IONOSPHERIC NETWORK ADVISORY GROUP (INAG)*

Ionosphere Station Information Bulletin No. 31**

* 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 80303, 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

I must again apologize for delay in preparing the INAG Bulletin. I seriously underestimated the pressure of work on me during my last few months before retirement and the consequential confusion and muddle when I tried to pack over 45 years collection of data and papers in a few days. So far the pressure has not decreased and I am as busy, but less productive as I was when working!

I would like to draw attention to the INAG meeting to be held at Geneva at 1000 am on Friday 20th June in a room to be provided by CCIR, We all regret the short notice of this meeting and hope that those attending the CCIR meeting will be able to attend. If not, as at Canberra, written contributions sent to me or given to our Secretary Virginia Lincoln at CCIR will be included in the next INAG Bulletin.

It is important that as many as possible attend or brief their representatives for the INAG business meeting to be held in conjunction with the URSI General Assembly August 10-19, 1981. Normally, I would try to arrange a special meeting of INAG to discuss your problems before the General Assembly but on this occasion there will be serious clashes in timing between the URSI General Assembly and the IAGA and MAP meetings in Edinburgh. In order to guide INAG on the best compromise to make please return the Questionnaire at the end of this Bulletin. If, as I suspect, the potential participants will be rather evenly split between the URSI and IAGA meetings, we shall need to consider holding an INAG meeting in Edinburgh as well as in Washington. As you can see from this Bulletin, the meeting held in conjunction with IAGA at Canberra was well attended and produced some useful input for INAG.

Since my retirement, I have conducted ionogram interpretation discussions in Peking (Beijing), Wuchang (Wuhan) and Hong Kong and will be publishing some of the more interesting ionograms in future Uncle Roy s columns. I took advantage of the visit to China to stress the mutual advantages of China joining the WDC and INAG cooperative systems. I found that the Chinese scalers whom I met were anxious to discuss detailed points from the Handbook and numerous difficult sequences were discussed. It was suggested at Canberra that I should do more of this type of work. I am willing to do so but the limitation will be financing such trips. I am not in the position to do this from my own resources to any great extent.

May I draw the attention of those groups who can contribute $10.00 U.S. toward the cost of producing the Bulletin to the need to contribute. With ever tightening financial conditions the future of the Bulletin must be in doubt unless more groups contribute. (INAG 29 p. 7 Future of INAG and invoice p. 55). I find the increased interest in our work most encouraging and feel that the Bulletin has still much to contribute in the future.

II. Report of INAG Meeting Canberra 12 December 1979

Participants:

D.G. Cole	Australia	Chairman of meeting
J.V. Lincoln	U.S.A.	Vice Chairman and Secretary INAG
J.R. Dudeney	U.K.	Alternate for W.R. Piggott
L. Bjorn	Sweden	
L. Bossy	Belgium	
I. Bozic	Australia	
J.0. Cardus	Spain	
P.L. Dyson	Australia	
E.A. Essex	Australia	
J.A. Gledhill	South Africa	
R. Haggard	South Africa	
D. Horton	Australia	
B. Hultqvist	Sweden	
RD. Hunsucker	U.S.A.	
T. Kelly	Australia	
K. Lassen	Denmark	
N. Matuura	Japan	
V.V. Migulin	U.S.S.R.	
J. Oksman	Finland	
I.M. Raspopov	U.S.S.R.	
R.G. Rastogi	India	
A.0. Richmond	U.S.A.	
D. van Sabben	Netherlands	
L.V. Shirochkev	U.S.S.R.	
D.G. Singleton	Australia	
V. Solaga	Australia	
R.S. Unwin	New Zealand	
P.J. Wilkinson	Australia	

Written contributions were received from Dr. D.R. Lakshmi, India, Dr. J.R. Manzano, Argentina and Professor R.D. Hunsucker, U.S.A. INAG would like to thank Dr. D.G. Cole for organizing the meeting, acting as Chairman and preparing the minutes. The meeting was attended by 28 representatives from 14 countries.

1. Chairman's Introduction

- Dr. Piggott was not able to attend INAG meeting because he is retiring from Brit. Antarctic Survey this month. He asked me to reiterate that he is not retiring from his INAG work —far from it, in fact he now intends to spend more time on research and INAG matters but he will need the support and encouragement of INAG members and friends.

Action — I think we all would wish Dr. Piggott well for the future, thanking him for the time he has given to INAG in the past and looking forward to his continued support of INAG in the future.

— Although the Chairman of INAG is not here, we have the Vice Chairman and Secretary, Miss Virginia Lincoln with us and I shall be leaning on her experience during this meeting to keep myself on the straight and narrow.

— There will be several questions raised today that have already been raised at other INAG meetings and in the INAG Bulletins. The reason for this is twofold; firstly, very few participants of these meetings overlap and secondly very few people reply to questions inserted in INAG Bulletins. So I stress again the need for written input to Dr. Piggott or Miss Lincoln particularly on issues of policy, otherwise the operation of INAG will lag behind the requirement.

— That INAG meetings and the INAG Bulletins have continued their high standard of support to the ionospheric community is due in no small part to Dr. Piggott and his colleagues in the British Antarctic Survey and to Miss Lincoln and those involved in the publication of the bulletins, and I would like to thank them all for their hard work and effort — they do not go unnoticed.

- The International Magnetosphere Study Initial phase closes at the end of this year and although the main pressure on ionospheric ground based data is released there will probably continue to be a post IMS magnetospheric program. There are also the STP activities included in the Middle Atmosphere Program and the Solar Maximum Year which should be considered when we discuss the role of INAG In the 1980s, the needs for ionosondes and the type of data to be scaled.

2. Helsinki Meeting Report

— This INAG meeting was held in August 1978 as part of the URSI General Assembly. At that meeting INAG gained continued financial support for the INAG bulletin for the next three years provided that those who could provide $US1O per 3 year subscription did so. I would urge those who can contribute $10 per copy to do so, in order that URSI will continue its grant to INAG. The subscription invoice address is given in INAG—29 page 55.

— The results of the questionnaire (published in INAG Bulletins 27 and 28) on the future of the ionosonde network after 11.15 were discussed. In particular the definite closure of 8 stations and the possible closure of the Canadian Chain, the German Chain and Port Stanley. The Canadian Chain has been reprieved at least until the end of 1980 through the lobbying of users of the data. What about the other closures? If we do not make an appeal, then we cannot expect to have the data.

The reported closure of Dourbes, in INAG-29 page 7, is an error. There is no intention of closing Dourbes.

3. Status of the Network

USA - Dr. Hunsucker, University of Alaska, reported that Sach's Harbour and Cape Parry will operate in the future on campaign basis. College and Kodiak record 15 minute data. Hourly data from College is sent in real time. Data from Kodiak will go to WDC-A until about 1981.

- No changes to US Network. White Sands will have digital ionosonde soon, same also at Fort Monmouth although here the data does not get to WDC—A. Bangkok now operates under new management.

USSR - New station to be opened at (Amderma) geog. latitude 67N, invariant latitude 65N, in the area of Murmansk—Dixon on the Barents Sea. Other stations operating routinely with data available. One ionosonde has been on drifting ice in North Polar region, but may not continue.

India - Haringhata, Madras, Hyderabad and Bombay no longer producing data. All India Radio will set up ionosondes at Nagpur, Srinagar and Gauhati shortly. They also have plans for 2 IPS-42 ionosondes to go to Bombay and Madras. Dr. Rastogi suggests that an ionosonde may be set up in Southern India.

Norway — New SEL digital ionosonde of MPI Lindau to be associated with EISCAT but not as yet in routine operation.

France — Lannion, Tahiti, Terre Adelie, Kerguelen, Ojibouti all routinely operating.

Belgium - No closures. Routine operation.

Holland - No change.

U.K. - South Georgia closed, Argentine Island will keep open (Union Radio Mark 2), Halley Bay will be upgraded with an SEL digital ionosonde (Advanced Ionospheric Sounder) in 1981. Appleton Laboratory, Slough, has purchased an IPS—42 ionosonde but there is no information on whether the Slough ionosonde will be resited. An IPS—42 sounder has also been purchased by Leicester University. Port Stanley will continue at least until 1983.

Green-land — Danish experimental station at Sondre Stromfjord is closed except for special campaigns. Olesen has recommended this site for a digital ionosonde.

Sweden — No change. Kiruna, Lycksele and Uppsala may be upgraded with ionosonde replacement.

Finland - Stations Sodankyla and Nurmijarvi improved with taller antennas. No danger of closing.

New Zealand - Raratonga closes end of March 1980. This ionosonde may be reestablished at Suva, Fiji under auspices of Skinner. Other NZ station will continue. Auckland for research only.

South Africa — Hermanus may reopen. Other stations operating. Continuing to digitize chirp sounder.

Spain — Ebro operating as usual.

Japan — All five stations plus Syowa all operative. (Matuura not in charge at Hiraiso.)

Aust-ralia — All stations except Brisbane now have IPS—42 ionosondes. Brisbane station was in jeopardy last year when the operator was forced to retire through ill health - an arrangement between the University of Queensland and IPS has been made under which IPS scales the data and the University maintains the equipment. This arrangement will be reviewed in 1981. Port Moresby is operating again, from December 1979, now under the University of Papua New Guinea, with data available through IPS.

Vene—zuela - New station planned.

Italy/ Greece — Digisondes in Rome, Turin. Sicily and Athens but no routine data available.

South America - INAG has been asked to support a recommendation for an ionosonde between Tucuman and Huancayo on the 60W chain.

4. Actions on 'Needs for Ionosondes in the 1980s.

- This URSI/IAGA joint working group report was discussed at the Helsinki meeting. It provided the basis for support of the minimum world network.
  After two years reflection Dr. Rishbeth now feels the report did not stress sufficiently the need for advanced ionosondes to produce routine data. Advanced ionosondes in bistatic or oblique modes could reduce the need for a close spaced network such as the European net. The report was not intended to make special pleas. The close spaced network should have scientific aims specified by the scientists.

- If ionosonde stations included additional monitoring equipment a better coverage of phenomena could be achieved and also would help preserve a useful ionosonde site.

5. Action on Proposed New Stations and Closure of Existing Stations

— Port Stanley will be reviewed in 1981.
- Brisbane will be reviewed in 1981.
- The damaged Hong Kong station will re—open shortly (operating February 1980).
— Dr. Piggott will visit Chinese network in February 1980.
- Belgium concerned that German stations have closed because they are at the mid point between two advanced ionosondes that could work in the oblique mode.
— Written contributions will be found in this Bulletin.

6. Training Problems and Use of Handbooks

— USSR wants a meeting to discuss high latitude scaling with subsequent revision and additions to the High Latitude Supplement. The problem of who could attend such a meeting, and where, would have to be resolved. Perhaps Dr. Piggott could more easily be moved?

Action - A high latitude scaling group should be formed within INAG to decide on scaling and interpretation, taking account of recent knowledge gained during the IMS. It could start through correspondence and then have Piggott visit the different groups.

Action — Dr. Rastogi suggests Dr. Piggott should attend the July 1980 Equatorial Aeronomy Symposium in Arecibo and give a workshop on low latitude interpretation problems. Organizers of the symposium (Balsley, Matsushita, Rlshbeth) should be approached for possible funding of Dr. Piggott.

