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IONOSPHERIC NETWORK ADVISORY GROUP (INAG)*

IONOSPHERIC STATION INFORMATION BULLETIN No. 43 & 44**

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

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Garry Elliot
Tony Sweetman

1. INTRODUCTION

W.R. Piggott, Chairman

This issue of the INAG Bulletin is intended to inform you about the important issues which will be discussed at the INAG meeting at the URSI General Assembly in Florence, so that you can come prepared to contribute your views or inform your representatives or the Chairman or Secretary, so that these can be considered.

The ground rules for a fundamental reorganisation of INAG were discussed at Washington and must now be confirmed, with modifications if necessary, and acted upon. Your present Chairman and Secretary will resign at this meeting, enabling major changes to take place.

The objectives of INAG clearly remain as stated at Washington (INAG 34, p.7) and all are important. However, the next major job which INAG should start is to exploit the possibilities of computers for handling the VI data and for research. Thus, INAG should investigate how the data produced by the VI network can best be made generally available in computer compatible form and to develop the synoptic aspects of digital ionosondes. The new officers of INAG should have more experience in such problems than your present Chairman and have contacts with experts and equipment for testing proposals.

Although the potentialities of digital ionosondes are well understood, in practice systematic tests showing how to exploit them synoptically are only just starting and it is not even clear which parameters and facilities are worth evaluating regionally or on a world-wide basis. Thus, the true situation is closer to that in the 1930's (when ionosondes were new) than in the 1950's, when the first international guides were written. For example, are the consistent changes in doppler frequency with time or frequency more important that the transient changes, or vice versa? Completely different analysis techniques, and possibly sounding schedules, will be needed for the two uses.

This job is roughly equivalent to trying to prepare the URSI Handbook in the 1930's, when the possibilities and difficulties were not well understood. I feel that the project will take 5-10 years to complete, but that it is important to start it as soon as possible so as to minimise subsequent changes. There may well be 20 digital equipments deployed by the end of the next three years.

In the past, our Secretary and myself have spent much time considering and commenting on contributions to the Bulletin. Although we feel that such comments are desirable, eg on the proposals of the Australian Operators Conference on Scaling of Particle E, we have left these to other contributors. They could be raised by letter or at Florence, if you so desire, but the time available there will be limited. I hope to be available for personal discussions on such matters outside the official INAG meetings.

This Bulletin contains an interesting analysis of scaling errors, comparing the early Australian ionosonde with later models and will be valuable to many who use the IPS 42 ionosonde. There is a great need for a similar comparison between digital ionosondes and non-digital. While the latter are capable of high accuracy, is this actually obtained in practice? With manual scaling, the answer appears to be that the non-digital are usually easier to scale accurately. Can we have some tests for the guidance of users of the data? Similarly, it would be valuable to have comments on the USSR ionograms published in INAG 42. Dr Wakai states that the work of translating the Japanese Ionogram Handbook is progressing and this may be available shortly.

The network continues to expand and my visits during the last three years to groups in widely different parts of the world, show that the support and interest in INAG is much greater than would be expected from the contributions to the Bulletin. I shall be available for further visits to discuss the INAG problems after Florence, though financing my travel may prove, as in the past, a real problem.

I would like to thank Mr Richard Smith and Mrs Irene Brophy for their help, both since INAG started in 1969 and in the precursory years, when I acted as URSI Consultant for VI Soundings. They both have made major, but largely hidden, contributions to the present high standard in the network and have trained many of our experts.

2. URSI GENERAL ASSEMBLY - INAG MEETING

There will be an INAG meeting in Florence on 30 August 1984 with, if necessary, a follow-up meeting later during the Assembly.

Agenda

1. Chairman's introduction
2. Report on INAG activities in last 3 years
3. Status of Network
4. Future of INAG and the INAG Bulletin
5. Election of INAG officers and members
6. International Digital Data exchange
7. Training problems and Handbooks
8. Analysis problems and rules
9. Aid to developing countries
10. Any other business

The objectives of INAG are:

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

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

\- To produce regularly a Bulletin to further its ends and to provide a link betwen administration operating VI stations and the users.

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

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

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

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

7. To encourage the use of ionosondes ~~and~~ acquisition and interpretation of ionosonde data in research campaigns.
8. To encourage theoretical studies as an aid to the interpretation

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

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

Most of the points to be considered in Florence have been raised in the INAG Bulletins issued since the meeting in Washington (INAG 34-44). Please be prepared to comment on these at Florence or provide your comments in writing to the Chairman or Secretary beforehand.

The most important points are the reorganisation of INAG and the problems of International Digital Data Interchange. Should INAG try to form special working groups to study particular problems? This might be the easiest way of promoting study of the best ways of using Digital ionosondes and getting draft rules for them. Similarly, CCIR is waiting for URSI guidance on the use and value of fxI, which was originally assigned to solve CCIR problems. How do we identify suitable members for a working group to study this problem and others such as those associated with low latitudes and would these be effective? There are clearly many problems to be solved using ionograms. Can INAG identify and provoke more interest in these problems?

The Chairman has made some suggestions in past Bulletins, but with little apparent effect so far. Is this because the INAG Bulletin does not reach those who might be interested? Is the present circulation satisfactory? In what ways can it be improved?

3. AUSTRALIAN COMMENTS ON DATA EXCHANGE STANDARDS

P.J. Wilkinson, Ionospheric Prediction Service, Australia.

1. Introduction

In selecting standards for data exchange, INAG should take account of standards already existing in the computer community. INAG should assist these standards to become commonly accepted within the ionosonde network and ensure their efficient use.

The real problem facing INAG is to discover ways of integrating non-standard computer media into the international data exchange. If INAG compromises, and tries to create secondary standards, it could split the ionosonde community away from the mainstream computer community. This must, ultimately, be a disadvantage.

A second problem area is the assimilation of non-computer oriented networks. Here, it may prove difficult to obtain ideal solutions and ad hoc collections of "what's available" may be the best solution.

In this document, the word 'record' is used to denote a complete set of data with its identification in computer compatible form.

2. Data exchange standard

2.1 Media standard

There is only one current compatible media standard for data exchange. This is, 1/2 inch, 9 track, 1600 bpi magnetic tape written using ASCII coded characters. This is a current standard and should remain for many years. The obvious change likely is a shift upwards to 6250 bpi but downward compatability will remain.

2.1.1 An historic point

Standardization is different now from the situation that existed 10 to 20 years ago. The early standards evolved from card images and data exchange was geared to shifting boxes of cards around from computer centre to centre.

Card images could be written to magnetic tape for greater ease of handling, but as far as I know there was no standardization of media at this step. Thus, for instance, IPS sent early tapes of card images to WDC-A on 7-track tape.

Today, the media standard has shifted from cards to magnetic tape. INAG must accept the international media standards and concentrate its efforts on recommending suitable record formats for magnetic tape usage.

2.2 Daily record format recommendation

2.2.1 Introduction

The current URSI record standard (UAG-23) is based on an 80 column card and requires two cards per 24 hourly values per parameter.

When storing data on magnetic tape two innovations are possible:

- constant information on station location and conditions can be placed at the head of each tape as a unique record or records,
- a full 24 hours data can be stored in a single record.

2.2.2 Hourly information

Each hourly record per parameter consists of:

- a 3 figure value, a default numerical zero being used if no value is recorded,
- qualifying letter, a default alphabetic blank being used if no qualifying letter is recorded.
- descriptive letter, a default alphabetic blank being used if no descriptive letter is recorded;

which, for example, could be read by the FORTRAN format (I3, A1, A1) or (I3, 2A1).

2.2.3 Daily information

Twenty-four hourly records should be collected together as one complete record for a single parameter.

Thus, for example (24 (I3, A1, A1) would read the 24 hourly scaled values per day to each paramter.

2.2.4 Record identification

Each daily record should be treated as unique and should carry sufficient redundancy for the record to be identified in isolation. The principal advantage of this is it eliminates any confusion about how records are formatted. This is essential as several parameters and stations may be mixed on an exchange tape.

Thus each record should carry the following identification:

Station identification (see next section)
Time identification
- year four numeric figures
- month two numeric figures
- day two numeric figures

Ionospheric identification
- URSI standard code (two numeric figures - see UAG-23).

2.2.5 Station identification numbers

Currently two station numbering conventions exist. URSI use a three figure system, described in UAG-23, each station being defined by a unique set of two figures and a character. In analogue data processing this had some advantages, although the main one appears to have been convenience of card formatting.

IUWDS adopted a five figure station identification system which encompasses most geophysical stations, including ionosonde stations. IPS suggest that INAG endorse the IUWDS station identification system as part of the standard record formatting.

2.2.6 Summary

IPS recommend that INAG support a tape format consisting of:

- one station parameter day per record

- each record containing

  i. station identification
  ii. ionospheric parameter identification
  iii. year, month, day
  iv. 24 sets of (value, qualifying letter, descriptive letter).

2.3 Monthly record format recommendation

Two options are open:

- either INAG can propose a new format similar to the daily record, but including a second hourly value for the median count

- or two separate records, each with the same format as the daily record, can be created using the day field to specify the record contents. For instance:

  - day = 40 median data
  - day = 41 median count

The latter has the advantage of uniformity and ensures tapes are easily read even if daily and monthly records are included together. Using two records wastes some space but convenience of handling, coupled with a realistic appraisal of how little data are involved, would justify this.

2.4 Tape blocking

Small block sizes lead to inefficient tape usage. The largest block size is generally limited by the available computer memory.

Evidently a good compromise is a block size between 5 K and 10 K.

2.5 Data ordering on tapes

Throughout sections 2.2 and 2.3 it is assumed a record contains only one day's data, for one parameter. While this adds some redundancy in constructing records, it is far more flexible.

Once the record length, or ordering of records, becomes part of a "standard", then considerable flexibility is lost. For instance, if more parameters were scaled all the "standards" would require changing. If fewer were scaled, then padding would be required to remain consistent with the old "standard". Some examples of recommendations which INAG would be unwise to support for the reasons just cited are:

- all parameters for an hour are treated as a record
- all data scaled for a day are treated as a record
- all records for a particular day are ordered chronologically on magnetic tape preceded by a day header.

The first two formats are attractive because they approximate the old analogue scaling sheet formats. However, these analogue attractions are misleading in a digital environment. Note: record length is not a particularly important efficiency factor in tape storage.

2.6 Summary

In a computing environment, record structures should be general and devised in such a way that a reasonably general program can interpret them. Computer programs can carry out all the data organisation necessary to interface the data to the researcher's needs.

The formats suggested, together with the media standard, are general and capable of further extension if required.

I believe INAG should accept the current media standard and should obtain agreement on acceptable record structures along the lines of those described here.

3. Non-standard data exchange

The term "non-standard" is used in the sense of not conforming to the standards recommended in section 2. Being "non-standard" should not imply " of lesser quality" and is not used here with that implication. However, non-standard data can mean greater problems exist in handling them. Various non-standards will be considered in successive sections.

3.1 Non-standard formats

Provided media compatability exists, then non-standard formats should only imply a software task for reading the data. Creation of such programs can be costly and time consuming, but are generally 'once-off' tasks requiring minimal maintenance once created.

This aspect of non-standard data has arisen mainly because INAG failed to keep pace with data storage and exchange needs. Consequently, all computer-based networks have produced their local variant of the standard URSI code.

One solution is always to send a copy of the program that generated a data tape with the tape. This gives the recipient enough information to be able to understand the format used. INAG should consider setting up an education list of required steps for exchanging data.

3.2 Non-standard media

There are many possible computer storage media available. This, coupled with the proliferation of computing facilities from personal computers to word processors, ensures that many networks will opt to use economic computing systems for processing their data.

However, INAG must then look at ways to ensure that these data remain accessible for general data exchange. Because this is a very dynamic area, INAG ...uld be most unwise to serve current needs.

...) highlight some problems here, three types of storage media are considered.

3.2.1 Floppy disks

On the face of it, these appear ideal for data exchange between small station networks. The disks are cheap and can easily be mailed around the world. However, there is a wide variety of different floppy disks (eg. 3", 5 1/4" and 8"), all of these being formatted differently, depending on the manufacturer and system using them.

There is currently no durable standard for floppy disks. If INAG were to select a standard from the available range it could find that within a few years the computer industry as a whole no longer supports it and the "standard" has become both obsolete and unserviceable.

3.2.2 Cassettes and cartridges

The comments made for floppy disks hold equally true for cassettes and cartridge systems. Cassette sizes, ...ke floppy disks, have a wide range both physically ...d also for storage. No standards exist.

...2.3 Fixed disks

Large fixed disk systems can be used for storing scaled data in random access form. Quite powerful data analysis are readily available for networks storing their data on such systems. However, these systems are too large, physically, for data exchange purposes. Furthermore, the formatting of the data on the disk will be completely dependent on the computer system that generated them. Such things cannot be standardised internationally, although they may prove highly successful for individual stations.

For data exchange, the disk contents could be read out to a more readily transported medium, such as a 9 track tape.

3.3 Exchanging non-standard data

INAG intends to assess the current computer usage within the ionosonde network and will be able to use the profile of current usage for seeking means of catering for non-standard media but not for establishing a consensus media type for use within the world ionosonde network. Once a profile has been established, techniques for exchanging non-standard data can be formalised. Two computer approaches follow.

3.3.1 Local arrangements

INAG should stress the need for data to be stored eventually on magnetic tape. While non-standard media may serve a local station well, a method for shifting the data to magnetic tape is essential.

INAG can seek assistance from organisations capable of handling several media (one of which is standard) and who would be willing to receive non-standard data and convert it to standard form for WDC's. While this is an obvious approach, it is important to realise that it is really an ad hoc arrangement subject to less publicised influences than control WDC operations. Obviously WDC's will be capable of handling a variety of media.

3.3.2 Computer communications

Data may be exchanged between computers via telephone lines. The basic disadvantages are the cost of using the line and the limited bandwidth available. Aside from these problems, the telephone line can be considered to have a similar status to magnetic tape as a computer media standard.

INAG has discussed telephone computer communications in a variety of modes ranging from overcoming postal delays or losses to the rapid access of near-real-time data. While the potential exists for these modes, telephone communications has the advantage that the line has well established standards and data fed into it must meet these standards. Consequently, the telephone line forces standards on different computer systems.

