INAG—28 June 1978

IONOSPHERIC NETWORK ADVISORY GROUP (INAG)*

Ionosphere Station Information Bulletin No. 28 **

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

** Issued on behalf of INAG by World Data Center A for Solar-Terrestrial Physics, National Oceanic and Atmospheric Administration, Boulder, Colorado 80302, U.S.A. The Bulletin is distributed to stations by the same channels (but in the reverse direction) as their data ultimately flow to WDC-A. Others wishing to be on the distribution list should notify WDC-A.

I. Introduction

by

W. R. Piggott, Chairman

This is the last INAG Bulletin before the major INAG meeting to be held during the URSI General Assembly at Helsinki, 31 July through 8 August, 1978. It is necessary for INAG to report to Commission G and for Commission G to decide whether INAG and the INAG Bulletin should continue for a further three years. The Bulletin is partly supported by a grant from URSI and also depends on support from WDC-A. without which it could not be published and circulated. *URSI will wish to know whether you feel that their money is well spent — tell your representative*. At Lima, URSI requested that we ask for subscription of 10 dollars for the three years from those groups who could afford such a subscription, as evidence that the Bulletins were worth-while. *Are you prepared to repeat this procedure for the next three years?* Views expressed at INAG meetings suggest that you wish INAG to continue. However, it is up to you and not to INAG to decide whether you are satisfied or would prefer a change. *This is also your last chance to comment on the URSI/IAGA report "Needs for Ionosondes in the 1980's" (INAG-26, pp. 7—14) before it is adopted by Commission G*. INAG believes that there may be some demand to add comments at this stage (see p. 5).

At Lima INAG proposed to circulate 9-12 issues of the Bulletin in the three year period. However, due to your Chairman not having enough time to prepare them, only 8 issues have been circulated. I must apologize for the short-fall. Your help by contributing articles or ionograms, or ionograms for Uncle Roy's Column would enable us to do better in the next three years. INAG has, however, held more meetings than in any previous three-year period (INAG-21, pp. 2-30, Lima; INAG-22, pp. 5-7, Uppsala; INAG-23, pp. 2-8, Geneva; INAG-25, pp. 2-5, Boulder; INAG-25, pp. 6-8, Cambridge; INAG-26, pp. 2-7 Seattle; INAG-27, pp. 2-14, Geneva).

The High Latitude Supplement, UAG-50, was published and circulated in October 1975, and generated much discussion. Japanese, Russian and Spanish translations are now available.

A very large number of problems have been raised and discussed in the INAG Bulletin, particularly Bulletins 21-27. These should be discussed at Helsinki and, if possible, decisions reached. *If you wish to contribute, please inform your representative or write to the Chairman*. The draft Agenda was given in INAG-27 pp. 14-15 (note error In Item 3, for URSI/ INAG read URSI/IAGA). *If you have other items, please inform the Chairman as soon as possible*.

An intensive effort has been made to republish the first four chapters of the Handbook with all corrections and modifications incorporated in the text. It is hoped to have at least a master copy available at Helsinki.

I would like to thank all those who have answered the INAG questionnaire which was circulated with INAG-27, and sent to URSI Commission G International Representatives. Replies are still coming in and probably more will be brought to Helsinki. A short note on replies already received is given in this Bulletin. An announcement of the time and place of the INAG Meeting will be made at Helsinki. The Chairman will be available from the evening of Sunday, 30 July, for discussions. Sample enquiries showed that, as at Lima, very few people were able to arrive before the main URSI meeting, so no attempt has been made to have a pre-URSI session. I hope to see you, or your representative, at Helsinki.

II. Honors for Professor Dr. Karl Rawer

Professor Karl Rawer fulfilled his 65th year on April 19, 1978. On April 21, 1978, he was awarded the Order of Merit of the Federal Republic of Germany. The order was presented by the Ministerial Director, P. Kistner, of the Ministry of Commerce for the State of Baden-Wurttemberg, and the celebrations included an address by the President of the Fraunhofer-Gesellschaft, Dr. H. Keller. This was followed by lectures by Professor Sir Granville Beynon, Dr. J. Hieblot, and Professor Dr. 0. Burkard. On May 2, 1978, Professor Rawer was also given a “Doctor rerum naturarum honoris causa” by the University of Dusseldorf.

Professor Rawer was one of the pre-war workers on ionospheric soundings and the problems of ionospheric radio-wave propagation and prediction. He first became directly connected with the international planning of ionospheric measurements as one of the Principal Consultants of the URSI IGY Special Committee on High Latitude Soundings, which reported to the URSI IGY Committee in September, 1955. Thus he was deeply involved in the first attempt to set up international scaling procedures which were suitable for the interpretation of high latitude ionograms. Up to this time, scaling procedures were fundamentally based on temperate and low latitude experiments.

The Special Committee on World Wide Ionospheric Soundings was set up in September, 1955, with the task of revising international programs and, in particular, the reduction and presentation of ionograms and ionospheric characteristics in preparation for the IGY. Professor Rawer was one of the original members of this committee which became famous as the World Wide Sounding Committee (WWSC) (alternatively the Wine, Women and Song Committee). He played a large part in the identification of the parameters now regarded as standard ionospheric parameters and of the rules by which they should be measured. The WWSC entrusted the job of preparing a standard Handbook of Ionogram Interpretation and Reduction to Professor Rawer and Mr. Piggott, and the form of both the first and second editions of this Handbook owes much to Professor Rawer’s keenly logical approach to ionospheric problems. When, after the end of the IGY, the WWSC was dissolved, Professor Rawer took on the job of World Consultant for Ionospheric Absorption Measurements, by the pulse absorption method (A1). He played an important part in the compilation of the IGY, IGC and IQSY absorption data collection (Report UAG-34, 1974). After IQSY he became subreporter for ionospheric drift measurements and published in 1965 as editor of vol. XXXIII of the ‘Annals of the IGY’ the results of drift measurements obtained during IGY and IQSY. In 1976 he published a Manual on Ionospheric Absorption Measurements (UAG-57), the standard instruction manual for this discipline.

Professor Rawer has not only been actively involved in ionospheric measurements for the last 40 years, but has also played a very important part in the deliberations of the Consultative Committee for International Radio (CCIR), In the international space research organization COSPAR he was until 1972 the coordinator for radio beacon measurements of the ionosphere using satellites. In these fields his outstanding knowledge of both theory and what actually occurs in practice, has been an invaluable guide to all of his colleagues.

On behalf of the ionospheric network, to whose well-being Professor Rawer has contributed so greatly, INAG wishes to convey to him their sincere congratulations.

III. Honor for Mr. W. R. Piggott

We are very pleased to announce that Mr. W. R. Piggott, the Chairman of INAG, has been awarded an Honorary Degree of Doctor of Science, by the University of Sheffield, U.K. In the following paragraphs we hope to show some aspects of Mr. Piggott’s distinguished career, and to demonstrate why this exceptional honor is so very well deserved.

Mr. Piggott was born after Marconi first propagated radio waves across the Atlantic Ocean, but before 1924 when radio waves were first used to explore the upper atmosphere. He obtained a degree in physics from Kings College, which is part of the University of London, where he took up his first job as a research student in artificial radioactivity, with Professor E. V. Appleton. He started ionospheric research in the beginning of 1933. He later moved with Appleton to Cavendish Laboratory in Cambridge, where he continued the development of techniques for studying the ionosphere which had started in London. He joined the Radio Research Station at Slough in 1939, but at the outbreak of war was seconded as personal scientific assistant to Sir Edward Appleton, who was then Secretary to the Department of Scientific and Industrial Research. The scientific problems of the war to which he gave his attention were very varied, ranging from radar, tropospheric and ionospheric propagation, advisor to intercept organizations to the development of cyclotrons. Much of Mr. Piggott's wartime and post-war exploits remain a mystery, and even a generous dose of brandy fails to encourage him to recount much of what happened during these years. However, even his modesty failed to prevent certain members of the upper echelons hearing of his activities, and as a result the young Queen Elizabeth II conferred upon him the Order of the British Empire in 1953, as a mark of his country's indebtedness to him.

With the war behind him, Mr. Piggott was able to return once again to his work in radio science, and during the next 25 years made major contributions to research in all regions of the ionosphere, both in theoretical, practical and observational work, during which time he published over 50 papers in standard journals.

He was responsible for the planning of ionospheric work on the Royal Society Expedition to Halley Bay, Antarctica, in 1956, and became Consultant for Ionospheric Work to the Falkland Islands Dependencies Survey (later British Antarctic Survey, BAS), in 1959 and Consultant on Upper Atmosphere Physics at The Radio and Space Research Station, Slough, in 1960.

In 1973 he was appointed Head of the Atmospheric Sciences Division of BAS, responsible for a very wide range of observations and research, from meteorology, radiation and ozone, to magnetism, magnetospherics and ionospherics.

In the international field Mr. Piggott has always been very active. He has been a member of URSI since 1953 in various capacities related to vertical incidence and absorption studies of the ionosphere. He has been the nominated representative to many international working groups.