— No interest for low frequency ionogram rules of IQSY Manual to be published In INAG Bulletin. Reference to previous rules thought to be sufficient during MAP.

- Olesen’s suggestion for a short introductory Handbook to be used in conjunction with present Handbook received strong support. Such a handbook could be drafted from regional training aids. Networks with training manuals (e.g. BAS, IPS) work with Dr. Piggott to draft a simplified handbook.

— On the matter of ionogram illustrations for handbooks it was pointed out that several groups had sent illustrations to the Chairman and these had not been acknowledged. The Australian network does have a series of ionograms illustrating scaling problems for training purposes.

— The “Correspondence Course” in the INAG bulletin has been enthusiastically received. Similarly the short article on the Earth’s magnetic field in the northern and southern hemispheres (INAG 30-5) was extremely useful for training and background knowledge. Further such articles would be appreciated.

— Articles on interpretation of ionograms from specific zones (e.g. high latitude, low latitude) appearing in Uncle Roy’s column could be labelled and collected by relevant networks as regional handbooks.

- Readers would like “alphabet history’ continued.

7. Equatorial Station Network Problems

- Already covered above.

8. Changes in Scaling Parameters

- Following the end of IMS, data support may decrease although MAP, Solar Maximum Year, and other activities will be taking place. Olesen’s suggestion of grading stations into partial and full routine scaling was supported by the meeting, leaving the grading to the local organizations concerned.

Action — IDIG should be asked to provide list of differences expected in ionograms produced by digital ionosondes compared with conventional sondes. Thereafter the scaling rules can be checked to fit with these differences.

- On the specific changes listed INAG-29 (page 9):

(a) All temperate latitude Es types combined as flat type was supported although h’Es (of dominant type?) was required to give information on atmospheric tides.

(b) Restriction of training to zones was not recommended.

(c) fmin scaling was recommended as optional. Although labelled as scientifically dubious, it is a useful indicator of equipment health.

(d) k and r-type Es to be combined at high latitudes — supported.

(e) Tightening of F1 scaling (when h'F2 is uniquely defined) — supported.

(f) Ignore Es if foEs is below foE — supported.

(g) Recommended that unless fxI was not actively supported and used, fxI should no longer be scaled. Though CCIR might support, INAG should withdraw recommendation unless some institution undertakes analysis of fxI.

(h) M and T to be eliminated — supported.

9. Status of New Ionosondes

IPS-42
Mr. Kelly has five units going to China, Indonesia and U.K. He expects 10-15 more to go out over the next 12 months, including possibly to the Middle East and S—E Asia. The present price will be held until June 1980.

- BAS has made a comparison of ionograms of the early IPS—42 and the Union Radio Mk at Argentine Island. There was no significant difference in h'F; more spread F and Es layers were seen on UR but the morphology generally was the same. Better height resolution was found on the 42; more multiple echoes on UR. The major difference was in M3000F2 values and a further check is being made of these.

- A Boulder ionogram comparison between IPS—42 and the 04 is at present being made.

— IS—14
Units at Uppsala, Sodankyla, Nurmajarvi.
Dr. Oksmann reported briefly on the IS—14 characteristics. The output is 5 kW, frequency range 0.5-16 MHz.

— Dr. Whitehead has recommended the concept of phase ionosonde to INAG mainly for Its excellent height resolution. The advanced ionosondes will incorporate phase height monitoring.

10. High Latitude Working Group
— Already discussed in minute no. 6.

11. IDIG
- Dr. Dudeney will add comments on IDIG to the report. The IDIG report will eventually appear in the INAG Bulletin.

Scaling rules must take the new digital ionosonde output into account.

- Digital ionosonde development which allows routine data to be monitored is to be encouraged by INAG.

12. Australian Network
- Support for Brisbane is needed if this is to remain open after 1981.

- The Australian network will modify its ionosondes over the next 2-3 years so that echo amplitudes will be monitored at several frequencies routinely.

- A simple and Inexpensive digitizing system is being deployed in the network. The ionogram is projected onto a digitizing board where a light pen enters frequency and height onto a visual display and a magnetic tape cassette, which can then be entered into a computer for verification and printing of the data.

III. International Digital Ionosonde Group

The establishment and history of the International Digital Ionosonde Group was reported in INAG-29, pp. 29—33. This group has now issued its first Bulletin, which has gone directly to members and consultants of the group. In accord with INAG policy to publish Bulletins for any URSI Working Group the first IDIG Bulletin is reproduced below. The Chairman of IDIG would like to hear directly from anyone who wishes to be more closely associated with the group, and also draws attention to the IDIG Scientific Meeting in Quebec, June 2—6, 1980 (Item 3 of IDIG Report). An informal IDIG business meeting was held in Canberra, 12 December 1979 during the IUGG Assembly.

URSI Working Group G.1O

INTERNATIONAL DIGITAL IONOSONDE GROUP

BULLETIN NUMBER 1

by

J.R. Dudeney

Chairman, IDIG. British Antarctic Survey, Madingley Road,
Cambridge CB3 QET, UK.

1. The Bulletin

This is the first of what I hope will be a fairly regular, but informal , series of information, news and discussion bulletins. Its frequency of occurrence and value will depend on your response in terms of contributions and comments; so please, please get thinking and writing! I intend sending it to everybody on the current IDIG mailing list, and will also publish it in the INAG Bulletin by kind permission of Dr. W.R. Piggott (Chairman of INAG). This first issue is mostly devoted to a report on the results of the recent IDIG Survey into the current level of interest and activity in digital sounding. I would like to thank all those people who took the time to respond to the Survey.

2. Report on IDIG Survey

(i) General

The survey produced 36 responses from 15 countries, split 22 to 14 between the Active' and 'Information only" categories. The replies included information on nine separate hardware systems, ranging from custom built highly complex instruments such as the NOAA sounder, to a C4 operated in conjunction with a microprocessor (see (II) below). There was also considerable information concerning scientific programmes, and it is clear that the main emphasis is on research rather than synoptic sounding (see (iii) below). Only two of the respondents were primarily concerned with scientific software development, indicating, perhaps, that most groups are still involved mainly with hardware and systems software development.

(ii) Equipment

Information on equipment development and deployment derived from the survey is shown in Table 1. I am aware that this table does not give a complete picture. For instance, digital sounders are known to be under development in Scandinavia and the USSR; also there is a very healthy network of Digisondes in operation, and a further SEL sounder at White Sands, USA. If you have been missed, please send me more information.

It is heartening to note the developments taking place in Argentina and Kenya, and I hope to report more fully on these in the future. The development of the Barry Chirp sounder being undertaken independently in Australia and South Africa is also of great interest. Rather than further summiarize (and possibly misrepresent) the individual responses to the survey question on equipment, I have reproduced them (in alphabetical order) below.

Survey Question 6

Additional Information on Equipment

Please give brief details as appropriate concerning: type of equipment; location; status of development; type(s) of data output; format and availability of data for general use.

Bossy: Digisonde 128.
Output for routine: display of the amplitudes on paper.

Cazenueve: A digital sounder has been developed by our engineers. The construction is intended to be advanced the next year.

Dudeney: We have one NOAA sounder, labelled by us the AIS. This will be undergoing operational testing at the Appleton Laboratory, Slough until October 1980, when it will be deployed at Halley Station, Antarctica. During the test phase we hope to carry out drift measurements for comparison with data from a co—sited Fabry—Perot interferometer which will provide neutral wind velocities from 6300 Å airglow observations (collaboration with Dr. Smith, Ulster College).

Earl: We have recently completed a two year ionospheric measurement program at Alice Springs in central Australia. The equipment was designed to measure and record backscatter sounding ionograms as well as HF spectra and noise data. It was configured around a PDP 11/40 minicomputer, a modified Barry Research FMCW sounding system, and a significant amount of electronic equipment developed within Defence Research Centre, Salisbury (ex Weapons Research Establishment). All data was recorded on magnetic tape in a calibrated mode. We are currently involved in the development of an improved system which, In addition to backscatter sounding, will include an oblique sounder (1200 km path) and a vertical incidence sounder.

Jogulu: IS—14A (KLT) Finland. Being procured by Physics Department, Andhra University, under UNDP assistance. Will be located in the field station of Ionosphere and Space Research Laboratories, Physics Department, Andhra University, Waltair.

Kelly: Manufacture and distribution of IPS—42 Transportable Ionosonde, DBD—42 Digital Receiver and the design and manufacture of obviously digital updates of the IPS—42 'sonde in future years.

Nagpal: Modification of existing C4 ionosonde in progress. A microprocessor controlled recording of foF2 on magnetic tape has been achieved. Location: 1.280S, 36.830E.

Poole: Barry Research Chirpsounders, under modification to provide digital output. Locations: Grahamstown, South Africa, and SANAE Base, Antarctica. Output initially on paper tape, ultimately on mag. tape. Parameters measured: amplitude, phase, virtual height of selected frequencies on twin channel receiver - allowing measurement of doppler velocity and angle of arrival.

Whitehead: Phase Ionosonde: data recorded on magnetic tape, control of PDP-11. Phase and amplitude at 4 aerials give: virtual height, angle of arrival. Error in h' < 100m sometimes less. Error in θ < ½°. Fourier analysis allows separation of echoes.
Cross-array: 3 frequency sounder. Microprocessor + PDP—11 control and data analysis.

Wright: Some additional remarks, for emphasis, to those already given concerning the NOAA digital ionosondes: the principal feature of these equipments deserving emphasis at present is their organization around a general purpose digital computer for all functions of system control , data acquisition and data processing. This adherence to the Dynasonde concept permits carrying out virtually any imaginable measurement objective, of which those mentioned in SEL Preprint No. 206 are examples. Two additional features of mainly future importance are:—

(a) The development of adaptive sounding methods, in which the current state of the ionosphere determines optimum time and frequency sounding patterns;

(b) Use of the programmable 'front-end processor' to study and develop better ways of interpreting echo waveform and phase information. This is especially needed for such phenomena as spread F and partial reflections, but applies to all echoes because of diffraction and dispersion effects.

(iii) Scientific Programmes

It is clear from the survey responses that a major research effort is developing around the digital sounder programme. The primary thrust of this effort appears to be aimed at the high latitude F-region and coupling between the magnetosphere and ionosphere. There also continues to be interest in communications research. The detailed responses are given below.

Survey Question 7

Scientific Programme:

Please give brief details of the scientific aims of your programme using digital sounders and whether you are interested in data interchange with other groups.

Bossy: Co-ordinated observations with other stations working with Digisondes (especially oblique soundings).

Cazenueve: Regular soundings at Beigrano are planned. Correlated measurements with magnetic, auroral and VLF activity are planned in order to study the coupling between storm activity and interplanetary conditions.

Conkright (WDC-A): As a Data Center we are interested in data collected and data exchange.

Dudeney: Our general interest is in the dynamics of the high latitude F—region. Initial aims of the Antarctic campaign are (i) to study the structure and dynamics of the F-region trough and its relation with the plasmapause, (ii) to study the interaction of the ionospheric plasma and neutral gas under the influence of neutral winds and electric fields. We expect to have co-sited collaborative programmes in riometry, airglow, VLF gonimetry and magnetic pulsations. We are keen to collaborate with the proposed Siple Sounder program, in particular we would like to carry out oblique sounding between Halley and Siple to (a) give information on the trough at a different longitude, (b) for communication studies.