Becuase of the ongoing costs involved using lines, there will be pressure on INAG to recommend some data compression mode for packing data records for transmission. This is an open question at present and INAG can take the initiative now.

3.3.3 Analogue data

Two major sets of ionospheric data not considered so far are:

- those stations still distributing data which are completely manually processed.
- past data which were manually processed prior to computerisation.

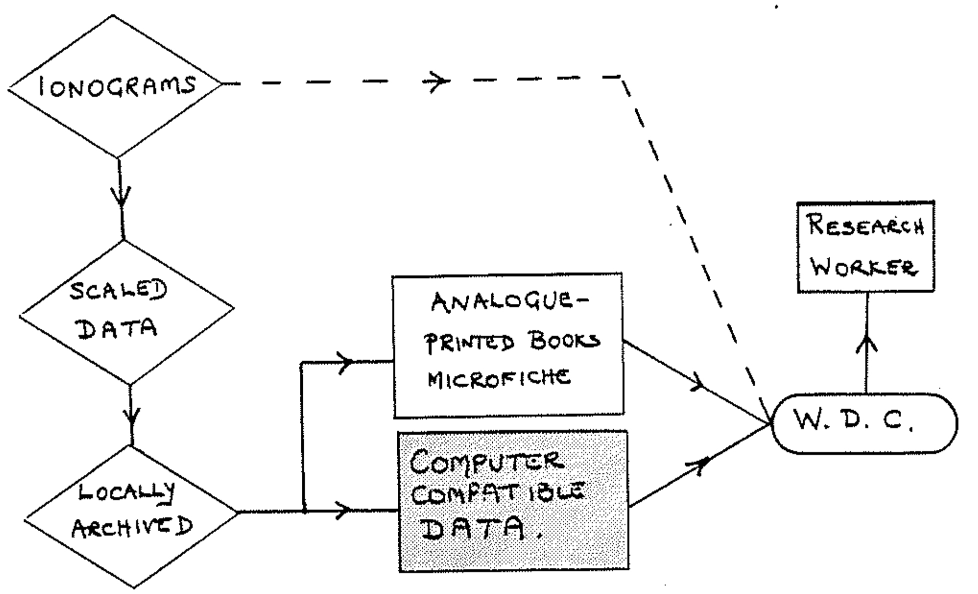
3.3.3.1 Current manual data

INAG should consider how best these data can be integrated into the current computer system. This means identifying how much manual data are being produced.

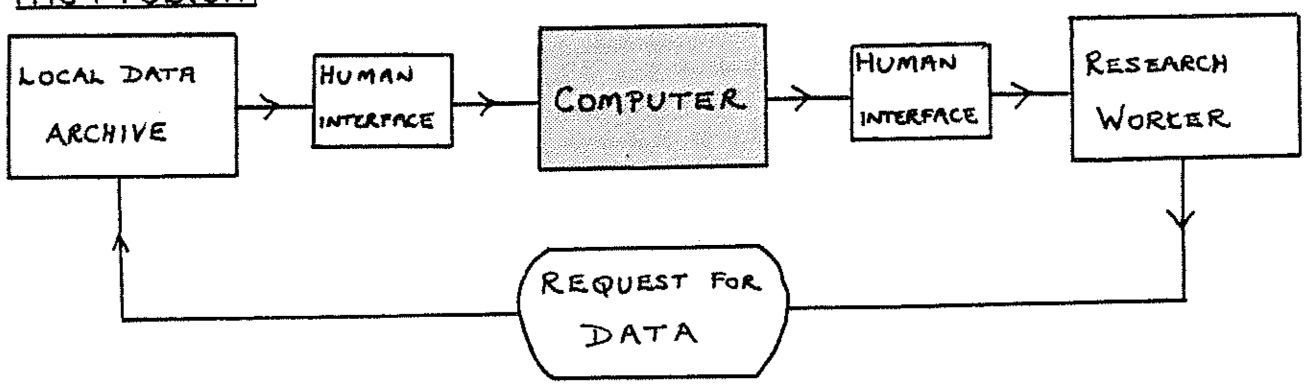
WDC's should indicate what proportion of a station's data is required in computer-accessible form before it can readily be stored. Having established this, INAG can ensure that if these data are put in computer-accessible form they are also forwarded to WDC's.

3.3.3.2 Past data

An important area for INAG to emphasise is the value of past analogue data being made computer accessible.



The Problem



This is especially the case for long established stations where quite large amounts of data are not easily accessed.

At IPS all hourly foF2 data are now available back to 1950 for all stations. This involved a considerable effort and it is unlikely that all scaled parameters will be treated the same way.

Two problems arise, both of which INAG should give guidance on.

First, scaling techniques have changed with time. There is presumably a break point where hourly values become less valuable because of changes in scaling conventions. While IPS make use of all median data available, we have generally assumed that scaling prior to the IGY was not standardised sufficiently for some parameters (say sporadic E) to be useful. In a sense, it was assumed that the variance associated with the F2 region was greater than scaling variance, so that foF2 was worth more effort than other parameters. This was a fairly arbitrary decision and is possibly dependent on latitude, low and high latitude stations being less reliably scaled even after the IGY, for some conditions. Is there ever a case for re-scaling?

Second, there can be major costs involved in assimilating past analogue data into a computer data base. Unless INAG can indicate the value of these data, much will not be considered for computer entry.

4. Summary

4.1 The current problem

The current problem faced by INAG is to rationalise the various interactions involved in data formatting and communications, (figure 1). In this article, the various standards and some possible solutions for non-standard data have been discussed.

4.2 The real problem?

Figure 2 perhaps addresses another problem, maybe the real problem - the human interfaces involved in data exchanges. Part of INAG's survey should consider the predictability of this area and should, in the future, give guidance on the general topic of data exchange.

4. A GUIDE TO THE EXCHANGE OF COMPUTER-READABLE DIGITAL DATA

As a result of the meeting of WDC - computer experts held at WDC-C1 for STP at Chilton, UK during August 1983, a guide to exchange of computer compatible data is being prepared. Edited highlights of this document are reproduced below to provide further material for discussion of this most important topic. It should be borne in mind that this meeting considered the requirements for geophysical data in general rather than ionospheric data in particular.

1. General introduction
2. Aspects of recording techniques
3. Recording formats
4. Recording codes
5. Recording media
6. Recording on 9 track magnetic tape
7. Supporting documentation
8. Transportation of magnetic tapes
9. Information that users should supply about their own computing facilities when requesting data from the WDCs.

1. General introduction

The past decade or so has seen a growing reliance on the use of computers for the storage, management and exchange of geophysical data. The onset of the computer age has undoubtedly opened up new horizons and possibilities, both for the creation of global data sets and for the exchange of data between scientists the world over. In the coming years the emerging technology, which continues to grow at an ever increasing rate, will give the scientist and the data manager ever more powerful tools.

Computer technology has also brought with it a proliferation of recording techniques, both at the logical (software) and physical (hardware) levels. If left unchecked this proliferation will serve to inhibit the exchange of data and place unnecessary burdens on the WDC system; global data sets can only be created effectively if the collating centres are supplied with data in a limited number of different forms. Some degree of standardisation is therefore necessary so as to ensure the continuing development of the data exchange system.

This guide provides general guidelines aimed towards the standardisation of the recording techniques used for international data exchange. Data suppliers are strongly encouraged to conform to these guidelines as closely as possible. The guide is not meant to prohibit the development of other standards where appropriate, or to discourage the data supplier from submitting data if he is unable to conform to the suggested guidelines. It is recognised, for example, that in designing recording techniques for large volumes of high resolution satellite data, the requirements for storage efficiency will often outweigh those for data exchange, particularly where supply is only envisaged to a few users.

Although one must be continually aware of and plan for future technology, new recording techniques are unlikely to be adopted for general data exchange until they are shown to be compatible to a large section of the scientific community. In adapting to new technology it is equally important to identify those techniques that are becoming outdated, eg. many scientists no longer have facilities for reading punch cards, paper tape or 7 track tape. It is a responsibility of the scientific community to ensure that data can be preserved for use by future generations. From time to time systems will need to be updated and data transferred to more up-to-date recording media.

For internal use in the laboratory, the scientist will usually design recording formats that are tailored to the specific computer system available to him - in terms not only of convenience, but also of effective utilisation of the recording medium, speed of access and speed of processing. However, for data exchange purposes, it is necessary to design formats that are geared towards ensuring maximum compatibility between as wide a range of data users/suppliers as possible. In practice these two requirements are rarely complimentary. In order to process data efficiently and to participate effectively in international data exchange, the scientist will invariably need to recognise two different formats: an internal format for use on his own computer and the common international format for data exchange. So as to minimise any potential conflicts between these two formats the users/suppliers of data are encouraged to bear in mind the international standards for data exchange when designing new systems or software. By taking this precaution the additional effort required to interface with an international standard should be small compared with the benefits that can be reaped from an active participation in the WDC system.

2. Aspects of recording techniques

There are three critical factors that influence the effectiveness of digital data exchange in a computer compatible form: the recording medium, the recording code and the recording format. All three have a considerable bearing on the amount of conversion software that needs to be written by the suppliers and receivers of data. In theory if we have N media and M formats in L recording codes we would in the worst case need some (L*M*N-1)*L*M*N conversion programs - for example, 3 media and 3 formats in 3 reading codes on each medium would require 702 programs at worst! It makes obvious sense therefore to avoid the unnecessary proliferation of different media, codes and formats and to standardise on as many aspects as possible.

3. Recording formats

The design of a format defining the content and structure of the fields and records for data recording usually has to be tailored specifically to the type of data being exchanged. Attempts have been made in some of the geophysical disciplines to develop a single formatting system to cover all types of data within that discipline. However, for the foreseeable future no such standardisation is envisaged to cover all the disciplines. In most cases, the format standards relate specifically to the type of data being exchanged and these are described in the relevant sections of the guide. Where an appropriate standard format is available the data supplier is strongly encouraged to use it for the purposes of data exchange. He should follow the format closely and should not made modifications, no matter how small, to the format unless absolutely necessary. The receiving WDC will usually have software already available to deal with correctly formatted data. If modifications are made these should be clearly brought to the attention of the receiving WDC.

4. Recording codes

For exchange purposes all data should be character coded in ASCII or EBCDIC code. Binary data should be avoided if at all possible.

Although the ASCII or EBCDIC codes look very similar on different computer systems, each computer system will often have its own particular version of the character set. It is necessary therefore to identify a common character subset for the purposes of data exchange.

5. Recording media

A wide range of different media are available for the recording of digital data. At the present time, 9-track magnetic tape is by far the most commonly used medium for geophysical data exchange. There are many other media that are convenient for the storage of data but most of these have problems of compatibility between different computer systems. The development of technology is very rapid in this area and other media may become available for data exchange in the near future. Telecommunications can be a very convenient way of exchanging small amounts of data although a number of problems need to be resolved before it becomes effective on a widespread basis e.g. limitations in data transfer rate, problems of quality and problems in international telecommunications.

Although there are obvious advantages to be gained in keeping abreast of the developing technology, care must be taken against proliferating the number of different recording media in use for data exchange. Exchange standards need to be directed to those media that are in most common use and for which minimal problems exist for exchanges between different computer installations. For these reasons it is recommended that conventional 9-track magnetic tape should be used as the normal medium for data exchange. The use of 7 track magnetic tape, punch cards or paper tape is strongly discouraged and should be avoided if at all possible. It is anticipated that floppy disks may in future have a greater role to play in data exchange - such disks may be sent to some of the WDCs by prior arrangement. In general, WDCs cannot handle special tapes such as cassette tapes, video tapes and tapes with data stored in continuous stream mode.

6. Recording on 9-track magnetic tape

Whenever possible, data should be supplied to the WDCs on 9-track magnetic tapes with the following characteristics:

i) tape width : 0.5 inch (12.7 mm)

ii) inter-block gap : greater than 0.5 inch (12.7 mm) or greater than 0.3 inch (7.6 mm) for 6250 bpi tapes

iii) tape length : up to 2400 feet (732 m) - greater lengths may also be acceptable providing the reel diameter does not exceed 10.5 inches (266.7 mm)

iv) tape density : 800 bpi or 1600 bpi tapes may only be submitted by prior arrangement with the receiving WDC

v) unlabelled tape

vi) block length : fixed and with a maximum of 5000 characters - the last block of each file may be short. Each block should contain an integral number of records

vii) record length : fixed and less than or equal to the block length

viii) character code : ASCII or EBCDIC code : restricted to the common character subset

ix) individual files should be terminated by a single end of file mark block (tape mark) - the tape itself should be terminated by two or more consecutive tape marks.

7. Supporting documentation

The following items of documentation should accompany data submitted to the WDCs:

7.1 Information on tape characteristics covering such items as tape density, number of tracks, character codes, block length, record length, single file/multifile. Additional information should be provided for those characteristics that do not conform to the standards laid down in paragraph 6 particularly if:

i) the tape is internally labelled : details on the labelling are required

ii) the tape contains non-standard codes or characters : details of the code table should be provided

iii) the tape contains blocks or records that are not of a fixed length : the maximum block size should be provided together with details on how the data are blocked.

7.2 Details on the format used:

i) if the data conform precisely to a recognised standard format the format need only be identified by name and a reference to where the format specified may be found.

ii) if the data are in a non-standard format then a detailed specification should be provided. This should include a detailed description of each record type and each of its data fields, together with the Fortran format statement for reading each record type. Individual data fields should be described in terms of:

a) parameter name and units - including a full definition of the parameter itself

b) character position of the field within the record

c) field length and type - i.e. integer, floating point or character

d) value used in field for indicating absent data value

e) whether field is signed according to Fortran or Cobol notation.

If available, listings of Fortran routines for reading the format should be included with the documentation.

7.3 Data documentation i.e. relevant information describing the instrumentation, methods and conditions applicable to the collection and processing of the data. Sufficient information should be provided for the data to be clearly understood by the recipient. Details of the documentation required for specific types of data may be found in the relevant sections of the Guide.

7.4 A sample dump and/or summary report - whenever possible the supplier should produce the dump/report directly from the tape being transmitted.

7.5 As the magnetic tape may become separated from its documentation during transit or archiving, it is important that a sticky label is attached to the tape reel for identification purposes. The sticky label may also include other useful items such as creation date, tape density etc.