He acted as Vertical Incidence Soundings consultant after the dissolution of the World Wide Soundings Committee as Chairman of INAG since its formation and has edited all the INAG Bulletins, which have a circulation of 300-400 copies, and are currently published in English, French, Spanish and partly in Russian, His Handbooks of Ionospheric Interpretation and Reduction, written jointly with Professor Rawer, have been a source of guidance and help to ionospheric physicists the world over, and have gained the affectionate subtitle of "The Bible".

It is relatively easy to assess a person's contribution to a particular field by his contributions in terms of published papers and work on International Committees. In Mr. Piggott's case this must be only a small factor. He has been, and still is, unselfishly giving advice to many ionospheric groups and individuals all over the world. His efforts in the UK in promoting ionospheric studies have been immeasurable and nearly all the prominent research scientists in the field have either worked directly under him or in association with him, at some juncture in their careers.

The ionospheric and magnetospheric community in UK is organizing a special meeting in his honor; the first time this has happened since Sidney Chapman received a similar award. The Meeting will be held on July 13, at Sheffield University.

I am sure that all readers in INAG will join us in UK, in wishing our newly-entitled Chairman, Dr. Piggott, our heartiest congratulations, and hope that he will continue to contribute to the ionospheric community for many years. It may truly be said that the ionosphere is “that part of the sky above Mr. Piggott’s head at noon”!

IV. INAG Questionnaire on the Future Operation of the VI Network

This preliminary analysis is based on twenty replies to the questionnaire, three of which gave the views of the controlling group for networks of up to 10 stations each. The views of networks and of individual stations were sometimes very different and in general very few comments have been made by users of the data. The questionnaire is duplicated at the end of this issue so as to encourage further contributions either direct to the Chairman, or to your representative at Helsinki. INAG can only make decisions on the basis of facts and opinions brought to its notice. If you feel strongly on only one point, return a questionnaire or letter with this point.

Status reports have been received for 53 stations, i.e., about 1/3 of the network. Of these, 2 stations have closed and 4 are due to close at the end of the IMS and the future of 6 is at present uncertain. If equipment were available, there was interest in opening a station at a new site or reopening one at an old site for 17 stations - more than the number that may disappear!

As might be expected, on the more detailed proposals, a considerable number of replies were “no opinion” and “majority views” are often based on rather small numbers. We need more replies! However, an overwhelming majority felt that the present line of parameters is satisfactory and objected to the replacement of any existing parameters by a new parameter.

Opinion appears badly split on whether the analysis procedures should be simplified after the IMS; the big groups are in favor, most individual stations against.

Most respondents had definite views on the frequency parameters, the least popular of which appear to be fmin and foF1. Even for these more respondents felt the parameter was desirable rather than undesirable. The frequency parameter on which fewest people had a firm view was fxI.

Most respondents had no view on M(3000)F1, the big groups were mildly in favor, but the remainder felt that this parameter is not useful. This point should be taken up with CCIR.

The consensus on whether the scaling of Es types be made optional and on simplification of Es rules, was “yes”. The option that “h” and “c” types be combined was unanimous amongst individual stations, but the big groups preferred to combine h, c, λ and f. No other possibility received any clear-cut support. A small majority was in favor of combining a, k, r and storm associated f.

The majority felt that numerical Es parameters should be reduced in number. The majority of those desiring a change preferred to omit foEs, though the latter had some support.

About half respondents attempt Spread-F typing, but are split on its value, the majority were against. The majority of respondents were against recommending that the use of certain letter symbols be restricted to particular regions.

There was overwhelming support for keeping the “essential letter” symbols as at present. On the "possible optional letter” symbols, M, 0, T and Z had least support, W and Y were supported, and on the remainder views were roughly equally balanced. Opinion seems about unanimous that T should be dropped.

The balance of replies has changed considerably since the earliest group were received, and it is not clear whether we have a true consensus yet. In particular, there have been no replies from several important networks and very few from users of the data.

V. URSI/IAGA Report on "The Needs for Ionosondes in the 1980s"

An important topic for discussion at Helsinki will be the URSI/IAGA Report on "The needs for ionosondes in the 1980's" published in INAG-26, pp. 9-14. It is essential that your views be known to the Chairman before the meeting. Alternatively brief your national delegate to INAG. Some criticisms have already been received from Dr. L. Bossy (INAG-27, p. 16).

Professor Rawer, commenting on the version published in INAG-26, makes the following points: "I disagree on the following main points:"

(i) The importance of the close spaced networks (6b and 13 in Report).
(ii) The needs for communications purposes (7, 14).
(iii) The policy for the future in paragraph 15.

The latter makes the IMS too important from the point of view of the worldwide network.

As for the communication needs, I do not agree with the statement given in paragraph 7, which apparently considers only advanced systems where particular sounding equipment is at hand for communication purposes. The large mass of communication users, however, applies the CCIR mapping programs, and these urgently need improvement, which will not be possible with a considerably reduced network. Work at Slough has shown that quite a number of satellite observations are not consistent with the present CCIR programs. We found the same with data from the AEROS satellites. It would be a pity if the stations would just disappear in the period when more and more reliable satellite data are to become available.

The most important point, however, where I disagree is the onesided position of the report with respect to "scientific needs". There are already important changes in emphasis which are likely to disclose new requirements in this decade. I feel this is not enough taken account of in this paper. Formerly, the electrons of the Ionosphere were an almost independent subject. Due to space research the Interactions between the different constituents and so between different methods and fields have become more important. Problems of this kind can, however, only be resolved with regional studies from rather dense networks. On the other side, the worldwide aspect continues, of course, to be very important, in particular since worldwide observations by satellites are still not available continuously."

After considering the Report, using input from INAG and the comments of Commission G, the Commission will need to make a recommendation on the future of the network. It is our duty to make sure that the Commission is as well informed as possible on this matter.

VI. Station News

South Georgia (54^0S, 37^0W)

The British Antarctic Survey has recently received funding for an advanced ionosonde (see p. 7 of this Bulletin). This is a major step forward for the Survey but necessitates a reorganization of current programmes. It has been decided that South Georgia will close at the end of 1978. Argentine Islands and Halley Bay will remain operational as synoptic stations.

South Georgia has operated continuously since 1 July 1970. It is regretted that the station could not continue till sunspot maximum to complete a solar cycle of good quality data from a remote and interesting location.

Port Stanley (51^0S, 57^0W)

It has not been finally decided whether Port Stanley will remain open after the end of IMS.

With the announcement of the closure of South Georgia the need for maintaining operation at Port Stanley becomes even more important. *If you have not already made your views known, write to the Chairman*. The closure of both these stations would be a great loss to the network.

Chungli (24.95 ^{0}N, 121.23 ^{0}E)

A vertical Incidence ionosonde is currently operating at Chungli, in the Republic of China (Taiwan). Total electron content measurements are also being made at Lunping (24.95°N, 121.15^0E).

VI. Station News (Cont'd.)

Digisondes

Dr. K. Bibl has contributed the following notes on the new deployment of his Digisonde 128 digital ionospheric sounding system (INAG-6, p. 13, INAG-7, pp. 10—12) and its latter developments, Digisonde 128P and 128P5.

(a) Digisondes in Greece, Italy and Sicily

In the last year we have built three new Digisondes 128P, two for Italy and one for Greece, while the prototype is still in our laboratory. One sounder will be installed in Rome and one in Sicily. Both digital sounders, monitored by Dr. Dominici, will operate in addition to and in communication with the Digisonde 128 which has been moved from Genoa to Dr. Rumi's institute in Torino. The third Digisonde will be installed near Athens by Dr. Moraitis.

(b) Digisonde at Kwajalein

A new Digisonde type 128P5 has been operated for almost a year near Kwajalein, one of the Marshall Islands in the Pacific (9.4^0N, 167.5^0E), near the magnetic equator. The system is described in: Klaus Bibl and Bodo W. Reinisch, "The Universal Digital Ionosonde", Radio Science, May/June 1978 (in print).

(c) Digisondes in AFGL aircraft and at Goose Bay, Labrador

We have modified the Digisonde 128 in the K 135 aircraft of AFGL and the AFGL Digisonde 128 in Goose Bay, Labrador, to include the new Processing Controller. Partial spectrum analysis and beam steering in the Ionogram mode and complete spectrum analysis and scanning of up to 24 antennas in the Drift mode permit a multi-dimensional study of the aurora phenomena and the severe spread-F conditions near the equator. Even in the aircraft, which is limited to one receiving antenna, the fast on-line spectrum analysis in up to 256 range bins (virtual heights) made direction finding possible. The simultaneous signal-to-noise improvement by coherent spectral integration is often needed to overcome the unfavorable conditions of a small antenna on an aircraft high above ground.

