IONOSPHERIC NETOWRK ADVISORY GROUP (INAG) *

IONOSPHERIC STATION INFORMATION BULLETIN No. 40 & 41 **

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

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With regret we share an announcement of the death of Prof. John M. Wilcox, Stanford University, on October 14, 1983. A memorial fund has been established by the Stanford University Libraries for materials concerned with Solar-Terrestrial Physics.

1. INTRODUCTION

by W.R. Piggott, Chairman

Owing to unavoidable delays in preparing INAG 40 for publication, it has been decided to combine INAG 40 and INAG 41 into one issue. These issues are mainly concerned with the INAG meeting at Hamburg and with contributions which have been received since INAG 39 was published. We apologise for the resulting delay.

There appears to be some confusion on the relations between INAG and the World Data Centre system. Although the working relations are very close, since many of the objectives of the two organisations are common to both, they are in fact completely independent and the aid which they give each other is entirely voluntary. In principle, the INAG Bulletin is available to every organisation or station which contributes to the WDCs and to the users of WDC data list. In practice, it is also sent to many who do not contribute but who are using ionosondes or ionosondes data. Every effort is made to ensure that anyone who is interested in receiving the INAG Bulletin actually gets it. While the Bulletin is written primarily for those who produce ionospheric VI data, translation problems prevent this from being entirely successful. Thus many stations do not receive the Bulletin though it may go to their administration. In the past, volunteers have translated parts or all of the Bulletins into other languages, in particular Spanish, French, Russian and some more local languages, but there is no organisation or finance to do this regularly. As has been recorded in past INAG Bulletins, the URSI Handbook and Supplement have been translated into several languages, Spanish, Russian, Japanese, Chinese; partial translations exist in some other languages also. We must note that producing the English version of the bulletin is a considerable drain on the research time of our Secretary, Alan Rodger. INAG thus depends entirely on voluntary effort which is unpaid and can only continue as long as there are people willing to provide this service. In contrast, the WDCs are financed long term by the Government of the countries in which they are established.

Formally INAG is a working group (WG) of Commissions G of URSI and, in common with all such working groups, is set up at each URSI General Assembly to work for the next three years only. In practice considerable experience is needed before the WG members can be effective, so most members continue to serve for several successive General Assemblies. However, to keep it active, there has been an INAG rule that any member who has not contributed to the Bulletin or attended a meeting in the three year period has to resign automatically. (This does not apply to Honorary members whose main value is in advising the Chairman).

The main costs of preparing the Bulletin are met by the British Antarctic Survey and the costs of duplicating and circulating it are shared between WDC, URSI and the contributions of those who subscribe to it.

Similarly the costs of members attending INAG meetings has to be met by the members' administrations, this is why we try to hold INAG meetings in conjunction with other international organisations, URSI, IAGA, CCIR etc, or during visits by the Chairman. The Chairman depends on the generosity of the Royal Society of London, local organisations in the countries in which meetings or visits are arranged or special sponsorship for particular meetings. It is not clear for how much longer such resources will be available. If they ceased, it would be urgent to appoint a new Chairman whose travel costs could be provided. Thus the future of INAG has to be kept continuously under review.

The Chairman and Secretary are reviewing past INAG Bulletins and discussing possible changes in content for the future. We would like to have your views and comments. One possibility is to have a special issue on training aids, in which we collect those already published, bring them up to date by including later modifications to the rules and, if possible, add to them your own versions with our comments. Have you suitable material? If so, please send it to us, even if you feel it still needs polishing. This should, at least partially, meet the demand for more help in training which has been expressed at many INAG meetings.

I am very pleased to announce the reception of the master copy of the Atlas of Ionograms of the USSR, prepared by Dr A S Bresprozvannaya and T I Shchuka (1982) with text in Russian and English. This is a book of high-latitude ionograms with line drawings and scaling as practised in the USSR together with training aids. While these differ in some details from the Handbook (see discussions INAG 35 p.3), they form a valuable addition to the High-Latitude Supplement and INAG is exploring the possibility of publishing the material, if necessary, as a special issue of the Bulletin.

It is very desirable that the actual practice at stations is known so that future users can interpret the numerical data accurately, especially when it differs from standard. I have found that some of the earlier data from other countries is now unusable because local rules were adopted which have not been recorded and are now forgotten.

My current studies of Es over Europe show clearly the necessity of distinguishing between foEs and ftEs. Unfortunately, the important station, Lindau, adopted the latter measure of Es. Although the statistics of the large and small values of foEs are reasonably meaningful, the middle values, which form the bulk of the data, are not and I have not been able to find any way, short of rescaling, to use the data even for sampling in 1-MHz interval boxes! Do not degrade your analysis because the phenomenon is very variable or the data becomes valueless.

I wish to draw attention to the WDC plans to put VI data (amongst others) into computer compatible form. I am not experienced in the problem of making compatible data from different computers, in different languages and with different formats, so can give little worthwhile guidance. The resources of the WDCs are limited and it is unlikely that much existing or new data can be treated unless some of the work can be done locally, e.g., by reformatting data into one of a few standard forms. If you have experience in, or are willing to study, such problems, please send me your name and address. I believe that all stations using microprocessors or computers use the Handbook codes but different local formats and programmes.

2. REPORT OF THE INAG MEETING held in Hamburg, FRG 23 August 1983

An INAG meeting was held on the 23 August 1982 during the Scientific Assembly of the International Association of Geomagnetism and Aeronomy. It was attended by 23 people representing 13 countries.

Participants :

W.R. Piggott	Chairman
D.G. Cole	Vice-Chairman
A.S. Rodger	Secretary
M. Ahmed	U.S.A.
L.F. Alberea	Spain
P. Dominici	Italy
J.R. Dudeney	U.K.
J.A. Gledhill	South Africa
A. Hedberg	Sweden
Yinn-Nien Huang	Taiwan
T.K. Kamei	Japan
K. Lassen	Denmark
J. Lastovicka	Czechoslovakia
N. Matuura	Japan
I.S. Mikkelsen	Denmark
0. Rasmussen	Denmark
R.G. Rastogi	India
H. Rishbeth	U.K.
Wang Shen	China
P. Triska	Czechoslovakia
Hsiao Tso	China
D.M. Willis	U.K.
J.W. Wright	USA/FRG.

Chairman's Introduction

W.R. Piggott briefly outlined the purposes of INAG emphasising that INAG formed an important link between the vertical incidence data collectors and those who use the data. At IAGA meetings, there were many scientific data users and the forum of the INAG meeting provided an ideal opportunity for them to air their views on INAG matters. Other matters raised by the Chairman are included in the appropriate section.

INAG Bulletin

Difficulties at WDC-A have resulted in several groups being omitted from the INAG Bulletin circulation list, or receiving an inadequate number of copies. If anyone knows of such problems could they please contact the secretary or assistant secretary, Raymond 0. Conkright.

There is a continuing shortage of articles, notes and ionograms for interpretation and discussion. These are absolutely essential if the Bulletin is to be produced on a regular basis. Please send contribution to Alan Rodger (address on p.1).

It was emphasised that those groups who could afford to contribute a subscription to the INAG bulletin (INAG 34 p.18) should do so. This shows the financial administrators that it is worthwhile. However, the Bulletin would continue to be sent to all those who want to receive the Bulletin irrespective of whether they paid a subscription.

Status of the Network

In the view of the Chairman, there were more synoptic V.I. stations operating now than at anytime since the International Geophysical Year. In addition, up to one third of the active stations are operated on an intermittent programme or do not usually analyse their synoptic ionograms. Such stations do not submit their data to the World Data Centres, thus their data cannot normally be used for studies of special events. The Chairman stressed that INAG and the World Data Centres need to know which stations are operating in this way and, if possible, for which periods data exist. He requested the groups involved to forward the necessary information.

The Chairman also drew attention to the fact that many of the stations for which long runs of data were available, have been closed. The number of stations established for sufficient time to carry out research on long-term trends were probably already too small to provide statistical significance. It is desirable to reopen a few such stations.

Reports from individual stations are reported in the Bulletin under Network News.

New Ionosondes and Ancilliary Equipment

A brief report including a short video film was presented on the DBD-43 digital add on system, the KEL-46 digitising tablet and the KEL-47 geophysical terminal. These equipments are described in greater detail later in this bulletin.

Dr Matuura (Japan) reported that the ionosonde at Kokubunji has been receiving signals propagated from 4 other ionosondes in Japan namely at Wakkanai, Akita, Yamagawa and Okinawa for approximately one year. This network of ionosondes (see INAG Bulletin 33 pp 25-27) is being upgraded in the future to allow oblique soundings between any pair of stations.

Dr Cole (Australia) stated that the ionosonde network on the mainland of Australia will be operated from a single central station. The data from the existing observatories will be available in real time at the Ionospheric Prediction Service, Sydney, Australia and will be used for practical forecasting purposes in addition to the standard analysis for synoptic purposes.

Interchange of Data

There was considerable discussion on the interchange of VI data through the World Data Centres and between different groups. At present this is mainly by the interchange of data books of tabulated data, computer printouts, microfilm or microfiche. The discussion centred on a number of separate but related topics.

These included :

1. What data should be submitted to the World Data Centre?

2. In what format should these data be presented to the World Data Centres?

3. What is the best way to interchange data for specialised studies, e.g., ionograms or partly processed data?

The network is very aware of the dramatic technological changes which have occurred in the last decade, affecting the construction of ionosondes, the recording of ionograms and the processing of the resultant data. If the network is to continue to flourish in the years ahead, everyone agreed that it is essential to make full use of modern methods of data collection and dissemination and INAG must be fully involved in the formulation of these ideas and recommendations. It is likely that much of the INAG meeting at the URSI General Assembly in Florence in August - September 1984 will be given over to this topic. It is very important to have as many views as possible discussed in the INAG Bulletin before that time.

There was a short discussion on whether the existing recommendations for data exchange should be altered (see chapters 7, 8 and 9 of the Handbook). The consensus of the meeting was to drop those recommendations which are not normally carried out by the majority of stations. The International Geophysical Calendar had reflected these changes. For example the recommendation for N(h) profiling had been changed from 1981. The Guide to International Data Exchange through the World Data Centres is to be revised in the next year. This leaves little time for a proper revision of the ionospheric part of the guide. The Chairman pointed out that the WDC's issued special catalogues of the VI data and that it should therefore be possible to issue a VI addition to the Guide at a later date. However, those responsible for the Guide revision would prefer to have a text for this volume, leaving the possibility of any revision of the VI section to a later date.
Your comments are requested on this matter.

The potentialities of the new ionosondes and recording methods were briefly discussed. It was pointed out that it might be easier hence more economical to standardize on 14-hourly recording for use in conjunction with automatic ionogram analysis, as the differences in ionospheric conditions under normal circumstances were not too great over 15 minutes. It was noted that automatic ionogram analysis appeared to be practical already but it might be better to use a semi-automatic method for very difficult sequences.

Central analysis of ionograms in near real-time from a group of stations might also influence current analysis techniques significantly. However most groups involved in this have not yet gained sufficient experience to make firm recommendations.

Another area where new technology was being used was in making films and videotapes of ionogram sequences to illustrate the dynamics of the ionosphere.

When data are required fairly quickly the daily work sheet or its computer equivalent was most important but there were also advantages in updating the day by hour tables each day. At present this is usually done only at the end of the month. There could be advantages in standardising the order in which each parameter was recorded though this would cause problems at stations which record special parameters, e.g., E2.

A discussion of facilities disclosed that some stations wished to continue to record and handle their data manually and that the remainder used a wide range of recording methods for scaled ionospheric parameters, such as paper tapes, magnetic tapes, cassettes and floppy discs. There was no accord on how this could be handled, some wanting a single international standard format using 1/2 inch, 1600 bpi magnetic tapes. Other people suggested a more flexible approach was necessary. Your comments on this matter are requested.

An increasing number of ionograms are being recorded by digital methods e.g., the Digisonde 256 (INAG 38 p5), the DBD-43 (this issue). In principle the data from digital ionosondes can be readily passed down a telephone line, hence all over the world in near real-time. INAG is aware of the greatly increased potential value of these ionosondes for uses such as short-term forecasts of radio propagation conditions. To take advantage of this possibility, each group must be able to exchange their ionograms with others. We need to consider how this could be achieved in practice. Here again we need to have contributions from groups and individuals throughout the world before a sensible consensus view can be formed.

International Digital Ionosonde Group (IDIG)

The most recent developments of IDIG are reported in Bulletin No.4 which was circulated in July. An extended summary of this bulletin is included later in this Bulletin.

Handbooks and Training

The Chairman announced he would be prepared to compile a low latitude supplement to UAG-23, if, and only if, groups from low latitude stations (defined as those with a dip latitude of ±25° and those stations which observe low latitude phenomena) provided ionograms.

The Ionospheric Prediction Service will be holding their operators Conference in March 1984.

Future of INAG

The meeting unanimously felt that there was still a real demand for INAG services, both in maintaining interest and accuracy at the stations and in providing a forum to keep the network up-to-date as far as possible.