Earl: The scientific aims of our program are to develop techniques in real time frequency management of HF circuits, and to establish a data base for the evaluation of models of HF propagation and noise. Some of our data will be made available upon application.

Hargreaves: Through Halley Bay Installation, possible areas of interest are (i) E—region structures in relation to auroral precipitation events; (ii) conjugate point experiments.

Hunsucker:

1. Co—operative studies with Chatanika radar.
2. TID/AGW studies.
3. Co—operative studies with NOAA MST radar.
4. F—region drift (Doppler sounding).

Jensen:

(a) We are interested in being kept currently informed on the subject, especially regarding possibilities for the availability of digital ionosondes at one or more of our 4 Greenland stations run in co—operation with NOAA.

(b) Scientific aims are mainly those related to ionospheric and magnetospheric processes in the polar cap and the auroral oval (CUSP). Special interest is in plasma Instabilities, plasma drifts and ionospheric irregularities, sporadic E, etc.

Jogulu: Study of N—h profiles, estimation of underlying Ionisation of the night-time ionograms and valley studies. F-region dynamical behaviour using N—h profiles. Interested in data interchange with other groups.

Kelly: KEL Aerospace at this stage Is particularly interested in receiving’ information from all groups and in exchange “supplying’ the correct and necessary equipment. In the longer term we would hope to become more active In the exchange of data with International groups.

Nagpal: My main interest is to look for small scale fluctuations in foF2 and to interpret them as a kind of wave motion. I would be interested In data exchange.

Park:
1. Particle precipitation, particularly VLF wave—induced events.
2. Trough-plasmapause relationships.
3. Magnetospheric electric field effects on the F—region.
4. Ionospheric irregularities and whistler ducts.

It will be useful to compare with data from Halley Bay and Millstone Hill.

Paul: Development of scientific software for Interdata computer (NOAA sounder) and application to data recorded with the new system.

Pitteway: I am interested in software, and theoretical developments relevant to the instruments, e.g. noise rejection, and real time data acquisition and display.

Poole: Broad purpose of digital sounder at high latitude (is) to observe variation of hitherto immeasurable ionospheric variables such as doppler velocity of the plasma, angle of arrival, etc.

Schmerling: Special soundings in co—ordination with rocket launches and spacecraft overflights. Interchange for special campaigns only.

Stiles: The sounder will be set up in Logan, Utah, for testing from May through August, 1979. From September 1979 to August 1980, the sounder will be located at Roberval, Quebec. In the fall of 1980 the sounder will be moved permanently to Siple Station, Antarctica. (Chairman's comment: I understand that due to slippage the sounder will not go to Roberval until Spring 1980).

The sounder will be used to study the dynamics of the high latitude ionosphere and ionospheric manifestations of magnetospheric processes. Some specific items of interest are trough and auroral oval dynamics, comparisons of magnetospheric and ionospheric electric fields, ionospheric effects of wave—particle interactions, and the effects of the ionosphere upon magnetic variations.

Stone: My use of digital sounders has been primarily as a source of data to correlate with my Holographic Radio Camera results. However, some digital sounders record coherent (phase and amplitude) data as an inherent part of their operation. Recently I have been interested with the possibility of applying inverse scattering theory to such data to obtain improved (unique?) electron density profiles. At some point In the future the availability of data for testing such a theory could be quite valuable.

Whitehead: Sporadic E, spread F.
With the cross—array - 0 region echoes.

Wright: A large part of our effort over the next few years must be committed to further refinement of the digital ionosonde itself through on—line and off-line software development. It has been our habit to motivate and test such efforts through the pursuit of scientific campaigns which (hopefully) yield results of geophysical interest as well. Examples of such campaigns now planned are:

(a) Comparison of F—region drifts by the moving pattern method, with neutral winds obtained by Dr. G. Hernandez (NOAA/AL) in the Boulder area from doppler shifts of the 6300A emissions,

(b) Further studies of opportunity during Platteville ionospheric heating campaigns. Principal examples of interest are the precipitation of energetic plasmaspheric particles under certain conditions, and the deployment of spread F.

(c) Campaigns of measurements using the NOAA system are planned at Cape Parry, NWT, in collaboration with Dr. H. Stenbaek-Nielsen, J.D. Winningham.

(iv) Working Group Meeting in Conjunction with IUOG

There appears to be sufficient interest (sixteen respondents thought it likely that they would attend) for me to organize the proposed ad hoc working group meeting in Canberra this December. I have therefore approached the organizers of the IAGA General Assembly who have agreed to the proposal, subject to availability of rooms. A few agenda suggestions were put forward in the responses, however, I would appreciate more ideas.

3. North American Radio Science Meeting and IEEE/APS International Symposium

These meetings are to be held at the Universite Laval Quebec, June 2-6, 1980. Mr. J.W. Wright is organizing a session entitled 'The Application of Digital Techniques to Ionosondes - Methods and Results". Please write to him for further information at the following address:

J.W. Wright
Space Environment Laboratory
NOAA R43
325 Broadway
Boulder, CD 80303
U.S.A.

TABLE 1

SOUNDING SYSTEM	STATUS	LOCATION	RESPONDENT
Lowell Digisonde 128	O	Brusselles, Belgium	Bossy
Space Environment Laboratory Sounder	O.T.	Boulder, Colorado, U.S.A.	Grubb
	?	Lindau, Germany	Kopka
(other names:- NOAA HF Radar,	D	FaIrbanks, Alaska	Hunsucker
Advanced Ionospheric Sounder)	O.T.	Cambridge, UK	Dudeney
	O.T.	Utah, U.S.A.	Stiles/Park
Instituto Antartida Argentina Sounder	U.D.	Buenos Aires?	Cazeneuve
KEL DBD-42	U.D.	Malvern, Australia	Kelly
Phase Ionosonde	O	St. Lucia, Australia	Whitehead
Modified Barry Chirp Sounder	O	Alice Springs, Australia	Earl
	U.D.	Grahamstown, South Africa	Poole
Modified C4	U.D.	Nairobi, Kenya	Nagpa
I IS—14	D	Waltair, India	Jugulu
Digital Topside Sounder (ISS-b satellite)	O		Matuura

Notes:—
O Operational
O.T. Operational testing
U.D. Under development
D To be delivered

URSI General Assembly in Washington DC August 10—19, 1981

As Working Group One of URSI Commission G INAG will need to hold a business meeting during the URSI General Assembly August 10—19,1981. At several previous General Assemblies, INAG has held a one or two day meeting immediately before the Assembly so as to allow time for detailed discussions of participants problems. The General Assemblies are always very busy and it is difficult for representatives to attend more than a short session during them. INAG would like to know how many groups would be prepared to bring material for a discussion if a pre-Assembly meeting was organized. An early reply is essential so that arrangements can be made. A questionaire is attached to this Bulletin.

This is an obvious opportunity to hold meetings on the following:
(a) The High Latitude scaling group (item 6 of Canberra meeting).
(b) Low Latitude interpretation problems (also proposed item 6 Canberra).
Will those interested in these fields be able to attend? (See questionaire). There are unfortunate clashes between the URSI General Assembly and the IAGA Scientific Assembly at Edinburgh, the IAMAP meeting in Hamburg and the TAGA/IAMAP, Middle Atmosphere Symposium. If there is enough demand, it may be possible to organize an INAG meeting at Edinburgh during or immediately before the JAGA meeting. An early response is needed if any of these meetings are to be arranged.

V. INAG Meeting in Geneva June 20th 1980

We much regret that, owing to the Chairman's absence in China, the announcement of the INAG meeting in Geneva has been seriously delayed.

The meeting will be held in the ITU building in Geneva, Switzerland starting at 1000 am on Friday June 20, 1980. The Chairman and Secretary will be in Geneva on Saturday and Sunday for further consultations or discussions with late arrivals.

This meeting forms a continuation of the series of meetings held in conjunction with meetings of CCIR Study Group 6 (formal meeting starting June 23rd 1980) to encourage cooperation between the vertical soundings network, INAG and CCIR so that problems in practical communications can be brought to the attention of INAG.

Agenda

1. Chairman's Introduction
2. Report to INAG on Chairman's visit to P.R. of China
3. Discussion Helsinki and Canberra Reports
4. Problems of Special Interest to CCIR
   (a) Needs for ionosondes in the 1980's
   (b) New stations
   (c) Closure of existing stations
   (d) fxI and Es
5. Changes in parameters, letter symbols and programs.
.6. Training problems. Handbooks.
7. High Latitude working group
8. Equatorial station problems
9. Status of network
10. Status of new ionosondes
11. International Digital Ionosonde Group

VI. New Address for INAG Correspondence

Material for publication in the INAG Bulletin and letters to the Chairman of INAG should be sent to

Dr. W. R. Piggott
21 Hillingdon Road
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Middlesex
UB10.OAD
ENGLAND

I note that complaints were made at Canberra that some ionograms for publication had not been acknowledged. I am very puzzled by this as I have received very few ionograms during the last year and had, I believed acknowledged their receipt. I have been away from England for considerable periods during the last year and it is possible that this has caused them to be overlooked. If you have sent such material without acknowledgment please let me know so that I can Institute a search for them.

VII. Further Notes on the Australian Ionosonde Operators Conference 1978

A short report on the Australian Ionosonde Operators' Conference 1978 was given in INAG-29 p. 10-11. As I had wished to comment on the remainder of the report and did not have time to do so before publishing INAG-29, a number of interesting and important points have been held up till this issue. The full text prepared by Dr. David Cole is reproduced below with Chairman's comments inserted. The points will be of special interest to those using the 4A, 1PS42 or similar solid state ionosondes.

The Australian Ionosonde Operators' Conference, 1978

The 1978 Ionosonde Operators' Conference was held in Sydney, May 24—26. All stations of the Australian ionosonde network were represented along with a representative from New Zealand. The main objectives of the conference were:

- a review of the scaling rules and their interpretation as a consequence of using the IPS 4A ionosonde,
- an investigation of the operational problems encountered with the 4A in the field,
- a discussion of any need to modify the 4A ionosonde in the future,
- a discussion of recent and future work at IPS.

Most operators had had 6 months to a year's experience with the 4A. While each station had its own minor problems the most common problem involved the camera operation. The common reasons for data loss were jamming of the film in the cassette and dirt collecting on the commutator contacts. Film jamming generally resulted from packing too much film into the cassette or careless threading of the film but the accumulation of dirt was more serious.

An improved camera movement is now being developed which substitutes a photo-electric cell for the mechanical contacts.

The 4A was modified during installation at the stations so as to monitor background noise. The complete removal of all interference bands had led to some scaling difficulties; in particular, Y, S, B or C all became reasonable choices as descriptive letters where gaps appeared in traces. While Y could normally be discounted, it was necessary to obtain some indication of the background noise level in a channel to decide whether interference or absorption had produced a gap. To give this indication, the output of the AGC is displayed in the first 50 km of the ionogram. Interference appears as an increase or spike in the AGC output and these spikes can be related to gaps in the ionograms. While the AGC information usually resulted in unambiguous interpretation of gaps in traces, there are still occasions when this is not so. Two specific examples discussed were where an E-region trace is broken near fmin (is the trace weak and intermittent or is interference causing the gaps — where is fmin?) and when disturbed nighttime traces coupled with interference make it difficult to unambiguously identify traces. In general it was agreed that such examples will be treated on their merits.