NOAA Recalls Ionosondes to Boulder

NOAA ionosondes which have been on loan to universities in La Paz, Bolivia and Popayan, Colombia are being recalled to the NOAA laboratories in Boulder, Colorado for inspection and overhaul. The C-4 sounders, now over 20 years old, have been inoperable for a long time. It is hoped that the ionosondes can be successfully restored to satisfactory operating condition. However, the shortages of some essential and unusual parts, as well as the difficulties In finding replacements for other parts, may dictate the cannibalization of one of the instruments to restore the other. Of course, it is also possible that both C-4s will be found beyond repair. NOAA does not plan to redesign the C-4 or its sub-assemblies at this time, but rather will retire these two sounders and others when they cannot be restored to their original configuration successfully.

Redeployment of the sounders, if rehabilitation is successful, will be to locations offering the best combination of geographic and scientific significance, expertise, and likelihood of a successful monitoring operation. Several requests for ionosondes have been received by NOAA, and all will be considered carefully.

The Inter-American Geodetic Survey (IAGS) is assisting in making arrangements for transporting the ionosondes back to Boulder.

VII. Advanced Ionospheric Sounder for the Antarctic

The British Antarctic Survey has recently received funding for an Advanced Ionospheric Sounder (AIS). This is a major new tool for remote sensing of the ionosphere using HF radio-waves, that has been developed by the National Oceanic and Atmospheric Administration of the U.S.A. (See INAG-21, pp. 14-15 and INAG-23, p. 23). It consists of a powerful pulse transmitter and sensitive receivers coupled interactively to a controlling mini-computer. The basic parameters measured simultaneously are echo-phase, amplitude, polarization and time of flight; all as functions of frequency, time and location. On-line computer control allows very flexible operation with real-time data processing giving, for example, h'(f, t), N(h, t), angle of arrival (sky map), moving pattern velocities, 0-region N(h) and v(h).

The AIS will be initially deployed at Halley Bay (75^0S, 26^0W, L = 4.2) probably in early 1981. This facility in Antarctica will offer the solar-terrestrial physics community important collaborative research opportunities in a geophysically unique region of the world. BAS wishes to encourage such collaborations and will also welcome proposals for complementary experiments.

The geophysical coordinates of Halley Bay (Table 1) and the experiments currently operating there are listed below:

Ionosonde	VLF Receiver
All Sky Camera	La Cour Magnetometer
Riometer	Fl uxgate Magnetometer
VLF Goniometer	RVM

Table 1

Halley Bay Geophysical Coordinates

Geographic Latitude	75.52^0S
Geographic Longitude	26.60^0W
Geomagnetic Latitude	65.8^0S
Geomagnetic Longitude	24.3^0E
Dip	-64.5^0
Dip Latitude	46.4^0S
L-Shell	4.2
Invariant Latitude	60.8^0S
B (Gauss)	0.47

Any individuals or groups requiring further information or wishing to discuss possible collaborations, please contact John Dudeney, British Antarctic Survey, Madingley Road, Cambridge, CB3 QET, UK.

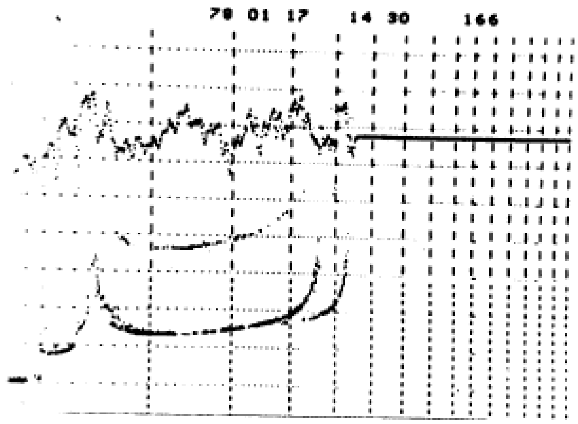
VIII. The Status of New Ionosondes

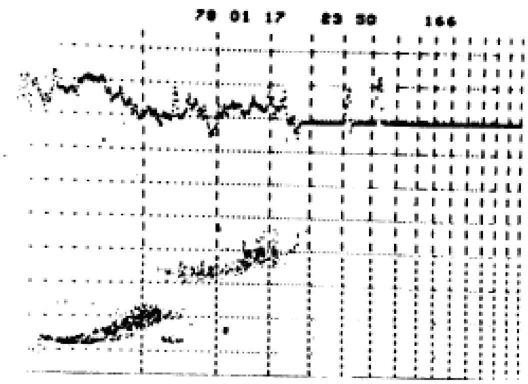
The Finnish IS-14 Ionosonde

The Finnish IS-14 ionosonde has been discussed in some detail in INAG-27. The manufacturers have provided the following information about the cost of the equipment:

Receiver and logic units	$45,000
Transmitter	$20,000
Recording Oscilloscope & Camera	$ 7,500
Cost of operational ionosonde	$72,500

This ionosonde is currently available on a commercial basis with delivery time of 9 - 12 months. Two IS-14 machines are operating as synoptic ionosondes at Sodankyla and Uppsala. Maintenance on the equipments has been minimal. Typical winter day- and night-time ionograms are shown below. The upper trace is an indicator of the gain of the receiver.





Lowell Digisonde Type 128 PS

The Digisonde 128 PS is a development of the Digisonde 128 using modern read-only-memories and microprocessors so as to provide a combined research ionosonde and monitoring ionosonde. It thus falls into the class of advanced ionospheric sounders (INAG-21, pp. 13-15, and references INAG-23, pp. 22-24), being capable of measuring virtual height, amplitude, phase, precise frequency and doppler offset, angles of incidence and azimuth, wave polarization. The main components are a 10 kW transmitter, processing controller transceiver, antenna switch and microprocessor. The equipment is designed to operate in two main modes. Ionogram mode giving range amplitude and frequency display, and Doppler-drift mode giving full resolution in Doppler-drift and angles of incidence and azimuth. The output is in digital form and recorded on 7-track magnetic tape, and can be displayed on a high intensity plasma display and electrostatic printer.

The equipment is commercially available from the University of Lowell Center for Atmospheric Research, Lowell, Mass. 01854, USA, and is fully described in: Klaus Bibl and Bodo W. Reinisch, “The Universal Digital Ionosonde”, Radio Science, May/June 1978 (in print).

IX. Rules for Ionogram Interpretation and Reduction

As Chairman of INAG and an editor of the Handbook, I am often asked why apparently complicated rules have been adopted for our classical reduction when simpler alternatives appear to be possible. In most cases, there was a reason for this which was strong enough to persuade the community at the time that the more complex rule was preferable and justified. It is now 20 years or more since these discussions were held, and few active workers today remember the difficulties which used to arise before the current rules were adopted. It appears timely to set down some of the arguments so that those wishing to simplify the rules can understand clearly the advantages and disadvantages of so doing. *If there are rules which you would like to have discussed in this way, please write to me and I will attempt to cover your points in a future INAG Bulletin.* This is particularly necessary since a number of groups feel that a simplified Handbook should be produced.

In general, it is INAG policy to allow plenty of time for discussion and to try to make any alterations only after an URSI General Assembly. Experience shows that it takes some years before any change of rules is adopted by all stations and in the meanwhile the data are, of course, not strictly compatible. Thus it is necessary to be very conservative in this matter.

X. Some Probable Changes in Ionogram Interpretation Associated with the Current Solar Cycle

by

A. S. Rodger and W. R. Piggott

Sunspots appear as dark areas on the sun in contrast to the brilliance of the disk. In fact, if a typical sunspot was isolated from the rest of the sun, it would be about 100 times brighter than a full moon on a clear night. A sunspot which is first observed on one side of the disk takes between 13 and 14 days to cross to the other extremity of the visible disk. Many spots have a life which is relatively long compared with the solar rotation period and they will reappear 13 to 14 days later. Direct observations of sunspot activity have been made continuously for the last 270 years. These provide the longest sequence of numerical measures of solar activity. The Zurich or Wolf number (R) (see UAG-23, 13.7, pp. 303-304) is the most common measure of sunspot activity and Is determined by counting isolated spots (5) and spot groups (G) on a daily basis. R = S + 10G.

Some spots are associated with local activity which generates X-rays, ultraviolet light, intense spectral lines, particle emission and solar radio noise, whereas others do not. Thus the sunspot number is only a rough indication of the actual level of solar activity.

The start of a new cycle is shown by the appearance of spots at relatively high latitudes on the sun. Also the magnetic polarity of spot pairs of groups reverses between successive cycles. There is often considerable overlap between successive cycles. Both the amplitude and duration of the solar activity cycle vary greatly from one cycle to the next, e.g., from R = 40 to 250 or duration 8 to 16 years. In the past the size of the maximum reached has been clearly associated with the rate of rise in the early part of the new cycle. However, the mean trend is often confused by temporary rises or falls lasting a few months.

By the criteria described above, sunspot minimum of cycle 20 was reached in June 1976 when R = 12; this also marks the beginning of cycle 21. The first 18 months of the new cycle were typical of many previous cycles, showing a gradual rise in R, reaching 50 for January 1978. The value of R for February 1978 jumped to 90 and both March and April have shown high values of R, 74.and 95, respectively. If this trend continues, cycle 21 may have a large maximum.