The Chairman reported that the Washington plans to spread the load of writing the Bulletin amongst more people was only partially successful. There had been a considerable increase in outside help especially in recent months but the main part of the work still fell on the Secretary, with some help from the Chairman. In accord with the Washington discussions he had concentrated on visits to some of the old and new networks. These had raised many interesting points and had cleared up a surprisingly large number of misunderstandings on the rules and the proper use of ionogram fingerprints. When, for example, typical auroral phenomena appeared at very low latitudes they were often ignored or not recognised. He reminded the meeting that at Washington he had asked to be replaced as Chairman at the next URSI meeting both be cause the difficulties in financing his attendance at major INAG meetings were likely to get serious and because he was finding it more difficult to hold all the detail of INAG problems in his head as he got older. However, he had been approached .privately with the request that he continue as Chairman for a further period so as to give more time for replacements to become more experienced. In view of the fact that the financial difficulties had been overcome in the last two years and that he still appeared to be useful, he would be prepared to accept a request to continue but would not volunteer to do so. He warned that any sudden change in these circumstances might make the appointment of an alternative chairman at short notice imperative. Dr D. Cole welcomed this statement and said that he felt that the Chairman should try to continue.

3. DATA INTERCHANGE THROUGH THE WORLD DATA CENTRES

by W.R. Piggott and A.S. Rodger

Introduction

The purpose of this note is to start discussion on the best methods of data interchange for the future through the WDCs in the VI and associated ionospheric sounding networks. The economic costs of duplicating and handling data in conventional form is steadily increasing. More and more users would prefer to handle and study the data with computers, particularly for multi-disciplinary or multi-technique studies. In the next ten years it is likely that use of data in the WDCs will become confined mainly to those which are held in computer compatible form. It is urgent that we discuss the possibility of putting our future data, and, if possible, the most important past data, into computer compatible form readable by the WDC computers. It is also important to determine what can be done best centrally and what locally.

The WDC steering committee has recently held a series of meetings with computer experts to investigate the possibilities of collecting and interchanging data in all disciplines using modern methods based on computers and proposes to modify the WDC guide to encourage this change. INAG has been requested to investigate the possibilities for the VI networks and to make recommendations for the new guide. At present, only WDC-A (Boulder) has significant experience of collecting, handling and supplying VI data in computer compatible form. These data are listed in the appropriate section of the WDC-A VI catalogue. Most of these data originate from networks who handle a chain of stations with central computing facilities but, even so, there were considerable difficulties in reformatting the data so that it could be used at the WDC. This was usually solved by detailed discussion between the groups involved, a time consuming and expensive exercise. The resources of the WDCs are quite limited, it is likely that these will, at first, be directed mainly to providing user transparent facilities (ie facilities which do not demand special training of the users). Thus if ionospheric data is to be put into this form for the future, it is essential that we devise cheap and simple methods of converting the data into standard forms. Ideally one would wish to have one standard for international interchange. For advanced modern experimental techniques such as rockets, satellites, incoherent scatter and research ionosondes, this is fairly easy and will probably be adopted. The problem of the VI network is more difficult as the availability of local computing facilities is very variable; for some stations all data are manually handled whereas others exploit microprocessors and computers fairly fully.

Background

The international interchange at VI data is based on the recommendations of the World-Wide Sounding Committee of URSI as modified by INAG and has been operating reasonably satisfactorily since the IGY. It is essentially a compromise between the costs of producing and circulating the data and its usefulness for studies internationally. In practice, each collaborating organisation decides to what extent it can comply with these recommendations. Most conform with the minimum standard recommendations, a few do less, a few add additional parameters or scale more frequently. Practices alter slowly as costs rise and techniques change, e.g., increases in film costs has resulted in a great decrease in the number of ionograms interchanged internationally. Changes in scientific or practical needs have resulted in the addition of new parameters (e.g., fxI, spread F typing) and some simplifications (e.g. Es-w) . As most of you will have noticed, the interchange rules for RWDs and other special intervals published in the International Geophysical Calendar have been modified to match what is internationally acceptable.

At present the international interchange is based on

(a) the hourly tabulations

(b) f-plots where available

(c) a few ionograms.

In the WDCs, the greatest demand is for monthly median data, then for R14D data and occasionally for special periods, mainly Retrospective World Intervals called for by the scientific community. Relatively few users study the detailed data. Much of the median data required by users of WDC-A has been put on the computer in standard form. The primary data in the WDCs is in the form of hand-written tables, books of tabulated data, computer print out, micro film or microfiche copies of such material. Some data are also held in parallel in computer compatible form.

In recent years, many stations have adopted data entry systems in which the original scalings are put into a microprocessor or computer at an early stage, sometimes directly using a digital scaling tablet. The hour by day and median tables needed for international interchange are then produced by a computer or microprocessor but often in the form of a print out. Most stations adopt the conventions recommended in Chapter 7 of the Handbook (UAG 23). Therefore, INAG needs to study the ways in which these data can best be transferred onto the WDC computers directly.

Future developments

At the moment, the network is changing rapidly. Many new ionosondes are being deployed. Rising film costs are compelling groups to consider the use of alternative techniques of recording ionograms, such as on video cassettes, magnetic tapes and floppy discs. Also it appears likely that many more stations will adopt data entry systems for analysis in the near future. It is now getting common for computers or microprocessors to 'speak' to computers by telephone line or satellite link. This offers the possibility of local or central collection of data by telephone. This can be a much cheaper technique than using postal services when the equipment is available. It also offers a complete new range of possibilities to those involved in real-time forecasting of ionospheric conditions. It is not clear how these developments will affect data interchange in the VI network.

We should also note the increasing availability of digital ionosondes, ranging from simple attachments to conventional observatory instruments, to computer controlled research equipments. With these, the original ionogram is in computer compatible form. Is it desirable to make any or all or such data available internationally? The WDCs will not accept raw ionograms with the exception of only small samples of ionograms (or equivalent raw data) which are needed to enable users of the data to monitor the analysis, otherwise the problems of storage of and access to the data are prohibitive. Thus it is likely that current practice, of raw data being held only at the originating administration, is likely to continue.

Another area where there is likely to be very significant development is in the automatic or semi-automatic analysis of ionograms. As this implies trace identification and trace following, it automatically gives information which could be used in N(h) analysis. Will this alter the importance of such analysis in the future? This is probably only practical when polarimeters are used to identify the o or x trace. However, a major difficulty is the presence of tilts in the reflecting surfaces which can introduce large errors.

These changes will completely alter the economics of producing and using VI data and demand a full review of the basic interchange procedures.

INAG action

At present, the discussion of data interchange is in its infancy. There is very little information on what the practices are at most of the V.I. stations, what plans are made for updating current methods and whether facilities and finance are likely to be available for modernising the international data interchange. Obviously, the current methods will continue for some years, for some stations indefinitely. We invite your views on the best way of tackling these problems. INAG practice is normally to invite those interested to act as INAG Consultants, mainly by correspondence but with special meetings if these appear practical, reporting the proceedings in the INAG Bulletins and at INAG meetings. We shall need advice on what is likely to be practical in many different countries so that we can devise a questionnaire to send to all administrations which is likely to produce the required answers. An example of the type of problem which needs to be resolved would be where a number of stations use the same format and instrument; it may be best for one of the WDCs to provide an interface which will convert this to a standard form. In other cases, relatively small modifications to local computer programmes could make the microprocessor output compatible with that of other stations, thus minimising the conversion problems. What should be our policy?

The computer experts and WDCs would prefer to establish an international standard format for all interchange. Is this practical for the majority of our networks? If not, how do we maximise the amount of data converted? WDC-A is willing to help with a few experiments to help determine the problems. It is desirable to know roughly how many stations would be willing to convert to computer compatible form for international interchange, since these methods are only really valuable when large data sets are available. The new Guide to International Data Exchange will, of course, continue to request data in existing form (unless we feel that new developments will require changes in these) but with the addition of new recommendations.

To start discussion, and provide the necessary background information, we would like to try to collect information on:

(a) How many stations use purely manual techniques and how many use data entry systems?

(b) How many stations produce digital ionograms?

(c) Can the outputs of the data entry systems be put in a form where they can be easily read by the WDCs? What effort is required for this- task? Can you or your group provide this effort?

(d) Is it likely that your stations might exchange data in the future via the telephone networks of the world?

(e) Are the formats of the hour by day tabulations easily standardised?

(f) Are your or your colleagues willing to try an experiment to discover the best way of making your data available internationally in a computer compatible form?

(g) Should we aim for one international standard or use a limited number of local standards to match the differing computer facilities of different countries?

4. INTEKNATIONAL DIGITAL IONOSONDE GROUP

BULLETIN NO: 4

by J.R. Dudeney, British Antarctic Survey, U.K.

A shortened form of this Bulletin is reproduced below. Those requiring the full version should write to the Chairman of IDIG, Dr J.R. Dudeney at British Antarctic Survey, Madingley Road, Cambridge, CB3 OET, England. In particular, material already published in the INAG Bulletin has been omitted. The proposals for nomenclature for ionospheric parameters are of particular interest to the INAG community, and anyone wishing to discuss them is invited to write to either Dr Dudeney, to the Chairman, or the Secretary of INAG. Note that the main difference between the IDIG virtual height parameter h'T and h' is that the former is only used when there is evidence that the trace was overhead.

1. Introductory Comments

The main purpose of this bulletin is to report to the Executive Meeting of IDIG held in Boulder in August 1982, and to look forward to the next URSI General Assembly scheduled for Florence in August 1984.

2. IDIG Executive Meeting

An executive meeting of the officers of IDIG and a small number of invited participants was held in Boulder, Colorado on 5th August 1982. Facilities were generously provided by the Space Environment Laboratory. The purpose of the meeting was to generate some definite action on topics of interest to IDIG. The meeting was lively and successful. However follow-up action has left much to be desired and it is hoped that the participants upon whom tasks fell will be spurred into activity by this reminder.

Participants

J.H. Allen	USA
P. Argo	USA
K. Bibl (Vice Chairman)	USA
I.Brophy	USA
R. Conkright	USA
K. Davies	USA
J.R. Dudeney (Chairman)	UK
R.N. Grubb	USA
L. Hones.	USA
R.I. Kressman	UK
L. McNamara	Australia
A. Paul	USA
M.L.V. Pitteway	UK
A.S. Rodger	UK
E. Schiffmacher	USA
J.W. Wright (Vice Chairman)	USA

Nomenclature for ionospheric parameters

The meeting agreed that it was highly desirable to standardize the nomenclature used within the digital sounding community. However, it was deemed unnecessarily restrictive to construct symbology for the convenience of computer programming. Instead, the construction should not require meaning to be put on whether a character was upper or lower case so that the same basic symbols remain common for the two cases.

As a first step a set of symbols to be used to describe the data obtained per transmitted pulse (or pulse set) were agreed. It was accepted that these symbols should be consistent with previous URSI practice for ionosonde data. Annex 1 gives the proposed symbols, no new symbols were defined for frequency information since the current URSI symbols are adequate. Comments and criticisms are requested, before the community is asked to introduce the new set.

The next, and more major, step will be to investigate whether summary-type parameters, akin to the URSI standard set (foF2, h'F etc) can usefully be defined for skymap and velocity information. Can a consistent procedure be defined for determining the mean skymap location and doppler velocity of the major echoing regions of the ionosphere that would allow a summary of this information for statistical purposes? If both the ionosphere and international inertia could be overcome to provide such data very powerful new tools for aeronomic research would result. Comments please.

Introduction of N(h) parameters

There has been considerable discussion within the IDIG community upon whether the techniques for automatically evaluating an N(h) profile from a digital ionogram were sufficiently well advanced to allow some standard set of N(h) summary parameters to he routinely evaluated from ionograms. Also, if this was the case what should the standard set be. The concensus of the meeting was that the state of the art was not yet sufficiently advanced to allow this to happen. However, it was seen as a very desirable goal. it was suggested that a document be prepared discussing the possible approaches to the subject, to be as collated by J.R. Dudeney.

Automatic trace recognition

An essential prerequisite to automatic N(h) inversion is the construction of a successful and efficient ionogram trace recognition algorithm. At the meeting Bibl described the developments towards this objective made by his group using Digisonde data. The automatic ionogram scalings he presented looked very promising, but expert scalars of conventional ionograms present at the meeting were dubious of a few of the results obtained when there was spread F and oblique echoes present.

There are a number of publications describing the Lowell work which are of interest and have appeared subsequent to the Boulder Meeting. These are Reinisch, B.W. and X. Huang (1982), "Automatic calculation of electron density profiles from digital ionograms". 1. Automatic 0 and X trace identification for topside ionograms Radio Sci., 14, p. 421.

Huang, X. and B.W. Reinisch (1982) "Automatic calculation of electron density profiles from digital ionograms. 2. True height inversion of topside ionograms with the profile-fitting method" Radio Sci., 17 p.837.

Reinisch, B.W. and X. Huang (1983), "Automatic calculation of electron density profiles from digital ionograms. 3. Processing of bottomside ionograms" Radio Sci., 18. May/June issue.

