The most probable value of foF2 is 2 MHz as suggested by the weak 2nd order trace or 1.9 MHz deduced from the x-mode trace. The F1-like cusps shown on the o- and x-mode traces are not due to a F1 layer but show the point at which the tilt in the layer increases as the frequency is raised. The upper traces are those oblique traces reflected from the layer which is overhead at 0900. At 0845 a distinct cusp can be seen at 1.5 MHz and h'F rises to 270 km. The thick layer trace is at a height of

170 km and multiples show that it is horizontal. There is a close connection between this trace and the multiple order traces between 1.1 and 1.5 MHz seen at 0830. The low frequency end of the trace shows some retardation suggesting that foE is near 0.9 MHz. At 0900 h'F has fallen to 210 km. The lower end of the F-trace is blanketed by sporadic E but retardation can be seen near 1.2 MHz, particularly, on the E+F mode. Clearly what has happened is that the lower part of the F ionization has been replaced temporarily by a high thick intermediate layer whose retardation increases h'F at 0845. In this case the critical frequency near 1.5 MHz was clearly not a normal E critical frequency. Examination of the f-plots for this station at this time shows several examples of this phenomenon, the apparent values of foE falling either near or below 1 MHz or near 1.4 MHz. The sequence leaves no doubt that the lower value corresponds to the normal E layer at this time of day. The 0900 record is very remarkable in that it shows a Gyro trace. For this station fB is about 1.2 MHz. This is the first time that I have seen such a trace so close to E layer sun-rise. Usually the absorption at this time would be too great.



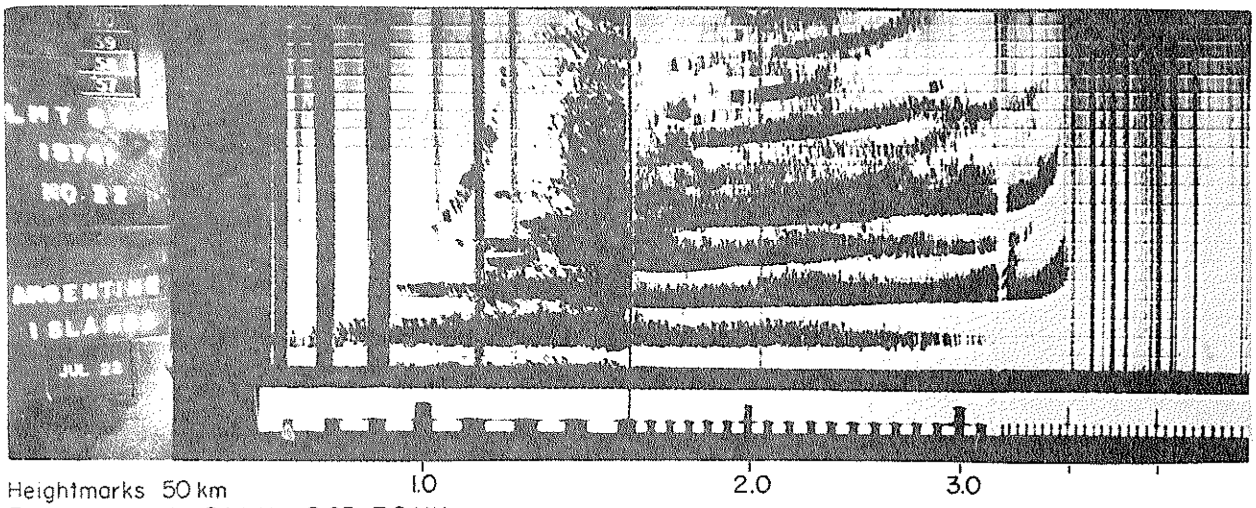
Heightmarks 50 km
Frequency marks 0.1 MHz 0.65 - 7.0 MHz

Fig. 4 Argentine Islands 0830 LT 22/7/74 Interesting Sunrise Sequence



Heightmarks 50 km
Frequency marks 0.1 MHz 0.65 - 7.0 MHz

Fig. 5 Argentine Islands 0845 LT 22/7/74 Interesting Sunrise Sequence



Heightmarks 50 km
Frequency marks 0.1 MHz 0.65 - 7.0 MHz

Fig. 6 Argentine Islands 0900 LT 22/7/74 Interesting Sunrise Sequence

XXIII. INAG Members

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