8. Transportation of magnetic tapes

Unless care is taken in their packing, magnetic tapes are sometimes damaged during transportation and data may be corrupted. The sender is therefore advised to ensure that the tape is adequately protected by paddings, and that the loose end of the tape is secured. Many groups put prominently on the package 'Magnetic Tape - Do Not X-Ray'.

9. Information that users should supply about their own computer facilities when requesting data from the WDCs

In order that data may be supplied in a manner than is most effective to both parties, it is important that the WDCs should be aware of the computer facilities available to their users. It is advisable therefore that the user should supply the WDC with the following information in first contact:

i) Computer name and hardware configuration

ii) Operating system and available languages

iii) Name of an equivalent computer system if any - the computer manufacturer can normally supply this information

iv) Available input devices and their size, speed and readable codes

v) Code tables if the input devices use uncommon codes.

5. A NOTE ON DATA EXCHANGE IN COMPUTER COMPATIBLE FORM

W.R. Piggott

The object of this note is to contribute to the debate on standardising international data exchange in computer compatible forms by giving my personal, possibly ill-informed, views - not as Chairman of INAG.

Any system adopted should be flexible, so that new parameters can be added easily without reorganising the whole structure. Economy is also important.

The needs of the user of the data should be considered carefully. While a computer is extremely flexible, its use is based on the assumption that all data on it are read and meaningful. One of our major difficulties is that most stations suffer from periods when the data are missing or needs a check for adequate reliability for use in the particular research. Thus, most users need to have the data presented initially in a form suitable for quick inspection - in the classical manuscript interchange day by hour tables are far more useful than the daily work sheet for this purpose. I think this problem will be permanently with us. microfiche.

There is also a fundamental practical problem. The initial proposals must be consistent with what is possible at the stations now, as well as with what will be best in the future.

The central problem in organising data exchange in computer compatible form for the VI data is that most stations exist primarily for local purposes and have very limited resources. Most computer developments have occurred in strong organisation, who do not have such severe limitations. These can therefore be easily overlooked by computer experts.

Even when the data are scaled, using micro-processor controlled data entry or direct digitising techniques, there are considerable problems in transferring these data into standard type form. For example, significant software must be developed and a suitable buffer provided before any large computer can accept the data. Many types of cassettes, tapes, floppy disks, etc, are in local use and the cost of interfacing each of these individually is likely to be prohibitive.

It is unlikely that organisations which do not own standard 1/2" magnetic tape decks will be able or willing to purchase them unless they have special local reasons to do so. The cost is high. Thus, we have to consider how the existing system, often based on microprocessors, can be best modified to be compatible internationally, but local costs must be kept small. I think that we should plan for interim solutions, which will allow more and more stations to contribute over the next five to ten years.

A possible solution is to form regional or equipment type-based subgroups, so that one type of interface could serve a number of stations. I feel that INAG should discover what the administration which operates stations are willing to do. To insist on an ideal system may well prevent most stations from collaborating in it.

The proposals of the WDC computer group appear sound for those with the resources to use them, though I would expect them to be modified as the difficulties become clearer. Rapid identification of data and quick access may demand considerable changes in the preferred layout of the data on the tapes. This can be done centrally at a later date. I concur that the standard type of magnetic tape advocated by Dr Wilkinson will probably be generally adopted.

I feel that the URSI standard table of parameters needs urgent revision and extension. Now that cards are no longer used, there is no reason why this should not be greatly extended. I think that the existing codes should be kept even if this disrupts the logical structure of the new table. Provision must be made for new parameters for use with both normal and complex digital ionosondes, duplicating standard parameters where the significance has changed (eg the IDIG provisional nomenclature could provide a starting point). The new system should be flexible. We do not know what new parameters will come into common use in the future, eg. electron density profile parameters, doppler parameters, ridge and trough parameters, sky map and possibly intermediate layers and oblique incidence parameters. Special parameters may be needed for some early pre-IGY data, which are non-standard. Otherwise, I feel that there has been a gradual overall increase in consistency with time, and most very long-term changes are real.

With limited resources, we need a priority system. Obviously, those with suitable facilities should transfer their data on standard 1/2" magnetic tapes using, as far as possible, an agreed format.

In the past, median data have been used most frequently. As we now have data from from a few stations for over 50 years, and far more since the IGY-IGC, I believe that this will continue to be true. The CCIR problems of up-dating prediction maps would be greatly decreased if more data were available in this form. I feel that a special effort should be made, possibly at the WDC's, to put all current median data with counts into the computer and to work back in time, especially for the long duration stations.

However, there is much interest in the use of ionosondes in real time forecasting of propagation conditions, which may well involve networks of stations interchanging data on an hour by hour or day by day basis. Since such systems will have easy access to large computers, they can act as the intermediary to the WDC's and any rules should be compatible with this.

In the past, INAG has dealt with the problem of major changes by getting advice from those with specialised knowledge, writing provisional rules, getting them tested by voluntary efforts at some of the stations, then adapting final rules. This has usually taken considerable time, typically 3-6 years. It is only possible to shorten this if the development can be expedited and workshops held to establish a consensus. All stations in the network are free to collaborate or not to collaborate, as they see best, and will only collaborate if they feel that they have been consulted and a general consensus obtained.

6. AUSTRALIAN OPERATOR'S CONFERENCE

by P.J. Wilkinson, Ionospheric Prediction Service, Australia

1. Introduction

The Australian operators conference was held in Sydney between 29 February - 2 March 1984 and was attended by operators from the four Australian mainland stations, IPS staff involved in scaling ionograms, Mrs P. Morris who is in charge of scaling New Zealand ionograms, and Mr B. Dundas of NITR, South Africa. Some sessions were also attended by members of KEL Aerospace.

The main objective of the conference was to document IPS scaling conventions and to ensure that they are in accordance with the recommendations of INAG. In addition, validity tables of pairs of qualifying and descriptive letters were checked for use in semi-automatic scaling systems.

A variety of topics were raised as a consequence of these discussions and are discussed below.

2. Accuracy usage

Correct interpretation of the accuracy rules for scaling ionograms can give trouble to scalers, partly because URSI, in UAG-23A, advocates three different methods for assessing accuracy:

- objective accuracy, or pure measures of accuracy, where clear error limits are placed on paramters using the observed ionospheric traces
- objective interpretation, or measures of consistency, where scalers make full use of their local knowledge of the ionograms to place limits on their interpretation of an ionogram.
- subjective assessment, or measures of peculiarity, where qualifier U may imply unusual and hence unmeasurable errors.

While objective accuracy is easy to teach, it can result in an unacceptable loss of data because little use can be made of extrapolation. For this reason, IPS stresses the use of objective interpretation. Two apparent departures from UAG-23A arise as a result of this:

- a descriptive letter may be used alone to indicate a loss of accuracy in scaling a parameter. This implies that, as far as the scaler is concerned, interpretation of the ionogram is consistent within 4%, but a subjective error of judgement of unkown magnitude may exist for reasons indicated by the descriptive letter.
- When using limit values qualified by E or D, the value scaled need not be the last visible portion of the ionogram trace near where the parameter is expected. Instead, it is the limit based on reasonable interpretations for the ionogram.

  Thus as an example, when the range of extrapolation exceeds 10%, and a limit value is appropriate, the limit used is that of the least possible, or greatest possible extrapolation - whichever is most appropriate.

This approach is harder to teach and requires practice before scalers can achieve consistency. However, it is essential that such an approach be adopted for complex ionograms, as are regularly recorded at high latitudes or during disturbed periods at other latitudes.

3. Interpolation

UAG-23A advocates that interpolation should be restricted to periods less than two hours and also specifies descriptive letters and parameters with which interpolation may be used.

In fact, interpolation is used at IPS only for obtaining an foF2 value for IUWDS rapid data exchange. There is no particular reason for limiting interpolation to these data and during the conference the value of interpolation was discussed.

In principle, interpolation can be used to supply a value for any slowly varying parameter, provided the parameter is not correlated with the phenomenon preventing it from being seen. For instance, when F region parameters are lost due to absorption resulting from particle precipitation, interpolation may not be appropriate because the regions of particle precipitation and F-region trough and ridge structures will often be related ionospheric structures.

INAG could reconsider the use of interpolation in three circumstances:

1) When a parameter is lost because there is increased attenuation in the vicinity of a critical frequency, interpolation would have to be used carefully. As this increased attenuation is sometimes augmented by low equipment sensitivity and regular diurnal changes in absorption, it may affect the same period each day. In these circumstances, the smooth variation of a parameter may be unknown.

2) By allowing interpolation for parameters which could be replaced by H, UAG-23A may confuse scalers. While disturbances can often be quite brief, allowing interpolation across the affected hour, appears to contradict the normal definition of interpolation. As many scalers know, there is rarely just one disturbance and when a disturbance is large enough to warrant scaling foF2 as replacment H, for instance, the F region can often be affected significantly.

3) When fxI was originally introduced, it was intended for used during periods of the day when its characteristics were essentially unknown. Thus interpolation would be inadvisable. However, if fxI is scaled for 24 hours of the day as a routine parameter, then interpolation appears appropriate at times. Furthermore, even at high latitudes where events within the E and F regions will be correlated, information may be lost if interpolation is not allowed. In this case researchers could regard values with the qualifier I as exploratory.

INAG should consider these areas and endeavour to expand the notes associated with interpolation so that further more numerical values may be obtained.

↑ write a note on this.

4. Identification flags

The presence of some ionospheric phenomena is apparent only when various descriptive letters are used. For instance, F on foF2 indicates spread F is present in the F-region. Provided clear conditions are set for recognizing a phenomenon, and when it reaches these limits it is always scaled, occurrence rates can be calculated using only the descriptive letters.

IPS has decided to formalise these conditions by introducing the term "flag". A flag is a descriptive letter, used with a particular parameter, which describes some ionospheric phenomenon. While the phenomenon may affect the parameter involved, it need not do so. For a flag to be useful for research purposes, it must have the highest priority of all descriptors scaled for the parameters to which it belongs. This is an important concept which is stated only implicitly in UAG-23A.

Thus, while descriptor F on foF2 is a flag for spread $\geq$ 0.3 MHz, on any other parameter F is a reason for a loss of accuracy. Similarly, Q on h'F is a flag for range spread exceeding 30 km.

If two flags are to be used on the same parameter, then an agreed heirarchy of usages must be established. This will allow researchers to have greater confidence in the occurrences associated with recorded flags.

Two phenomena that serve as examples of how flags can be used are lacuna and the presence of a 3-mode trace.

Lacuna has frequently been discussed in INAG. However, rather than use a new scaling letter for this important phenomenon, descriptor Y was retained with three different meanings - gaps in the trace, severe tilts and lacuna. IPS has decided to flag lacuna according to the conventions:

- if lacuna affects the E region, use Y with foE
- if lacuna affects the F1 region, use Y with foF1
- if lacuna affects the F2 region, use Y with M(3000)F2.

Y is then used on these three parameters only when lacuna is present. Y may also be used with other parameters affected by lacuna, thereby enriching the description of the ionogram. For instance Y on foF2 and M(3000)F2 can now by only lacuna.

Z-mode traces are observed infrequently at most Australian stations and is worthy of further study. IPS uses the flag Z for various situations:

- on foE if a Z mode is observed for the E region
- on foF1 if a Z mode is observed for the F1 region
- on M(3000)F2 if a Z mode is oberved for the F2 region.

If a z-mode and lacuna are both present for the F1 or F2 regions, Y over-rides Z. This choice is made partly because lacuna appears to be a more important phenomenon and partly because it is observed less frequently than z-mode traces.

M(3000)F2 was chosen to carry the F2 region z-mode lacuna and flags, in preference to foF2 or h'F, because at IPS, frequency and range spread are flagged on these parameters. While unconventional, it ensures no information is lost. If foF2 were used for both frequency spread and z mode, the z mode statistics would be rather incomplete if F took priority over Z on foF2. However, as spread is regarded as the more important phenomenon, Z could not supercede F as z modes are seen with no accompanying spread and their presence could distort the spread statistics.

5. Scaling aids

Various scaling aids published previously in INAG and UAG-23A were discussed in view of a proposed possible INAG bulletin devoted to scaling aids. We were surprised to find the various aids were open to a range of criticisms. Sometimes the drawings are imprecise and on other occasions it is not clear exactly where parameters have been scaled.

In view of the value placed on aids, irrespective of their shortcomings, it was felt that redrafting of some of the diagrams is advisable prior to republication. It could also be useful, where several scaling conventions now exist, to offer several scaling tables.

For aids to have full impact, there should be some reference to published ionograms similar to those portrayed in the aid. This is especially important where line diagrams represent fairly unusual ionograms.

6. Scaling M(3000)F2

Considering that M(3000)F2 is probably the second most important parameter scaled from an ionogram, there is relatively little guidance on how to scale it in either UAG-23A or in the INAG bulletin.

The discussion in UAG-23A on how to construct and use an M-slider is not clear. If the person reading that discussion happens to have a linear frequency scale, he is most infortunate. Similarly, accuracy usage with M(3000)F2 is rarely mentioned. While most scalers using manual systems had a reasonable concept of accuracy, it is less obvious for semi-automatic systems. INAG needs to stress these points and could do so by producing a scaling aid for M(3000)F2.

Often, the M(3000)F2 point of tangency can be measured more accurately than foF2. As more semi-automatic scaling systems are now being used, INAG should consider supporting the scaling of MUF(3000)F2 which can be calculated without reference to foF2 and is always more accurate than the equivalent value calculated from tabulated M(3000)F2 values.

It is not obvious how to scale M(3000)F2 when foF2 is affected by a disturbance described by H. UAG-23A states that M(3000)F2 should be scaled from "the regular layer as a whole", while foF2 is scaled from the top trace with respect of the stratification. When the stratification is wide enough in frequency with respect to the rest of the F2 region, the first point of tangency can be on the stratification rather than "the normal F2 region". Is M(3000)F2 read from the stratification, or not? If the transient stratification is ignored, and a point of tangency is found on the maintrace, then will not foF2 by inconsistent?

When the foF1 cusp is described by L and the M(3000)F2 point of tangency lies close to foF1, or below it, how is M(3000)F2 scaled and described? IPS and New Zealand felt the descriptor L was useful if tangency was within the F2 region and replacement L if it was in the F1 region.

7. F1 parameters

IPS felt that a training aid for foF1, M(3000)F2 and h'F2 combined could be useful, particularly as scaling rules associated with the appearance and disappearance of foF1 were changed at the 1981 URSI General Assembly.