Reinisch, B.W., J.S. Tang and R.R. Gamache (1982) "Automatic scaling of digisonde ionograms, test and evaluation report" AFGL-TR-82-0324, Sci Rpt No. 4, ULRF-413/CAR, Air Force Geophysics Laboratory.

Wright described similar developments under way for use with the data from the NOAA sounder. It became clear from the discussion that bench marking tests of the two approaches would be very useful. However, neither technique was readily applicable to the other data type. Thus, possibly the best way to compare the results was to acquire data from a co-sited Digisonde and NOAA sounder. A potential opportunity for such a comparison should be pursued vigorously.

Digital Data Formats

The meeting agreed that it was important to define the types of data which should be interchanged and archived at World Data Centres. Representatives from WDC-A in particular were seeking guidance as to what data they should hold. There was concensus that the formats for interchange should not be the raw data formats used by the various types of machine. Instead an agreed family of geophysical data sets should be devised, which each group could derive from its own raw data then circulate in a standard format. Potentially there were three levels of data summary identified.

Level 1

A file of soundings, in which each sounding consists of a table of geophysical quantities determined from each echo, and ranked by sounding frequency and/or time. Here a sounding is equivalent to one ionogram or one K-mode runs, for example. The table would thus consist of a chosen subset of the parameters given in Annex I ranked by frequency and time. (This type of file forms the basis of the BAS approach to data analysis). A skeleton format might look as follows

Level 1 file

File header

Location, equipment type, antennae type etc.

Sound header

Sounding type, start time, other relevant equipment parameters

Data

t, f, R'_T, P_L, S_N, A_d, R^*, R'_S, N'_S, W'_S, V^*

Sounding header

Data

Etc.

There appear to be no technical problems to hold up an international agreement for this level but further discussion, comments and suggestions are requested.

Level 2

Level 2 was envisaged as consisting of an appropriate subset of URSI standard parameters such as foF2, foE, M(3000)F2 h'F, plus the summary parameters suggested above. Thus, we may be able to define for example, N'_S F2, W'_S F2, V*F2 and their counterparts for the other ionospheric layers. Clearly much work will be necessary before this level will be achieved operationally. However, it is probable that the current URSI formats can be adapted for the purpose of data interchange.

Level 3

This level would be the parameters that could be scaled to summarize the N(h) profile. Little can be said concerning this level yet.

No timescale for producing operational schemes was discussed at the meeting. Realistically, we should try to produce a detailed specification of level 1 in time for discussion at the Florence URSI General Assembly. There is considerable work proceeding in BAS which is relevant to level 2 and we may have some initial ideas for presentation in Florence. As regards level 3 I have no feel as to how far down stream a working scheme may be.

IDIG view of remote sensing within URSI

At the Washington General Assembly the question was raised of whether special arrangements were necessary to incorporate the interest of the 'remote sensing' community. The Boulder meeting took the view that it was not clear whose interests were being considered since the title remote sensing potentially covered a very broad spectrum of activities. All the work of both IDIG and INAG is after all remote sensing. If there was a specific set of activities, e.g., remote sensing of the Earth's surface by satellites, for which representation was required, then clearly arrangements should be made. However, this could probably be dealt with within the existing framework of commissions, and the new group should have a more appropriate and specific title.

IDIG view of merger of commissions G and H

Another important issue raised at the Washington General Assembly was the proposal to merge commissions G and H. The consensus at the IDIG executive meeting was that such a merger would result in a very large and unwieldy commission. In particular, the new commissions, scientific. sessions would become hopelessly difficult to organise unless a much finer line was taken to discourage involvement by people whose main interest was in aeronomical or space science rather than radio science. In the past, many presentations at General Assemblies have at best paid only lip service to the radio science aspect. In IDIG's view the status quo in which some aeronomical results are allowed is preferable to the proposed merger. Comments, particularly any contrary views would be appreciated.

IDIG's relationship with IAGA

The general feeling was that, whilst IDIG is primarily a radio science and technique oriented group, it does and should concern itself with aeronomic research.

Thus IDIG should retain an interest in the activities of IAGA, in particular those of Division II. Whether this is best done by a formal link with IAGA or just by informal contacts was not decided. However, it was agreed that the IDIG Chairman should have informal discussions with the Chairman of IAGA division II.

URSI Fairbanks Symposium

As many of you will be aware URSI sponsored a symposium entitled "Radio probing of the high-latitude ionosphere and atmosphere: new techniques and new results", held at the Geophysical Institute of the University of Alaska in Fairbanks. A short business session of IDIG was held at this Symposium in which the outcome of the Boulder meeting was briefly summarized. Also several papers of interest to the IDIG community were presented during the scientific sessions. A special issue of Radio Science will be devoted to the conference proceedings.

The Florence General Assembly

The next General Assembly of URSI is to be held in Florence from the 28th of August until the 5th Sept. 1984. IDIG has not proposed a specific session in the scientific proceedings, but a number of the proposed sessions will be of interest. The tentative schedule includes sessions entitled - "Modeling of the ionosphere: application to radiosystems" (Commission G) " Plasma instabilities in the ionosphere" (Joint G and H) "Active and passive radio techniques applied to the study of the ionosphere magnetosphere and solar wind" (joint G, H and J). "Data, signal and image processing in radio science" (open Symposia). Also at the Assembly a business session of IDIG will be held and there will of course be business sessions of Commissions G and H. Many of the topics discussed in this Bulletin will remain live issues for these Meetings. If you have any comments on these, or any other issues you wish to have raised please contact John Dudeney. One more Bulletin will be produced between now and the Florence Meeting so your views will be given an airing before the event.

ANNEX 1 PROPOSED NOMENCLATURE

The symbols and their definitions given below are designed to be applied to any digital sounder data which contains echo phase and amplitude information.

1. Virtual slant range (km)

   a) Determined from time of flight R_T'

   b) Determined from stationary phase R_S'

2. Virtual height (km)

   a) from time of flight h_T'

   b) from stationary phase h_S'

3. 'Skymap' echo-location

   This refers to the horizontal virtual range in km to the echo point in the cardinal directions

   a) North-South N_S'

   b) East-West W_S'

4. Phase range (km) R*

5. Phase height (km) h*

6. 'Line of sight' Doppler velocity (ms^{-1})

   defined as $\frac{Dr^*}{dt} = V^*$

7. 'Virtual' velocity (ms^{-1})

   defined as $\frac{dR'}{dt} = V'$

8. Polarization index

   This takes the character values

   0 for ordinary mode
   X for extra ordinary mode
   N for unknown Symbol P
   L

9. Signal Amplitude

   a) linear A_v

   b) logarithmic A_d

10. Signal-to-noise ratio S_N

Note The skymap definitions are not those proposed at the Boulder Meeting (S_N' and S_E' were suggested there).
The change was made so that S_N could be used for signal-to-noise ratio.

5. NETWORK NEWS

Sanae, Antarctica

A modified chirp sounder which will provide additional information such as doppler, polarisation and angle of arrival information will be deployed at SANAE in January 1984.

Tsumeb

Tsumeb will probably close next year. At present ionograms are recorded but no analysis is undertaken.

Darwin

A station at Darwin became operational in January 19-83.

McQuarie Island

McQuarie Island ionosonde observatory will re-open in 1984. The four 6-hourly UT foF2 values will be available each week from the Ionospheric Prediction Service in Australia but fully scaled ionograms are unlikely to be available before October 1985.

Davis, Antarctica

The Ionospheric Prediction Service in co-operation with the Antarctica Division of Australia expect to open a station at Davis in 19-85.

INAG 40/41 October 1983

RECENT DEPLOYMENT OF IPS-42 IONOSONDES, DBD-43 IONOSONDES ETC.

Two further IPS-42 ionosondes have been delivered to France, making a total of four which are deployed at Dakar, Oagadagu, Poitier and Lannion.

Other new installations not reported include Hong Kong University, the Radio Research Laboratories, Seoul, South Korea, Auckland University, New Zealand, the Geophysical Institute, Yugoslavia and the Science Research Council of Iraq in Baghdad.

DBD-43 digital ionosonde systems have already been installed in Hong Kong, Holland and Yugoslavia.

KEl-46 Data Analysing systems have been deployed in Indonesia, Venezuela, Nigeria, Iraq, Korea and France. The first of the KEL-47 Central Processing Systems has been sent to South Korea.

Beijing

A digisonde 256 is to be installed at Beijing, China, during 1983. The ionosonde will be the responsibility of Professor Fang Zhen-Zhi, Academy of Sciences at the Institute of Space Physics in Beijing.

DIGITAL SOUNDER DATA

Drs. Ahmed and Wright have indicated that there are a number of sites where digital ionosondes have been operated on limited campaigns, the data from which they would be prepared to make available on request, These include data from Boulder Colorado 1977-19-82, Arecibo, Summer 1981 and Huancayo, March, 1983.

NATIONAL INSTITUTE OF TELECOMMUNICATIONS RESEARCH (NITR), SOUTH AFRICA

Since the last note describing the work of N.I.T.R. (INAG Bulletin 38 p5) specifications have been finalised and an order placed for a BR Communications Chirpsounder. This sounder is to be used as a research tool, whilst synoptic soundings will be carried out using the I.P.S. - 42 ionosondes. By incorporating procedures developed by Mr. Allon Poole of Rhodes University, the sounder will be an extremely versatile instrument for ionospheric research. The modifications to the standard instrument include microprocessor control, fast fourier transform processor to retain phase information, multiple antennas, and a programmable multicell sounding structure. Since Rhodes University also operates a similar BR Chirp sounder, it will be possible to use these instruments for oblique propagation also over a path length of about 820 km and a VI ionosonde may be operated near the path mid-point. In the vertical mode the extra data obtained include separation of x and o modes, angles of arrival, stationary doppler, or swept frequency doppler. Also, a small portion of the spectrum, can be continuously sounded for fixed frequency doppler measurements.

By using separate synthesizers for receive and transmit, two phase matched receivers, and with computer control over the various active components of the system, the BR Chirpsounder provides a very flexible research tool. It will be used to evaluate directional error during quiet and disturbed periods and comparison of predicted results with real measurements to confirm theoretical work.

The System is expected to be operating September/October, 1984. If any readers are interested in obtaining further information concerning the system or its use, please contact Ms. Lambert or Mr. B.P. Dundas at N.I.T.R., Box 3718, Johannesburg 2000, Republic of South Africa.

DIGISONDE 256 USERS GROUP

With the deployment of identical ionosondes in various parts of the world it is possible to carry out medium and long distance H.F. propagation studies. One such experiment planned for the near future is described below. The information has been provided by Dr. Bodo Reinisch at the University of Lowell, Massachusetts, U.S.A.

The availability of the Digisonde 256 at a number of stations provides the possibility to conduct oblique propagation experiments without large additional costs. The only additional hardware requirement is a horizontally radiating transmitting antenna, assuming that the receiving antenna array with antenna switch is already used for the vertical ionograms. After setting the internal clock in the 256 with reference to a time standard, and selecting agreed transmission programs the Digisondes will operate synchronously. The HF links will be operated in three different modes:

(1) Ionograms with linear frequency sweep from 6 to 30 MHz in 100-kHz increments.

(2) Fixed-frequency transmission in ionogram mode.

(3) Doppler-Drift mode at four selectable frequencies.

Amplitude, phase, doppler frequency and incidence angle will be measured at each station.

Data will be recorded on digital magnetic tape and in form of paper printouts. Analysis of the data will include studies of the maximum usable frequency, multi-path propagation, absorption, signal fading, signal-to-noise ratios, the effects of HF phase coding and its use for digital communication purposes, dependence on geophysical parameters especially the magnetic activity and the occurrence of the auroral oval along the propagation path.

Status of the Digisonde Network (DNW)

Only stations with the model Digisonde 256 can participate in these oblique propagation studies. At the present time three stations operate a 256, the Rutherford Appleton Laboratories in Slough, England, the Institut Royal Meteorologique at Dourbes, Belgium and the University of Lowell at Lowell, Massachusetts, U.S.A.9 in co-operation with the GTE Sylvania Systems Group in Needham, Massachusetts. The U.S. Army at Fort Monmouth, New Jersey, U.S.A., will start operating a 256 toward the end of 1983. Receiving antenna arrays exist currently at Dourbes, Lowell and at Fort Monmouth but no operational horizontal transmitting antenna is available at any station.

Near and Long Range Plans

The immediate goal is to link the existing Digisonde stations and conduct one or two weeks of propagation experiments. This should be accomplished during this calendar year.

Detailed transmission schedules will be established when the different stations are linked to the network. During 1984, systematic investigations will be conducted in the three modes described .above. During 1985,the DNW will develop adaptive HF techniques using the phase-code of the HF pulses as digital messages and the microcomputers in the 256 as decision processors.

It is expected that as other 256 sounders become operative (La Trobe University, Australia, and the U.S. Air Force Goose Bay Ionospheric Observatory in Canada) the oblique DNW will grow.