Ultraviolet (UV) and X-ray radiation may vary with sunspot number. These radiations are primarily responsible for the production of ionization in the ionosphere. Consequently, parameters such as foF2, foF1 and foE have shown very significant increases in February and subsequent months over the corresponding values in 1976 and 1977. The parameter foF2 is particularly sensitive to changes in R for the winter hemisphere in daytime. For example, the median noon value for Slough in 1977 was 6.2 MHz but had risen to 8.8 MHz in 1978.

Another effect of the increased solar activity is an increase in the rate of change of electron density with height in the lower E layer. This causes a weak gradient reflection which is frequently seen near noon in summer and equinox. This reflection appears like Es-λ and is difficult to distinguish from a conventional Es layer. It has caused difficulty in interpretation in previous cycles when R exceeded about 100.

Not every sunspot produces a magnetic storm, and conversely not every magnetic storm is caused by a sunspot, but there is a strong statistical correlation between the occurrences of the two phenomena. The frequency and magnitude of magnetic disturbances may be expected to increase in the coming months.

The recent increase in R has been associated with very active spot groups. Such groups often generate abnormal solar proton emissions giving rise to polar cap absorption events (PCAs, UAG-23, 13.43, p. 296) and severe magnetic storms.

Increased solar activity increases the ion and neutral temperature of the F region causing a corresponding rise in the density at fixed heights. This increases satellite drag. Consequently, the unexpected rise in sunspot number from February 1978 may also reduce the operational lifetime of some of the current satellites orbiting earth.

XI. Scaling of foEs and fbEs when No Es Layers are Observed

by

A. S. Rodger, British Antarctic Survey

Chairman's Note: At its Geneva meeting, INAG requested that special training material be made available in the INAG Bulletin to help other groups. This paper is another contribution from the British Antarctic Survey training group. In the absence of corresponding material from other groups, some of the set training aids have been incorporated into the manuscript of Chapters 1-4 of the Handbook, to be published shortly. As with other training aids of this type, only the 0-mode trace is shown in the Figures.

When no Es echoes are observed on ionograms convention dictates (see section 4.25, UAG-23) that numerical values for foEs and fbEs must always be used except when there is total blackout or complete equipment failure. This note details the reasoning for adopting these conventions.

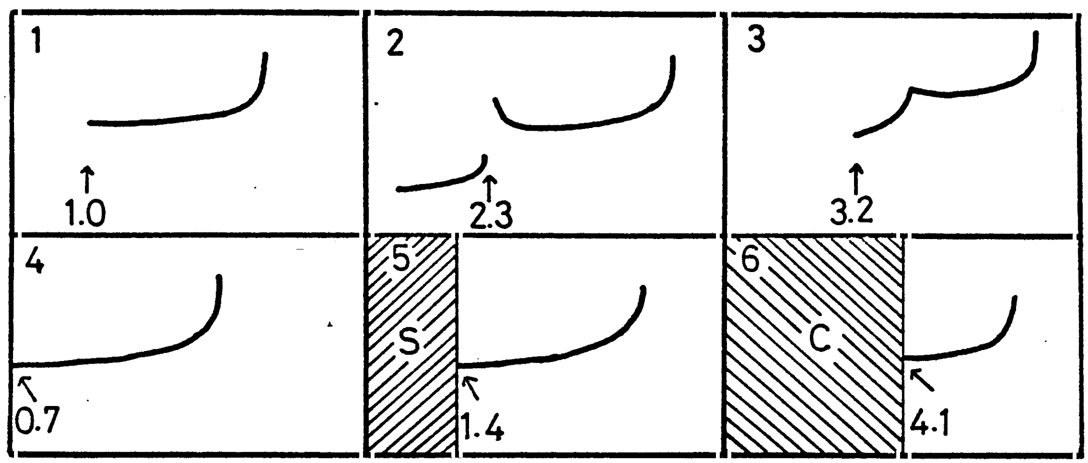
The figure shows six occasions when no Es layer is observed. The appropriate scaling of foEs, fbEs and h'Es are shown in the accompanying table. Examples 1 and 2 show typical night-time and daytime ionograms, respectively. The minimum frequency at which echoes are observed (fmin) is relatively high in example 3 due to increased absorption. This can occur at any time of day but with an F1 layer present this is obviously a day-time example. Examples 4-6 show three cases where the low frequency end of the ionogram has been affected by the lower limit of the ionosonde, interference and equipment failure.

foEs, fbEs and h'Es scaling when no Es layers are observed

Example	foEs	fbEs	h'Es
1	010EB	010EB	B
2	023EG	023EG	G
3	032EB	032EB	B
4	007EE	007EE	E
5	014E5	014E5	S
6	041EC	041EC	C

Note that the normal accuracy limits (5 - 20% or ±5Δ) do not apply. Also that h'Es is replaced by the descriptive letter used in conjunction with foEs and fbEs.

The need to use numerical values in preference to no entry or a descriptive letter only, can best be



illustrated by a simple example. Suppose at a particular hour in a month foEs is observed at 7.0 MHz on three occasions but no Es is observed on the other 28 possible occasions. The median value of the days when observations were made is 7.0 MHz. This is clearly not representative of average ionospheric conditions and can be seriously misleading to the data user. Therefore, allowance must be made for the times when Es was absent. In cases 1, 3, 4—6 the value used for both foEs and fbEs is the minimum frequency observed qualified by E and described appropriately. Case 2 is the exception. Here the value

of foE must be used, again qualified by E and described by G. The value foE is used in preference to fmin on this occasion to allow for the possibility that there are Es layers in the valley between the E region and F region which will not be visible on conventional ionograms. The letter G implies that the electron density of the Es layer is less than that of the thick E layer and the trace of the Es layer is therefore not observable.

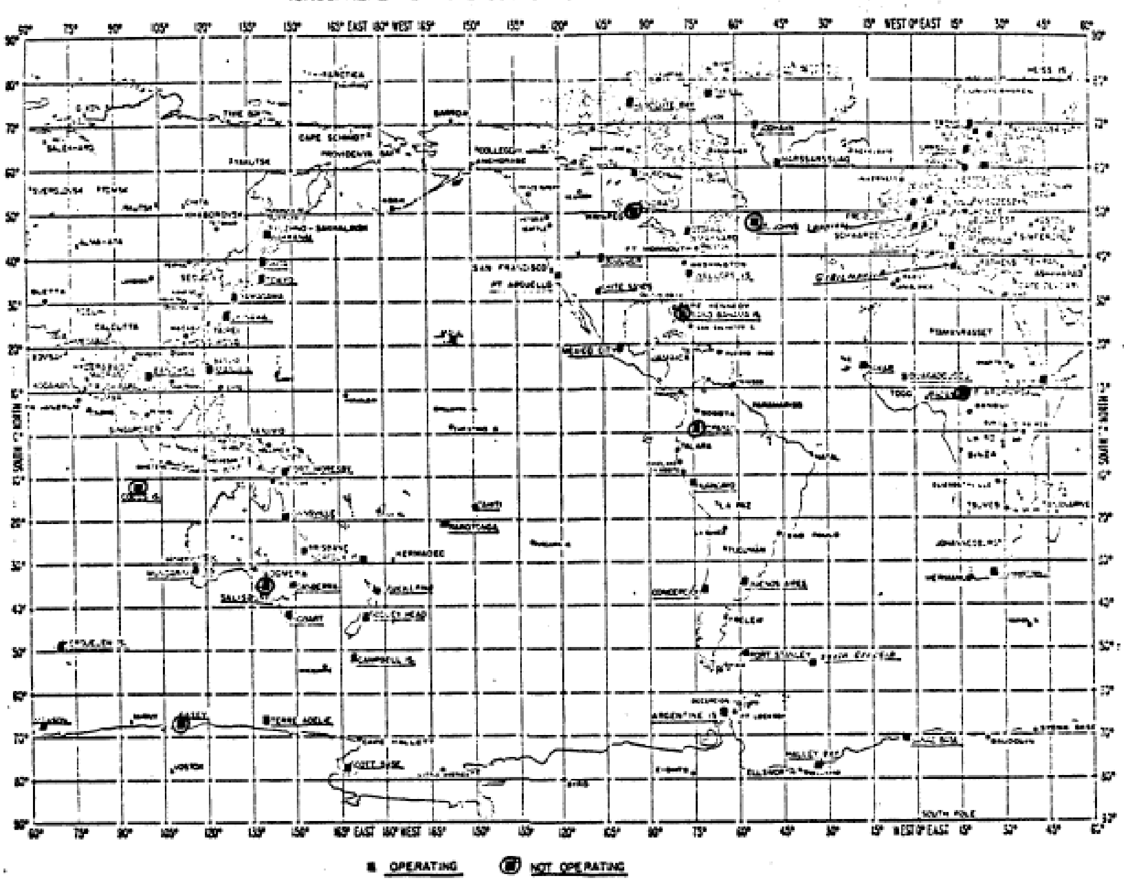
From the practical point of view, Es can give propagation at frequencies above the normal E layer MUF. When Es is absent the E mode is limited by this MUF. Thus the convention prevents misleading predictions of the importance of Es when it is present for only part of the time.