8. Scaling spread

IPS has decided to adopt, as a definition for fxI the following:

fxI recorded = maximum of (observed foI + 0.5fB)

and (observed fxI)

which we believe will produce consistent fxI values.

On occasions, there can be more spreading on the o-component than on the x-component. In such cases INAG has recommended the usage (foI + 0.5fB)OB. IPS prefers the scaling OF, indicating that spread is different for the O and X components, especially when foI is much larger than fB.

In this condition, when foI is equal to or greater than fxF2, there can be an unknown error in the value of fxI. Such instances could be conveniently indicated by using descriptor F on fxI. Of course, if F is scaled on fxI as a flag, this is not possible.

For some time, IPS has scaled X on fxI when there is no F on foF2. This is also done automatically by some computer-based scaling systems. We have now decided to scale X only when there is no spread present on the F2 traces. Thus, occasions may arise when neither F2 or fxI has a descriptive letter.

IPS uses two local parameters for scaling spread F. This has allowed us to discriminate between resolved and unresolved spreading. INAG could consider introducing an alternate descriptive letter for F (on foF2) and Q (on h'F) when discrete spreading is observed. Possibly M or T would be appropriate.

9. E-region parameters

When several cusps appear in the E region at morning, it can be difficult to set simple rules for deciding which cusp to scale as foE. Experience usually overcomes this problem, but it does not necessarily yield a consistent solution. It has been suggested that foE should be scaled from the cusp controlling the MUF of the normal E-layer. Is it possible to construct a slider (similar to the M(3000)F2 slider) to quantify this statement? Would an M(1500)E slider be appropriate?

Australia and New Zealand have continued to scale particle E according to the rules prior to the 1981 URSI General Assembly and still discriminate between overhead and oblique particle E. However, judging by scalings in INAG-42, the change in the rules appears likely to create two disjointed data sets. INAG could consider making the following rule changes:

- whenever particle E is scaled (Es-k) or Es-r) the descriptive letter K is added to foEs and h'Es.

- when particle E is overhead (Es-k), it is also scaled with descriptive letter K in the foE and h'E tables.

Since IPS does not feel that oblique particle E (Es-r) can blanket, fbEs cannot give a useful value. However, this remains a subtle and disputed point.

10. Severe tilts

UAG-23A uses Y to describe "severe tilts" observed in ionograms. However, there is no clear indication what is meant by a severe tilt other than a rather special case of tilted F2 daytime ionograms requiring the scaling (foF2)EY. (See UAG-23A, p96, fig 3.34) This is usually a result of a major travelling disturbance.

On many occasions the entire F region can be tilted, as a result of large scale ionospheric features. At present, no descriptive letter exists to note this condition, although Y or H may be used.

INAG could consider refining the meaning of "severe tilt" to imply a tilted ionosphere and use descriptor Y for this, while broadening the definition of H to include all transient disturbances no matter how large or small.

Currently IPS adheres to the URSI conventions for using H and Y, but feels there is room for improving their usages.

11. Disturbed ionograms

In the future, much more use is likely to be made of ionograms recorded in near real time. INAG should be giving guidance now on how to discriminate between disturbances that are likely to be local to a station and those which indicate possibly larger spatial extent.

Features such as enhanced absorption - weaker traces than usual, spread occurring at times when it is rarely seen and the uncharacteristic appearance of foF1 are all indicators of a generally disturbed ionosphere. INAG should prepare lists of similar features together with guidance on how to make general interpretations of ionograms in real time. This is an old area that will become progressively more important as more ionosondes are used for real time HF management.

12. Conclusion

The three day operators' conference was successful in attaining its objectives, although the comments in this note show a number of areas where further discussions will take place. The good agreement on general scaling principles between Australia, New Zealand and South Africa was gratifying - as was the agreement over areas where further clarification from INAG is required.

The possible future of INAG was also discussed briefly and all those present declared that the INAG bulletins had been particularly helpful and expressed the hope that they would continue to appear in the future.

Comment There are several interesting points raised by the IPS operators conference. The Chairman and Secretary often comment or attempt to answer the queries raised. Sometimes, we feel that this approach limits the discussion so on this occasion no comment is provided and it is hoped that other groups will respond to the provoking ideas provided by Dr Wilkinson and his colleagues.

7. SOME PROBLEMS IN Es ANALYSIS

by W.R. Piggott

I have recently been studying Es over Western Europe and have noted certain difficulties in the use and interpretation of the data. These are discussed below.

Night-time interference

The most common fault is to operate the ionosonde at too high a gain at night with the result that for considerable bands of frequencies, ionogram traces are obscured or missing. The best solution is usually to switch an attenuator so that the signal entering the receiver is adequately decreased. Typically 20dB to 30 dB is needed and with very large receiving antennas even more. Attenuators cut down cross-modulation at the early stages of the receiver as well as minimising over-loading. Simple relays are quite adequate for this if crudely screened. Decreasing the receiver gain at night helps considerably but does not decrease the cross-modulation which is now the main problem nearly everywhere in the world.

Weak trace rules

A few stations have large enough antennas and sufficient signal to noise ratio to record weak partial reflectins from steep gradients to high frequencies in the daytime. Such traces should be ignored under the weak trace rule in standard analysis: if there is difficulty in deciding whether the trace is weak (e.g. with ionosondes with short time constant differentiating circuits), a decrease in gain of about 10dB will usually solve the problem without significantly altering the analysis of other parameters. As has been stressed by Dr Turenen, too much sensitivity is counter productive, particularly in Es studies. The presence of these weak traces can be recognised readily from the tabulated data since foEs increases to large values without corresponding changes in fbEs. For proper Es traces, there are close relations between foEs and fbEs with the count of high values of the former being about three times that at the same frequency for fbEs. (The statistics are most regular using foEs and fbEs-foE). For research purposes, it is generally best to reject data from stations at which foEs is influenced seriously by weak trace problems.

Use of ftEs

A few stations have occasionally used ftEs, the top frequency of an Es trace, instead of foEs or fxEs. In my analysis, this caused sufficient perturbation of the statistics to prevent the data being useful except for high values where ftEs is the same as fxEs. Lindau had used this convention systematically and I made great efforts to use the data, but found it impossible. Therefore, foEs should always be scaled. (As far as I know no station now used fxEs though several did thirty years ago.)

Low Es

Except at high latitudes, most low Es in Europe shows foEs < foE. Gradient traces can be relatively important at these frequencies but are normally rejected under the weak trace rules. Special care is needed when foEs for low Es is greater than foE and there is no other Es trace present with a larger value of foEs since a gradient can be easily mistaken for a true value of foEs > foE. In comparisons between daytime counts of Es, this confusion shows up as a significant but apparently uncorrelated decrease in the number of occasions no Es is seen at the station relative to those of other stations within a few hundred kms. The latter are usually significantly correlated.

Total blanketing

Many stations use replacement letter A for fbEs when total blanketing is present, implying fbEs = foEs. This considerably increase the work of anyone using the data as these relatively high values are very important and have to be identified from the foEs table. This is very time consuming. It can give errors when done by hand and involves a special programme when using a computer. It also means that foEs=fbEs for all cases of total blanketing. This is usually true for less than one half of the events and is therefore misleading.

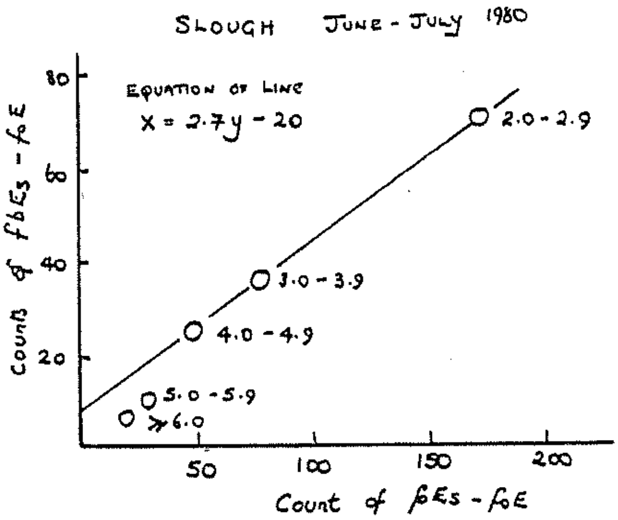
Use of AA, AT with total blanketing

The use of AA in total blanketing has been rather irregular at most European stations. A few stations some of the time, and more all of the time use (fbEs)=(foEs) AA for all cases of total blanketing. This is incorrect and can seriously modify the statistics of fbEs (see below). The Handbook stresses the need to look at the top frequencies of multiple Es traces so as to identify fbEs when total blanketing is present. Some stations have followed this instruction for most of their analysis and the French network have adopted a local rule that values of fbEs deduced from multiple traces be described (fbEs) AT or (fbEs)-T if the numerical value is likely to be within the accuracy rule limits for good observation. This is most helpful to those analysing the data and could be adopted by INAG for worldwide use if so agreed. Your comments are invited.

Effect of incorrect use of AA

Using data which appears to be correct the typical relations betweent the counts of (fbEs-foE) and (foEs-foE) are similar to those found at Slough and shown in the figure. The counts of no Es, indicated by the replacement letter G, and of values of (foEs-foE) below about 2 MHz are much greater for (fbEs-foE) than for the corresponding (foEs-foE) but above this level the reverse is true. Depending on the amount of Es activity the slope a, of the relation

$$(foEs-foE) = a(fbEs-foE) + b$$



is between 2 and 3, with the counts of the highest values of fbEs-foE often falling below the line of best fit. The effect of putting fbEs=foEs is to increase the apparent count at the higher intensity levels for the blanketing events, which are mostly high values thus decreasing the value of a and tending to make the counts at high intensity levels be above the line of best fit - the opposite to that which probably really occurs. This also modifies the shape of the distribution of counts above a given level for fbEs. In my rather limited samples, the densest part of an Es cloud, as shown by (foEs-foE) only passes over the stations, as shown by (fbEs-foE) for about one quarter of the very intense events implying that the very intense clouds are highly localised.

h'Es

h'Es is normally measured to the nearest 5 km, at a few stations to the nearest 2 or 2.5 km. The latter appears to be scientifically worthwhile, at least for changes in h'Es. However the statistics show clearly that a significant minority of stations in practice measure to he nearest 10 km - a quite inadequate evaluation of h'Es. Most stations show small systematic differences in the means of the hourly median values probably due to inadequate allowances for receiver delay times (typically equivalent to 2-15 km in h'Es). These may often be identified by comparing mean values of h'Es at different stations. Some rather serious errors have been found up to 35 km! These would, of course, cause corresponding errors in h'F and M(3000) F2 which do not appear to have been detected as all the data are wrong for periods of many months.

While it is complicated and time consuming to measure height data with a true accuracy of 2 km, in practice it would be valuable to read to this accuracy even if the corrections for echo amplitude and receiver delay were not applied. The great majority of the data would be consistent, at any one station, to the nearest 2 km in this case.

Use of D, E and U

Too frequently D or E are used for foEs and fbEs in an interference band when the accuracy rules would allow the centre of the band to be adopted with US. This is particularly evident at some stations after midnight when the interference levels fall and the bands contract.

An interesting but I think mistaken convention has been adopted by at least one station. Logically mostly both foEs and fbEs in an interference band foEs must be greater than the lower limit of the band i.e. lower limit DS while fbEs must be less than the upper limit of the band upper limit ES. As, in most statistical work, limit values have to be treated as real values this makes fbEs consistently greater than foEs instead of consistently less than or equal to it. Also it causes difficulties in the calculation of the medians. The Handbook rule, to use the value which is most helpful for median calculation when either can be used, automatically makes most of these values fbEs=(lower limit) DS minimising the distortion of the fbEs statistics.

When using logic, it is essential to consider the effects of the logical conclusion. These are usually beneficial but in this case produce disastrous consequences. I have been able to use the data by averaging foEs and fbEs in these limit cases and using them as if they were U values but this involves much work which is generally not justified.

In conclusion, I think that it is easier to identify and reject foEs data influenced by partial reflection traces than to solve the problems of fbEs and the former has much larger counts of strong Es than the latter. This minimises the sampling error problem which usually limits the usefulness of hourly data. Thus I have studied foEs and (foEs-foE) in preference to the more usual studies of fbEs.

8. A COMPARISON OF SCALING ERRORS FOR 3E AND 4B IONOGRAMS RECORDED BY IPS

by P.J. Wilkinson, Ionospheric Prediction Service, Australia

Introduction

Scaling errors in ionospheric characteristics scaled from ionograms recorded by 3E ionosondes were discussed in an earlier study (INAG-27, p20) where it was shown that errors associated with IPS data are within the URSI accuracy limits as set out in the URSI Handbook of Ionogram Interpretation and Reduction (Piggott and Rawer, 1978). However, the ionograms used for that study had a different format and appearance from those recorded on the current IPS ionosondes, the 4A and 4B series (see INAG-39 for examples of the 4B and IPS-42 ionograms). The basic differences in presentation are:-

- the 4A and 4B series ionograms have clearer station identification height and frequency markers than the 3E ionograms,
- interference is removed from the 4A and 4B ionograms using simple signal processing techniques,
- the 4A and 4B ionograms display virtual heights up to only 800 km whereas 3E ionograms could display up to 1000 km.

Because of these differences in the ionogram format, a second scaling exercise was undertaken in 1978, to ensure scaling accuracy had remained within URSI standards. As the commercial version of the 4A and 4B series of ionosonde, the IPS-42, has essentially the same format as the 4B ionosondes, and is installed at over 40 sites in the world, the results of this study now have wider significance.

A full day's ionograms were obtained from the Australian stations Vanimo, Townsville, Norfolk Island, Canberra and Hobart.

Six people scaled the 4B test film - five station operators and a scaling supervisor. To allow direct comparisons between the current 4B analysis and the previous 3E analysis, the 3E data were re-analysed by the same six people. Note: heights were measured to 1 km from the 4B ionograms and to 5 km from the 3E ionograms so the height results are not directly comparable.

Results

1. Provided ionogram production is good and the ionosphere is undisturbed, values should be scaled within the scaling resolution limits proposed in UAG-23A and shown in Table 1 under the heading 'minimum scaling division'. The median error in scaled values is an estimate of scaling errors for reasonably uncomplicated ionograms, or more precisely, an estimate of objective errors, and should be less than the minimum scaling division. In this context, objective errors are practical errors associated with deciding where to make a measurement. Table 1 shows all characteristics are measured within this limit (sometimes well within it) for both 3E and 4B ionograms, and even more so for the subset of those values scaled without any descriptive or qualifying letters which are labelled 'good' in Table 1.