> Chairman's comment: Several groups have difficulty with the weak trace rule at frequencies near fmin. The object of the weak trace rule is to eliminate consideration of traces which are intermittent (eg. meteor traces) or weak compared with the normal tracing. It is not intended to eliminate analysis of normal traces weakened by absorption, defocussing or aerial limitations. In this context a trace broken up by interference would have been a normal trace in its absence and should be treated accordingly. Thus the general rule where interference is severe is that fmin is the lowest frequency at which the trace can be seen, whether intermittent or not.

The 4A ionosonde has incorporated in it a low frequency filter usually set to 1.6 MHz, to prevent local broadcast stations from blocking the receiver. When fmin fell below this low frequency limit most scalers used the descriptive letter C, rather than S, to indicate that 1.6 MHz is not the minimum frequency detectable by the ionosonde but rather the limit is due to a non-ionospheric cause. It has been decided that operators will check the need for the low frequency filter at their particular sites. Having set this limit because of the presence of interference, the descriptive letter S will be used in the future rather than C when the AGC monitor indicates strong interference. This approach has been adopted primarily because, irrespective of the definition of C, it is usually reasonable to take the occurrence of C as a subjective indicator of ionogram quality.

> Chairman's comment: I concur with the decision to use "S" where a filter is used to minimize the effects of medium wave interference at night and do not like the use of "C'. It is quite common for low frequency ionosondes to be operated for synoptic work with a relatively high lowest frequency e.g. starting at 1.0 to 1.5 MHz when the ionosonde is capable of starting at 0.2 MHz. Where this practice is normal it seems best to use the starting frequency as the effective lower limit of the ionosonde so that parameters falling below this limit are treated as E values. The main use of Es instead of EE is when echoes can be received in the medium wave band during the day but not at night. If the filter prevents echoes from being observed at all hours. The

transmitter should not be radiating in the medium wave band and the effective starting frequency is that given by the filter.

In discussing the scaling of Spread F it was felt that the 4A simplified scaling, the main trace being resolved by the ionosonde. Because of the discrete frequency steps the presence of slight spreading could potentially be detected more easily.

Much general discussion on scaling was initiated from comparisons of scaling from a representative film of 4A ionograms. It was apparent from these discussions that the exact aims of ionogram scaling were not always clear. Three broad objectives were proposed - to maintain consistent scaling rules, to represent what is on an ionogram and to enable median calculations to be made. There is some conflict between the first two objectives as a consequence of the third.

Chairman's comment: In the early days of the subject there was much stress on obtaining representative values for the hour of the parameters and the Handbook still shows some effects of this philosophy. In practice, for many years, it has been found impossible to use this principle and the stress is now to give the ionospheric conditions as near overhead as possible as shown by the ionogram. The value of the medians depends primarily on the median count, which should be as large as possible within the limitations imposed by the accuracy rules. The only cases where there is a real choice are in:

(a) deciding the inaccuracy likely to be present
(b) in the choice between a D (greater than) or E (less than) limit where either could be used

The controversies usually arise where there is sufficient evidence from the ionogram for one limit to be clearly more likely than the other (see extrapolation discussion section 2.4 Handbook). In such cases, while the maximum inaccuracy possible would demand a limit value, a sensible application of the extrapolation techniques will generally show that a U value somewhat greater than the lower limit value is most appropriate. When this is not true there is usually no controversy and 0 or E is chosen to minimize the difficulties in calculating medians. Where one limit Is certain and the other is ill defined one has to use the more certain value even if it implies calculating a second median.

The scaling exercise reported in INAG-27 and a later exercise using 4A ionograms show that there is good scaling consistency between the Australian scalers. This result is in accord with IPS policy and previous operators conferences have helped maintain this consistency. However, the maintenance of consistency was felt by some to result in incorrect scalings. The operators were divided on the question of whether the rules should interpret the physics of the ionogram or reproduce the ionogram. Such differences in opinion are reflected more in letter usage than scaled values and are often due to scaling conventions preferred for median calculations replacing scalings more consistent with the observed ionograms. For Sporadic E parameters this was considered especially difficult, median requirements often preventing more informative scaling letters being used.

Chairman’s comment: The official INAG view is that operators should not be asked to make physical interpretations and ‘adjust’ the conventions to match these. This has always been a controversial matter where the gain in physical consistency at stations with highly trained and highly skilled operators must be weighed against the wide variations in practice which are possible (and have been seen in both the past and present), when incorrect physical principles have been applied. The consensus has been that scalers should scale what they see, using the scaling letters most appropriate to the particular ionogram. An attempt to force all types of doubt into one or a very few classes distorts the time picture. If less than half of the usable ionograms show one source of error dominating, that source is not dominant for describing the median and it is misleading to say that it is.

Overall, it was felt that any major revision of scaling conventions should define the ultimate objectives of scaling and, in particular, the requirements of scaling in its relationship to median determinations versus the use of hourly values.

A little time was spent considering future ionogram scaling requirements in the 1980’s. With a growing need to support HF digital communications circuits it may be that the optimization of bit error rates instead of MUF’s will necessitate a change in emphasis in scaling. Critical frequencies will probably prove less important than minima in virtual height (h’F and h’F2) and electron density gradients.

Chairman’s comment: INAG would like to encourage more discussions of this type. However, care will be needed to make sure that any new data will actually be used. There is still much controversy on how many stations should measure fxI, a parameter which clearly is of first importance to practical communications. Analysis of its value and applications of it to communications problems have been distressingly small. I am convinced that fxI is important both scientifically and for practical applications but am disappointed at the relatively small use so far. This should be raised with CCIR at Geneva.

While these problems are not yet fully understood, they could soon become part of the requirements for HF communications and in turn become part of the ionogram scalers work load. The development of semiautomatic scaling systems such as that developed for use in New Zealand will prove useful if all the necessary data are to be retrieved from ionograms on realistic time scales.

Information talks on present research at IPS were given during which some time was devoted to summarising microprocessor techniques and was highlighted by demonstrations of a remote ionogram display and a data logger collecting solar—geophysical data. Future development of the 4A ionosonde is likely to incorporate microprocessors, so these talks served as a useful introduction.

Chairman's comment: Several groups have tried or are trying the use of microprocessors to handle ionogram data from the equivalent of the daily work sheet, i.e. direct typing of ionogram parameters into a microprocessor. I feel that this should be encouraged, the combination of a cheap observatory ionosonde and this technique for making the data computer compatible at a very early stage appears to offer the most economical solution for future synoptic observations. It would be helpful if those working on these problems could contribute short articles to the Bulletin.

As a consequence of the conference a series of ionograms displaying spread F are being collected and scaled in order to bring to light any inconsistencies or difficulties in their scaling.

The success of this operators' conference was largely due to the participation of the operators themselves in conjunction with the IPS observation group. In particular it was rewarding to have a representative from New Zealand and from the Bureau of Mineral Resources which operates the Mundaring ionosonde.

Chairman's comment: The maintanance of good scaling demands continuing discussion of this type and INAG hopes that more groups will collaborate in similar exercises. One danger which is not at present adequately guarded against is the gradual growth of differences in scaling methods between different networks. One of the main reasons for the creation of INAG was the apparent control of ionospheric phenomena in the I.G.Y. by national boundaries: As a result much I.G.Y. data have had to be reanalyzed. Even without language difficulties it is not easy to be sure that all groups have interpreted the scaling rules in the same way. There are many examples where this is clearly not true:

VIII. Discussions on Changes in Parameters

Contributions from J.K. Olesen on possible changes in parameters to simplify analysis (These are abstracted from a long letter with minor changes in wording to clarify his objectives). (See discussion INAG-29 p. 8—9 and Canberra meeting report this Bulletin)

Es types

(i) I would recommend either to exclude Es—types or to simplify them, e.g. by redefining types c, h; λ, f as one single type and redefining types a, k, r as one single type.

(ii) The new types should be denoted by new symbols to avoid confusion with previous rules, e.g. 't' (thin) for the combined c, h, λ, f groups and 'b' (broad) or 'p' (particle) for a, k, r.

Naturally it would be easier to accept this reduction of information, if it is an alternative used only by some stations, while the complete information was continued at some stations at least in anticipation of possible new research results on the individual Es types. I wonder, whether the simplified rules might be made optional to this end.

fmin

Should be kept. It is extremely important for the indispensable control of the equipment sensitivity, the lack of which currently produces misinterpretation.

foEs, fxEs, ftEs

fEs scaling, if continued, might be limited to ftEs scaling determined from all traces appearing up to 160 kin, this would probably imply, that when o and x components may be clearly identified, then x component should be tabulated. I am aware that some of the ft-values would be fo rather than fx (i.e. when the latter does not show up), however, I feel that the present rules probably often involve so much guess work, that the final result might not justify the extra effort by the present, more complicated rules.

fbEs

If any parameters should be omitted it should not be fbEs, which I find more important than e.g. foEs.
(There is a strong minority group which holds this view. It is also held by the Es scientists, e.g. Matushita - Chairman)

Es—k

I agree with those who think that the present rules on scaling of particle E/Es, letter k, is more complicated than desirable. Couldn't we endeavour to make a clear-cut choice between an F or Es type of layer for the k—type and form our scaling rules accordingly? I prefer to regard the k-type as an Es-type, however, it is not too important to me, which of the two alternatives we choose, but I have always been unsatisfied with the present "mixed" scaling, so I should recommend a simplification if possible.

The USSR practice of combining k and r types as 'auroral E/Es' might be considered further (see also INAG—21, p. 3—4).

U, N

On the use of U and N: I should prefer the rules formed so that N is used for uncertain interpretation, and U is restricted to show an uncertain value.

Y

I am satisfied with the use of Y as given in UAG—23A, particularly when I combine them with the Chairman's statement in INAG—29, "that the F2 lacuna probably demands a different explanation to that for F1 lacuna.

Chairman's comment:

(i) Es- c, h, λ., f. Use of Fs-t No clear cut consensus has, as yet, appeared on possible changes in Es types, opinion is split between those wishing to keep the present system and those who would like the types c, h, λ. and f to be combined into one type, either 'f' or, as suggested by Olesen 't' (thin Es layer). The latter suggestion has not been widely considered. What is your view? If these types are combined should f or t be used? There is much to be said for a change in symbol as it is unlikely that the stations who want no change will alter their use of 'f'. Also the scientist will be confused if f is used in two ways. With no c, h, λ. types some groups feel that the importance of h'Es would be increased.

(ii) fmin. The consensus is to keep fmin, though some groups do not concur. Do you have views on this?

(iii) foEs, fbEs. I do not agree with Olesen's suggestion which has been tried at some stations but given up. It seems to me that we have only three choices:

(a) no change i.e. keep foEs and fbEs
(b) keep foEs only
(c) keep fbEs only

Each has their supporters. The users seem to have a fair case for (a) but are not, of course, fully aware of the problems at the stations. Both foEs and fbEs contribute to the science in different ways each being especially valuable for part of the field; C.C.I.R. when last asked, wanted both for this reason.

(iv) Es-a, k, r. There seems general agreement that the distinction k, r is not important in the difficult cases where foEs-k is close to foEs for type r. The rules could be easily simplified (INAG-29, p. 9 (iv)).

(v) There appears to be a consensus in favor of adopting (iv), (vi), (vii), (viii) from INAG-29 p. 9 in the near future. Do you wish to object? If so act soon!