XII. Measurements of fxI

At Geneva, INAG was asked whether there are now sufficient measurements of fxI over the world to allow a detailed analysis. A number of small analyses have been reported to the Chairman based on data from a limited zone but for both operational and scientific reasons, worldwide analysis is required. An analysis made by WDC-A, shows that 68 stations have measured fxI and provided fxI data to WDC-A of which 9 are now closed. A list of these stations is given below and reproduced on the map. Clearly, there is now adequate data to justify a full analysis of the parameter and its usefulness. In contrast, Spread-F typing has been reported from only 13 stations most of which are at high latitudes. We believe that some other stations are, in fact, classifying spread-F, e.g., in the standard F-layer tables, but these have not been identified.

The results of the earlier tests showed that the parameter was valuable for identifying the additional frequency bands available by Spread-F modes of communication and in most cases enable operational MUF (Handbook, section 1.07E) to be deduced. So far as we know, the use of fxI to give a numerical measure of Spread-F over the earth has not, as yet, been fully exploited.

IONOSPHERE VERTICAL SOUNDINGS STATIONS



STATION	fxI	Classification used	
Akita	fxI		
Argentine Is	"	F,P,Q	
Auckland	"	F	
Bangkok	"		
Boulder	"		
Brisbane	"		
Buenos Aires	"		
Campbell Is.	"	F,P	
Canberra	"		
Casey	"		closed
Christchurch	"	F	
Churchill	"		
Cocos Is.	"		closed
Concepcion	"		
Dakar	"		
DeBilt	"	F	
Djibouti	"		
Ft. Archambault	"		closed
Garchy	"		
Gibilmanna	"		
Godhavn	"		
GBI	"		closed
Grahamstown	"		
Halley Bay	"	F,P,Q	
Hobart	"		
Huancayo	"		
Kerguelen	"		
Kiruna	"	F	
Lannion	"		
Lycksele	"	F,P	
Manila	"	F,Q	
Maui	"		
Mawson	"		
Mexico City	"		

STATION	fxI	Classification used	
Mundaring	fxI		
Narssarssuaq	"		
Norfolk Is.	"		
Nurmijarvi	"		
Okinawa	"		
Ottawa	"		
Ouagadougou	"		
Point Arguello	"		
Poitiers	"		
Popayan	"		closed
Port Moresby	"		closed
Port Stanley	"		
Rarotonga	"	F	
Resolute	"		
Rome	"		
Salisbury	"		closed
Scott Base	"	F,P	
Slough	"		
Sodankyla	"	F,P	
St. John's	"		closed
So. Georgia	"		
Tahiti	"		
Terre Adelie	"		
Thule	"		
Tokyo	"		
Townsville	"		
Tromso	"		
Uppsala	"	F,P	
Wakkanai	"		
Wallops Is.	"		
White Sands	"		
Winnipeg	"		closed
Yamagawa	"		
Sanae	"		

XIII. Review of High Latitude Phenomena and Associated Rules

We are now in the position that the Special Committees on High Latitudes and the World Wide Soundings Committee reached when writing the standard rules in the 1950s, so far as new rules made to assist IMS studies are concerned. Like them, in effect we have been using provisional rules for some years, and as a result, have now a clearer view of the new parameters, and the difficulties involved in using them. These include the definitions of the high latitude types of sporadic E and the reduction procedures needed with them, fxI, tilted layers, spread-F, etc. It was pointed out in the High Latitude Supplement, that different groups were apparently using different names for the same phenomena and that in some cases possibly different phenomena were being classified under one heading. *Is the present situation sufficiently satisfactory for no further action to be taken, other than occasional discussions in the INAG Bulletin, or is there a general desire, particularly amongst high latitude workers, for a discussion meeting to qualify and codify high latitude analysis?* If needed, this would be based on the High Latitude Supplement; the main objects being to simplify rules for handling complex high latitude ionograms, to agree their interpretation in terms of ionospheric and magnetospheric phenomena, and to provide material for a chapter in the Handbook on such ionograms.

The evaluation of the need for such a meeting and its organization is a considerable task which will take many months. Your Chairman will probably be in a position to help actively in such a project in about 18 months time if there is enough demand.

XIV. The Use of Symbols G and Y when F2 Lacuna are Present

by

S. Cartron

Chairman's Note: This paper has been slightly modified, with permission, from a French text by S. Cartron. Readers of the INAG Bulletin will remember that INAG felt that the distinctions between G and Y when F2 Lacuna was present (INAG-9, pp. 5-10) and the distinctions F and V for weak Lacuna were too difficult for worldwide use, and they were therefore excluded from the Handbook. Experience shows that where the phenomena are common these difficulties are readily resolvable. This paper shows the importance of making the distinction at such stations. The necessary expertise can be readily obtained by studying sequences of ionograms. A good selection of Lacuna ionograms was included in the High Latitude Supplement and INAG Bulletins, The INAG Meeting in Geneva 1978 has proposed that the use of V for all cases should be encouraged at stations where the necessary knowledge is available.

The paper also makes a comment on the possible confusion due to the two different uses of V given in the Handbook. As pointed out in INAG-14, p. 6, this is a real point though its importance may be overestimated. In practice, the two phenomena seldom, if ever, occur in the same region. However, the consensus at the time of the decision was that the use of V for severe tilts was preferable to using H, the possible alternative. Most people felt that the presence of severe tilt should be identified in a special way. I have not seen any papers exploiting the knowledge made available by this use of Y and it is possible that the representations made by the High Latitude Groups, in particular Olesen and Sylvain, to keep V for Lacuna only, should now be reconsidered. It is clear that the Lacuna of high latitude phenomena vary with magnetospheric conditions, solar wind and interplanetary magnetic field. *INAG would like to have your views on these points.*

1. Introduction

The main object of this paper is to stress the importance of distinguishing between F2 Lacuna, V. and G conditions. At Dumont D'Urville, where Lacuna phenomena occur every day in summer months, these modify not only individual values of foF2 but also the monthly median values. This can also be important at the other high latitude stations who have published Lacuna ionograms in the High Latitude Supplement; e.g., Heiss, Dixon, Casey, Godhavn, Narssarssuaq, etc. At stations where Lacuna is uncommon, the distinction is not very important, individual values of foF2 will be too small but this will not effect the medians significantly.

2. Use of letter V

The definition of the symbol V in the Handbook, Chapter 3, is "Lacuna phenomena or severe layer tilt". Thus, Y denotes two completely different phenomena:

(a) the absence of a trace (Lacuna phenomena), Figure 3.31, 3.32, or
(b) the presence of an abnormal trace, Figure 3.34, in the case of severe layer tilt.

This is not logical.

3. Definition of Lacuna

The description of Lacuna given in section 2.75 conforms more closely with the definition we proposed in INAG-9, section VI, pp. 5-10. It is interpreted as a scattering or defocusing process, which also accounts for the close association between Fl Lacuna and the Slant Es condition (J. K. Olesen, INAG-12, pp. 14-19, High Latitude Supplement, pp. 227-239). Pending the identification of the causes of all types of Lacuna, it appears to be more logical and clearer for the user to redefine Lacuna on a purely morphological basis. It should be noted that in the present description of Lacuna, two types of perturbation are described, the total loss of trace and, in the weaker forms, the replacement of a solid trace by a weak scattered trace. Thus Y identifies a weakening of the traces and the existence of spread. Which is more obvious depends on the sensitivity of the equipment and the intensity of the phenomena. In INAG-9 three different types of Lacuna are identified:

F1 Lacuna - absence or weakening of the upper E and F1 traces.
F2 Lacuna - absence or weakening of the F2 trace.
Total Lacuna - absence or weakening of the whole F-layer trace.

The same letter, Y, is used by the scalers for all three types though it is highly probable that the physical causes of the Lacuna are different in each case. Thus it is important to keep the three names.

At Dumont D'Urville, Lacuna and quasi-Lacuna of all three types occur very frequently in summer months. This is shown, for two months taken at random, in Figure 1. The solid line gives the number

of values of foF2 as a function of time of day which are neither qualified or described; i.e., accurate values, the dashed line indicates the number of foF2 values including F2 Lacuna and G values, and the dotted line shows the effect of including total Lacuna also. Clearly between about 0400 and 1500 LMT, Lacuna effect a significant number of values of foF2. For the hours of maximum rate of occurrence at least one ionogram in two shows an F2 or a total Lacuna. The figure does not show the presence of F1 Lacuna which are also very common.