6. The Solar Annular Eclipse of 4 December 1983

A rare opportunity for inter-tropical ionospheric physics will be provided by the solar annual eclipse on 4 December 1983. Five F2 layer trans port processes which are normally mixed up will be separately measurable during the course of the eclipse. An appeal is being made by Paul Vila to invite any groups interested in collaborating to contact him. Observations by radars, ionosondes, magnetometers, balloons and satellites are requested.

The annularity path (see Fig.) intersects the dip equator near 1200 UT off the Guinea Coast at about 70N, 150W. Then is runs nearly parallel to the average locus for December day-time of the Southern Tropical ionisation crest. Five processes in the F-region will be separately disturbed by the eclipse. These are

(1) Direct solar heating (cooling)

(2) Ambipolar diffusion associated with the $\underline{E} \wedge \underline{B}$ equatorial reversal.

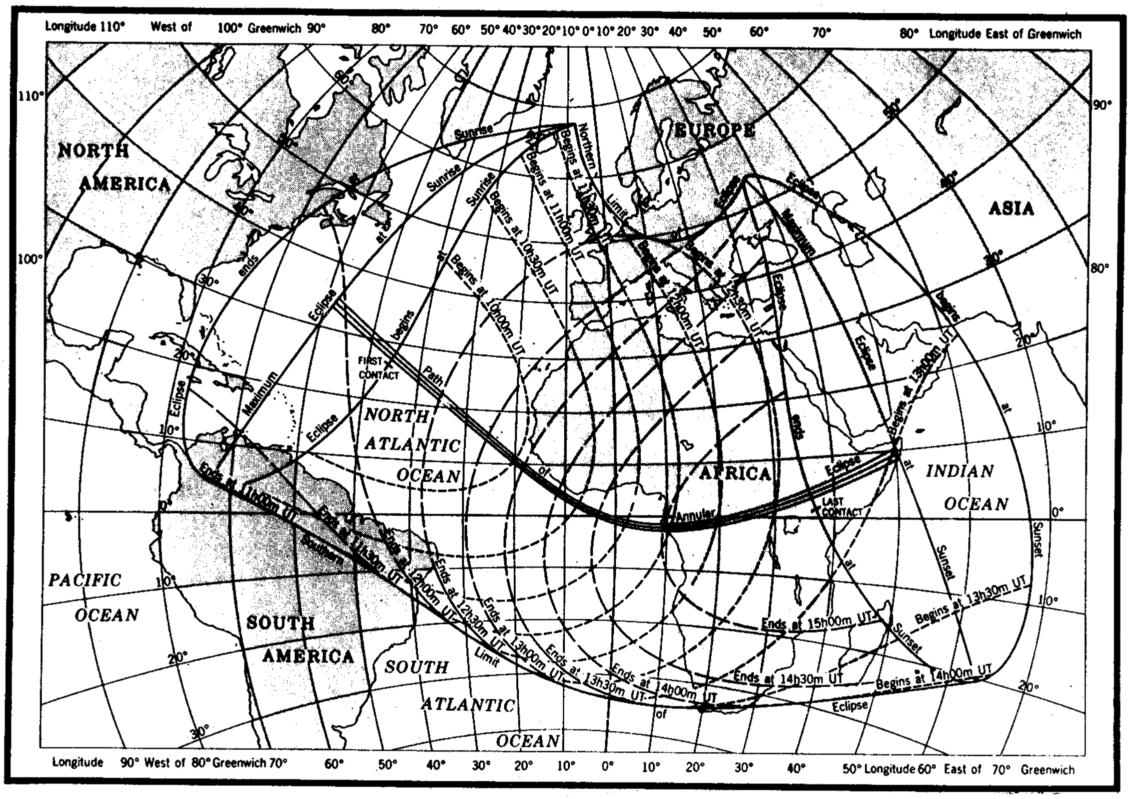
(3) Gravity waves from the wake of the supersonic cooling shock

(4) Northern Tropical ionisation crest upwelling caused by the cut-off of conjugate photo electrons.

(5) Energetic electron flux deposition in the de-ionised and contractual ionosphere.

It is hoped to have a number of ionosonde and magnetometer measurements from the vicinity of the eclipsed region but further measurements are highly desirable. For further information regarding scientific objectives and co-ordination of measurements contact: Paul Vila, CRPE, CNET, 92131. Issy-les-Moulineaux. France.

ANNULAR ECLIPSE OF 1983 DECEMBER 4



SOLAR ECLIPSE DIAGRAMS

For total and annular eclipses the mid-times of the total and annular phases are generally within 5 minutes of those given for the middle of eclipse; semi-durations, which depend on the precise position relative to the path, are not given. Further details of the paths and times of central eclipse are given in the *Astronomical Almanac*.

7. ON THE ORIGIN OF ES TRANSPARENCY

by P. Bencze, Geodetical and Geophysical
Research Institute, Hungary.

It has been recognised for a long time that sporadic E' layers partially reflect radio waves and that the frequency at which the Es layer becomes largely transparent is called the blanketing frequency (Rawer, 1955). Recently radar measurements have shown that the "patchy" character of the Es layers is caused by irregularities in the electron density distribution (Miller and Smith, 1978) This transparency of Es layers can be understood if we consider the processes responsible for the formation and maintenance of the layer and also those involved with the dissolution of the Es layer. According to the wind-shear theory mid-latitude sporadic E is formed and maintained by wind-shear and by the presence of metallic ions of meteoric origin. As regards the dissolution of the Es layer, wind-shear theory considers only recombination. However, there is another process which contributes to the dissolution of the Es layer and with which the irregular character of the stratification is connected, namely turbulence.

It has been shown by Reddy and Matsushita (1968), and by Bencze (1978), that the vertical shear of the horizontal wind can be computed using the wind shear theory for the formation of mid-latitude Es. Then using atmospheric models for the calculation of the vertical temperature gradient and the gradient of Richardson's number (see INAG 37 p.6), the criteria under which turbulence arises can be determined. Woods(1969) has shown that turbulence occurs if the gradient of Richardson's number is less than 0.25. Our computations have shown that the criterion for turbulence is fulfilled under most circumstances in Es layers.

This finding urged us to study further the relationship between the transparency of the Es layers and the wind-shear. The difference between the critical frequency foEs and the blanketing frequency has been defined as transparency of the Es layer (Rawer, 1955). Since the background electron density, necessary for the determination of wind-shear, has been computed from an ionospheric model using measured foE values, the present calculations have been restricted to day time hours only.

Fig. 1. shows the average transparency of the Es layer (full-line) and that of the wind-shear (dotted line) with altitude for the year 1968. It can be seen that both the transparency and the wind-shear decrease with increasing height. This implies that if the wind-shear is diminishing the transparency of the layer is also decreasing. Hence if the wind shear is weak, then the intensity of the turbulence is also low. Therefore, the Es. layer is less irregular and less transparent (i.e. foEs- fbEs is small). It is suggested that irregularities (patches) in the Es layer are mainly by the result of eddies created by the wind-shear.

The seasonal variation of the transparency and magnitude of the wind-shear are shown for one year 1968, in Fig.2. There is reasonable agreement between the two quantities for the year with the exception of November and December. It is suggested that the larger wind-shears in summer are responsible for the greater transparency of the Es layer (larger foEs-fbEs), and the smaller transparency of the Es layer in winter is caused by the smaller wind-shears. However further study of the results for November and December is required before firm conclusions can be drawn.

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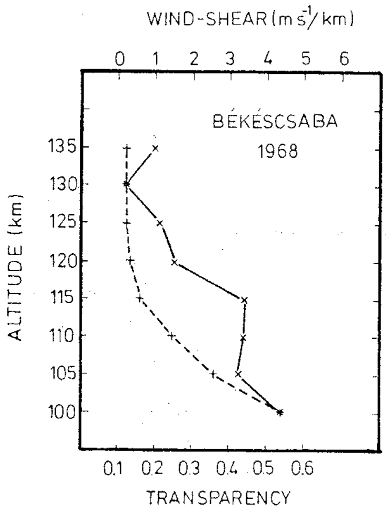


Figure 1

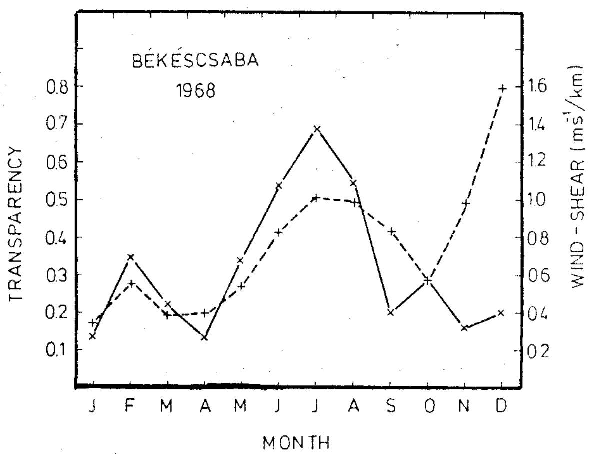
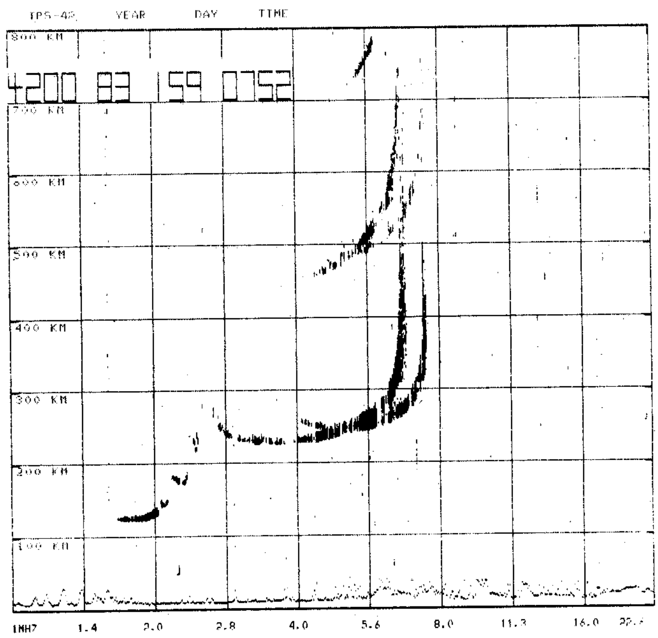


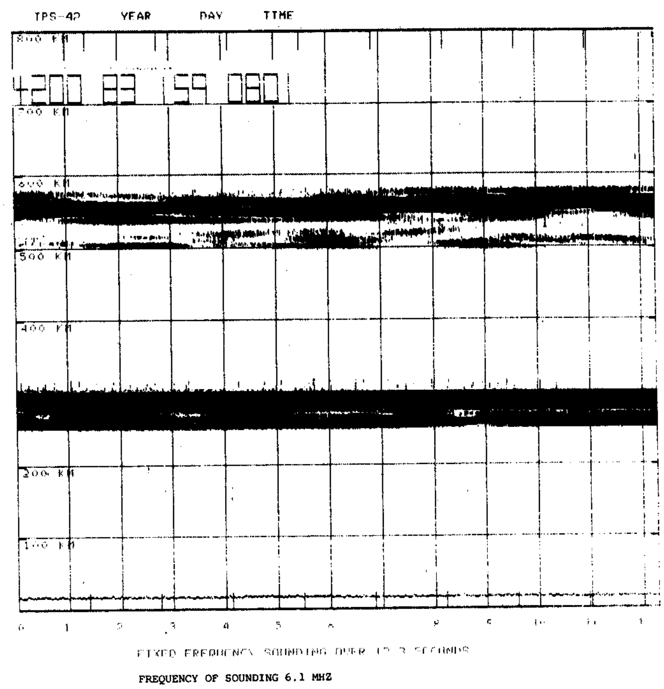
Figure 2

8. NEW EQUIPMENT

a) The DBD-43 Digital Add-On System

The DBD-43 digital system can be easily fitted to.4A, 4B and IPS-42 ionosondes. The addition of a DBD-43 considerably extends the capabilities of these conventional ionosondes so that the data are recorded digitally rather than on film. The DBD-43 can provide immediate results by displaying the last ionogram or it can be used to replay ionograms as a time lapse sequence. Hard copies of these can be obtained by the interfacing of a dot-matrix printer. An example ionogram produced by this method is shown below. The data recorded by a DBD-43 can be easily transmitted from remote sites via existing telephone networks, thus offer the potential to those involved in real time radio wave propagation forecasting excellent additional information. The DBD-43 can also record fixed frequency soundings for periods of 12 seconds; an example of F-region reflections at a frequency of 6.lMHz are shown in the second figure below:





FREQUENCY OF SOUNDING 6.1 MHZ

Specification of the DBD-43 is as follows:

Microprocessor	8-Bit,6502. Operating at 1.5MHz.
Software	Machine code in R.O.M. includes Ionogram recording, display, tape movement, diagnostics, and serial output.
R.O.M.	14 K Bytes.
R.A.M.	2 x 24K Byte Static R.A.M. Cards (Expandable)
Real Time Clock	Crystal controlled, with battery back-up
Video Display	High Resolution (256 x 576) green phosphor (12 cm). Video Card has extra 18 K Bytes of R.A.M.
Data Storage	20M Byte 114" serial tape storage unit. 4 Tracks, 6400 BPI. Uses standard 600 ft data cartridges. Fully software controlled. Stores 1000 Tertiary or 500 Secondary Ionograms.
External Interfaces	IPS-42 Ionosonde, External Video Monitor, Keyboard & 2 x RS-232 25-pin Serial Ports.
Controls	Complete control is possible with the Keypad which is built into the DBD-43. An optional modular keyboard is used for writing data into records.

Specification of DBD-43 (contd)

RFI Environment	The DBD-43 has been designed to operate beside the IPS-42 transmitter without interference under normal standard operating conditions.
Power Supply	Mains Operated. Can be set at 95 to 130 V.A..c. or 190 to 260 V.a.t. Suited to 50 or 60Hz.
Cabinet Dimensions	H=0.32m, 1,1=0.50m, D=0.55r.q
Weight	30 kg (66 lbs) Approx.

b) The KEL-47 Central Processing System

The KEL-47 Central Processing System can provide a data base which, for a single station can span a cycle of 11 years, providing fast random access to any particular ionogram or to any monthly report of ionogram data. A small series of other data may be selected from the data base under simple instructions from the standard software package and the time taken to produce that data will obviously vary in proportion to the size and complexity of the selection task specified.

Users will also be able to write their own data selection routines in basic, assembler or machine language to specify selection of particular series of ionogram data, which is stored on the hard disk system.

The system is based on the popular 650Z and Z-80 microprocessor designs and most circuit maintenance is simple and straightforward with readily available components. Hard-disk systems are highly reliable, but are also highly specialised systems where service is concerned. It is most advisable, therefore, to ensure that all Data Bases are 'backed up'. There is an optional Backup system for the KEL-47 and this requires the use of a VCR or Video Cassette Recorder.

The KEL-47 Central Processing System consists of the following:

..5 - 1/4" Floppy Disk Reader

..20 Megabyte Hard Disk Storage System

..Microprocessor Controller with Keyboard and VDU

..Optional Printer with Graphics capability.

..Software Package designed to

..Store 100,000 Ionograms

..Print Monthly Reports

..Print Monthly Graph Data for 6 Parameters

..Recall Limited Series of Data

..Softward Expansion capability.

..User Programmable Terminal Communications capability (KEL.47 to KEL.47), if both are suitably configured.

Note KEL-46 to KEL.47 Communications capability is also possible, with proper compatible configuration of each system.

For further information on these products contact
KEL Aerospace Pty. Ltd., 12, Brennan Close, Asquith,
N.S.W. 2078, Australia.

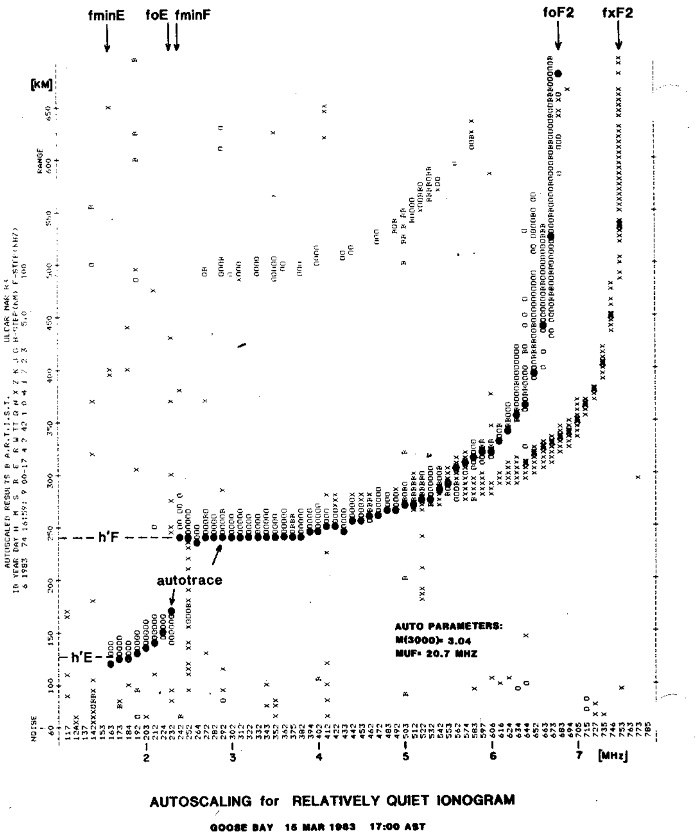


Figure 1

9. THE DIGISONDE 256 - Additional Features

by B.W. Reinisch, University of Lowell,
Massachusetts. U.S.A.

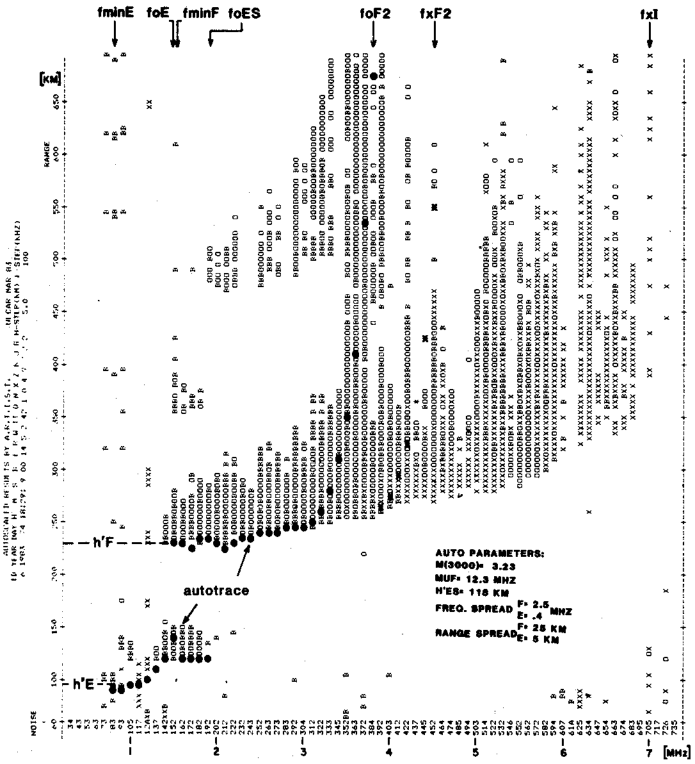
The brief summary of specifications listed under item 6 of INAG 38 was limited in extent and did not mention two features of the Digisonde 256: (1) fully automatic ionogram scaling and true height calculations, and (2) spaced-aerial Doppler-drift measurements. I would like to add the following brief description of these features.

Automatic Real Time Ionogram Scaler with True Height A.R.T.I.S.T.

Since March of this year, Air Force Geophysical Laboratory's sferics Observatory (J. Buchau, AFGL, Hanscom AFB, Bedford, Massachusetts) has been equipped with the new ARTIST which was developed for the Digisonde 256. The ARTIST is an 808618087-based data analyser housed in a 10-inch high rack mounted chassis. Amplitude, phase, incidence angle, polarization and Doppler shift measured in the Digisonde are analyzed to extract the overhead ordinary and extraordinary trace even during disturbed ionospheric conditions (Reinisch and Huang, 1983). The electron density profile is calculated from the ordinary trace using the profile-fitting method (Huang and Reinisch, 1982). Some 8000 Goose Bay ionograms have been automatically processed (Reinisch et al., 1982) and the results were remarkably accurate. Examples of the ARTIST's performance under quiet and spread F conditions are shown in Figures I and 2 respectively.

The ARTIST currently scales the following 18 parameters: foF2, foF1, h'F, h'F2, MUF(3000), M(3000), fminF, fxI, foE, WE, foEs, h'Es, fminE, fmin, range spread F, range spread E, frequency spread F, frequency spread E. Amplitude and Doppler information is retrieved; the electron density profile is given in form of coefficients. The efficient algorithms can process one ionogram every minute. A measure of performance is the success rate of scaling foF1 and foF2 within 0.5 MHz, namely 96% and 94% in spite of the fact that Goose Bay (64.60N geomag.) ionograms show spread-F more than 50% of the time.

All output data, including the h'(f) traces, are stored on magnetic tape. For four ionograms per hour, one tape will store one-half year of data. A subset of data is printed on a 300 baud (or faster) printer (local or remote through telephone lines). Another RS232 port is available for a dial up telephone data set. Program control of the ARTIST (and the Digisonde) via the same telephone lines is provided. Output data can also be stored on one of the two available floppy disks. But this is not recommended since floppy disks have no proven record as a reliable archiving medium, and few computer centres can read them.



AUTOSCALING for SPREAD F CONDITIONS

GOOSE BAY 15 MAR 1983 18:29 AST

Figure 2

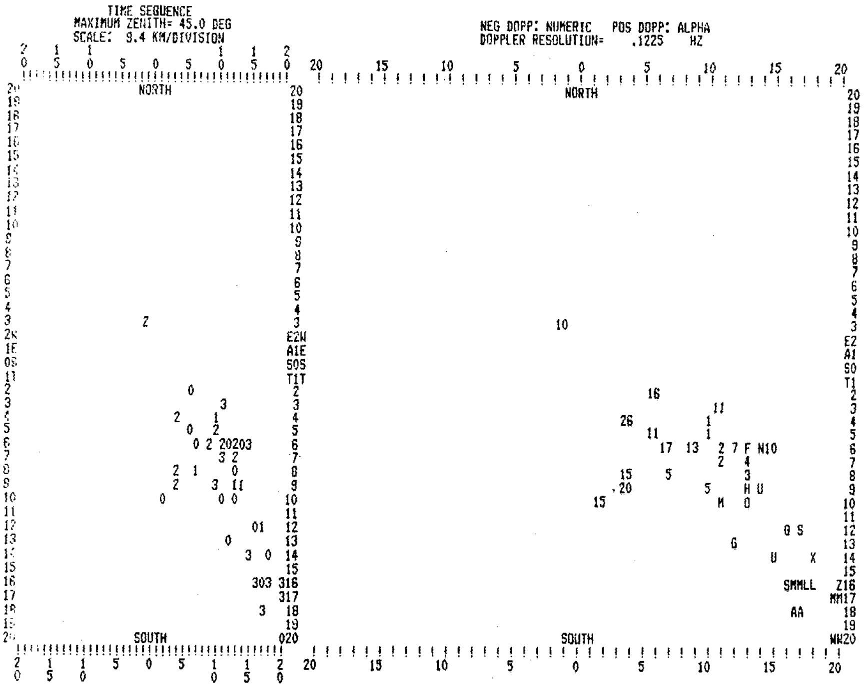


Fig. 3

DOPPLER SKY MAP
26 JAN 82 GOOSE BAY
20:18 AST 3 MHZ 375 KM

<u>Doppler-Drift Measurements</u>

The method of converting the Doppler shifts of signals received on spaced antenna into ionospheric drift measurements was described by Pfister (1971) and by Bibl et al. (1975). When the Digisonde operates in the drift mode (Bibl and Reinisch, 1978; Bibl et al, 1982) in between ionograms it measures the complex spectrum (amplitudes and phases) for each antenna signal. In general, the measurements are done with three suitably selected sounding frequencies to probe different heights. Sky maps of the ionospheric reflection points are obtained by cross-correlating the spectra from the different antennas. Each drift measurement is made within 9 or 18 seconds, and a sequence of measurements is displayed in one sky map. Fig. 3 shows a composite sky map for Doppler-drift measurements on 3.0 MHz in Goose Bay on 26 January 1982, 20:18 AST. The map on the left of Fig.3 gives the location of the reflection points for measurements 0, 1, 2 and 3. The map on the right shows the Doppler frequencies for each reflection point in units of one-eighth of one Hertz. The best fit velocity vector is calculated for each sky map. Fig.4 (Dozois et al. 1983) shows results for an 11-hour period of drift observations at Goose Bay, on 26/27 January 1982.