2. Errors associated with interpretation of the ionogram are allowed for by using descriptive and qualifying letters. These are often subjective errors and are best measured by the upper decile differences. The rows 'c' or Table 1 show that the subset of 'Good' 3E and 4B ionogram characteristics agrees within about 5%, or the minimum scaling division, except for foEs, and the same is true for over half the characteristics when all the data are used.

3. The previous analysis of 3E ionograms showed that M(3000)F2 accuracy was poor. It is now apparent that poorer scalers contributed significantly to this result as the subset of 3E scalers analysed in the present exercise show greater consistency than in that analysis. The present analysis shows M(3000)F2 to be scaled more accurately for the 4B ionograms than the 3E ionograms. Some scalers suggested M(3000)F2 was easier to scale from 4B film, but others disagreed with this, so we can suggest no consistent reason for the increased scaling accuracy.

4. Errors associated with scaling sporadic-E parameters are large and relatively similar for both sets of ionograms.

5. Tables 2A and 2B both show that there is good agreement between letter usages associated with the 3E and 4B ionograms. Even the off-diagonal entries show similar percentage occurrences. If percentages associated with sample sizes greater than 20 are assumed significant, then there are very few inconsistencies between the two sets of data.

6. The agreement between off-diagonal entries in Tables 2A and 2B suggest that there are some consistent differences of opinion between the scalers and these have not been affected by the changed format of the ionograms scaled. This appears to be good evidence showing that the ionogram format has not significantly affected scaling interpretation.

TABLE 1 - ERRORS IN SCALED VALUES

		ALL		'GOOD'		Minimum Scaling Division	SAMPLE SIZE		
		4B	3E	4B	3E		4B	3E	
foF2	A	0.06	0.01	0.06	0.01	0.1 MHz	795	1195	ALL
	B	0.2	0.2	0.2	0.1		569	535	GOOD
	C	3.4	4.3	3.0	1.9				
fxI	A	0.06	0.01	0.01	0.06	0.1 MHz	773	1342	ALL
	B	0.3	0.2	0.1	0.3		14	445	GOOD
	C	3.0	3.6	2.2	4.8				
foF1	A	0.01	0.01	0.01	0.01	0.1 MHz	366	407	ALL
	B	0.1	0.1	0.1	0.1		162	173	GOOD
	C	2.3	2.5	2.2	2.4				
foE	A	0.03	0.03	0.007	0.007	0.05 MHz	376	600	ALL
	B	0.2	0.2	0.1	0.08		108	209	GOOD
	C	4.6	4.9	2.9	3.1				
fmin	A	0.01	0.01	0.01	0.01	0.1 MHz	821	1456	ALL
	B	0.1	0.1	0.1	0.1		441	780	GOOD
	C	6.4	10.0	5.7	8.1				
foES	A	0.06	0.06	0.02	0.06	0.1 MHz	561	738	ALL
	B	0.5	0.5	0.4	0.4		460	684	GOOD
	C	15.0	11.9	11.9	9.9				
fbEs	A	0.01	0.01	0.01	0.01	0.1 MHz	554	728	ALL
	B	0.2	0.2	0.1	0.1		324	441	GOOD
	C	6.4	8.4	5.0	6.0				
M(3000)F2	A	0.03	0.05	0.03	0.03	0.05	678	979	ALL
	B	0.08	0.2	0.08	0.1		593	580	GOOD
	C	2.6	5.4	2.5	3.4				
h'F	A	1.6	0.7	0.6	0.6	5 km	661	1112	ALL
	B	10.4	7.8	5.6	5.6		174	435	GOOD
	C	4.3	3.0	2.5	2.4				
h'E	A	1.8	0.7	2.3	0.6	5 km	366	539	ALL
	B	6.5	10.3	6.4	5.6		251	339	GOOD
	C	5.6	8.4	5.6	4.9				
h'Es	A	1.4	0.6	1.4	0.6	5 km	561	792	ALL
	B	5.4	5.6	5.3	5.6		542	743	GOOD
	C	4.4	4.9	4.3	4.9				

TABLE 2A. QUALIFYING LETTERS .

MODE								SAMPLE SIZE
b	90 90		1 1	3 3		 1	5 5	1911 2794
A	9	87 100		4				11 1
D	26 17		63 64	2 2	 5	3 1	6 12	13 21
E	15 20			81 80			3 2	291 147
J	25 15		4 4	4 2	64 73	 2	4 6	4 33
O	27 11		2 5			71 83		9 47
U	28 25		1 3	1 4			69 67	137 125
	b	A	D	E	J	O	U	ALTERNATE

TABLE 2A. Qualifying Letters.
The percentage occurrence of the qualifying letter used by the majority of scalers (the mode scaling) together with the occurrence of alternative scalings are tabulated in rows. b is used to indicate occasions when no qualifying letter was scaled. The sample size (the total number of ionogram characteristics) is given to the right of each row. The upper figure in each row gives the occurrence for 3E ionograms and the lower figure is for 4B ionograms. All percentages are rounded off to the nearest 1%.

TABLE 1. Errors in Scaled Values
The estimates of error in values for the ionogram characteristics scaled are given for all the available data (labelled ALL in the table) and for the subset of the data for which scalers did not use qualifying or descriptive letters (labelled 'Good'). Three statistics are quoted for these error estimates and labelled:

A. The median difference, which is an estimate of the objective scaling errors and which should be equal to, or smaller than, the minimum scaling division shown in column 5.

B. The upper decile difference, which is an estimate of the subjective scaling errors. The upper decile difference for the 'Good' data subset should be comparable to the minimum scaling division.

C. The upper decile of the percentage difference from the median scaling, which is an alternative estimate of subjective errors, and which should be less than 5% for 'Good' data.

The sample sizes for the various sub-divisions of the data are also included.

7. As with the previous study, type of sporadic-E was not scaled well, there being considerable mixing of high, cusp and low type sporadic-E, lending partial support to the URSI recommendation that these three types should be grouped under the single type W - world type sporadic-E. (Results not shown.)

8. A comparison of the subset of 3E scalers presented here with the previous analysis (INAG 27) suggests an overall scaling improvement associated with more experienced scalers. The differences between the two sets of 3E results suggest that scaler differences far outweigh any ionogram format differences.

A more detailed account of this work has been published in an IPS-R Series Report.

TABLE 2B. DESCRIPTIVE LETTERS

MODE	b	A	B	C	E	F	G	H	K	L	N	Q	R	S	V	X	Y	Z	SAMPLE SIZE / ALTERNATE
b	88 89	2 2	1 1	 1		1	1 1	1 1				1	1 1	2 3					1342 2189
A	9 11	82 80	2 1	 1			1	1 2	1			 1	2 3	2 1					196 180
B	8 19	1 3	80 67	8 7	1									2 5					107 32
C	30 15			61 80									5 1	 2		4 1			8 119
E	5		7		65									22					39 -
F	7 8					88 75		1					1	3 17					162 12
G	14 28		3				78 72							4					65 3
H	18 16	2 1		 1		1 2		71 76		 2		3	2	1	1		1 2		49 43
L	13 11	 1		 1				11 6		76 82									27 55
Q	12 17	5 13	1 4	 4	1			1				64 63	1	14					22 4
R	19 15	6 6	1	 2		2	 1	5			1		57 59	2 8			5 10	2	17 19
S	11 15		4 3	 11	3	1	1						 5	79 64		1 1			227 254
X	3 1												2	2 1		94 97			114 253
Y	7	 10						21					 10				71 80		2 5

TABLE 2B. Descriptive Letters.
The same format as Table 2A is used for the descriptive letters.

9. RETIREMENTS OF IRENE BROPHY AND RICHARD SMITH

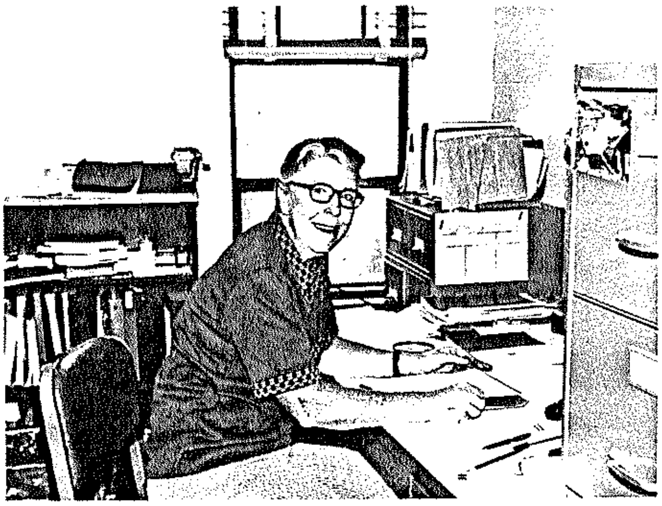
The World Data Centres in Boulder and in Didcot saw the retirement of two of the most experienced ionogram interpretation experts in the world, Irene Brophy and Richard Smith. A short tribute to each of them is given below.

Irene Brophy

Irene Brophy retired from the World Data Center A in Boulder at the end of 1983. She will be missed by the ionospheric community as she was one of the outstanding interpreters of vertical incidence ionograms and an excellent trainer of new station personnel. Irene began her career in October of 1956 in the Data Review and Research Group of the Sun-Earth Relationships Branch of the Radio Propagation Division of CRPL headed by Alan H. Shapley and Robert W. Knecht. Her training was under the tutelage of Lucile Hayden and Stanford Gladden. At that time, the goup monitored and supervised the data reductions of 48 ionospheric observatories. Also personnel were trained for the U.S. Antarctic stations and for the ten stations operated by the U.S. Army Signal Corps. In addition, Irene assisted in the publication of 'Ionospheric Data' and in the compilation of prints selected for the 'Atlas of Ionograms'.

In October 1965 with the creation of the Environmental Sciences Services Administration, she worked in the Institute of Telecommunication Sciences. For the next five years the emphasis was on ionogram analysis for special projects. For example, ionograms from the worldwide network were analysed to assist the Gemini IV flight co-ordinated from the Manned Space Flight Center in Houston. Another example was the preparation of electron density profiles for the November 1966 solar eclipse. In May 1969, Irene and Lucile Hayden transferred to the Ionospheric Predictions Branch under Margo Pokempner. Their work then concentrated on computerised electron density profiles and the analysis of topside ionograms.

After the creation of the National Oceanic and Atmospheric Administration, Irene and Lucile transferred in August 1970 into the World Data Center A for STP under J. Virginia Lincoln in the National Geophysical and Solar-terrestrial Data Center directed by Alan H. Shapley. From March 1972 Irene was manager of the vertical incidence ionospheric data. She served as deputy to Raymond O. Conkright, Chief of the Ionospheric Branch, beginning in 1974. Data reduction continued for special requests and for training purposes. However, her major duties involved archiving, acknowledging and cataloging the data received from the worldwide network of ionospheric



stations and from other World Data Centers. She prepared the WDC-A data for international exchange and supplied upon request, copies of the data in the archives. Close contacts for training in data reduction continued with the staff of Maui, Boulder and Wallops Island stations.

Irene lists as highlights of her career the IGY and IGC period, Boulder's hosting of the International URSI meeting in 1957, the launch of Sputnik I, work with the U.S. space programme, trips to Wallops Island, Point Arguello and Maui, and assistance to the many wonderful visitors who made brief or extended visits to Boulder to work with the ionospheric archives. She received much gratification from acknowledgements for her services received by letter, or given in publications.

World Data Center A for STP will not be the same without the devoted services of Irene Brophy in the field of vertical incidence ionospheric data. With her retirement, an era of U.S. specialisation started with the IGY has come to an end.

Irene's personal feelings are expressed: 'Upon my retirement I received many beautiful cards and letter from so many people that I have met in person, over the telephone or by correspondence over these past years and I would like to say "Thank you" to each and every one of you. I really enjoyed by working years and meeting so many of you. You made my job very special. Thank you all so much for the many years of cooperation and assistance. Your "well wishes in my retirement" are deeply appreciated.'

Richard Smith

Richard Smith is well-known to readers of this Bulletin for his aids to analysing and numerous other contributions and to the community as a whole for his help as officer-in-charge of the World Data Centre - CI for the Ionosphere, Rockets and Satellites. He retired from this post on 31 December 1983.