4. F2 Lacuna and the G condition

As the Handbook does not include the case of F2 Lacuna, the absence of an F2 trace is treated as a G condition which also applies to the absence of an F2 trace. Instead of Y which would imply that foF2 probably had not changed in value foF2 is denoted (<u>foF1</u>)EG which is the lower limit value for foF2. Thus foF2 can be significantly underestimated when F2 Lacuna is present. The effect at Dumont d'Urville for January 1974 and November 1974 is shown in Figures 2 and 3. Line (a) shows the median values of foF2 taken using accurate values of foF2 only (solid line in. Figure 1), line (b) the median values of foF2 when all F2 Lacuna cases (shown as o on the figure) are treated as G cases. The difference exceeds 1 MHz at hours when F2 Lacuna are most frequent. Thus the Handbook, by imposing a definite rule, introduces a systematic distortion in the interpretation which is probably not justified. This is confirmed by

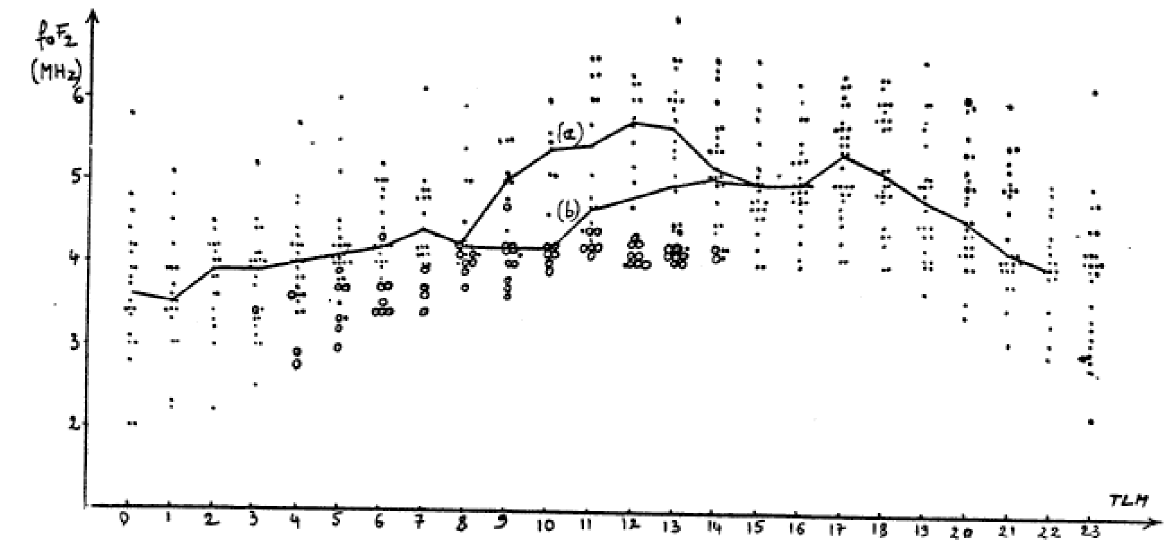


Fig. 2

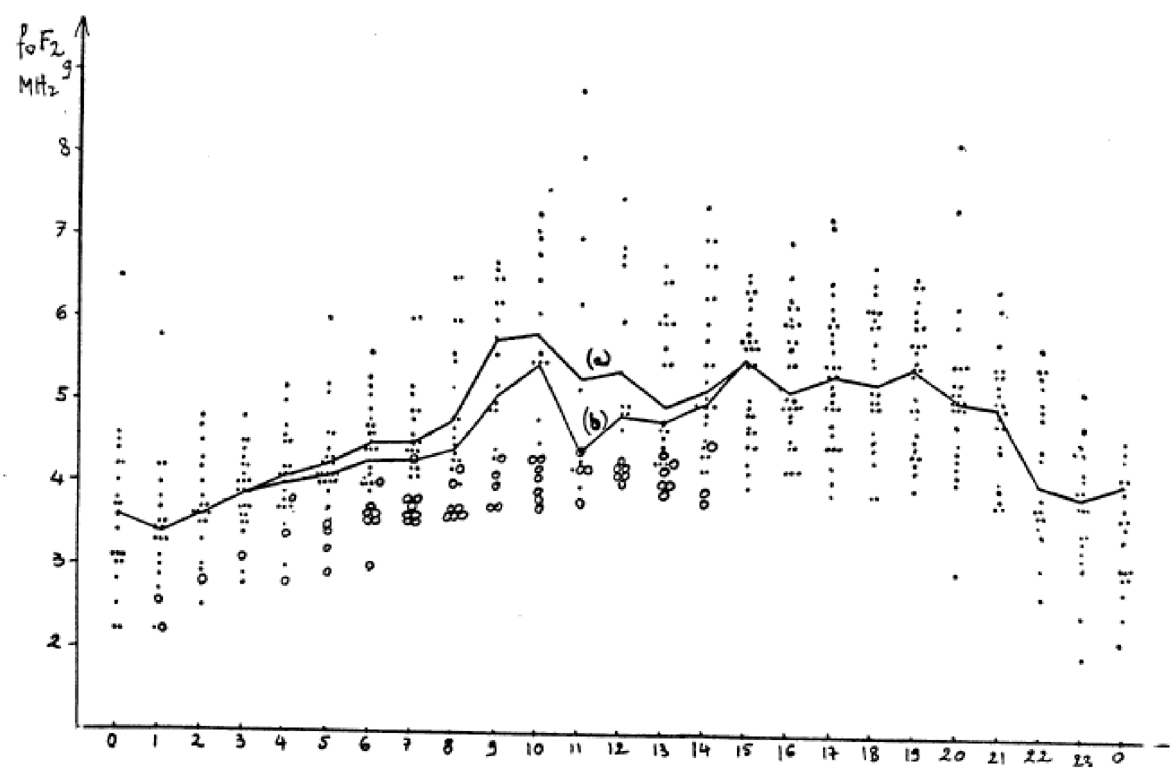


Fig. 3

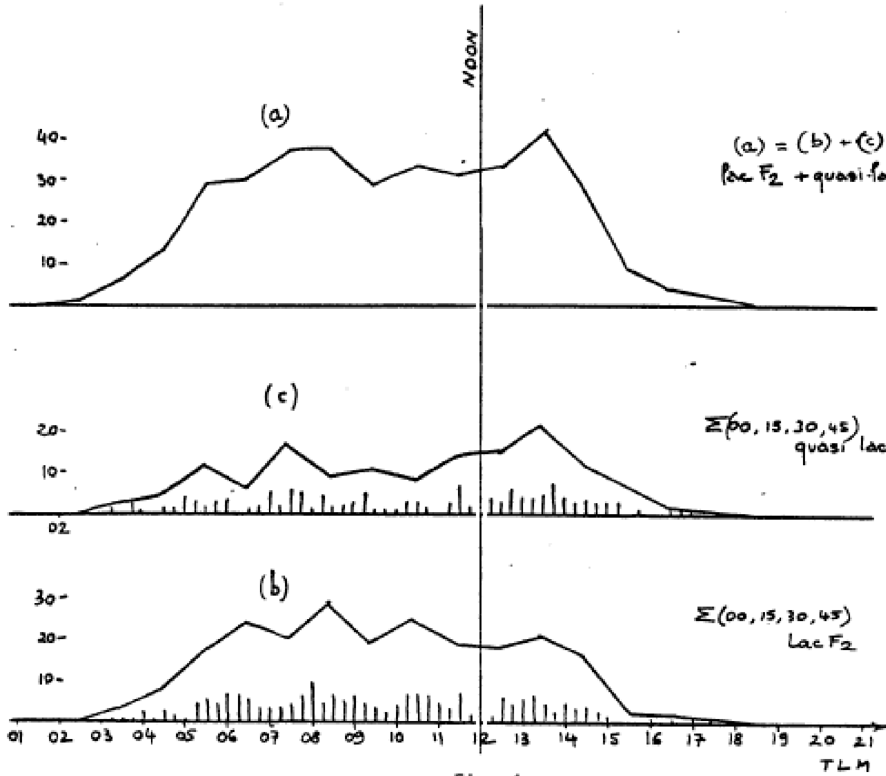


Fig. 4

observations on partial F2 Lacuna where the residual weak traces show that foF2 is definitely greater than foF1. Figure 4 shows that the diurnal variations of number of occurrences of quasi F2 Lacuna (curve Cc)), F2 Lacuna (curve (b)) and the sum of both (curve (a)) are essentially similar, making it reasonably certain that the quasi F2 Lacuna can be used as a guide to the value of foF2 when F2 Lacuna are present.

5. Conclusion

This paper shows the risks involved in interpreting the absence of an F2 trace as a G condition at stations where Lacuna are common. I feel that the Handbook should stress this point so that scalers are more prudent. G condition certainly exists but it is not recorded as frequently in topside soundings as it was the monthly tables of foF2, during the IGY and, before Y was used. In the data discussed above for November 1974 I have noticed four cases of probable, but not certain, G conditions for which I have put foF2 = (foF1)EG. In the same month F2 disappeared on at least half the ionograms at the time of maximum occurrence of Lacuna (Figure 1). During an examination of Ionograms for the IGY from a dozen polar stations made by Dr. Sylvain and myself at WDC-A at Boulder, we found many cases of F2 Lacuna. The tabulated data were quite inadequate for this study and we had to interpret the ionograms ourselves.