(iv) Omit Es-k values from foE table. Mixed Es-k, Es—r traces are then identified by the fbEs table (fbEs = foE-K) and foEs table (foEs gives value for Es—r trace).
(vi) Discontinue use of letters M and T which are seldom if ever used at present.
(vii) Tighten foF1 rules so that DL, EL no longer are permitted. foF1 only tabulated when h'F2 is uniquely defined.
(viii) Ignore all low Es traces with foEs < foE.

IX. Key and Support Stations

From time to time in the history of INAG, and before INAG was formed, during the periods when the URSI World Wide Soundings Committee and the URSI Consultant for VI Sounding were active, it has been suggested that some stations should be denoted as key stations, and asked to do more accurate or more frequent observations than the remainder. This could, in principle, also result in some simplification of the work at the remaining stations. The idea is very attractive, but has always, in the past, failed. The suggestion has been raised again recently, and I feel that it may be helpful to analyze the reasons why it has failed in the past. The main points are:

(a) An inadequate number of station administrations have been in a position to volunteer to become key stations.

(b) In practice, something like the existing network is needed to provide a reasonable world wide cover.

Two limitations are important in (a):—

(i) Most Administrations who would like to have key station status lack adequate training of the analysis staff or, in some cases, an adequate ionosonde which would make it possible. In other cases, they may lack an important geophysical position, their importance being due to relations with other stations.

(ii) Many of the Administrations who maintain a high standard are aware that this depends on one or two individuals who are hard to replace. It is usual for first class stations to have periods, often lasting several years, where the data are poor in quality or not reasonably complete. Responsible Administrations often feel that they cannot assume the responsibility to maintain accuracy implied in key station status. At the last exercise, a few years ago, only one station volunteered to be a key station! Expanding point (b) most stations have periods when the data are good with some periods when they are poor. In practice, it is usually just possible to obtain adequate coverage for scientific or practical work by looking at all the data available. This is a powerful argument for keeping the International Rules uniform over the network and as many stations operating as is possible.

Furthermore, nearly all stations are set up for local reasons. There is no central fund to put stations where they are most desirable or to maintain them when provided. Thus INAG can only draw attention to gaps and hope that someone will be willing to fill them. Similarly the fate of stations usually depends on local factors. When these are not decisive, international needs and the needs of the science as a whole are usually taken into account. An obvious gap is that the needs of the synoptic network are seldom considered when ionosondes bought for research purposes become redundant. The discrepancy between the number of ionosondes known to have been produced and those known to be in use or to have become very obsolete is striking (over 50 ionosondes). There are many groups who could use these equipments if they could be made available at reasonable cost.

Your Chairman feels that the situation has not changed enough in the last five to six years to justify reconsidering this proposal but he is willing to do so if requested by several groups.

X. Handbook Simplification

Several collaborators have taken advantage of meetings with the Chairman to express their views on possible Handbook simplifications and/or changes in the parameters to be exchanged (see INAG—29, p. 89) and there have been more replies to the INAG questionnaire (INAG—28, p. 4—5: INAG-27, p. 37-40).

On the Handbook problem, the following suggestion has been made by J.K. Olesen, and is published here for your comment. I feel that it may well be a good way of meeting the requests made. What is your view?

0lesen:

'As to the Handbook simplification, I cannot deny the need for at least some kind of summary of the present 4 volumes, totalling about 1000 pages! of text and ionograms. If you present this wealth of information to a trainee or a scientist in another discipline, they must give up at once. To solve that problem each group or individual, who must teach a 'beginner', will have to elaborate a special set of basic information, which may not be adequate for reliable scaling and which may not be suitable for the transition to the original Handbook material. For these reasons I should appreciate the existence of a "Basic Handbook" of a limited size. Even if a simplification of the scaling conventions themselves is not desirable, I could imagine that a reasonable abstract of the existing Handbooks with a sort of summary of the very basic scaling information and with suitable references to the original Handbook sections would meet the demands."

The consensus of views put to me so far is in favor of a very short introductory and training Handbook with the present Handbook to be regarded as the guide for all difficult cases. I would like to have more views on this. It would be helpful if groups having suitable material e.g. training handbooks, could send me a copy.

XI. Training Workshops

There are a small number of regular training courses on scaling of ionograms, mostly held annually to train staff for Antarctic stations and some major groups in particular in the USSR and Australia, hold training and discussion seminars roughly every three years. In addition there have been special training courses set up by National initiative, usually when it was possible to obtain help from expert scalers. INAG would like to ask those organizing such courses to let it be known when a course is first proposed so that a notice can be put in the INAG Bulletin to inform prospective users from other countries of its occurrence.

In practice the main problem is usually lack of funds to enable scalers to attend. INAG wishes to encourage more activities of this type so as to improve the accuracy and uniformity of the data. This is particularly important in zones where there are a number of ionosondes since considerable improvement can then be obtained with relatively little cost.

The Chairman would be willing to help in such projects within the limits imposed by costs to him.

XII. Additional Corrections to UAG 23A

The original Fig. 2.1, page 30 of UAG 23 was omitted by error. This illustrates section 2.22. It is exactly equivalent to Fig. 2.1a, 2.1b which gives the corresponding rules in total range of inaccuracy from section 2.23. Either may be used though most scalers appear to prefer the total range from section 2.23 shown in Figs. 2.1a and 2.1b. Note in INAG-29 p. 11 sequence S of Fig. 2.12 in Table 1 p. 48 of UAG-23A. The explanation of the use of H in this case is given in INAG-29. This would, of course, only be used in practice when a rapid sequence (e.g. 3 gain runs at hour) showed that the pattern had an abnormal shape, otherwise foF1 would not be described -H.

XIII. New Ionosondes

(i) Note by Chairman on Design Policy. INAG welcomes comments by those operating ionosondes on experiences in the field, particularly stressing ease of analysis of ionograms, reliability, signal-to-noise ratio and ease of maintenance. We would like to have more views since INAG itself does not have facilities for independent tests on ionosondes and so cannot give views on their merits.

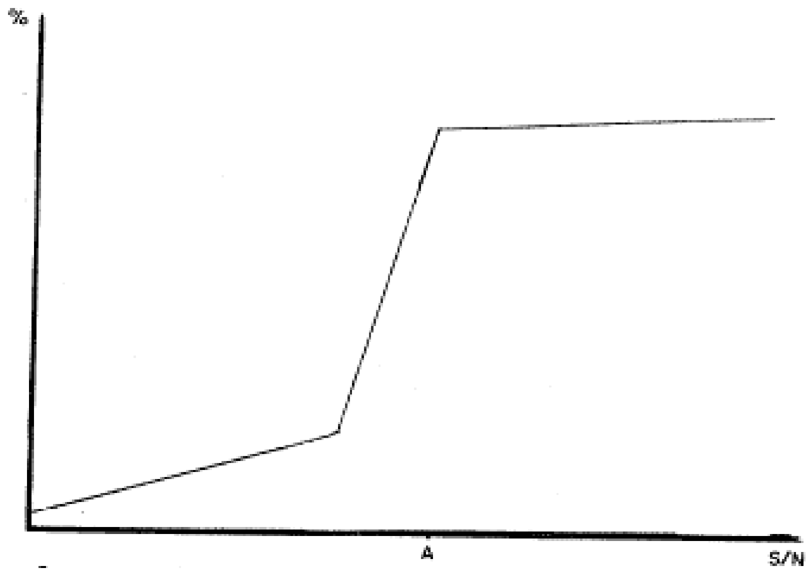
In practice, the optimum compromise varies from station to station and relative small adjustments can change on particular equipment from 'unusable as an observatory instrument' to more than adequate. Probably the most important of these in modern conditions is the effective bandwidth of the instrument, to which the pulse width should be adjusted for best results. This is normally determined by two factors:—

(a) the bandwidth of the intermediate frequency amplifier;
(b) the time constant of the differentiating circuits.

In both cases an improvement of signal-to-noise ratio involves a penalty. Decreasing the bandwidth increases the discrimination between overlapping signals and increases the variation of delay in the echo pulse with amplitude and the absolute delay in the receiver. Shortening the time constant of the differentiating circuits rather rapidly decreases the amount of amplitude information retained and thus destroys the contrast between dominant rays and even quite weak scattered signals. The differences between the C3, C4 and J5 mentioned by Mr. Olesen (below) are primarily due to differences in this latter factor.

My personal view is that most designers of ionosondes for observation use have given too much attention to height discrimination and height accuracy with the result that there is inadequate signal-to-noise to give good ionograms. Good height accuracy is of no use if the traces are missing and very few observatories in the synoptic network work to better than 5 km accuracy in practice! Such observatories would be better off with more signal-to-noise and more amplitude information, i.e. a narrower overall bandwidth with corresponding increase in pulse width and less differentiation. With the present severe overloading of the HF and MF spectra, the improvement in average signal-to-noise ratio for quite small decreases (e.g. 10 — 20%) in bandwidth can be quite spectacular in the zones where station interference is greatest.

The relation between the quality of the ionograms as measured by the number and accuracy of parameters reduced and the signal-to-noise ratio is very non-linear. This is illustrated in the Figure. As the effective noise level varies over the earth an equipment may operate above or below point A in different parts of the world.



Percentage of parameters usable as a function of signal-to-noise ratio

With wide band input circuits, cross modulations can also greatly decrease the effective signal-to-noise ratio. For this reason it is often worthwhile to introduce an attenuator between the receiving aerial and receiver, using relatively high attenuation at night.

(ii) Comments on new ionosondes by Mr. J.K. Olesen. "I have noticed the various notes on the many new ionosondes developed in recent years, including also the Australian 4A (1PS42). After having seen how badly the Swedish J5 treats our high latitude ionosphere as compared with the old C3, which was also better than the C4 in my opinion, I am a little cautious to praise new instruments, I prefer to have seen their function in practice in our region, similar to what BAS has done with the prototype 4A. I feel, we would not be satisfied with 4A without improvements. Even on the AIS I have doubts, I understand it has a lot of desirable characteristics. I still don't know, whether it can give the same fine details as a conventional analog machine, I hope so. Still, I agree, there must be a need on a simpler instrument, Especially it would be nice, if it also, in addition to meeting the several natural requirements for an up—to—date machine, including ionograms of a quality as the best existing analog ones, had the merit of (1.) low interference to nearby receivers (chirp?), and (2.) facility for tape recordings suitable for later digital (and if needed: analog) data-handling. The item (2.) facility might be desirable as an option to existing ionosondes also.

Chairman's comment: (a) Mr. Olesen's comparison is really between ionosondes with different amounts of differentiation. In general those with a longer time constant give better ionograms for analysis at high latitudes and this is often worth the loss in signal-to-noise ratio.

Chairman's comment: (b) The AIS is a very complex instrument suitable at present only for groups with considerable resources. Its great flexibility is inevitably paid for by additional complexity In both soft and hardware and it needs a strong group to take advantage of its possibilities. In my view, it should be regarded as a powerful research tool and not as an observatory instrument though, of course, it can produce synoptic data in parallel with its more advanced modes of operation. (See also INAG-23 p. 23 for alternative view).

Chairman's comment: (c) I am aware of work in UK aimed at producing a cheap chirp sounder, but this still needs considerable more development. South African experience shows that a chirp ionosonde can be satisfactorily serviced at an Antarctic station provided that adequate test gear is provided. At present the main difficulty is the high cost of chirp equipment and the care needed to operate it at vertical incidence. Are any other groups working on the problem of producing a cheap chirp ionosonde?

Chairman's comment: (d) The new solid state ionosondes usually use preselection of echoes with coherent time delay or phase to improve the signal-to-noise ratio. The echo is only recorded if m out of n successive pulses are seen obeying these criteria. This can cause some complication when spread F is present, particularly at high latitudes or near the magnetic dip equator. More work is probably needed to find how m and n should be selected for optimum use in these extreme conditions. However even at normal conditions, spread—F analysis appears significantly more difficult than with the older ionosondes. This needs more research.

(iii) IPS 42 Ionosonde. The Chairman was present when a comparison was presented between ionograms taken on a modified C2 ionosonde in good order, and on an 1PS42, both using the same aerials, at Boulder, Colorado. Film sequences of the A42 taken in Australia, were also shown which were very good. It was necessary to modify the ionosonde at Boulder by the addition of two active filters to suppress local broadcast signals before any usable ionograms could be obtained. After this modification, it was difficult to decide which sets of ionograms were better.

Thus the tests suggested that the A42 as modified at Boulder was equivalent to a standard observatory ionosonde at least so far as appearance of ionograms was concerned. Further comparisons are being made and it is hoped that a report will be available in due course. BAS tests using a prototype 4A ionosonde built by IPS were less successful, but this may be due to faults in the particular example. In general the available signal-to-noise ratio was too small for reliable observatory use. Further tests are underway to try to clarify this problem.

As Chairman of INAG, I must point out that, in the past, success in tests set up in major centers has not always been followed by success in the field. Comparatively trivial difficulties to a knowledgeable group may be major difficulties to the group actually operating the equipment. For example, BAS has been able to operate the 1946-50 series of DSIR Mark II ionosondes to produce regularly over 98% of possible ionograms per year, for quarter—hourly operation, but most groups using these ionosondes have had to replace them with equipment which is easier to maintain.

The success of the Boulder tests together with the successful operation of 4A's by the Australians for several years suggests that the A42 ionosonde may be suitable for observatory use but this is not as yet fully established. INAG would like to hear from other groups using this, or other, new ionosondes. KEL announced that the price of the 1PS42 will be held constant until the end of June 1980.

XIV. Lacuna, SEC Problems -- Note by J.K. Olesen

See discussion in INAG—29, pp. 11—17, and previous discussions. The following note has been sent by J.K. Olesen, who also refers to the paper by Sylvain et al. in *Planetary Space Science,* 26, 1978.

"I have now got a much better understanding of the nature of our disagreement, which is partly due to the fact that we base our views on two greatly differing models and partly is caused by some misunderstandings on both sides.

Since I find it important for future work I should like to add the following comments on the subject:

To my opinion there was in the previous discussion at least the following two misunderstandings:

1. As I thought I had indicated it at several occasions and also in INAG-29, but maybe not clearly enough: It has never been my intention to maintain, that all cases of missing F2 traces were G conditions. For example, I can easily make the F2 echoes alone disappear from an ionogram, simply by reducing the equipment sensitivity. I would not be inclined to scale "G" unless the sequence made it reasonable and unless adjoining high gain ionograms were completely free of F2 traces. (To decide this our Godhavn ionosonde is operated routinely with high gain for all recordings except the 59-minute ionogram used for full hour fmin scaling). Although I understand Dr. Sylvain's dissatisfaction with the need for high gain ionograms for reliable scaling of G-conditions, I am afraid we cannot do without, when we deal with gain sensitive echoes as the F2 may be at high latitudes, and it would probably not be reasonable to compensate for that need through the scaling rules.

2. One fact, which combines to the problem in item 1. above, is, that when I have dealt with "F2 lacuna" I have had in mind only cases where the F2 echoes were "completely absent", checked with the highest possible equipment sensitivity. I now understand, that the French group scale F2 lacuna, when the F2 echoes are weak or not seen at some equipment sensitivity, i.e. are "weaker" than the lower frequency echoes (e.g. F1) as evaluated from the ionogram appearance. Naturally this is a possible procedure, my dislike to it is partly due to the possibility of misinterpretation by use of Y for other mechanisms, that may contribute to F2—echo weakening, such as: low reflectivity of the F2 region, lower equipment sensitivity at F2 frequencies, deviate F1 and F2 absorption, non-deviate D-region absorption, and of weakening effects from a possible simultaneous F1 lacuna (e.g. scattering at F1 levels).

I hope through these short comments to have eliminated some misunderstanding of my statements (possibly caused by my insufficient command of language) and since I now feel to have understood more fully the basis for the proposed F2—lacuna scaling — not least as a convenient scaling rule — I think its use as recommended in UAG-23A is an acceptable compromise for the time being."

XV. Multidiscipline Studies Using Ionograms

Note by Editor. It is INAG policy to encourage VI stations to examine their data in conjunction with data from other techniques. Many suggestions will be found in Chapters 11, 12, 13 of the Handbook (UAG-23), pp. 247—304. Most experts continue their studies to their own discipline and there is. much room for new discoveries of fact which, when published, will attract the attention of theoretical workers. The following paper falls in this class.

For those not conversant with absorption techniques, I should point out that a uniform absorbing layer can only cause a constant absorption on all frequencies up to a certain frequency unit or an absorption which decreases with increasing frequency. In the former case a small change in fmin would be expected, in the latter probably total blackout if the absorption were overhead. The combination of no change in fmin, the time of maximum solar noise shifted relative to the riometer events and the increase in absorption with frequency are all consistent with the author's Interpretation. A low probability, alternative explanation is that an absorption band was present which was not overhead and totally obscured about half the main lobe of the aerial. This could be checked by giving the normal polar diagrams of the riometers at 13 and 25 MHz or by showing that the times of the events were approximately constant in sidereal time.

The paper has been submitted by Prof. N.P. Benkova of IZMIRAN.

XVI. A Remarkable Decrease of Cosmic Noise Radiation Near the Main Ionospheric Trough Region

E.F. Kozlov, N.I. Samorokin

Arkhangelsk. Ionospheric Station

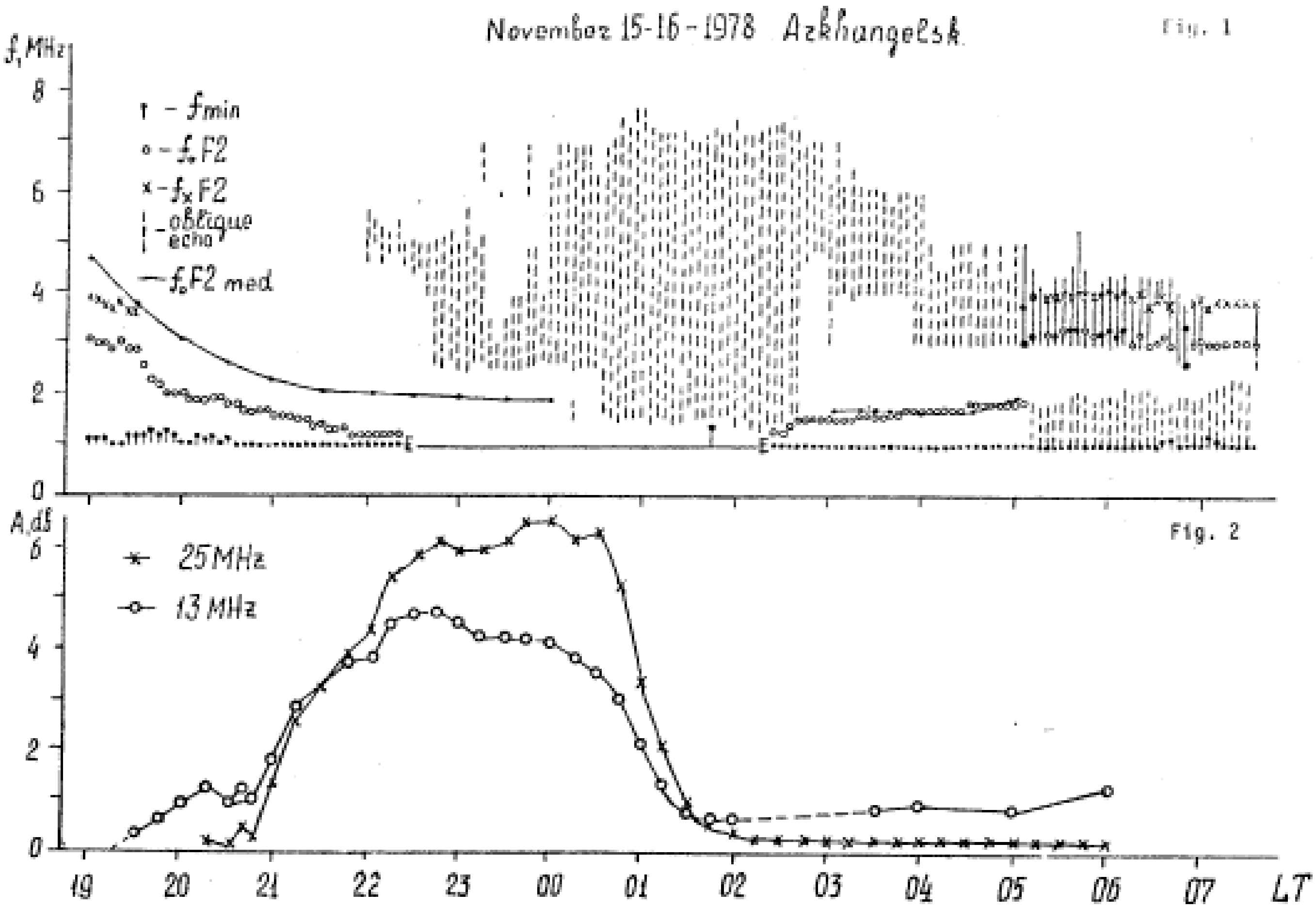
A remarkable bay-like decrease of the cosmic noise radiation (CR) level was observed in Arkhangelsk (L = 4.09) on the night of 15-16 November 1978. Fig. 1 shows the riometer record of 13 and 25 MHz signals and the ionospheric f—plot for this period. From 2030 to 0230 LT, a strong decrease of CR level was registered by riometers, whereas no fmin increase was seen from the vertical sounding data. The decrease of CR at 25 MHz was more pronounced than at 13 MHz. As shown by Arkhangelsk magnetogram, the magnetic field was only weakly disturbed: the maximum variation of H-component did not exceed 30 γ. No sporadic polar-type layers were observed in E-region. Therefore, the above CR decrease can be explained neither by usual absorption in the lower ionosphere, nor by scattering at small-scale F-region irregularities.

In this connection, let us consider the ionospheric situation on the night of 16 November 1978. The evening values of foF2 were less than those on quiet days.' At 2200, oblique reflections were observed to appear in the F-region. When first seen, their virtual range was of the order of 700 km decreasing with time, which points to the approach of a reflecting region to the station. At the maximum of the CR bay (2230—0030) the virtual range of oblique reflections was 500-400 km, the values of foF2 being at this time lower than the ionosonde minimal frequency (1.0 MHz). Thus, the variation of ionospheric parameters shows that near midnight, Arkhangelsk was in the main trough region so that the oblique reflections may be interpreted as reflections from the polar—side wall of the trough approaching during the disturbance.

The above case of a remarkable CR decrease was not the only one. A combined analysis of riometer data, f—plots and magnetograms has revealed further cases of a bay—like decrease of the CR level with a weakly disturbed field and no fmin increase. These bays are smooth like the described one, but have smaller amplitudes ($A_{25} \sim 1 + 1.5$ dB). As seen from the vertical sounding data, all bays were observed when the polar-side wall of the main ionospheric trough approached the station and soon after the passage of the most intensive CR source.

The cases of remarkable CR decrease are most pronounced around the midnight in October-November when under weak magnetic activity conditions Arkhangelsk is near the polar wall of the main ionospheric trough and the maximum of CR source occurs before the midnight.

The relationship between the remarkable CR decrease and the location of polar wall of the main ionospheric trough suggests that when refracting at the trough wall, CR are partly deviated (see Fig. 2) which results in attenuation of the riometer signal. This effect is naturally most pronounced during maximum CR intensity.



XVII. Use of Ionosondes for Communication Purposes

With support for ionospheric vertical soundings moving from organizations responsible for radio communications to other, in particular, meteorological institutes, the value of the data for radio communications is liable to be overlooked. Their continued importance was stressed in the International Solar— Terrestrial Predictions Workshop held in Boulder, April 23—27, 1979 during which the conclusions were discussed of 13 working groups who had been active for a year or more. The extent of the interest expressed by participants of the working groups and their representatives at the Workshop show renewed interest in these problems. Details will be found in the Solar—Terrestrial Predictions Proceedings edited by R.E. Donnelly, Space Environment Laboratory, NOAA.

Solar-Terrestrial Predictions Proceedings

Volume I. Prediction Group Reports (Superintendent of Documents Stock No. 003—023—0041—9)
Volume II. Working Group Reports and Reviews (Superintendent of Documents Stock No. 003-017-00417-6)
Volume III. Solar Activity Predictions (Superintendent of Documents Stock No. 003—017-00473—2)
Volume IV. Prediction of Terrestrial Effects of Solar Activity

Volume I reviews the current practice In solar—terrestrial predictions. Volume II presents the recommendations and reports developed by the working groups at the Workshop held in Boulder, April 23-27, 1979. Topical reviews and papers on the current and future needs for predictions are also included. Volume II reports the results of discussions of questions such as: What predictions are needed? Where are current predictions inadequate? What recent results from solar—terrestrial research should be applied to improve solar—terrestrial predictions? Volumes III and IV present individual suggestions for particular prediction schemes.

Volume I (432 pp) is currently available with soft covers for about $8 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A., phone 202—783—3238. Volume II

(733 pp) was sent to the printer in December 1979 and should be available from the U.S. Government Printing Office in April 1980. We hope to send Volumes III and IV to the printer by April 1980 and hope they will be available from the U.S. Government Printing Office by July 1, 1980.

Comment by Dr. Lakshmi Sent to Canberra INAG Meeting

Needs for Ionosondes in the 1980s:

The potential of routine ionosondes for any detailed study of ionospheric phenomena and for high quality research in ionospheric physics is probably behind us. For such fundamental ionospheric studies it will be necessary to install a few sophisticated ionosonde systems that have become available recently (of course rather expensive). We do have routine ionosonde data now for about 3 solar cycles. In view of this, the question often raised is whether extensive morphological measurements around the globe are any longer necessary. To compound this there is the problem of the quantum of utility of HF communications in future. Our experience in India as well as from several other countries at low and middle latitudes is that HF communication is very much in business, especially for point— to—point links and quite often it is impossible in several countries to get any new frequency in HF band allocated. However, it should not be forgotten that the sun may change its course any time and may exhibit periodicities unknown so far. The reaction of the ionosphere to such changing solar conditions cannot be studied unless a continuous and balanced chain of observation is maintained. From our experience in India it is absolutely necessary to maintain the routine ionosonde stations for pure morphological studies in addition to one or two advanced sounding instruments. These advanced Instruments can be used to study detailed dynamic response of the ionosphere which can form an input for improving the predictions, especially short-term predictions.

XVIII. Use of Station Data by Australian Ionospheric Prediction Service

The following statement on the use of ionospheric station data has been provided by Jack Turner of the I.P.S. INAG would like to have similar statements from other users. Most administrations who operate VI stations have little knowledge of how much their data are used. In the current situation of lack of funds, it is important to provide some feedback, otherwise stations which are widely used will be closed by default.

The Resolution No. 2 from the 3 September 1977 meeting of IAGA urges authorities responsible for operating ionosondes to consult INAG before considering closing any station to ascertain whether it is of special importance. In order to assist INAG in assessing the importance of stations in the network the Australian Ionospheric Prediction Service would like to record its need for data from two groups of stations. This does not mean that ionospheric data from stations not in the lists are not used but that there are at least two groups of stations which are known to be of great importance to IPS. Unfortunately some of the stations in the lists appear to have ceased to operate already.

Data from the first group of stations are used for computing the monthly 'T' ionospheric index. These stations were selected to give a balanced geographical distribution and because of their length of operation. They are:

Christchurch	Tokyo	Falkland Island	* Wallops Island
Hermanus	Moscow	* Frelburg	* Adak
Johannesburg	Okinawa	* Maui	* Fairbanks (College)

Those indicated by * are not providing data and some have been closed. Their loss makes the remaining stations more important.

Editors Comment: Maui and Wallops Island data are available and can be sent to IPS. Fairbanks ionograms are not presently routinely reduced.

The second group are stations which provided data for the URSIGRAM data exchange. The data from these are used to determine a short term ionospheric index. They are:

Scott Base	Moscow	Tokyo	Lannion
Christchurch	Alma Ata	Slough	Dakar
Campbell Island	Irkutsk	Poitiers	Kodaikanal
Rarotonga	Boulder	Ojibouti	St. Johns
Lindau/Harz	Wallops Island	Ougadougou	New Delhi

XIX. Station Notes

Greenland

Sondre Stromfjord, Greenland, was closed after the IMS. A C3/4 on loan from NOAA was operated most of the time in the period Nov. 1976-Nov. 1978. In the future it will only be operated during special campaigns. We regret that lack of money has forced us to stop in view of the important location at 75° N geom. This site should be considered for deployment of a digital ionosonde (e.g. Advanced Ionospheric Sounder).

Canadian Stations

Mr. Olesen supports the continuance of the Canadian stations (see also INAG-29, p. 4, and previous comments) and states:—

> "Also, I would regret the possible closure of the Canadian stations. Among other drawbacks, it will reduce the possibilities for regional studies in combination with our Greenland stations."

This is essentially similar to the points raised by the other high latitude groups.

There is a special case to maintain the Canadian station at St. John's Newfoundland which is conjugate to Halley Bay. This pair is of special interest for studies of conjugate behavior in VLF, ELF and magnetic pulsation phenomena which can be influenced by ionospheric conditions. Much active work in these fields has been done in the last two or three years and interest is increasing.

South American Chain

Dr. Manzano (Tucuman) points out the scientific importance of the South American chain of stations (60° W) and stresses:

(a) the importance of keeping Port Stanley and Argentine Islands in operation
(b) the need for stations in the gaps between Buenos Aires and Port Stanley and between Tucuman and Huancayo.

A good chain is needed to study perturbations starting in the auroral zone and progressing to low latitudes.

Alaskan Chain of Stations

Prof. Hunsucker has provided the following report on the status of the Alaskan stations.

> At the present time there are four "C3/4" type sounders deployed around Alaska and the Canadian Northwest Territories under the jurisdiction of the Geophysical Institute of the University of Alaska. All of these sounders are on loan from the NOAA Boulder Labs and we are indebted to Mr. Alan Shapley, Ms. Virginia Lincoln, Mr. Ed Schiffmacher, Mr. Ray Conkright and others for this loan and for excellent support on maintenance and logistics. The status of the sounders is described below:

Location	Geomag. Lat.	Sounding Schedule	Prin. Investigator	Remarks
Sachs Harbor (NWT, Canada)	75.3° N	Variable. Mainly used during rocket campaigns near cusp.	Hans Stenbaek Nielson Geophysical Institute	Usually 2 "campaigns" per year. Seeking funding for continued operation.
Cape Parry (NWT,Canada)	73.7° N	Variable. Mainly used during rocket campaigns near cusp.	Hans Stenbaek Nielson Geophysical Institute	Usually 2 "campaigns" per year. Seeking funding for continued operation.
"Sheep Creek" College, Alaska	64.8° N	Every 15 minutes	Dr. Robert Hunsucker	Data and telemeter to Eileson AFB Sounder in College for over 25 yrs.
USCG Commsta Kodiak, Alaska	57.4° N	Every 15 minutes	Dr. Robert Hunsucker	Used by USCG Contmsta for operations since May 1979. Hope to keep operational until end of calendar 1980.

Notes: 1.- All data are eventually archived at WDC/Boulder

2.- Sheep Creek Sounder data also archived at College, Alaska

Indian Ionospheric Stations

Dr. Lakshmi, N.P.L. New Delhi, has contributed the following notes:

Ionosondes were established more that 20 years ago at Delhi, Ahmedabad, Haringhata, Kodaikanal, Tiruchirapally, Madras, Trivandrum, Bombay and Hyderabad and some usable data have come out of these stations until 1975, except for Madras which was discontinued around 1970. The position started slipping somewhere around 1975 partly due to deterioration of the older systems and partly due to lack of interest and support. Haringhata, Calcutta, Madras, Hyderabad and Bombay have either become completely defunct or at least to a point where the data are not redeemable. The Radio Science Division, has been publishing monthly bulletins of the Ionospheric Data ever since 1955 and have been making continuous efforts to keep the data flowing. In view of the geographical location of India and in view of the history of ionospheric research in the country, it will be of extreme importance to rejuvenate some of these stations. Recently, the Research Department of All India Radio has developed a semi—automatic ionosonde system of 10 kW peak power and such ionosondes will be set up at Nagpur, Srinagar and Gauhati very shortly. In addition, they have also plans to purchase two IPS—42 systems from KEL Aerospace, Australia for Bombay and Madras stations. In addition, we understand that the University Grants Commission in India is planning to finance purchase of some ionosonde systems as tools of ionospheric research in some Indian Universities. If all these plans materialize in good time, it is hoped that data position will improve,

Chinese Stations

The main chain of Chinese vertical incidence stations on the mainland are operated by the Institute of Radio Propagation Xin—Xiang, in some cases in collaboration with other Institutes. From North to South these are:— Mauzhouli, Changehun, Beijing (Peking), Lanzhou, Chungqin, Wuhan (Wuchang), Guanjzhou (Canton),Hainandau. For some years most stations operated using manually operated ionosondes but these have mainly been replaced by automatic equipment similar in general design and performance to the U.S.A. C2-C4 type ionosondes. More details will be given in the next INAG Bulletin.

U.S. Cooperating Observatories

Because of a severe budget limitation the National Geophysical and Solar-Terrestrial Data Center has been forced to reduce the frequency of sweeps at the ionosonde stations using NOAA equipment and provided with film from NOAA. The stations now on hourly instead of 15—minute sweeps are Boulder, Maui, Huancayo, Manila, Thule, Concepcion, Bangkok and Fortaleza. The Geophysical Institute is supporting 15-min sweeps at College, and the USAF is providing the necessary film for 15—min sweeps at Godhavn and Narssarssuaq. Wallops Island is continuing 15—min sweeps through NASA support.

XX. Uncle Roy's Column

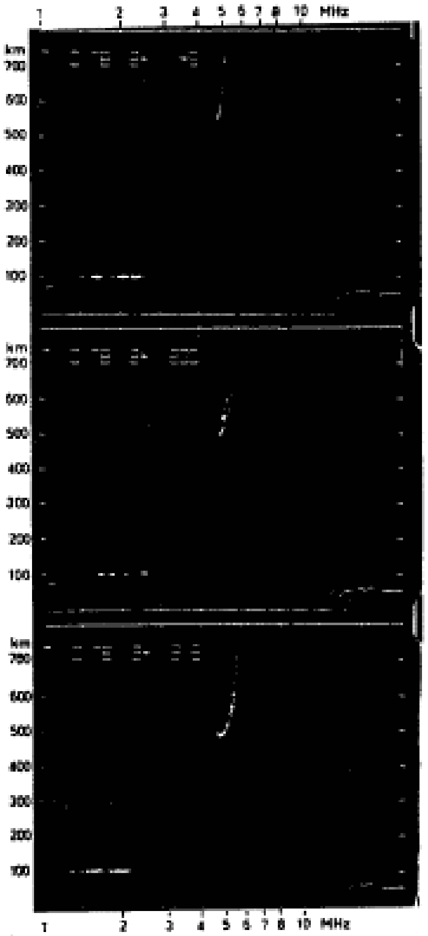
(1) Some Lacuna Problems: Hobart 4 May 1978

The following ionograms and queries have been provided by Dr. Cole, Australia:

Note that the table is not in standard form and that the qualifying and descriptive letters are written O--X etc.

From previous ionograms it is known that it is the 0-trace that is displayed. Also, the value of foE is above foEs. Two queries arise in scaling fbEs and fxI. In scaling fbEs the conflict arises between G (Indicating fbEs is less than foE, ref. Fig. 4.32, No. 5, p. 133 of UAG—23A) and Y (indicating a major lacuna condition) We would assign greater importance to Y. In scaling fxI the clash comes between X (indicating no spreading of the F2 trace) and B (indicating high absorption). We would assume that the lacuna indicates high absorption and use B. May we have your comments please?

Local Analysis



HOBART IONOGRAMS 1978 DAY 124 (4 MAY 1978)

PARAMETER	TIME (LT. 150E)		
	1145	1200	1215
fmin	14	15	12
foE	Y	Y	Y
h'E	Y	Y	Y
foEs	25G	25G	21G
fbEs	G or Y	G or Y	G or Y
h'Es	100	100	100
h'F	Y	Y	Y
foF1	Y	Y	Y
foF2	50	52F	54F
fxI	O(58)X or B	O(53+07)B	O(56+07)B
Type Es			

Comments: (a) These ionograms correspond to the presence of F1 lacuna with most probably a weak or quasi-F2-lacuna phenomenon also present. Without knowing the normal value of fmin at this time of day, it is impossible to state whether additional absorption is present or not - the values of fmin do not appear to be very abnormal. For an ionosonde of normal sensitivity one would expect to see an x-trace at frequencies below 3.0 MHz when fmin was 1.5 MHz or less. The lack of the x-trace and scattered nature of the 1200 F2 trace strongly suggest a weak F2 lacuna, Y, rather than effects due to non-deviative absorption, B. This could be readily confirmed by examining normal day ionograms when fmin was between 1.2 and 1.5 MHz, noting the corresponding values of fminx the minimum frequency on which x-mode traces are seen.

While lacuna is often accompanied by some increase in absorption, there are many cases where this does not occur and very many where the increase is small. The change in fmin from its normal value is the only reliable measure.

(b) It is most unlikely that the flat trace seen is an Es trace, it is far more likely that it is the lower part of the normal E trace cut off below foE by the lacuna (see section 3.30 Y especially Figs. 3.31, 3.32 on p. 94 UAG-23A where this point is stressed). Unless there is strong evidence to the contrary, e.g. totally reflecting low type Es is normal at this time of day, the E interpretation is preferable. It can be checked by comparing h'E on normal and the Y days.

(c) Having given the interpretations suggested by the ionograms, I would suggest amending the analysis as follows:-

h'E	100	100	100	
foEs	Y	Y	Y	
fbEs	Y	Y	Y	
h'Es	Y	Y	Y	
fxI	O(58)X	O(60)Y	O(63)B	in standard form
fxI	0580X	0600Y	0630B	

(d) Note: The 1145 ionogram trace is clean, there is little difference in spread 1200, 1215 despite fmin failing from 1.5 MHz to 1.2 MHz so it is unlikely that the spread is absent because of absorotion; and at this time of. day fmin is not sufficiently enhanced to prevent spread F being observed if present. Hence B not very important and presence of clean 0-trace demands use of X at 1145. The main cause of the absence of the x trace is the weak F2 lacuna. Hence use Y.

(e) This is a good example of the difficulties which can arise when a phenomenon is rather rare at a station. As soon as the abnormal phenomenon, in this case lacuna, Y, is identified it is essential to look at the part of the Handbook which describes the phenomenon. The solid nature of the E traces at 1145 and 1215 suggests that the absorption is not very great at these times so that lacuna effects are causing most of the departures from a normal ionogram. See UAG—23A section 2.73 p. 53-57 and section 3.29 Y p. 93—96.

XXI. Activities at World Data Centers

World Data Center A for Solar-Terrestrial Physics, Boulder, Colorado

The catalog of vertical incidence holdings has been put into computer format on a minicomputer. Printouts may be provided upon request. Development of a microfiche catalog is in progress similar to Report UAG-54, since the printing funds at WDC-A preclude preparation of a 'hard copy' UAG-report at this time.

May we remind you that WDC-A is the control point for assigning the two letter station code and the three—digit computer code for any new vertical incidence ionospheric station.

Stations reporting to WDC—A (NOAA Cooperating Observatories)

Arecibo	Concepcion	Huancayo	Narssarssuaq	Wallops Island
Bangkok	Fortaleza	Manila	Thule	White Sands
Boulder	Godhavn	Maui		

Other stations sending directly to WDC-A

Ahmedabad	Dakar	Kerguelen	Ouagadougou	Tahiti
Auckland	De But	Kiruna	Poitiers	Terre Adelie
Bombay	Delhi	Kodaikanal	Pruhonice	Thumba
Brisbane	Ojibouti	Lannion	Pt. Arguello	Tiruchirapalli
Buenos Aires	Dourbes	Lindau	Rarotonga	Tortosa
Budapest	Gibilmanna	Lycksele	Resolute Bay	Townsville
Calcutta	Goose Bay	Mawson	Rome	Tromso
Campbell Is.	Grahamstown	Mexico City	Sanae	Trelew
Canberra	Hermanus	Miedzeszyn	Scott Base	Tsumeb
Casey	Hobart	Mundaring	Seoul	Tucuman
Christchurch	Hong Kong	Norfolk Is.	Sodankyla	Uppsala
Chung Li	Johannesburg	Nurmijarvi	Sofia	Ushuala
Churchill	Juliusruh/Rugen	Ottawa	St. John's	Vanimo

Data sent directly from other WDC's to WDC-A

WDC-C2 Japan

Akita	Okinawa	Syowa Base	Wakkanai	Yamagawa
Kokobunji				

Also microfilm of all Indian stations and Taipei

WDC—B2 USSR

Alma Ata	Irkutsk	Moscow	Rostov	Tomsk
Ashkabad	Khabarovsk	Murmansk	Salekhard	Tunguska
Dixon Is.	Leningrad	Providenya	Sverdlovsk	Vostok
Gorky	Miedzeszyn	Pruhonice	Tbilisi	Yakutsk
Heiss Is.				

WOC C1 UK

Argentine Islands	Graz	Ibadan	Slough	Also French stations
Cape Zevgari	Halley Bay	Port Stanley	So. Georgia	Also Swedish stations

World Data Center C1 for Ionosphere, Slough U.K.

Ionospheric Stations reporting directly to WDC-C1 from within catchment area

Argentine Islands	Garchy	Kerguelen	Poitiers	South Georgia
Bekescaba (Budapest)	Grahamstown	Kiruna	Port Stanley	South Uist
Cape Zevgari	Graz	Lannion	Pruhonice	Tahiti
Dakar	Halley Bay	Lindau	Rome	Terre Adelie
De Bilt	Hermanus	Lycksele	Sanae Base	Tortosa
Djibouti	Ibadan	Miedzeszyn	Slough	Tromso
Dourbes	Johannesburg	Nurmijarvi	Sodankyla	Tsumeb
Freiburq	Juliusruh/Rugen	Ouagadougou	Sofia	Uppsala

Ionospheric stations reporting directly to WDC-C1 from outside catchment area

Ahmedabad	Campbell Is.	Delhi	Norfolk Is.	St. Johns
Auckland	Canberra	Hobart	Ottawa	Thumba
Bombay.	Casey	Hong Kong	Rarotonga	Tiruchirapalli
Brisbane	Christchurch	Kodaikanal	Resolute Bay	Townsville
Buenos Aires	Chung Li	Mawson	Scott Base	Ushuaia
Calcutta	Churchill	Mundaring	Seoul	Vanimo

Ionospheric stations whose data are sent to WDC-C1 from other WDCs.

WDC—A USA

Boulder	El Cerillo (Mexico City)	Huancayo	Wallops Island	White Sands

WDC-C2 JAPAN

Akita	Okinawa	Syowa Base	Wakkanai	Yamagawa
Kokubunj i				

WDC—B2 USSR

Alma Ata	Heiss Is.	Leningrad	Rostov	Tbilisi
Ashkabad	Irkutsk	Moscow	Salekhard	Tomsk
Dixon Is.	Khabarovsk	Murmansk	Sverdlovsk	Yakutsk
Gorky				

Editor's Comment: Similar information from WDC—B2 Moscow and WDC-C2 Tokyo would be informative, and would permit the World Data Centers to not duplicate unnecessary copies for each other.

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

Activities for the period April 1978 to March 1979

1. Data received from WDCs A, B2, C1 and other ionospheric stations:

   Booklets and Sheets: 1800 sheets Microfilms: 40 cans (1000 ft per can) Microfiche: 178 sheets
30 cans (100 ft per can)
2~ Data sent to WDCs A, B2 and C1:
   Booklets and Sheets: 358 sheets Microfilms: 63 cans (100 ft per can)
3. Data services:

Tables and Plots of Vertical Incidence Soundings:	2719 station months	Ionospheric Absorption Tables:	118 station rnonths
Ionograms:	3180 frames	Miscellaneous:	541 station months

4. Adjustment and compilation of microfilms data received from each WDC and ionospheric stations in C2 region:

WDC-A:	Ionograms	10 cans (1000 ft per can)	WDC-B2:	Ionograms	40 cans (1000 ft per can)
	Others	3 cans C 100 ft per can)		Others	28 cans (100 ft per can)
WDC-C1:	Ionograms	2 cans (1000 ft per can)	C2 region:	Ionograms	197 cans (100 ft per can)
	Others	1 can (100 ft per can)			

5. Catalog of data in WDC-C2 for Ionosphere

   New catalog of ionospheric data for the period July 1, 1957 to March 31, 1979 will be available in August 1979.

6. Daily hourly values of ionospheric data observed by Japanese stations are stored on magnetic tape since June 1968.