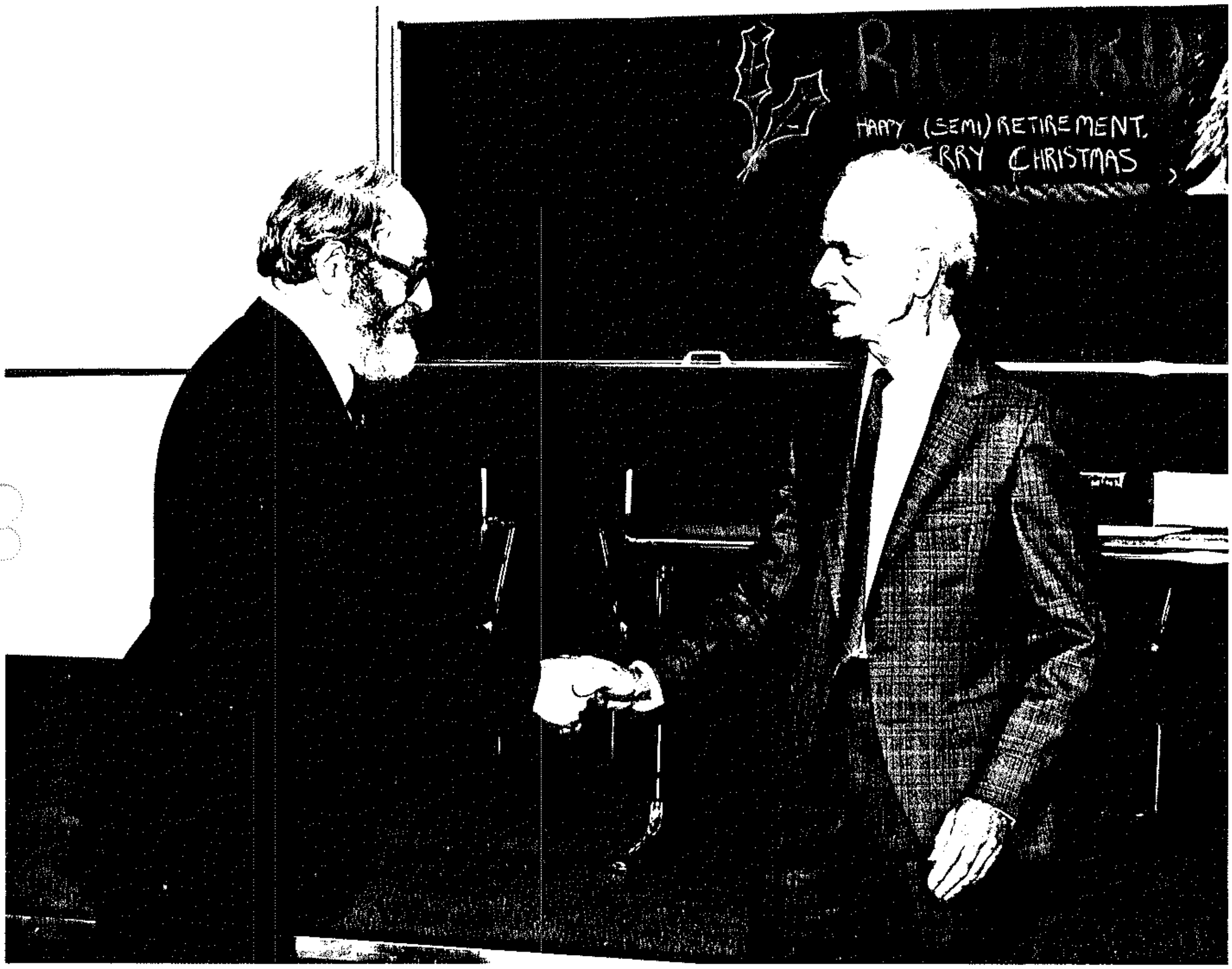
Richard originally joined the Radio Research Station at Slough in November 1941 where his first job was to work with me (W.R. Piggott) on the measurement of ionospheric absorption by the pulse method (Al) and with Mr Naismith on producing Slough ionograms, then made semi-automatically. He quickly became highly proficient and took over the routine absorption measurements from me. He also helped greatly with some of the war-time projects involving ionospheric propagation in particular position-finding using the ionosphere. This was usually carried out after the station was closed, thus in effect he was doing two days work per day!

He took one of the early DSIR automatic ionosondes to Loth in Scotland for the first post-war eclipse in 1945, producing excellent ionograms. In 1951, he was appointed officer-in-charge of the R.R.S. ionosonde observatory at Singapore staying till 1954

In 1967, he rejoined me to help with the training of ionosonde staff for the British Antarctic Survey and the observatory at Port Stanley. One of his notable trainees was our present Secretary, Alan Rodger. His comments on the problems of training helped me greatly in the planning and writing of the second edition of the URSI Handbook. INAG and the community owe him a great deal of gratitude for this, largely hidden, work on their behalf, that was characteristic of the man. Like several other members of the Research Station he met his future wife while both were working for me, in what was later called "Piggott's Marriage Bureau".

His work at the satellite tracking station at Winkfield on the first transistorised rocket and satellite equipment and with me on the Ariel 3 satellite data gave him a good background on these techniques. In 1973, he was put in charge of the World Data Centre - CI for the Ionosphere, Rockets and Satellites at Slough where his unique experience, care for detail and enthusiasm resulted in a very efficient and helpful WDC. All who have used this Centre will remember with gratitude his willingness to stop what he was doing to help his visitors, his monitoring of the in-coming data his wide knowledge of the data in his care and his helpful comments on the users problems. In recognition of his continued excellent service he was awarded a special medal by the Queen in her Jubilee year, 1977.

The smooth operation of world wide monitoring of our environment depends critically on the work of people like Richard Smith who continue to support essential services without much recognition. I am sure that you would wish me to convey to Richard our best wishes for a happy retirement, making full use of the book of European birds and gardening implements presented to him on his departure.



10. THE SCALING OF PARTICLE-E

by P.J. Wilkinson, Ionospheric Prediction Service, Australia

1. Definition

(Pre-Washington 1981) Particle E is a thick overhead layer which totally blankets up to its critical frequency, foEs. The conventional scaling for particle E was the top frequency of the o-component and was scaled (foE)-K, (foEs)-K, (fbEs)-K and the height was scaled (h'Es)-K, (h'E)-K.

2. Discussion

For some time prior to Washington, it had been realised that particle E was seen both as an overhead layer (Es-k) and obliquely (Es-r) - the latter state being identified as retardation sporadic E. There was little disagreement over the identification of Es-k, but the definition of Es-r was gradually modified from the early IGY definition, which did not allow Es-r to blanket.

Simplistically, Es-r - an oblique layer - cannot blanket an overhead layer. However, realistically, Es-r and Es-k merge and may also be augmented by increased absorption due to more energetic particle precipitation. Furthermore, the F region is not necessarily overhead. These factors produced complex scaling situations and URSI adopted an easing of the Es-r definition after IGY, allowing partial blanketing in its definition.

Unfortunately a degree of blanketing was now introduced, which in time has further complicated the discrimination between Es-r and Es-k. At Washington, networks with severe training problems persuaded URSI to relax its definitions further and lump all particle E types under the one title Es-r. This has resulted in some networks scaling Es-r and Es-k using the old URSI rules and some just scaling Es-r for both types. The two data sets, as defined, are inhomogenous. This is an unsatisfactory situation.

3. Resolution

Accepting that many stations are now going to scale Es-r for all particle E layers and in many cases describe these layers by K, I feel the rules associated with particle E should be changed to accommodate all parties.

i) If a (thick) particle E layer is present and foEs should be scaled from it then foEs and h'Es tables should include the descriptive letter K.

ii) If the layer is oblique, or if there is no discrimination between oblique and overhead layers, enter the Es type as Es-r.

iii) If there is discrimination between overhead and oblique layers, and the layer is overhead
   (a) Scale as Es type k and add to foE and h'E tables with descriptor K.
   (b) If the particle E layer does not give foEs, only scale it in the foE and h'E table, type k now being the second Es type.

By this definition, data described by K in the foEs and h'Es tables refer to all particle E layers (overhead, k, or oblique, r) whereas data described by K in the foE and h'E tables refers only to overhead particle E.

For the various reasons mentioned in the section 2, fbEs becomes a nuisance. If particle E is overhead, it is scaled as the top frequency of the layer and is described by K. However, when particle E is oblique, blanketing is a problem as indicated above and a problem which is increased when Es-r refers to all particle E layers.

While not accepting that Es-r can blanket, I feel obliged to accept whatever the appropriate value of foEs present as fbEs described by K. However, should a scaler feel this is inappropriate in specific circumstances, especially in association with Es-r, I feel the scalers assessment should be accepted.

4. Summary

	using K	not using K	using K	not using K
foEs	---K	---K	---K	---K
fbEs	---K	---K	---?	---K
foE	---K			
Type of Es	k	r	r	r
h'Es	---K	---K	---K	---K
h'E	---K			
	overhead		not overhead	

The various scalings are shown in the table. By using descriptive letter K for all particle E layers and by flagging overhead particle E by Es-k, together with foE and h'E, both versions are made homogenous. The only problem is scaling fbEs for Es-r when Es-k can be used. I do not think INAG should make recommendations here.

11. OBSERVATION OF SLANT SPORADIC-E

by Daverka P. Grubor, Geomagnetic Institute,
Grocka, Yugoslavia

Although ionospheric observatory at Grocka (44°38'N, 20°46'E), near Beograd, is a typical midlatitude station, occasionally, slant Es trace appears on the ionograms. Considering the invitation to ionogram scalers, (INAG 39), an analysis of slant Es appearance, during 1982, was carried out.

Observations are as follows.

a) Mostly, Es-s occurred at the night hours. 2000-0300 LT.
b) The occurrence of Es-s does not appear to be associated with any unusual phenomena. The values of foF2 and h'F were in agreement with medians.
c) In the case of 32 most intensive magnetic storms as reported by several Northern Hemisphere stations during 1982 in Solar-Geophysical data issues, 23 corresponding occurrences of slant Es were recorded on the ionograms. In five cases comparison was impossible due to the lack of ionospheric data. Two examples of Es-s appeared in the periods when there was no major magnetic storms.
d) Slant Es trace was always weak and usually non-blanketing.
e) The rise of virtual height was variable. Height difference between the point of rising and the point at which the trace is still visible, (2.4 MHz and 3.7 MHz respectively, on an average), was changing from 100 to 250 km. In some cases Es-s rose from satellite trace, above normal Es-f trace. Often a multiple, due to mixed reflection, was present.

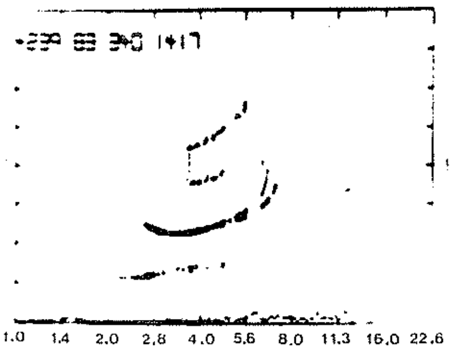
The sequence of ionograms recorded on 6th December 1983, between 1408 and 1445 shows a formation of decay of day time Es-s. Only ionograms for 1411, 1417 and 1445 are reproduced here. The corresponding storm, on a ground base magnetogram from geomagnetic observatory of Geomagnetic Institute at Grocka, was registrated.

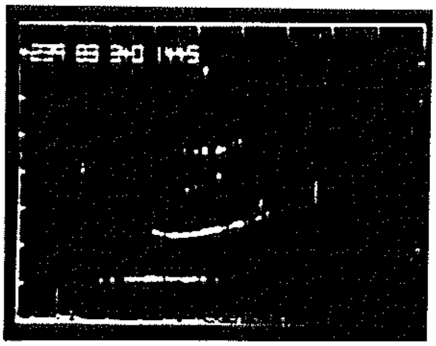
Further investigation is in progress, with the aim of understanding the facts mentioned above.

Comment by Alan Rodger

I was very pleased to reveive this contribution which has been stimulated by the discussion and example ionograms published in the recent INAG bulletins.

The ionogram sequence reproduced above, together with the morphological description suggest that some differences may exist between this type of Es-s layer and those observed at higher and lower magnetic latitudes. For example, these ionograms from Grocka are the first occasion, which I have seen, that show the presence of an N-reflection (see UAG-23A section 1.9) at the same time Es-s has been scaled. The sequence also shows that the virtual height of the Es-s layer at a fixed frequency steadily falls towards the end of the event. By 1445, the Es layer should no longer be scaled as Es-s but as an Es-c layer. The interpretation of both the change of virtual height with time and the presence of the N-reflections throughout the sequence strongly suggest that the Es-layer is seen at oblique incidence at the beginning of the sequence and gradually moves overhead.





This gradual temporal and probably spatial variation of the Es-s layer is rather different to Es-s observations at high magnetic latitudes, where the appearance and disappearance of Es-s layers is more rapid and the character of the Es-s layer changes little through the event. Dr Grubor reports that Es-s is mainly a night-time phenomenon, whereas at high and low magnetic latitudes it usually occurs during the day.

I would be very interested to hear of other analyses which have been performed at other stations, to see if a global pattern of the occurrence and morphology of Es-s can be established.

12. INTERNATIONAL DIGITAL IONOSONDE GROUP (IDIG) BULLETIN NUMBER 5

by J.R. Dudeney, British Antarctic Survey, UK

1. Introductory comments

This bulletin looks forward to the forthcoming URSI General Assembly which will be held in Florence, Italy from 28th August to 5th September this year. At this Assembly I will present a report of the group's activities since the last Assembly (held in Washington) and convene a business session of our group. We do not have any scientific sessions devoted specifically to our topic area, but there are several sessions of relevance which were itemised in section 4 of the last Bulletin.

2. Progress on action topics

The IDIG executive meeting held in Boulder, Colorado in August 1982 carefully reviewed the sorts of problems it was pertinent and practical for IDIG to address. Bulletin 4 reported on these in some detail. Briefly, they were:

a) Development of a standard nomenclature for ionospheric parameters. A draft scheme was presented in Bulletin 4 with an invitation to comment.
b) Preparation of a discussion document on alternative approaches to introducing N(h) parameters.
c) Benchmarking of auto-scaling techniques.
d) Development of a hierarchical framework for data interchange. A draft scheme was proposed in Bulletin 4 with an invitation to comment.

I am very sorry to have to report that progress since the distribution of Bulletin 4 has been nil for all these topics. For this, I as chairman must carry the responsibility, and I intend to offer my resignation at the Assembly. However, I would like to point out that I have received no response from anybody (including my two vice-chairmen) to any of the contents of Bulletin 4. I am frankly dismayed by this state of affairs and have radical suggestions to make an attempt to rectify them (see section 4 below).

3. IDIG View in various matters

In Bulletin 4 I presented what I perceived to be the concensus view of the membership on several topics, and invited comment. The topics were:

i) Remote sensing within URSI;
ii) the proposed merger of commisions G and H;
iii) IDIG's relationship with IAGA.

Again, I have received no comment from anybody on these issues. Thus, if I deem it necessary to present an IDIG view at the forthcoming Assembly on any of them, it will be on the basis of Bulletin 4.

4. Plans for the forthcoming assembly

I shall present a written report to the business session of Commission G detailing IDIG activities. It should be clear by now that this will make pretty dismal reading because there has been precious little activity. I do not believe that this is because there is little useful for the Group to do. Indeed, I consider the topics identified by the executive meeting to be very relevant and important, particularly the establishment of sensible protocols for data interchange. Rather, I feel the inactivity results from a combination of an executive which (for whatever reason) has not devoted sufficient time to be effective, an almost totally apathetic membership, and a good measure of political, commercial and personality infighting which has stunted what little progress there might have been. Because of this I shall resign and I expect the vice-chairmen to follow suite. I shall suggest that the case for continuing IDIG in its present form be critically examined. In this examination, we should consider three possible courses of action:

1. Maintain IDIG as it is. This would be on the basis that there was perceived to be both much useful work to do and people willing to do it.
2. Merge with INAG. It should be noted that INAG has reached a watershed in its activities, precipitated by the impending resignation of Dr. Piggott and Alan Rodger from the posts of Chairman and Secretary respectively. It may well be that the way forward for both groups is to amalgamate so as to pool the precious resource of active, able people. The two groups already have many areas of common interest, and these are likely to converge still further in the future.
3. Disband IDIG completely.