A discussion on these problems with the people in charge of stations where Lacuna are present should be fruitful and make it easy to identify new rules to clarify the scaling without complicating it.

References

Additional papers quoted in the French version before shortening are:

LEBEAU:	1965	Sur 1'activite magnetique dans les calottes polaires, *Annales de Geophysique, 21,* 167.
VASSAL, BERTHELIER, LAVERGNAT and SYLVAIN	1976	A study of ionospheric absorption events at very high latitude, *JATP, .38,* 1289.
SYLVAIN, BERTHELIER, LAVERGNAT and VASSAL		F-lacuna events in Terre Adelie and their relationship with the state of the ionosphere (to be published in *Planetary and Space Science).*

INAG strongly supports the suggestion of further discussion and offers help if required by those directly involved.

XV, Forthcoming Lunar Occultations of the X-Ray Source SCO X-1

by

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Ditton Park, Slough, Berks. 5L3 9JX, U.K.

ABSTRACT

A series of lunar occultations of Sco X-1 in 1978/80, observable from the Southern Hemisphere, may provide opportunities to determine whether this galactic X-ray source does produce small ionospheric effects.

Many years ago, it was suggested that the galactic X-ray source Scorpius X-1 could produce observable effects in the lower ionosphere [Anathakrishnan and Ramanathan 1969]. This suggestion was apparently refuted by detailed calculations [Thomas 1974, Poppoff et al., 1975]: Sco X-1 contributes only around 1% of the nighttime ionization rate in the D-region, so the siderеally-related phenomenon observed by Anathakrishnan and Ramanathan must have some other explanation. If any doubt remains, the series of lunar occultations of Sco X-1 may provide an opportunity for testing the matter. The table gives some details of the events, obtained by inspection of the diagrams published by H. M. Nautical Almanac Officer Morrison, 1977].

In considering what might be learned from such observations, one should note that an occultation merely affects the rate of ion production so that changes of ion concentration only develop gradually during the occultation, which typically lasts about one hour. The major difficulty is of course the extreme smallness of the anticipated effects, which necessitates the use of specialized techniques capable of giving very accurate data on the lower ionosphere. Ordinary ionosondes and long-path LF and VLF observations cannot be expected to give useful results for this purpose, though short-path VLF may. Even with good opportunities and suitable experiments the chances of obtaining clear-cut results seem small and any observations will have to be carefully planned within the capabilities of the available equipment. One recalls that solar eclipses, which produce much greater effects, have yielded little quantitative data on ionospheric processes from a vast number of observations. Admittedly, the severe problem presented by the unobscured coronal radiation in a solar eclipse does not arise for Sco X—1.

Sco X-1 is so near the Northern edge of the zone of possible occultations that the events are visible only from the Southern Hemisphere. The occultations occur every lunar month over a three-year period, but the table omits those visible only from oceanic regions where no ionospheric observatory exists. Though only nighttime events offer any real chance of detection, the table includes events at any local time. The Moon's 'shadow' travels roughly from WNW to ESE, and crosses several tens of degrees of longitude in the course of about two hours; the table shows approximately where the 'shadow' is centered at the actual conjunction of the Moon and Sco X-1. At this place, the source transits at mid-occultation whereas, at places more than about 30° to the east or west, the occultation takes place too far from transit to be favorably observed. To illustrate possibilities, the table gives, for some selected places, the approximate LT and the source's hour angle HA (distance from transit) at mid-occultation. Accurate predictions for specific events may be requested from H. M. Nautical Almanac Office, Royal Greenwich Observatory, Herstmonceux Castle, Hailsham, Sussex, BN27 1RP, England.

References

ANATHAKRISHNAN, S. and K. R. RAMANATHAN 1969 *Nature, Land. 223*, 488.

MORRIS, L. V. 1977 Nautical Almanac Office Technical Note No. 42, Royal Greenwich Observatory.

POPPOFF, I. G, R. C. WHITTEN and D. S. WILLOUGHBY 1975 *J. Atmos Terr Phys. 37*, 835.

THOMAS, L. 1974 *Radio Sci., 9*, 121.

LUNAR OCCULTATIONS OF Sco-X1

Greenwich Date Yr Mo Da	Conjunction UT	Center		Some Places where Observable (grazing if bracketed)	LT (hours)	HA
78 11 02	1945	90S	90W	Argentine Is.	16	+2
78 12 27	1540	80S	90W	Argentine Is.	12	+2
79 01 24	0155	73S	90E	Kerguelen	06	-2
79 02 20	0950	52S	60W	Stanley, Argentine Is. (B Aires)	06	0
79 03 19	1550	51S	165W	Christchurch, Campbell Is.	03	-2
79 04 15	2130	69S	75E	Kerguelen	02	-½
79 05 13	0435	68S	45W	{S Georgia	03	+½
				{Stanley, Argentine Is.	00	-1½
79 06 09	1310	70S	150W	Campbell Is., Macquarie Is.	00	+1½
79 07 06	2240	68S	30W	S Georgia	20	-1
79 08 03	0810	48S	165E	{Christchurch, Campbell Is.	20	+½
				{Hobart, Canberra (Brisbane)	18	-1½
79 08 30	1600	44S	30E	Grahamstown (Johannesburg)	18	-½
79 09 26	2210	48S	90W	Concepción	18	+2
79 10 24	0350	60S	165E	{Campbell Is. (Christchurch)	15	+½
				{Hobart (Canberra)	13	-2
80 01 14	0440	53S	60E	Kerguelen	10	+1
80 03 08	2130	49S	120E	W Australia	05	-½
80 06 25	2350	75S	30W	S Georgia	22	-½
80 07 23	0840	63S	180	Campbell Is. (Christchurch)	20	-1

XVI. Comments to Note in INAG-27 of J. R. Dudeney "The Nature of the Ionospheric Characteristic foF1"

by
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University of Lowell
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In old times, when physicists used to analyze ionograms, foF1 was found to be a very steady parameter of the ionosphere. It was to indicate the maximum critical frequency of the lower part of the F region and described a normal layer; i.e., a Chapman-like layer with a thickness corresponding to the scale height and an equilibrium between ion production and recombination. Solar flare effects and specifically solar eclipse effects [Bibl and Delobeau, 1955] could easily be seen and demonstrated the usefulness of the chosen definition. Although I agree with J. R. Dudeney that in his last case the letter D should not be used, I doubt that it was the intention of the data analysis rule to find the maximum slope of the F-region profile. Certainly his curves are no proof for anything. Measured ionogram reproductions should be taken of sequential days with different apparent transitions. If true height analysis were taken with magnetic field correction, It would show that the lower part of the F region is rather stable and that the variation in the transition between Fl and F2 ionization are due to the change in height and shape of the F2 ionization. I believe that these changes in the F2 profile are caused by the changes in the diffusion coefficients influenced by the variable dissociation height, by E fields, wind-induced drifts, tides and other gravity waves. Thus I claim that the internationally agreed definition indicates the maximum critical frequency of a normal layer if the F2 ionization were absent, similar to the definition of foE [Bibl, 1951] to be used in cases of cusp Es.

References

BIBL, K. and F. DELOBEAU	1955	Ionospharische Beobachtungen wihrend der totalen Sonnenfinsternis vom 30. Juni 1954, *Zeitschrift fur Geophysik, 21*, 215-227.
BIBL, K.	1951	L'ionisation de la couche E, sa mesure et sa relation avec les eruptions solaires, *Annales de Geophysique, 7*, 208-214.

XVII, First Ionogram Interpretation Meeting of the National USSR Geophysical Committee, Section on Ionosphere and Aeronomy

The first ionogram interpretation meeting of the National USSR Geophysical Committee, was held at Arkhangelsk, 6 - 10 March, 1978. There were 18 participants. The following summary of the proceedings has been prepared by INAG member Dr. A. S. Besprozvannaya.

The following problems were discussed:

1. The review of physical phenomena occurring in the polar ionosphere, which characterize the processes of the interaction between the ionosphere and magnetosphere.
2. The use of the vertical soundings and development of a single method for the reduction and interpretation of high latitudinal ionograms for the study of these phenomena.
3. Problems associated with the changes of the rules of the International Handbook with regard to high latitudes.

4. Training of specialists for high latitude ionogram reduction and interpretation.

The meeting adopted the following recommendations:

(a) To note with satisfaction the research which uses extensively the data of ground soundings aimed at the study of the structure features of the magnetospheric plasma (plasma sheet, cusps, plasma-pause) and large-scale electric fields and parameters of the neutral atmosphere.

(b) To note with satisfaction the importance of experiments aimed at the comprehensive study of the processes in the ionosphere and magnetosphere with the use of satellite, rocket and ground geophysical observations.