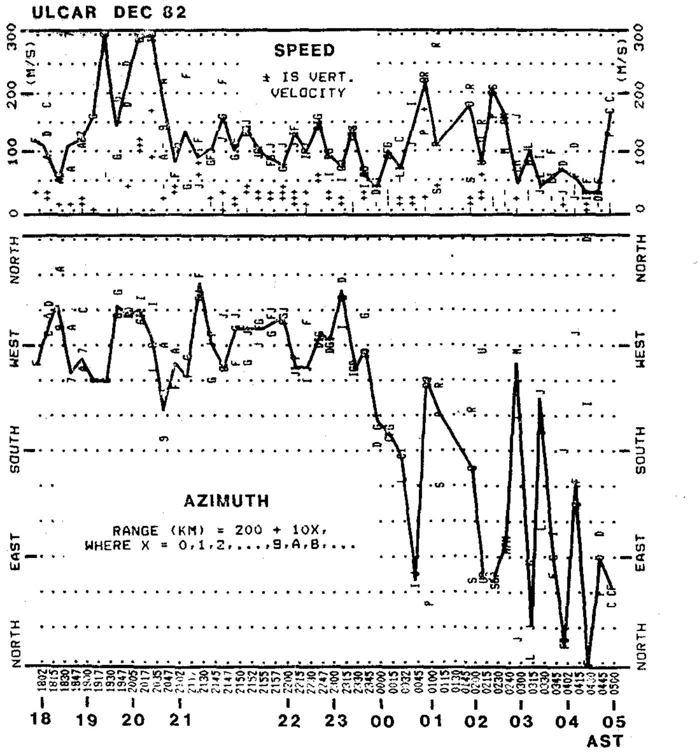


Fig.4 F - REGION DRIFT
DIGISONDE OBSERVATIONS AT GOOSE BAY, LABRADOR
26/27 JAN 82 18 TO 05 AST

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10. RESOLUTIONS

The following resolutions by international organisations have been received by INAG and may be of interest to INAG readers

a) ICSU Resolution on World Data centres The 19th General Assembly of ICSU held in Cambridge, U.K., from 13-17 September passed the following resolution on the World Data Centres:

Aware that in 1982 the system of World Data Centres in geophysics and solar-terrestrial physics celebrates its 25th anniversary;

Noting that the data collected by the World Data Centres during the past 25 years contain the results of observations from a world network of stations in a wide range of scientific disciplines, from international and national expeditions to remote regions of the globe including Antarctica, from ocean research vessels, and from space probes in the near-Earth environment; and that these data were the source of many important discoveries in the fields of planetary geophysics and solar-terrestrial physics;

Noting further that many countries have sent large sums to finance observations the results of which are now stored at the World Data Centres and made generally available to the world scientific community; and

Recognizing that the principles underlying the activities of the World Data Centres and the relations these activities have established among national scientific communities are a demonstration of the great progress achieved in international co-operation among scientists;

Thanks the ICSU National Members in the USA, USSR and other countries for arranging the facilities necessary for maintaining the operation of WDCs A, B, and C; and

Recommends that scientists within the ICSU family who have not availed themselves of the services offered by the World Data Centre system establish contacts with the system and with the ICSU Panel of World Data Centres.

CCIR Resolutions - Routine Ionospheric Sounding

Considering

(a) that the routine observations from the existing ground-based ionosonde network together with satellite and oblique sounding programmes provide the bases for continuing improvements in both long and short-term ionospheric predictions;

(b) that the increasing importance of space research and Earth-space communications will require continued collection of such information, derived as a matter of routine, together with possible increases and changes in the quantity and nature of the information;

(c) that URSI Commission G has formed an Ionospheric Network Advisory Group (INAG) which is responsible for advising ionospheric sounding stations on scientific questions and for advising URSI on questions concerning the network as a whole.

Is unanimously of the opinion that administration should make every effort:

1. to continue the operation of the ionosonde network, which as of 1975 consisted of 160 stations, and the interchange of basic data, for which there is much demand, through the World Data Centres;

2. to establish new ionosondes at, or transfer existing ionosondes to, places recommended by the CCIR in fulfilment of Study Programme 26C/6 or to support the organizations responsible for new and relocated ionosondes;

3. to consult URSI (INAG) on all questions relating to the establishment or closure of stations in the ionosonde network and proposed changes in the programme of operation or analysis of the ionograms;

4. to support the work under Study Programme 26C/6 concerning the use of ionospheric data from satellite programmes and to explore the use of such data as are now available at the World Data Centres, for ionospheric predictions.

Note - The Director, CCIR, is requested to transmit the amended text to the International Union for Radio Science (URSI) The International Union for Geodesy and Geophysics (IUGG), the Special Committee for Solar-Terrestrial Physics (SCOSTEP) the Scientific Committee for Antarctic Research (SCAR) and the Committee for Space Research (COSPAR) for comments.

Improvements in the world-wide ionospheric observing programme for numerical mapping purpose

Considering

a) that the present world-wide network of ground based ionosondes, operating regularly and participating in the world-wide interchange of data, is far from ideal for predicting propagation within and through the ionosphere

b) that regular satellite observations could be used in ionospheric numerical mapping, but at present, satellite soundings are not conducted often enough in certain regions to permit accurate deduction of median values of foF2 and hmax; at present the number of satellite telemetry stations is seriously limited;

c) that other regular ionospheric observations could be used in ionospheric numerical mapping,

Unanimously decides that the following studies should be carried out:

1. the identification of geographical areas within which, for either long or short-term predictions.

- the installation of at least one fixed ionosonde would provide a significant and necessary improvement

- the actual density of fixed ionosondes working on a routine basis is more than adequate;

2. the practicability of incorporating, in the work of numerical mapping ionospheric observations from satellites, when they are made on a regular basis:

- by comparing soundings from above, within and below the ionosphere, to determine whether any systematic errors are present due to interference, horizontal electron-density gradients, or non-vertical paths;

- by identifying regions where additional telemetry stations would make improved coverage possible;

3. the possibility of improvement in the work of numerical mapping by incorporating ionospheric data derived from observations of airglow, observations from oblique incidence sounders, (including highly directional back-scatter sounders), and other techniques when they are made on a regular basis.

Note 1. The Director, CCIR, is requested to transmit this text to the International Union of Radio Science (URSI) and the Special Committee for Solar-terrestrial Physics (SCOSTEP) for comment.

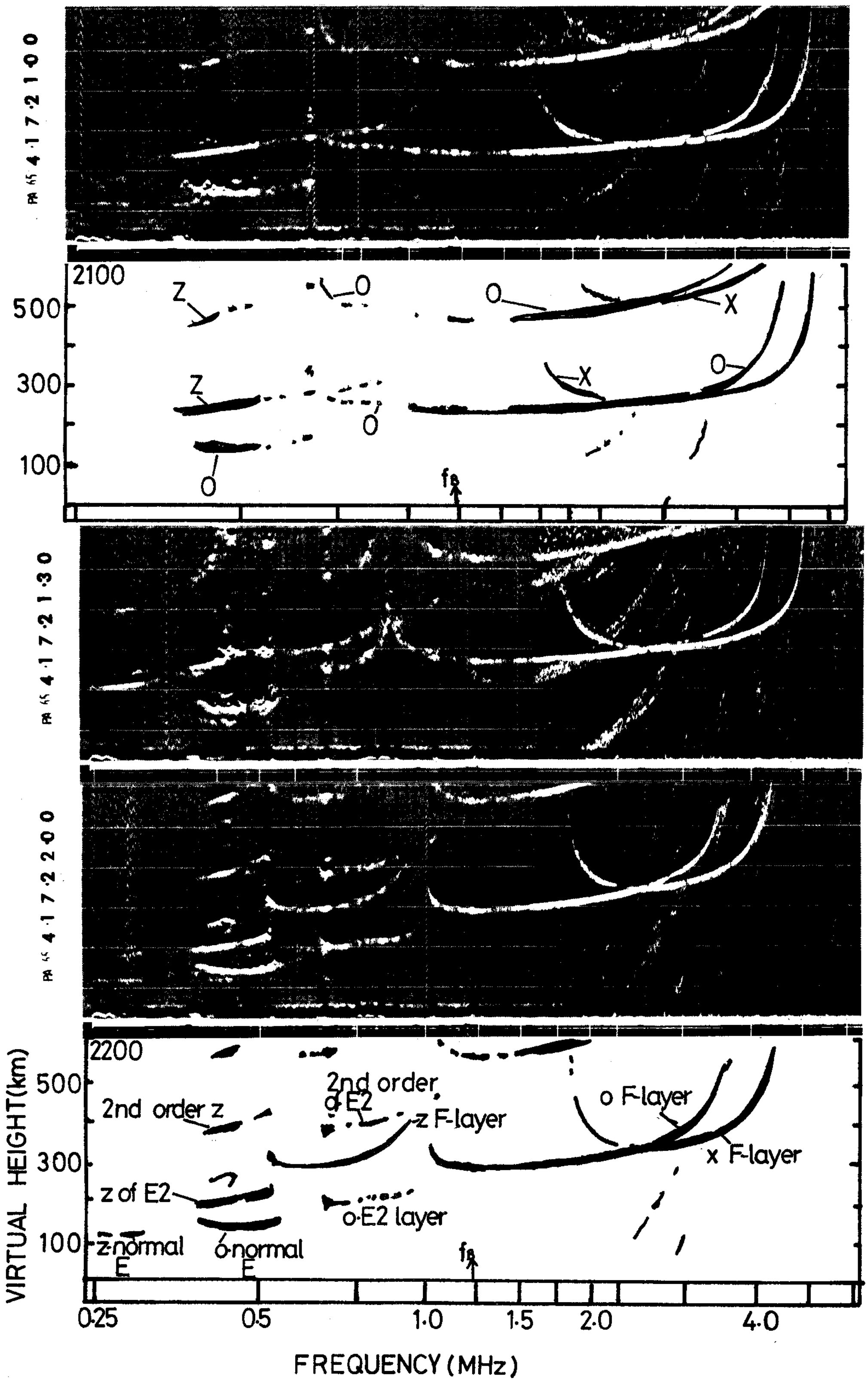
11. LOW FREQUENCY IONOGRAMS

by A.S. Rodger, British Antarctic Survey, U.K.

There has been some discussion in recent INAG bulletins (INAG 39,p.11-12 and the references therein) about traces in the vicinity of and below the electron gyro-frequency. Miss Irene Brophy of World Data Centre-A in Boulder, kindly supplied a selection of ionograms from Point Arguello (360N, 2390E). This observatory is located in a natural depression. The surrounding hills screen the observatory very effectively from medium wave radio interference, allowing the traces below the gyro frequency (1.2Wz to be clearly seen.

In the first sequence from 17 April 1965, three ionograms are shown for 2100,2130 and 2200 LT, together with line drawings for two of these on which some of the traces have been identified. At 2100 there is a normal E region o-mode trace extending from about 0.4 MHz to 0.7 Wz with a virtual height of 130 km. The trace extending from about 0.4 MHz to about 1.1 MHz for a virtual height of 230 km is a z-mode trace for the F-region.
Two points of interest regarding this trace are that it becomes progressively weaker as the frequency increases. The other point is that this z-trace shows no group retardation in the vicinity of foE (D.7 MHz). This is, therefore, different from the picture given in Fig. 1.5, and the explanation for this is given by Piggott in INAG 39, p. 11-12 which discusses the effects of thick and thin o-mode layers on the group retardation of the z-trace. The normal E region o-mode echo and the corresponding low frequency end of the F-trace (o-mode) show little group retardation; thus in this case the normal E region has the effect on the z-mode echo of a thin layer.

Thirty minutes later (.2130 LT), foE has fallen from 0.7 MHz to 0.6 MHz but an E2-layer has formed. For the o-mode echo h'E2 is about 250 km and foE2 is 0.9 MHz. The ionogram c, f 2200 is much clearer but shows basically the same pattern, with both normal E (foE= 0.6) and E.2 layer (foE2 0.9 MHO still present. The line drawing of all ionospheric echoes also shows each layer labelled. On this occasion, the z-mode echo of the F-layer shows very significant additional group retardation in the vicinity of foE2, but again no group retardation results from the presence of the o-mode normal E echo. The slight turn up at the low frequency end of the Fz trace is due to the presence of the E2. layer, i.e. fzE2.


4·1 7·2 1·0 0
2100
Z
O
O
X
500
Z
X
O
300
O
100
O
fB
4·1 7·2 1·3 0
4·1 7·2 2·0 0
2200
500
2nd order
o E2
2nd order z
z F-layer
o F-layer
300
x F-layer
z of E2
o-E2 layer
100
z-normal
E
o-normal
E
fB
VIRTUAL HEIGHT (km)
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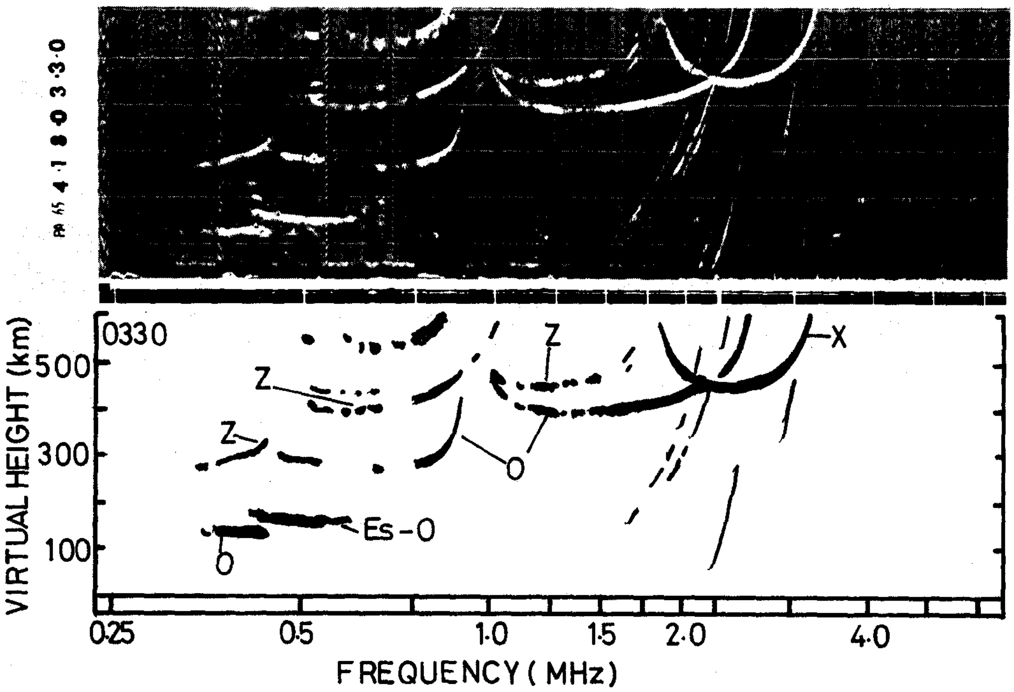
0·5
1·0
1·5
2·0
4·0
FREQUENCY (MHz)



The final example of low frequency ionograms is for 0330 LT. on 18 April 1965. This ionogram shows very many similar features to that of the preceeding night, however, it does show the z-mode F trace between the frequencies foE2 and fzF2, i.e. between 1.0 and 1.75 MHz . This is particularly rare and the trace is normally very weak. The ionogram pattern at 0330 is very similar to that of Fig.1.5 UAG-23A except that the additional group retardation of the z-mode echo is at foE2 rather than foE.

These ionograms from Point Arguello show some excellent low frequency traces and illustrate clearly the effects of both thick and thin traces of o-mode echoes on the group retardation of z-mode traces below the electron gyro frequency.

12. IONOGRAM INTERPRETATION MEETING

Mmlles Davy and A. Bourdila of the Centre National d'Etudes des Telecommunications (CNET) France visited British Antarctic Survey on 26 - 27 May to discuss ionogram interpretation with W.R. Piggott, R.W. Smith and A.S. Rodger. They provided some fascinating ionograms particularly from La Reunion (210S, 560E) which opened in October 1981.

Some sequences clearly showed the effects of particle precipitation at these low magnetic latitudes, a point which our Chairman has emphasised in recent INAG bulletins. Extracts from these sequences will be reproduced in subsequent bulletins and INAG is grateful to our French colleagues for providing such interesting ionograms for discussion.

13. NTERPRETATION QUERY REGARDING THE SCALING OF fmin AT NIGHT

by R.W. Smith - World Data Centre – C1 for Solar Terrestrial Physics.

Some recent night-time ionograms from South Uist have shown a clear x-trace affected by retardation and absorption in the vicinity of the gyro-frequency. The o-trace has been completely obliterated by broadcast station interference. What is the recommended value for fmin and hence of foEs and fbEs when no Es present?

Chairman's reply. In this case, f min for the 0 component must be equal to or less than fmin for the x-component.

If there is a gap between fmin x and the interference in which o-traces would normally be expected, the best value would be fmin numerically from the interference boundary with letters EE not ES. The value is unknown because foF2 has j-decreased too far to be observable. Most operators would give (fmin x) ES which is acceptable but misleading in that foEs would have been observed if it had been present above (fmin)

EE. I do not think that the difference is of much consequence since foEs is usually much below (fmin) EE in such cases.

14. PUBLICATIONS OF INTEREST TO THE V.I. NETWORK

In recent years there have been a considerable number of publications in the scientific literature and in special reports on points of great interest to the 'V.I. community, e.g. ray tracings through theoretical models to match ionograms, structure of ES by incoherent scatter etc. It is not possible for INAG to organise a literature search or review but we would be willing, as an experiment, to publish references submitted either by authors or readers who feel that a particular paper should be drawn to the attention of the INAG community. As an example, INAG has received a

paper entitled "Interpretation of ionograms in the vicinity of the dayside auroral oval by ray tracing" from P. Hfeg and E.Ungstrup. This paper to be published soon in Radio Science describes some theoretical ray-tracing studies for which there are significant spatial gradients in electron concentration. The authors use these studies to interpret some patterns of traces recorded in the auroral oval but their results are generally applicable to any region where gradients occur including low latitudes.

15. BOOK REVIEW

Propagation des Ondes Radioelectriques dans L'Environnement Terrestre

by L. Boithias

This little book, published by our French colleagues in CNET, is essentially a guide for radio engineers concerned with the establishment and operation of radio wave links. The author, a Chief Engineer at CNET, is primarily interested in troposphere propagation and this field, which forms the main body of the book, is exceptionally well explained with numerous graphs, diagrams etc., to simplify the engineers' solutions of propagation problems.

Ionospheric propagation is discussed in Chapter 9 and the main prediction methods briefly described, but the space allowed (37 pages) is rather inadequate. However, it is a fairly good introduction to the French and CCIR techniques with useful (but not complete) practical references. Appendix 1, on the probability laws used in propagation, is very clear and collects and contrasts the different distributions usually found in practice. This will be particularly useful for those involved in finding problems. Tropospheric and ionospheric forward scatter are well discussed. The book should be particularly useful to those who read French and are starting work in these fields as a result of the special efforts of the World Communications Year 1983.(INAG 36 p.2.)

FIRST AGREEMENT SIGNED ON JOINT ESA/ISAS/NASA
INTERNATIONAL SOLAR-TERRESTRIAL PHYSICS PROGRAM

On Sept 27-28, NASA hosted a preparatory meeting of representatives of the European Space Agency (ESA), the Japanese Institute for Space & Astronautical Science (ISAS), and the National Aeronautics & Space Administration (NASA). The objective of the meeting was to consolidate earlier discussions into an action plan for integrating proposed missions of represented agencies into a joint International Solar-Terrestrial Physics (ISTP) program concentrated on space techniques. The report of this meeting provides Information on science emphasis and timelines for satellite launches and may form a basis for planning added joint space programs and for coordinating ground-based, rocket, and airborne campaigns -- see diagram below.

At the Williamburg Economic Summit, commitment was made to international cooperation in planning space programs. This is realized in part by the charges which were the focus of the recent meeting, namely: (1) Evaluate and prioritize solar-terrestrial research objectives of the international community for the late 80's and early 1990s; and (2) Review STP programs within ESA, ISAS and NASA to formulate a strategy for an ISTP effort based on space techniques, to present it for approval by relevant advisory committees and to seek Implementation by the pertinent space agencies.

Science objectives are summarized from the US RAS CSSP/SSB's "Kennel Report" (1980) and are outlined under: Solar Physics; Physics of the Hellosphere; Magnetospheric Physics; Upper Atmosphere Physics; and general STP. Ongoing missions are identified which address some of these objectives but the proposed ISTP will be in addition and will consolidate a number of major missions still in planning.

Six satellite missions are listed for ISTP as shown below with new starts beginning In late 1985 for-, launches beginning in mid-1989 and continuing operation through the mid-90's. The earliest mission would get a much needed solar wind monitor in orbit to support the International Solar Polar Mission and continue to provide solar energy input baseline measurements during the ISTP program. Recommended missions briefly abstracted here are:

WIND: at least two years in double lunar swingby orbit to 250 Re with optional shift to tight halo orbit around the Sun-Earth LI point.

EQUATOR: 3x12 Re orbit to measure thermal and energetic plasma from plasmasphere or forced by solar wind.

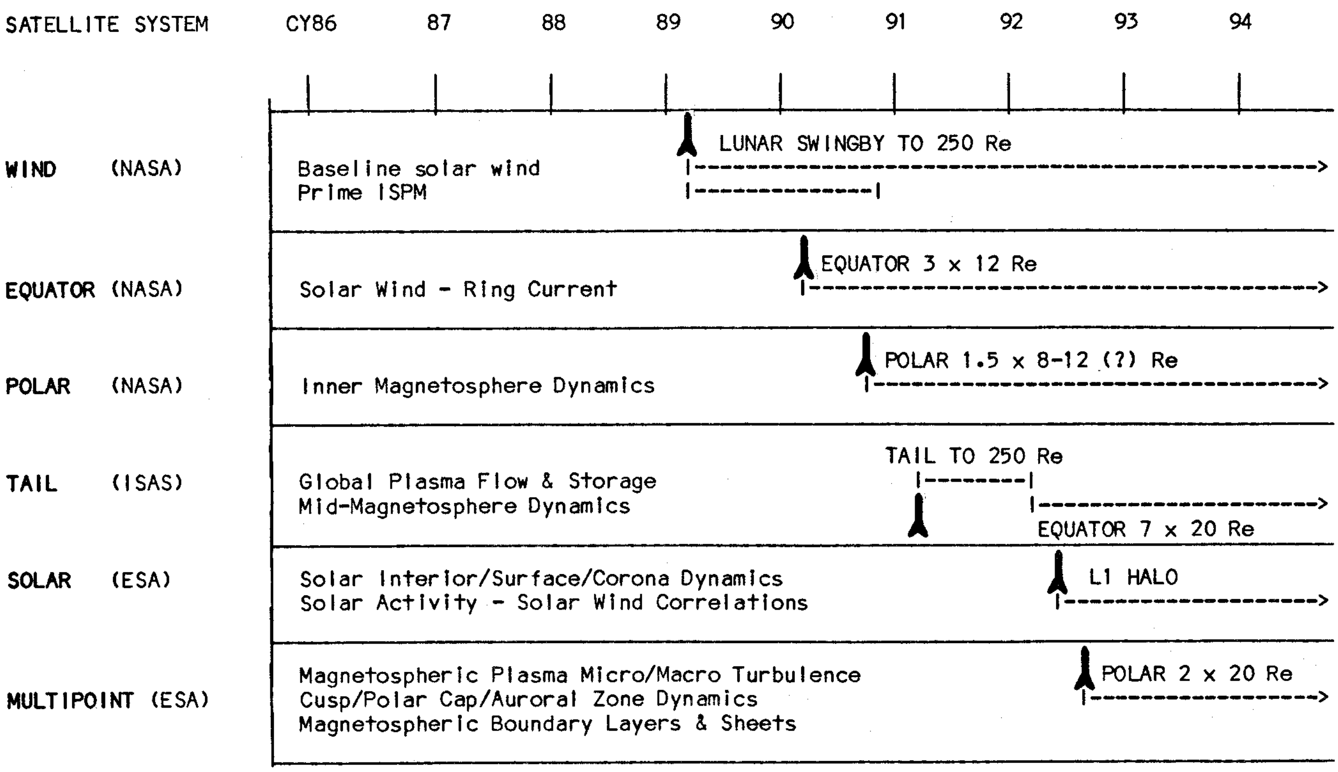
POLAR: polar orbit at 1.5x8 Re measuring plasma in and out flux in dayside cusp, polar caps, and auroral zones.

TAIL: double lunar swingby orbit on nightside to 250 Re for 1 year to measure plasma flux in and out response to solar wind variation, and 7x2O Re equatorial orbit to study middle magnetosphere dynamics.

SOLAR: Lagrangian (LI) halo orbit at 266 Re to measure dynamics in solar corona, acceleration of solar wind, solar oscillations, and solar wind parameters for correlative study.

MULTIPOINT: 4 spacecraft with polar orbit and 20 Re apogee for 3-D plasma turbulence and small scale structure studies in key interaction regions, e.g. bow shock magnetopause, cusps, boundary layers, and tall plasma sheet.

ISTP PROGRAM TIMELINE



For further Information about the status of the developing ISTP contact: Dr. S.D. Shawhan, Code ST-5, NASA Headquarters, Washington, D.C. 20546, USA.

International Geophysical Calendar for 1984

(See other side for information on use of this Calendar)

	S	M	T	W	T	F	S
	1	2	3	4	5	6	7
	8	9	10*	11*	12	13	14
JANUARY	15	16	17+	18+	19+	20	21
	22	23	24	25	26	27	28
	29	30	31	1	2	3	4
	5	6	7*	8*+	9	10	11
FEBRUARY	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	1	2	3
	4	5	6*	7*+	8	9	10
MARCH	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28	29	30	31
	1	2	3*	4*+	5	6	7
	8	9	10	11	12	13	14
APRIL	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	1	2	3	4	5
	6	7	8*	9*+	10	11	12
MAY	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31	1	2
	3	4	5	6	7	8	9
JUNE	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26+	27*+	28*+	29	30
	S	M	T	W	T	F	S

S	M	T	W	T	F	S	
1	2	3	4	5	6	7	
8	9	10	11	12	13	14	
15	16	17	18	19	20	21	JULY
22	23	24	25*+	26*	27	28	
29	30	31	1	2	3	4	
5	6	7	8	9	10	11	
12	13	14	15	16	17	18	AUGUST
19	20	21	22*+	23*	24	25	
26	27	28	29	30	31	1	
2	3	4	5	6	7	8	
9	10	11	12	13	14	15	
16	17	18	19*+	20*	21	22	SEPTEMBER
23	24	25	26	27	28	29	
30	1	2	3	4	5	6	
7	8	9	10	11	12	13	
14	15	16	17*+	18*	19	20	OCTOBER
21	22	23	24	25	26	27	
28	29	30	31	1	2	3	
4	5	6	7	8	9	10	
11	12	13	14*+	15*	16	17	NOVEMBER
18	19	20	21	22	23	24	
25	26	27	28	29	30	1	
2	3	4	5	6	7	8	
9	10	11	12	13	14	15	
16	17	18	19*+	20*	21	22	DECEMBER
23	24	25	26	27	28	29	
30	31	1	2	3	4	5	
6	7	8	9	10	11	12	
13	14	15+	16*+	17*+	18	19	1985 JANUARY
20	21	22	23	24	25	26	
27	28	29	30	31			
S	M	T	W	T	F	S	

- 17 Regular World Day (RWD)
- 18 Priority Regular World Day (PRWD)
- 15 Quarterly World Day (QWD) also a PRWD and RWD
- 4 Regular Geophysical Day (RGD)
- 6 7 World Geophysical Interval (WGI)
- 17+ Incoherent Scatter Coordinated Observation Day and Coordinated Tidal Observation Day
- 30 Day of Solar Eclipse
- 4 5 Airglow and Aurora Period
- 10* Dark Moon Geophysical Day (DMGD)

NOTES:

1. Days with unusual meteor shower activity are: Northern Hemisphere Jan. 3, 4; Apr 21, 22; May 2-5; Jun 8-12, 27-29; Jul 27-29; Aug 10-13; Oct 19-22; Nov 2, 3, 17; Dec 12-15, 21, 22, 1984. Southern Hemisphere May 2-5; Jun 8-12, 20, 21; Jul 26-30; Oct 19-22; Nov 2, 3, 17; Dec 5-7, 12-15, 1984.

2. Middle Atmosphere Program (MAP) began 1 Jan 1982 and runs through 1985.

OPERATIONAL EDITION, September 1983

EXPLANATIONS

This Calendar continues the series begun for the IGY years 1957-58, and is issued annually to recommend dates for solar and geophysical observations which cannot be carried out continuously. Thus, the amount of observational data in existence tends to be larger on Calendar days. The recommendations on data reduction and especially the flow of data to **World Data Centers (WDCs)** in many instances emphasize Calendar days. The Calendar is prepared by the **International Ursigram and World Days Service (IUWDS)** with the advice of spokesmen for the various scientific disciplines. For greater detail concerning explanations or recommendations your attention is called to information published periodically in **IAGA News, IUGG Chronicle, URSI Information Bulletin** or other scientific journals.

The definitions of the designated days remain as described on previous Calendars. **Universal time (UT)** is the standard time for all world days. **Regular Geophysical Days (RGD)** are each Wednesday. **Regular World Days (RWD)** are three consecutive days each month (always Tuesday, Wednesday and Thursday near the middle of the month). **Priority Regular World Days (PRWD)** are the **RWD** which fall on Wedsnesdays. **Quarterly World Days (QWD)** are one day each quarter and are the **PRWD** which fall in the **World Geophysical Intervals (WGI).** The **WGI** are fourteen consecutive days in each season, beginning on Monday of the selected month, and normally shift from year to year. In 1984 the **WGI** will be February, May, August and November.

The **Solar Eclipses** are: May 30 (annular) beginning in the equatorial Pacific Ocean, crossing Mexico, SE United States, Atlantic Ocean and ending in N. Africa (the partial zone ranges from NW S. America to arctic Canada, Greenland, Scandinavia); November 22-23 (total) beginning in New Guinea, crossing north of New Zealand, and ending west of Chile (the partial zone includes the Philippine Islands, Australia, Indonesia, west Antarctica and the extreme south of S. America).

Meteor showers (selected by P.M. Millman, Ottawa) include important visual showers and also unusual showers observable mainly by radio and radar techniques. The dates for Northern Hemisphere meteor showers are: Jan 3, 4; April 21-22; May 2-5; Jun 8-12, 27-29; Jul 27-29; Aug 10-13; Oct 19-22; Nov 2, 3, 17; Dec 12-15, 21, 22, 1984. The dates for Southern Hemisphere meteor showers are: May 2-5; Jun 8-12, 20, 21; Jul 26-30; Oct 19-22; Nov 2, 3, 17; Dec 5-7, 12-15, 1984. Note that the meteor showers that come in the first week of May and the third week in October are of particular interest (fragments of Halley's comet) because of the approach of Halley's comet in 1986.

The occurrence of unusual solar or geophysical conditions is announced or forecast by the IUWDS through various types of geophysical **"Alerts"** (which are widely distributed by telegram and radio broadcast on a current schedule). Stratospheric warmings **(STRATWARM)** are also designated. The meteorological telecommunications network coordinated by WMO carries these worldwide Alerts once daily soon after 0400 UT. For definitions of Alerts see IUWDS "Synoptic Codes for Solar and Geophysical Data, Third Revised Edition 1973" and its amendments. **Retrospective World Intervals** are selected and announced by MONSEE and elsewhere to provide additional analyzed data for particular events studied in the ICSU Scientific Commitee on Solar-Terrestrial Physics (SCOSTEP) programs.

RECOMMENDED SCIENTIFIC PROGRAMS
PLANNING EDITION

(The following material was reviewed in 1983 by spokesmen of IAGA, WMO and URSI as suitable for coordinated geophysical programs in 1984.)

Airglow and Aurora Phenomena. Airglow and auroral observatories operate with their full capacity around the New Moon periods. However, for progress in understanding the mechanism of inter alia, low latitude aurora, the coordinated use of all available techniques, optical and radio, from the ground and in space is required. Thus, for the airglow and aurora 7-day periods on the Calendar, ionosonde, incoherent scatter, special satellite or balloon observations, etc., are especially encouraged. Periods of approximately two weeks' duration centered on the New Moon are proposed for high resolution of ionospheric, auroral and magnetospheric observations at high latitudes during northern winter.

Atmospheric Electricity. Not-continuous measurements and data reduction for continuous measurements of atmospheric electric current density, field, conductivities, space charges, ion number densities, ionosphere potentials, condensation nuclei, etc.; both at ground as well as with radiosondes, aircraft, rockets; should be done with first priority on the **RGD** each Wednesday, beginning on 4 January 1984 at 1800 UT, 11 January at 0000 UT, 18 January at 0600 UT, 25 January at 1200 UT, etc. (beginning hour shifts six hours each week, but is always on Wednesday). Minimum program is at the same time on PRWD beginning with 18 January at 0000 UT. Data reduction for continuous measurements should be extended, if possible, to cover at least the full RGD including, in addition, at least 6 hours prior to indicated beginning time. Measurements prohibited by bad weather should be done 24 hours later. Results on sferics and ELF are wanted with first priority for the same hours, short-period measurements centered around the minutes 35-50 of the hours indicated. **Priority Weeks** are the weeks which contain a PRWD; minimum priority weeks are the ones with a QWD. The World Data Centre for Atmospheric Electricity, 7 Karbysheva, Leningrad 194018, USSR, is the collection point for data and information on measurements.

Geomagnetic Phenomena. It has always been a leading principle for geomagnetic observatories that operations should be as continuous as possible and the great majority of stations undertake the same program without regard to the Calendar.

Stations equipped for making magnetic observations, but which cannot carry out such observations and reductions on a continuous schedule are encouraged to carry out such work at least on RWD (and during times of **MAGSTORM** Alert).

Ionospheric Phenomena. Special attention is continuing on particular events which cannot be forecast in advance with reasonable certainty. These will be identified by Retrospective World Intervals. The importance of obtaining full observational coverage is therefore stressed even if it is possible to analyze the detailed data only for the chosen events. In the case of vertical incidence sounding, the need to obtain quarter-hourly ionograms at as many stations as possible is particularly stressed and takes priority over recommendation (a) below when both are not practical.

For the vertical incidence (VI) sounding program, the summary recommendations are: (a) all stations should make soundings at least every quarter hour. Stations which normally record at every quarter should, if possible, record more frequently on **RWDs, particularly at high latitudes;** (b) all stations are encouraged to make f-plots on **RWDs**; f-plots should be made for high latitude stations, and for so-called "representative" stations at lower latitudes for all days (i.e., including **RWDs** and **WGIs**) (Continuous records of ionospheric parameters are acceptable in place of f-plots at temperate and low latitude stations); (c) copies of hourly ionograms with appropriate scales for **QWDs** are to be sent to WDCs; (d) stations in the eclipse zone and its conjugate area should take continuous observations on solar eclipse days and special observations on adjacent days. See also recommendations under **Airglow and Aurora Phenomena.**

For incoherent scatter observation program, every effort should be made to obtain measurements at least on the **Incoherent Scatter Coordinated Observation Days**, and intensive series should be attempted whenever possible in WGIs or the **Airglow and Aurora Periods**. Give Apr 4, Jul 25 and Dec 19 lower priority if you must compensate for the extended 3-day periods in Jan, Jun 1984, and Jan 1985. The need for collateral VI observations with not more than quarter-hourly spacing at least during all observation periods is stressed. Dr. M.J. Baron (USA), URSI Working Group G.5, is coordinating special programs.

For the ionospheric drift or wind measurement by the various radio techniques, observations are recommended to be concentrated on the weeks including **RWDs.**

For traveling ionosphere disturbances propose special periods for coordinated measurements of gravity waves induced by magnetospheric activity, probably on selected **PRWD** and **RWD.**

For the ionospheric absorption program half-hourly observations are made at least on all RWDs and half-hourly tabulations sent to WDCs. Observations should be continuous on **solar eclipse** days for stations in eclipse zone and in its conjugate area. Special efforts should be made to obtain daily absorption measurements at temperate latitude stations during the period of Absorption Winter Anomaly, particularly on days of abnormally high or abnormally low absorption (approximately October-March, Northern Hemisphere; April-September, Southern Hemisphere).

For back-scatter and forward scatter programs, observations should be made and analyzed on all **RWDs** at least.

For synoptic observations of mesospheric (D region) electron densities, several groups have agreed on using the **RGD** for the hours around noon.

For ELF noise measurements involving the earth-ionosphere cavity resonances any special effort should be concentrated during the **WGIs.**

It is recommended that more intensive observations in all programs be considered on days of **unusual meteor activity.**

Meteorology. Particular efforts should be made to carry out an intensified program on the **RGD** — each Wednesday, UT. A desirable goal would be the scheduling of meteorological rocket sondes, ozone sondes and radiometer sondes on these days, together with maximum-altitude rawinsonde ascents at both 0000 and 1200 UT.

During **WGI** and **STRATWARM** Alert Intervals, intensified programs are also desirable, preferably by the implementation of **RGD**-type programs (see above) on Mondays and Fridays, as well as on Wednesdays.

Middle Atmosphere Program (MAP). MAP runs from 1 January 1982 through 1985. Techniques for observing the middle atmosphere should concentrate or center their observations on the RGDs, PRWDs, and QWDs. It is recommended that observing runs for studies of planetary waves and tides be at least 10 days centered on the PRWDs and QWDs. Non-continuous studies of stratospheric warmings and the effects of geomagnetic activity on the middle atmosphere must be initiated by STRATWARM and MAGSTORM alerts, respectively. For more detail see the "Recommended Scientific Programs" on the reverse of the **Middle Atmosphere Dynamics Calendar for 1984**, which will be published as a special edition of the **IGC for 1984.**

Solar Phenomena. Observatories making specialized studies of solar phenomena, particularly using new or complex techniques, such that continuous observation or reporting is impractical, are requested to make special efforts to provide to WDCs data for **Solar eclipse** days, **RWDs** and during **PROTON/FLARE ALERTS**. The attention of those recording solar noise spectra, solar magnetic fields and doing specialized optical studies is particularly drawn to this recommendation.

Space Research, Interplanetary Phenomena, Cosmic Rays, Aeronomy. Experimenters should take into account that observational effort in other disciplines tends to be intensified on the days marked on the Calendar, and schedule balloon and rocket experiments accordingly if there are no other geophysical reasons for choice. In particular it is desirable to make rocket measurements of ionospheric characteristics on the same day at as many locations as possible; where feasible, experimenters should endeavor to launch rockets to monitor at least normal conditions on the **Quarterly World Days (QWD)** or on **RWDs**, since these are also days when there will be maximum support from ground observations. Also, special efforts should be made to assure recording of telemetry on **QWD** and **Airglow and Aurora Periods** of experiments on satellites and of experiments on spacecraft in orbit around the sun.

For URSI/IAGA Coordinated Tidal Observations Program (CTOP) contact Dr. R.G. Roper (USA) for the 1984 Calendar.

The **International Ursigram and World Days Service (IUWDS)** is a permanent scientific service of the International Union of Radio Science **(URSI)**, with the participation of the International Astronomical Union and the International Union Geodesy and Geophysics. IUWDS adheres to the Federation of Astronomical and Geophysical Services (FAGS) of the International Council of Scientific Unions (ICSU). The IUWDS coordinates the international aspects of the world days program and rapid data interchange.

This Calendar for 1984 has been drawn up by H.E. Coffey, of the IUWDS Steering Committee, in close association with A.H. Shapley, member of MONSEE of SCOSTEP, and spokesmen for the various scientific disciplines in SCOSTEP, IAGA and URSI. Similar Calendars have been issued annually beginning with the IGY, 1957-58, and have been published in various widely available scientific publications.

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