If there is strong support for continuing the group as an independent entity, and new people willing to devote the necessary time and energy to do it, then I recommend the executive structure be changed. The current arrangement of having a Chairman and two Vice-Chairmen but no Secretary has not been successful. I shall suggest instead that the group has a Chairman, a Secretary, and a small cardre of active members (say four) as an executive. It is most important, however, that the people chosen have the enthusiasm, vision, and above all, the time, available to make a significant contribution. Without this it would be best to disband.

If you have any views whatsoever on my proposals, if you think I have maligned you, or if you have comments of any sort of relevance to IDIG, PLEASE let me know.

13. WORKSHOP ON LOW LATITUDE IONOSONDES

by P.J. Wilkinson, Ionospheric Predition Service, Australia

A workshop on the use of ionosondes at low latitudes was held on an evening during the Seventh International Symposium on Equatorial Aeronomy ISEA7 held in Hong Kong between 22 March and 29 March, 1984. About 40 people attended the workshop. This report summarises comments made both during and subsequent to the meeting together with some of my own impressions.

Station reports: Brazil reported that it is opening five new stations. Indonesia has opened one station and will probably open a further three.

The workshop submitted a resolution to ISEA7 supporting Huancayo ionosonde station as a key location and stresses that funds should be found to keep the station in permanent operation.

Techniques and ionosonde operation: Unavailability of spare parts for old style ionosondes will possibly force the closure of some stations in the future. While no stations were specifically named, the general problem was stressed. Possibly INAG could consider ways of advertising available spare parts of old ionosondes.

Many stations currently use 35 mm film, but are finding film costs increasingly expensive. While 16 mm film is cheaper, camera conversions are not always simple. INAG should study such conversions and, where possible, publish conversion information and recommendations on the use of 16 mm film for recording ionograms.

Low latitude supplement: Feelings here were divided. Some felt that no extra scaling guidance, beyond that given in UAG-23, was required for scaling low latitude ionograms, while others supported the general idea of producing a low latitude supplement. However, nobody feld strongly enough about the low latitude supplement to propose a workshop resolution supporting its production.

If INAG could obtain articles from each of the low latitude ionosonde networks over the next three years, then these articles could form the nucleus for a more substantial discussion on the value of a low latitude supplement at the next Equatorial Aeronomy conference in 1988.

INAG: Few present in the audience received INAG bulletins and indeed one person had experienced considerable difficulty getting on the INAG mailing list. While the general concept of the bulletin was quite strongly supported by both professional scientists (who wished to remain in contact with ionograms) and station operators (who wished to improve their scaling), it appears likely that INAG is not reaching either of these audiences as effectively as it might. Hopefully both these problems can be discussed during the forthcoming URSI General Assembly.

Ionosondes and research: Two broad groups using ionosondes at low latitudes could be identified; those who use ionosondes during complex experiments such as rocket probes and incoherent scatter radar experiments, and those who use ionosondes for routine measurements for supporting communications. While this latter group includes researchers carrying out synoptic studies of the ionosphere, most regarded a single ionosonde as an inadequate research instrument.

Comparisons between ionograms from digital ionosondes and conventional ionosondes were demonstrated in one paper delivered at the conference. This showed that such comparisons could be invaluable in emphasising some of the finer points of conventional ionogram interpretation. INAG should solicit such examples wherever possible.

The workshop submitted a resolution to ISEA7 supporting an intensive study of ionospheric waves in the East Asian sector and proposed the period of the Space Shuttle ionospheric experiments, planned for September 1984, as being particularly suitable. The University of Hong Kong Physics Department has offered to co-ordinate the observations and subsequent data analysis.

14. RECENT PUBLICATIONS

Experience with proposed improvements of the International Reference Ionosphere (IRI) has just been published as UAG-90. It contains contributed papers mainly from the URSI-COSPAR workshop held in Budapest in 1980. This volume is edited by K. Rawer and C.M. Minnis and is available through the World Data Center-A for Solar Terrestrial Physics. The full address of the WDC is given on the front of the INAG bulletin.

15. UNCLE ROY'S COLUMN - AN INTERESTING INTERMEDIATE LAYER SEQUENCE

The sequence of ionograms from Concepcion reproduced below was provided by Dr. Foppiano, Chile. They show an intermediate layer sequence during the night of 21 September 1982 with drastic redistribution of the F-layer ionisation.

1700 - 1800 LT. The F-layer is decreasing in height with little change in foF2 but the retardation at the low frequency end of the F trace is increasing instead of decreasing as the normal E layer decays in the evening. The shape of the x-trace strongly suggests that this is mainly due to a build up of a tail to the F-layer. However the presence of a thick layer below it, with critical frequency near the lowest frequency recorded, is also possible.

1900. The upper part of the F-layer has moved up considerably and the shape near foF2 clearly shows a strong east-west gradient near hmF2. At the low frequency end of the trace two subsidiary F-layer ledges are present.

2000. The tail has broken off to form an intermediate layer at about 180km. The x-trace of this layer is clearly visible. The mean F-layer trace is near that at 1800 but the shape near foF2 still shows much east-west tilt near hmF2.

2100. The F-layer continues to fall slowly with tilt near hmF2. The maximum plasma frequency of the intermediate layer, foIL, has decreased temporarily for this ionogram.

2200. The intermediate layer is now well formed at almost 150 km. The retardation of the F-traces shows that this is a thick layer but little retardation is seen on the intermediate layer trace which looks like a very high Es. The retardation of the F-trace at foEs and fxEs clearly shows that this is a particle E class trace (Es type k).

2300. h'IL(h'Es) decreases to 115km and foIL(foEs-K) increases. The structure at the low frequency end of the F-trace shows that there is a considerable F-layer tail probably extending down to the intermediate layer.

0000-0100. foEs-K, as shown by the F-trace, has decreased. The F-layer has moved down and foF2 now exceeds that at 1700. It is not clear whether the Es is part of the intermediate layer sequence or an independent Es superimposed on it. The constancy of foEs suggests the former but more frequent ionograms are needed to prove whether this is so. The Es layer appears to become partially reflecting by 0300 then dies away. The F-layer is now slowly rising with little change in foF2.

As has often been stressed by INAG, the presence of a thick layer at night below the main F-layer is always scientifically interesting. It may be due to particle activity, the classical Es-k or Es-r cases or may be due to other phenomena. Provided that its presence is properly recorded in the foEs (and preferably also foE) tables by letter K, it can easily be found by interested scientists.

Note that the Es-k trace due to intermediate layer mechanisms can be at any height up to about 200km. This is similar to the situation at high latitudes when normal E near sunrise is often seen at similar heights at seasons when the solar zenith angle is slowly changing and near 92°. It would be helpful if analysing staff could be careful to note Es-k so that the extent of the phenomena can be determined.

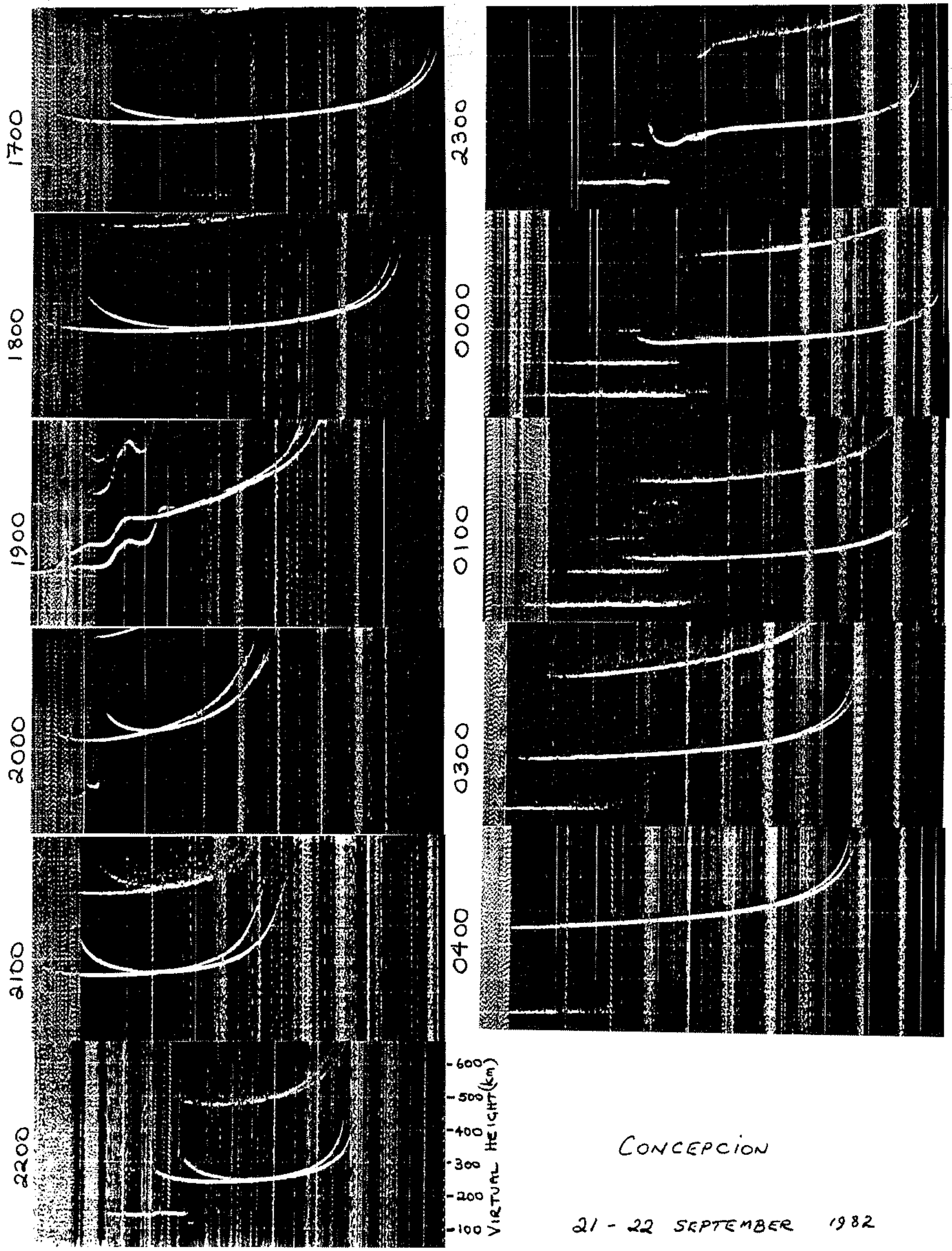
Special nomenclature for intermediate layers
Dr Henry Rishbeth has asked INAG whether it could invent a nomenclature and rules for helping the study of the intermediate layer seen at night. Unfortunately, the phenomenon does not appear to show characteristics on the ionograms which are unique. It has always been a fixed rule with INAG, and with the WWSC before it, not to ask analysing staff to use physical principles but only to record what is actually seen. It is important not to depart from this rule. Well intentioned attempts to introduce physical principles in analysis in the past have usually proved disasterous and lowered the standards of analysis finally obtained at the stations employing them.

In this case there is a further difficulty, namely that as the critical frequency of the intermediate layer is usually around 1MHz, it cannot be observed clearly on the majority of ionosondes which start recording at this frequency. Thus, only a small minority have the possibility of being interested and studying this phenomenon. In this situation, it is best for INAG to encourage collaboration between any groups interested in it and to offer space in the Bulletin for contributions from such groups.

16. THE FORMATION OF INTERMEDIATE LAYERS

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

Intermediate layers, such as those illustrated in Professor Foppiano's ionogram sequence from Concepcion are regularly observed in many parts of the world, but they have not been extensively discussed in the INAG bulletin. The evolution of an intermediate layer follows the schematic pattern illustrated in the figure. Normally, the intermediate layer is observed first near 180km. At this altitude it resembles a thick E-layer causing group retardation at the low frequency end of the F-region traces. The virtual height of the intermediate layer falls steadily with time typically at a rate of $15 ms^{-1}$($60\ km\ h^{-1}$). As it descends, it normally thins and may eventually form a convectional mid-latitude Es trace. The maximum plasma frequency of the intermediate layer indicated by foIL in fig. 1 is about 1MHz and changes little through the event. Intermediate layers are a night-time phenomenon often with a strong seasonal variation in occurrence. A summary of the phenology of the intermediate layer as observed over South Georgia (54°S 37°W) are given in the table. However, intermediate layers at many stations are rarely observed because ionospheric echoes near foIL are



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Schematic diagram of the development of an intermediate layer

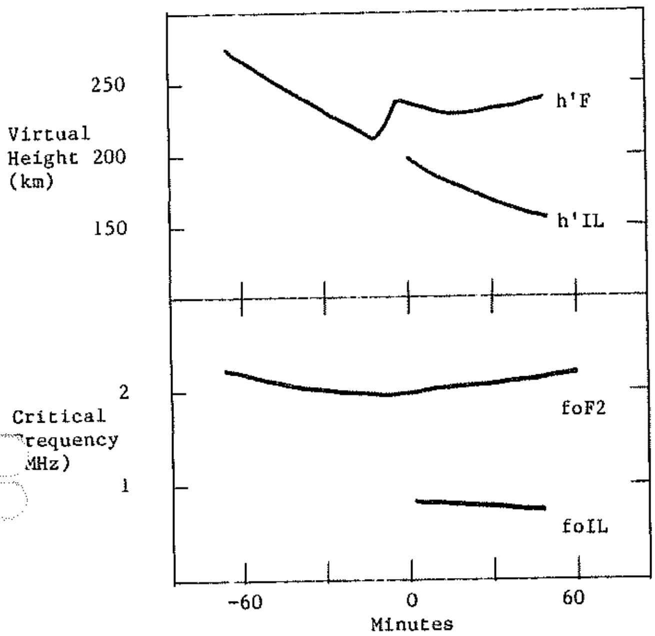


Table. Summary of characteristics of intermediate layers observed at South Georgia.

SEASONAL OCCURRENCE	:	Mainly restricted to between May and September. ie. austral winter with a strong maximum in June/July.
DIURNAL OCCURENCE	:	Mainly observed 1930 to 2300 LT, with maximum near 20000. Infrequently observed after midnight.
HEIGHT RANGE OF INTERMEDIATE LAYER	:	130 - 180 km.
INITIAL THICKNESS OF: INTERMEDIATE LAYER (NEAR 180 km)		10 - 20 km.
FINAL THICKNESS OF INTERMEDIATE LAYER (NEAR 130 km)	: :	< 5 km.
LIFETIME OF LAYER	:	Typically 1 - 2 hours.
RATE OF DOWNWARD MOVEMENT OF LAYER	:	Near 180 km typically 15 ms^{-1}, but ranging from 10 to 30 ms^{-1}.
RELATIONSHIP WITH GEOMAGNETIC ACTIVITY	:	Probably none.

usually obscured by medium wave broadcast interference. Intermediate layers have been extensively studied by incoherent scatter radar which does not suffer from this limitation.

The appearance of the E- and F-region traces during an intermediate layer event show that it should be scaled as a particle-E layer (see chapter 4 of UAG-23A). However, the development of the layer strongly suggests that its formation is due to the transport of ionisation from the F-region rather than the result of particle precipitation. Prior to the formation of the intermediate layer, a perturbation is observed in the F-region, that can take one of two forms. Either the height of the F-layer is seen to fall at approximately the same rate of the fall of the intermediate layer or a stratification of the F-layer is seen (as shown in examples 7 and 8 in Fig. 2.12, UAG-23A). Also the very smooth varaition in foIL and the virtual height of the intermediate layer cannot be reconciled with a particle precipitation source which in general varies rapidly in space and time.

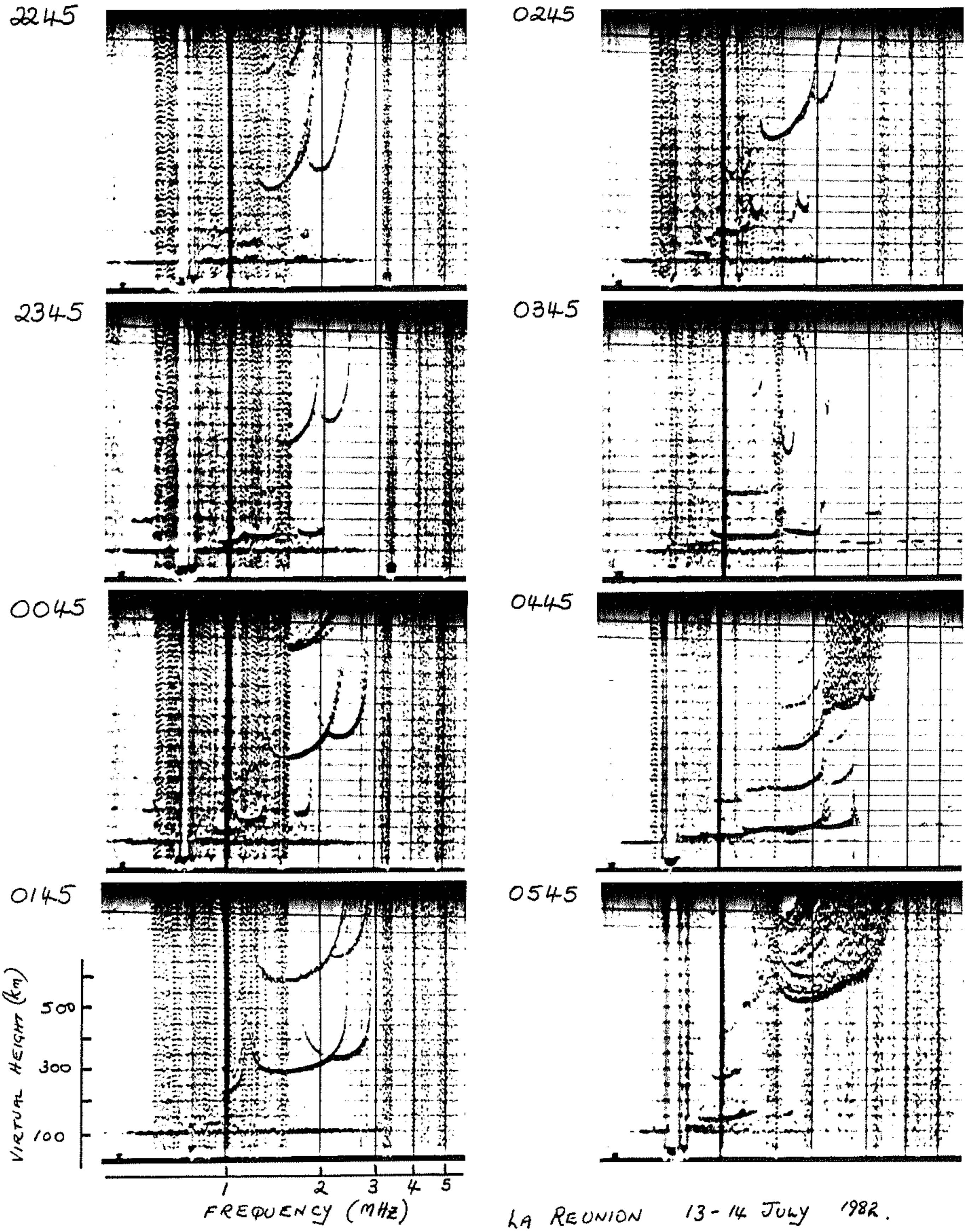
The typical intermediate layer event lasts about 2 hours from the first disturbance of the F-layer trace to its final disappearance as an Es trace. This period is too long for the layer to be caused by an internal gravity wave (travelling ionospheric disturbance) either of a medium scale (period of ~ 20 minutes) or of a large scale (period ~ 1h). The characteristics of the intermediate layer are compatible with a disturbance associated with the solar semi-diurnal tide. The effects of this tide can be regarded as similar to those of a gravity wave but with a much longer peiod, typically 12 hours. The tide is generated by heating of the stratosphere by the sun though there is a small contribution from the heating of the ionosphere.

The semi-diurnal mechanism can explain the rate of descent of the intermediate layer, the time of its occurrence and even the seasonal distribution in occurrence. The latter results from the different effectiveness with which the tide can propagate from the stratosphere into the ionosphere caused by seasonal changes in the winds and temperature of the D-region of the ionosphere. Therefore, observations of intermediate layers are now forming a most important indicator of the coupling between the stratosphere and the ionosphere.

17. PARTICLE PRECIPITATION AT LOW MAGNETIC LATITUDES

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

In recent INAG bulletins, our chairman has drawn attention to the possibility of there being significant particle precipitation at low magnetic latitudes. In this note, particular attention is given to describing the differences between observations of particle E at high and low magnetic latitudes using ionograms from La Reunion (21° S, 56° E; geomagnetic latitude~ -30°) to illustrate an Es-k layer at low latitudes. The ionograms were provided by the Centre National d'Etudes des Telecommunications in France who are responsible for the La Reunion observatory since it was established in October 1981 (see note 40/41, p 20).



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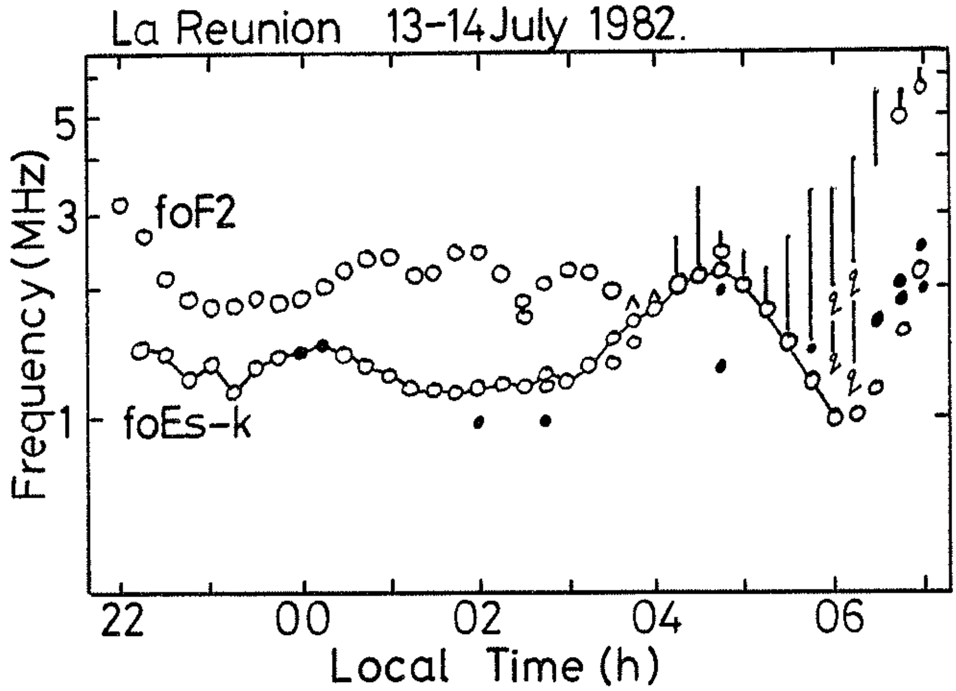

The sequence of ionograms was recorded on the night of 13-14 July 1982. There was a very large magnetic storm in progress with the Kp magnetic index (see section 13.54 of UAG-23) reaching its maximum value of 9 and the Dst value (section 13.59) exceeded - 300 nanoTesla. Eight ionograms at hourly intervals from 2245 local time have been reproduced but the event extended from 2215 through till sunrise near 0600 LT.

The variation of the maximum plasma frequency of both the F-layer and the Es-k layer are shown in the f-plot. The time variation of the virtual height and the foEs of the particle E layer clearly show that this event has very different characteristics to the intermediate layer sequences discussed elsewhere in the bulletin. However, there are several striking differences to the Es-k layer seen in this event and those observed at high magnetic latitudes near the auroral oval.

The f-plot shows that foEs is always less than 2.5MHz in the example, whereas at high magnetic latitudes foEs-K usually exceeds 5MHz and often is greater than 10MHz. Also, the temporal variation of foEs during this event is very slow. Changes in foEs over 15 minutes are less than 0.3MHz. In contrast, in the auroral zone foEs can change by several MHz between ionograms separated by a few minutes.

A further significant difference between this event from those seen at high latitudes during magnetic disturbances is that the radio wave absorption is very low throughout the night, as indicated by fmin being below 1MHz. At high magnetic latitudes, blackout and high values of fmin are very common occurrences under magnetically disturbed conditions.

The combination of these observations strongly suggests that there are major differences in particle precipitation at high and low magnetic latitudes. The low values of foEs indicated that the flux of particles is significantly less. The comparatively high virtual height and low D-region absorption (low f_{min}) show that the spectrum of the particles is much softer than observed at high latitudes, and the temporal variation of foEs-K reveals that a "drizzle" of energetic precipitating particles is much more likely than impulsive, short-lived events that are typical in the auroral oval.

One other area in which these ionograms are different to those at high latitudes is in the complete absence of spread-F during the initial 6 hours when particle-E was present. At high latitudes, spread-F is invariably present when particle precipitation is present.

In summary, there appear to be four major differences in the Es-k events seen at low latitudes compared with these at high magnetic latitudes. These are

(1) foEs-K is much lower
(2) foEs-K changes more slowly with time
(3) little or no change in radio wave absorption (no D region effects)
(4) absence of spread-F through much of the event.

I would be very interested to see more ionograms illustrating particle-E at low magnetic latitudes to see if these four features are a consistent signature of particle precipitation at low magnetic latitudes. If this event is typical, then it suggests that the mechanisms for particle precipitation under disturbed conditions at low latitudes is fundamentally different to that in the auroral zone.

Note by Chairman. I concur with the remarks given above. However at Wuhan I have seen absorption events at night during disturbed magnetic conditions but these are not so closely connected with Es-k as at high latitudes.

The ionograms also show a low type Es trace for which foEs greatly exceeds fbEs and may well be a partial reflection phenomenon. Its virtual height is about 95km and appears to be a storm related feature at Wuhan. More study is required to ascertain if this is also a result of particle precipitation.

QUESTIONNAIRE ON INTERNATIONAL DIGITAL DATA EXCHANGE

INAG wishes to ascertain the views of the administrations responsible for vertical incidence soundings stations throughout the world on the possibility of making the maximum amount of VI data available internationally in computer compatible form, as requested by the WDC Committee. Please return this form direct to the Secretary, or send it through your Commission G representative for consideration at the URSI General Assembly in Florence.

Standard ionosounds

1. Do you analyse your ionograms manually, without use of a microprocessor or data entering system? YES NO

2. If YES to 1. - If you changed your technique would you be willing to adopt a cheap standard technique and co-operate in making the data available in computer compatible form? YES NO

3. If NO to 1. - Please tick a, b, c, d or e:
   Are you data initially produced:-
   a) in microprocessor memory, VDU and tabulated output?
   b) on cassette?
   c) on floppy disk?
   d) on ½ inch magnetic tape?
   e) other method (e.g. direct to computer)?

4. State name and type of equipment used. (Needed to establish compatibility and possibility of setting up centres).

5. Will you be able to convert this output into standard ½ inch 9 track 1600 bpi tape? YES NO

6. Would you be willing to buy equipment to make this possible? YES NO

7. If NO to 5. - Would you be prepared to collaborate in having your data read and converted at a suitably equipped centre? This would imply sending a copy of the data to the centre with, initially, enough information to enable it to be read. YES NO

8. Are you able and willing to help with preparing programme or interfaces to make the data readable? YES NO

9. Would you be interested in exchanging data via telephone lines? YES NO

10. Any comments?

11. Do you possess or are you likely to possess a digital ionosonde? YES NO

12. If YES to 11. - What make and type?

13. Will this be used for synoptic observations? YES NO

14. Are you able and willing to carry out tests to evaluate the use of your type of ionosonde at your site to enable a Digital Ionosonde Handbook to be prepared? YES NO

15. Do you feel that the provision of data in computer compatible form will significantly increase the use of VI data? YES NO

Name: .... Address: ....
....
....

Stations involved: ....
....
....

Please send to: Mr. A. Rodger, Secretary - INAG,
British Antarctic Survey, Madingley Road,
Cambridge CB3 OET, U.K.

or give to Mr. A. Rodger at URSI General Assembly as early as possible.