(c) For the development of uniform procedures of complex ionogram reduction and interpretation to arrange for an experimental ionogram reduction at the high latitude network of stations for the period of 1 - 15 December 1977, and to send them to the AARI for the comparison and analysis (f-plots and ionograms).

(d) It was felt desirable to discuss in the INAG Bulletin problems of interpretation of complex ionograms which were not sufficiently covered in the Handbook, these are: distinguishing of the main trace under the condition of a trough/ridge and a cusp beneath, the ionogram interpretation, with oblique traces, winter lacune, classification of E traces (a-type) and the like.

(e) It was also felt desirable to discuss in the INAG Bulletin problems connected with the simplification of the Handbook rules for standard reduction of the vertical sounding data.

(f) It was felt important to organize an international High Latitude Meeting for the development and discussion of the practice for complex ionogram reduction and interpretation.

INAG draws attention to the proposed *Special Study Period*, 1 - 15 December 1977. It would be mutually profitable if other high latitude groups in the northern hemisphere also collaborated in this study. Further information can be obtained from Dr. A. S. Besprozvannaya, The Arctic and Antarctic Institute, Fontanka 34, Leningrad 192104, USSR.

XVIII. Data Interchange for Regular World Days

A sample analysis has been made at WDC-A of the extent to which international recommendations are followed. An extended interchange of data on Regular World Days (in particular on priority RWDs) has been accepted by a considerable part of the network, thus considerably increasing the data available on these days. The original idea, that special experiments would be concentrated on RWDs also appears to have had appreciable support. However, the detailed recommendation (e.g., International Calendar) that stations normally operating at quarter hourly intervals should make soundings at five minute intervals has been adopted by very few stations - too few to form an effective network. In present conditions, it appears more useful to organize regional studies of definite periods to study the rapid change delineated by five-minute soundings. INAG therefore suggests that groups wishing to make such studies should make proposals for a limited regional study either directly to the stations involved or through INAG and proposes to withdraw the recommendation for five-minute sequences on RWDs. *If you wish to object, do so now*. The general recommendation to operate at quarter-hourly intervals on RWDs, which has proved useful, will continue as at present.

XIX. Reports from World Data Centers

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

Activities for the period April 1977 to March 1978

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

Booklets and Sheets	: 2000	sheets
Microfilms	: 8	cans (1000 ft. per can)
	35	cans (100 ft. per can)
Microfiche	: 76	sheets

2. Data sent to WDCs A, B2 and C1:

Booklets and Sheets	: 415	sheets
Microfilms	: 80	cans (100 ft. per can)

3. Data services:

Tables and plots of Vertical Incidence Soundings	: 4799	station months
Ionospheric Drifts tables	2	station months
Ionograms	: 748	frames
Miscellaneous	: 138	station months

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

WDC-A	: Ionograms	-	7 cans (1000 ft. per can)
	Others	-	3 cans C 100 ft. per can)
WDC-B2	: Others	-	9 cans (100 ft. per can)
WDC-C1	: Ionograms	-	2 cans (1000 ft. per can)
	Others	-	2 cans (100 ft. per can)
C2 region	: Ionograms	-	1564 cans (100 ft. per can)
	Others	-	138 cans (1000 ft. per can)
		-	27 cans (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, 1978 will be available in August 1978.

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

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

As of June 1, 1978, the World Data Center A for Solar—Terrestrial Physics has archived 1700 station months of hourly scaled vertical sounding data (together with their monthly medians) in a master magnetic tape system. Many more station months of data have been received from the worldwide network which will be added as time permits. When data not in the system are requested, they are added as promptly as possible.

The World Data Center A for Solar-Terrestrial Physics has received its first input of digital data (on punched cards) in the standard URSI format from a station operating a Digisonde 128. These data from the Goose Bay station, consisting of hourly scaled data from December 1974 through May 1977, are being incorporated into this master magnetic tape archive. The monthly medians will be computed and made part of the archive.

INAG Questionnaire on the Future Operation of the V.I. Network

Please fill in the sections on which you have views and return to:

Mr. W. R. Piggott
Chairman of INAG
British Antarctic Survey
Madingley Road
Cambridge CB3 0ET
United Kingdom

INAG wishes to discuss the future of the V.I. network at the General Assembly of URSI, August 1-10, 1978, and, for this purpose, needs to know whether the producers and users of the data wish the current procedures to continue in the 1980s, or feel that they should be reviewed. The Report of the Joint IAGA/URSI Working Group on these problems: "Needs for Ionosondes in the 1980s" was published in INAG-26, pp. 7-14. This recommends that an important network be maintained, and suggests criteria for deciding which stations are most needed. Points from letters will be reported in the INAG Bulletins.

Future of V.I. Network

1. At the present time at your stations:

   (a) Do you expect the stations below to continue operation in the 1980s?

   (b) Are you expecting them to close at the end of the IMS?

   (c) Not known

Station	(a)	(b)	(c)

2. If suitable ionosondes become available, might you be interested in opening a station at a new site, or reopening one at an old site?

YES	NO

   If YES, please indicate possible sites.

3. Should the analysis procedures be simplified after the IMS? (Note this implies that post- and pre-IMS data will not be compatible.)

	YES	NO
If so, by reducing list of parameters to be measured?		
If so, by simplifying Handbook rules on interpretation?		
If so, by simplifying or omitting some letter symbols?		

4. Should any new parameters be adopted in place of an existing parameter?

YES	NO

If YES, list new parameter and if possible, proposals for existing parameter to be omitted. (Note: INAG cannot increase the workload at stations, some stations want it reduced if possible.)

5. Parameters to be Circulated

The international recommendations on parameters to be circulated represent a compromise between work involved and usefulness of data. In recent years they were increased by adding fxI. INAG needs to know whether you find the current list satisfactory or, if not, which parameters you would like to see made optional.

Present list satisfactory?

YES	NO

In the list below please tick in:

(1) For parameters you feel must be circulated.
(2) For parameters you feel the value of the data does not justify the work needed.
(3) For parameters you feel probably justify the work involved.
(4) No opinion.

	fxI	foF2	foF1	foE	foEs	fbEs	fmin
1							
2							
3							
4							

	M(3000)F2 or MUF3000 F2	M(3000)F1 or MUF3000 F1	h'F2	h'F	h'Es	h'E	Es types
1							
2							
3							
4							

In reviewing the parameters to be circulated in the 1980s, the INAG meeting at Geneva felt that definite views should be requested on the following to guide discussion at Helsinki:

	YES	NO
(i) Es Types		
Should the scaling of Es types be made optional:		
(a) at high latitudes.		
(b) at temperate latitudes		
(c) at low latitudes.		
Should Es types be simplified:		
If YES, should the following be combined:		
(a) h and c		

	YES	NO
(b) h, c and f		
(c) h, c, ℓ and f to give a temperate latitude Es class		
(d) k and r		
(e) a, k and r		
(f) a, k, r and storm-associated f, to show any type of of Es due to particle activity.		
(ii) Should any new rules be made to simplify analysis of Es, e.g., should Es low be ignored unless fbEs exceeds foE for the trace?		
(iii) Should the numerical Es parameters be reduced in number?		
If YES, prefer fbEs		
prefer foEs		
prefer fxEs		
prefer fEs (ignoring whether o or x mode).		
Is h'Es worthwhile		

(iv) fxI

The value of fxI is being reviewed by CCIR and INAG. Pending the results of this analysis, INAG would like to know whether you find scaling fxI more or less difficult than scaling foF2. (Note: Spread-F typing should be ignored in this statement.)

More	Less	Roughly Equal

(v) Spread-F typing (optional parameter)

	YES	NO
Do you attempt spread-F typing at your station		
Do you think spread-F typing is useful?		

INAG is intending to carry out some tests on the usefulness of spread-F typing data using those stations which have recorded it.

Letter Symbols

(i) Note: A full list of letter symbols must be available so that there is guidance on how to analyze with the greatest accuracy, particularly where special phenomena occur. However, the work at many stations could be made simpler by making the use of certain symbols optional and permitting others to be used in place of them. In order to see whether there is enough demand for such simplification to justify a full discussion of each possibility, INAG wishes to know your present views. If sufficient demand exists, it will then set out the pros and cons of any proposals so as to form a consensus of opinion.

(ii) Essential Letter Symbols

At present there appears to be a general view that the following symbols are essential. If you feel that the rules for using them should be simplified, please put X after the symbol; if you feel the rules should be kept as at present, put ✓ ; if no view, leave blank.

A B C D E R G J L S U

(iii) Possibly Optional Letter Symbols

Should any of the following symbols be made optional? If YES, put X; if no, put ✓; if no view, leave blank.

H I K M N O P Q R T V W X Y Z

(iv) Regional Use

Do you feel that certain letter symbols should be recommended for use only in certain regions?

YES	NO

If so, which?

(a) At high latitudes	
(b) At temperate latitudes	
(c) At low latitudes	

(v) Other Changes

Do you want to suggest other changes?

YES	NO

State changes desired: