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IONOSONDE NETWORK ADVISORY GROUP (INAG)*

IONOSPHERIC STATION INFORMATION BULLETIN NO. 51**

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

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Issued on behalf of INAG by World Data Center A for Solar Terrestrial Physics, National Oceanic and Atmospheric Administration, Boulder, Colorado 80303, USA. This Bulletin is distributed to stations by the same channels (but in the reverse direction) as their data ultimately flow to WDC-A. Others wishing to be on the distribution list should notify WDC-A.

1. From the Chairman

by J A Gledhill

Ray Haggard and I were gratified to learn that members of INAG thought enough of our efforts over the past 3 years to re-elect us for a further period during the Tel Aviv meeting, which neither of us was able to attend. We are most grateful to Bodo Reinisch for running the meetings in Tel Aviv, and to Henry Rishbeth, Klaus Bibl and Peter Bradley who stepped into the breach to produce the minutes that appear later in this Bulletin.

One of the most important recommendations, arising from the meeting in Novgorod in May, is that parameters should be investigated which may allow the characterization of the E-F valley from ionograms. This is a difficult task which will almost certainly involve scaling both the o- and the x-traces above foE. I have written to J E Titheridge, who has devoted much thought to problems of this nature, and invited him to write a short article for the next INAG Bulletin. In the meantime we would very much appreciate other opinions on the feasibility of scaling such parameters without too much trouble, especially on a routine basis. We look forward to receiving letters from all concerned persons on all aspects of the proposal.

E/F valley.

2. Letters to the Editor

THE SOLAR FLARE OF JULIAN DAY 2435526

Dear Sir

Last year you kindly published my pieces on the terrestrial effects of the great solar flare of 1956 February 23, and on "Julian Days". The purpose of this letter is to thank the people who responded to those items, which also appeared in the MAP Newsletter; to apologize for not having found time to reply to them individually; and to report the outcome. Letters and papers have reached me from the UK, USA, Denmark, Sweden, India and Australia. One arrived only a few days ago, so maybe there are more to come. I will send copies of this note to all these correspondents; so anyone who wrote to me, but has not heard by the time this appears in print, has to assume that the letter went astray.

Only two writers confessed to being old enough to have observed the 1956 event in person. At the time, Dr Bhonsle had just completed the 25 MHz cosmic noise monitor at PRL, Ahmedabad. He and his colleagues were excited to record the spectacular 6.5 dB absorption during the flare. Dr Olesen, on the other side of the world in Greenland, sent me the ionosonde fmin data he recorded at Godhavn in February 1956. The flare onset was at night (0034 LT = 0334 UT on the 23rd). From 02 LT on the 23rd until 18 LT on the 25th, he recorded 'B for blackout' almost continuously, broken only by a few very high values of fmin. He nearly took his C3 ionosonde apart to see what was wrong with it! Dr Olesen has formed the impression that "Es occurrences are very scarce in the days following a major solar event", and wonders whether anyone else has the same experience and has made a statistical study. Professor Bengt Hultqvist mentions that "energetic heavy ions" were originally proposed as the cause of what we now call a "proton event".

The "I-Thought-The-Equipment-Had-Gone-Wrong Club" must have a large membership worldwide. Professor Mike Kelley was trying to launch balloons from Alaska in 1972. He found the College riometer oscillating so fast that red ink was running off the chart on to the floor. Actually, the pen was responding to the solar radio emissions that accompanied the great flare of 1972 August 9. I was pleased to receive descriptions of the 1972 and 1986 events from people who were involved, but this letter will be too long if I mention everyone individually. My proposed "research note" may be written some day, but the RAL Library has now discarded some of the relevant journals.

Regarding Julian days: absolutely nobody has defended the solecism of describing "days of year" as "Julian days". But, despite its elegance, my suggestion of using numbers 000-365 in leap years and 001-365 on ordinary years is firmly voted down as unworkable. As rightly implied by Drs Andy Smith and Tom Croft, operators in the Antarctic or elsewhere, who have just "welcomed" the New Year, cannot be expected to decide whether the counter should be reset to 000 or 001. There is a legend that one of the British banks' cash-dispenser networks collapsed on 1985 January 1, the software having been defeated by the preceding 366-day year.

Dr George Wilkins has kindly clarified the definition of the start of the Julian epoch. It is 12 UT on BC 4713 January 1, which was the beginning of JD0 (not JD1). To quote from George's letter: "The Julian date is therefore the interval in universal (mean solar) days from BC 4713 January 1.5 in the Julian proleptic calendar." He goes on to say that "the international standard for calendar dates when written in purely numerical form requires that the sequence year, month, day be used. This removes the ambiguity between European and American practice and means that dates can be sorted into sequence as if they were ordinary decimal numbers (provided that leading zeros are inserted)." I supposed, then, that if you write 1956-02-23 or 560223, that must meant the day of the flare (if we take AD for granted!); but 56223 would be taken to mean 1956 August 10.

As a tailpiece, Dr Mike Hapgood - forward looking as ever - reminds us that in designing digital displays and databases, we must allow for the not-so-distant change from 1999 to 2000!

Yours sincerely

Dr Henry Rishbeth

INAG BULLETIN

Dear Sir

I thought that I would like to write to you to encourage you and those assisting you in the production of the INAG Bulletin. I was one of those present at the meeting in Ottawa in August 1969 when Roy Piggott, backed principally by Virginia Lincoln and Alan Shapley, created the Ionosphere Network Advisory Group. These same persons also undertook at great personal effort and with no apparent support to produce a sort of regular bulletin. Of course, the INAG Bulletin was it. Its first issue appeared in October 1969 and its 50th has now been received in August 1987.

Earlier this month I re-read all 50 issues. I had intended to write a brief history of INAG but I have not. However, I was reminded of the unique and valuable character of the Bulletin. The ionosphere is of interest to so many organizations, eg, URSI, IAGA, COSPAR, CCIR, SHASG, IUCSTP, etc. It is of interest to scientists and engineers. However, it is also of interest to the technical staff who operate the world-wide network of ionospheric stations and to the administrators of the organizations both responsible for the stations and for the use of the data produced at them. There is no other publication that brings together the common interests of the above organizations and persons.

Its uniqueness is further demonstrated by the fact that it is the only publication of which I am aware that is designed to promote the efficiency, effectiveness and world-wide compatibility of a data producing network of stations, owned and operated by organizations of such diverse natures and interests.

This excellent and necessary bulletin should continue to be published at least 3 times per year, preferably 4 times.

I read the 50 issues with a critical eye to see what material should not have been published and which subjects have been treated inadequately. The first conclusion from this study was that almost every item published was worth publishing in this particular bulletin. The second was that any deficiencies were due to the shyness or selfishness of those persons for whom the publication is produced. The shy must be encouraged to realize that their problems, ideas, findings and experiences are as valuable as anyone else's and as interesting. The selfish should be made to realize that, unless all who can do contribute, the network will not develop and improve to the degree possible. This means a poorer quality network, much wasted effort and continuing problems regarding the validity of data.

Let me just point out the variety of topics which have appeared in the first 50 issues. These should show that it is possible for all who receive the Bulletin to contribute to it. I will list below the topics that I think are most relevant:-

1. Scaling and other station problems - answering problems, clarifying rules, data formats.

2. Notes from stations - lists of equipment used, experience with different ionosondes, which ones worked during special periods, changes in data presentation and use of rules.

3. Training - description and availability of aids, courses, manuals, handbooks and atlases of ionograms.

4. Description and availability of relevant literature - of use in scaling and interpreting ionograms, in what languages, geophysical calendars.

5. Recommendations of various international bodies regarding vertical incidence sounding - URSI, CCIR, IAGA, ICSU, IRI Group.

6. Advice of and preparations for international cooperative programs - MONSEE, IMS 1976-78, solar eclipses, ASHAY 1975-77, WITS.

7. Notes from WDCs - what has been received, data services available, periods for which data are available and in what form, data used.

8. Notices of meetings relevant to ionosonde data, stations and networks and reports on them - INAG meetings, symposia on equatorial aeronomy, conferences on the high latitude ionosphere and on the cause and structure of temperate latitude Es, URSI General Assemblies, meetings of CCIR, SHASG, IDIG, IAGA, etc.

9. Specifications and availability of new equipment - Digisonde 128, VIS-1, DBD-43, DEL-46, Japanese ionosonde, Finnish ionosonde, La Jolla Sciences Inc riometer.

10. Outline the role of v.i. data in new experiments - magnetosphere studies, incoherent scatter, meteors and meteor shower activity, satellite beacons, improving HF communications, navigation errors.

11. Outline the functions of bodies using v.i. data and list their numbers - INAG, SHASG, URSI, CCIR, IUWDS, COSPAR.

12. Questionnaires on - the future of the v.i. network, the needs of the network, data exchange, essential stations, mailing list.

13. Outline new areas of research using v.i. data - tilts, gravity waves, conjugate point studies, absorption.

14. Advice on v.i. network - new stations, closed stations, size of network, data accuracy, the need for higher accuracy ionosondes, the need for ionosondes at new sites, the adequacy or inadequacy of the network.

15. List - UAG reports, key review papers, IDIG reports, Guide for International Data Exchange, literature citations, interational computer codes for v.i. stations.

16. Notes on matters of minor interest and longer articles on matters of greater interest or importance. Some examples are:

    16.1 Growing interest in real-time observations.

    16.2 Meteors and their effects on the ionosphere.

    16.3 Effects of changes to scaling rules for ionospheric characteristics.

    16.4 The determination of fxI and spread-F scaling.

    16.5 The use of UT in reporting ionospheric data.

    16.6 Problems scaling f min.

16.7 Scaling in the presence of low type Es.

16.8 Data exchange standards.

16.9 The ionospheric alphabet.

16.10 Deriving the M3000 factor from the x-trace.

16.11 On the source mechanisms for SEC (slant Es and Lacuna)

16.12 New parameters of the F1-layer.

16.13 Measurement of ionospheric absorption.

16.14 Scaling errors.

16.15 Tilts on ionograms.

16.16 Gain-sensitive parameters.

16.17 Problem of comparing ground-based and satellite data.

16.18 Deduction of magnetospheric phenomena from ionograms.

16.19 Spread-F typing.

16.20 Slant-E condition.

16.21 Particle E (Night E).

My above listings are not exhaustive. They do show that every recipient of the INAG Bulletin can provide material that should be included in the bulletins. By the way, I omitted to list reports from INAG members and reporters. The supply of material should not be left to the Chairman and his editor.

One of the beauties of the INAG Bulletin is that it allows discussion of vague and contentious issues. The notes and articles can be short or long and do not have to present faits accomplis.

Please excuse me in being so long-winded but I wanted to stress the importance of the Bulletin and to show that everyone has something to contribute to it. Please continue your efforts to ensure that it continues to appear at appropriate intervals, say, 3- or 4-monthly.

I wish you every success.

Yours sincerely

Clarrie McCue

3. 1984-87 Report on Handbooks and Training Aids

by P J Wilkinson, IPS, Australia

1. The main item of the last three years in this area was the distribution of the Japanese Scaling Manual.

   This is an excellent resource book for training novice scalers, especially those who will only scale part of an ionogram.

   Two editions have now appeared, the second edition containing several minor corrections in the first edition. This has been the first major addition to the available training material for many years and the Japanese are to be applauded for their contribution here.

2. No other aids or handbooks were made generally available during the reporting period.

3. INAG carried only two articles that were related to scaling, and therefore indirectly related to training of scalers.

   In INAG 45, Besprozvannaya and Shulgina offered some discussion points for scaling fxI. Only Dr Piggott offered some comments. His point, that further discussion is advisable here, is a good one.

   INAG 47 carried an article by Wilkinson on the IPS scaling validation tables. These tables, used in a computer programme, can be used to check scaling of ionograms. In themselves, they will not teach scaling, obviously, but they can be a useful reminder to scalers.

4. INAG also carried two articles on M(3000)F2 by Paul (INAG 45) and Rodger and Linton (INAG 46).

   Paul briefly discusses a numerical method of deriving M(3000)F2 from a set of (f,h') pairs. This method is useful for simple computer aided scaling systems.

   Rodger and Linton show empirically that M(3000)F2 can be scaled from either component and propose that values scaled this way should carry the qualifier J. INAG should consider this proposal seriously.

   While neither of these contributions adds to training material, they do ease some problems in scaling M(3000)F2 for novice scalers. It is worth noting, however, that training material for M(3000)F2 is quite poor although the Japanese Scaling Manual has gone a long way towards solving this problem.

5. No other training material or articles appeared in the reporting period.

   It may be worth considering at this point what audience is being addressed by training material. At IPS, for instance, our very experienced scalers are retiring and we will not be able to replace them. Our main training thrust is directed at temporary staff who operate ionosondes in Antarctica and only scale a few foF2, fxI and fmin values. The bulk of the ionograms are scaled in Sydney well after the event. For these people the Japanese Scaling Manual is an ideal introduction to scaling with UAG 23 and UAG 23A only being of interest to a few of the better operators. In the longer term, automatic computer based scaling systems will replace fully manual methods and training will take on quite a different identity.

   If INAG is to be successful in offering training material, it may be useful to survey currently operating stations to discover what training assistance they feel they still need.

6. Summarising, the Japanese Scaling Manual is a very substantial contributrion to training and has made this an important period for training resources. However, apart from this contribution little else has been achieved during the reporting period.

4. Report of the INAG Meeting, Vancouver, Canada

An INAG meeting was held on 17 August 1987 during the XIX IUGG General Assembly in Vancouver, Canada. The meeting was attended by 26 people representing 18 countries.

Participants:

D Kelly	Australia
T Kelly	Australia
P Wilkinson	Australia
L Bossy	Belgium
M Abdu	Brazil
A Foppiano	Chile
I Lastovicka	Czechoslovakia
J Taubenheim	German Dem. Rep.
G Moraitis	Greece
A Bartara	India
M Devi	India
P Ramarao	India
G De Franceschi	Italy
K Marubashi	Japan
W Baggaley	New Zealand
J As	Netherlands
J Gledhill (Chairman)	South Africa
J Cardus	Spain
Y-N Huang	Taiwan
V Migulin	Union of Soviet Soc. Rep.
J Dudeney	United Kingdom
A Rodger	United Kingdom
T Berkey	United States of America
K Miller	United States of America
P Richards	United States of America
B Reinisch	United States of America

4.1 Chairman's Report

After welcoming those present the Chairman gave a brief report on the activities of INAG since the Florence meeting of URSI in 1984.

In answer to the request for funds for the production of the Bulletin, 2 500 US Dollars had been provided by several donors and the South African CSIR had contributed 4 800 Rands. This had enabled the purchase of a word processor, printer, etc. and allowed Mr Haggard to attend the 1986 COSPAR meeting in Toulouse for the INAG meeting there. Five INAG Bulletins had been issued, with a wide range of contributions. The Chairman expressed thanks to Messrs R Haggard and R Conkright for their work in producing the Bulletins.

Advice had been provided to several enquirers on the availability of ionosondes.

There had been no response to the telex sent to New Zealand at the Toulouse conference, expressing the hope of INAG that at least some of the ionosonde stations there be continued. Dr Baggaley said that in fact Christchurch and Scott Base are running at a reduced level but that Campbell Island has been closed and the ionosonde sent elsewhere.

A message of congratulations on the 30th Anniversary of the IGY was sent to Sir Granville Beynon by the Chairman.

4.2 INAG Bulletin

The participants present expressed general satisfaction with the INAG Bulletin and recommended that it be continued.

4.3 UT on ionograms

After considerable discussion it was agreed that UT should be clearly indicated on ionograms and on f-plots, to avoid confusion which arises from the choice of local time used on ionograms and f-plots.

4.4 INAG and WITS

The meeting was informed that India is putting in a chain of ionosondes, and could help with the deployment of ionosondes in developing countries. A Foppiano mentioned that it may be possible to station an ionosonde on Easter Island if a strong enough resolution from URSI could be passed. It was agreed that all stations must be encouraged strongly to report all data to the World Data Centres, especially during WITS.

4.5 Real-Time ionograms

It was clear that there is a growing interest in real-time ionograms from distant sites. B Reinisch reported that there are about 20 digisondes reporting in real-time at present. T Kelly would like to see more use of the facility, available with the Kel ionosondes, and felt that once it was realised that it could be done the demand would grow. The main hindrance is finance in many groups.

4.6 CCIR Communication

The meeting noted a communication from CCIR (opinion 22.4) which stresses the importance of INAG and urges administrations to consult INAG before closing stations or opening new ones. (See page 8).

4.7 International Workshop on Ionospheric Informatics

Recommendations from the international workshop on ionospheric informatics, held in Novgorod, USSR, from 25-29 May 1987 were considered. They are published on page 9 of this Bulletin. Comments, views and suggestions are requested from the community especially the users and scalers.

4.8 De Bilt Ionospheric Observatory

The meeting heard with dismay of the proposed closing of the De Bilt Ionospheric Observatory and the Witteveen Geomagnetic Observatory in the Netherlands. It was unanimously resolved to support strongly the resolution proposed by Dr

J A As on the high priority of bringing to the attention of Governments the importance of continuing such observations, despite economic difficulties.

4.9 Ionosonde network status

Reports were given on the status of ionosonde networks in the countries represented. Most were continuing or improving their facilities, with the exceptions of Netherlands and New Zealand as noted above.

5. Report of the INAG meetings, Tel Aviv, Israel

The 22nd URSI General Assembly at Tel Aviv was attended by some 800 scientists, demonstrating that radio science in its broadest form is alive and kicking. The Working Group G1, INAG, of Commission G held three meetings during the Assembly. On request of Dr J A Gledhill, INAG's Chairman, who because of illness could not come to Tel Aviv, Bodo Reinisch acted as Chairman for the INAG meetings. The INAG resolutions with other relevant Commission G recommendations are given in the Appendix, page 7, and in the report on the International Workshop on Ionospheric Informatics, page 8.

Minutes of Business Meetings

First Meeting, 26 August 1987, 1700 - 1810

Reporter: H Rishbeth

Present: B W Reinisch (Acting Chairman) and 15 members

1. Prof Reinisch reported that he had been asked to act by the INAG Chairman, J A Gledhill, who had been unwell and was unable to come to Tel Aviv. Neither the Executive Secretary, R Haggard, nor the Bulletin Circulation Secretary, R Conkright, were able to attend the URSI Assembly. H Rishbeth, as Vice Chairman of Commission G, agreed to send a message of sympathy to Professor Gledhill on behalf of INAG.

2. Three Year Report of INAG Activities

Since the Florence General Assembly, five meetings of INAG had been held, in association with international conferences:

Sydney, Australia, February 1985, URSI/IPS meeting

Prague, Czechoslovakia, July 1985

Toulouse, France, July 1986: COSPAR. The question of whether ionograms should be timed in UT or LT was discussed, but no consensus emerged.

Novgorod, USSR, May 1987: URSI/COSPAR Workshop on Ionospheric Informatics. Two of the Workshop recommendations concerning the accurate determination of N(h) profiles were suggested as a resolution for Commission G (see Minute 8).

Vancouver, Canada, August 1987: IUGG. The main topics were the report on the status of the network; the importance of the WITS to INAG, and whether "remote" ionograms are useful.

In addition five issues of INAG Bulletin had been produced. This publication was considered to be of great value as a means of exchanging information and maintaining the "coherence" of the Network. Continued financial support from URSI was strongly recommended. The outstanding work of R Haggard and R Conkright was acknowledged.

3. E/F Valley Problem and Additional Ionogram Parameters

The derivation of electron density/real height profiles - N(h) profiles - is still subject to several problems, notably the determination of the E/F valley. Several detailed recommendations arising from the Novgorod Workshop were debated, in particular the addition of extra parameters to the ionogram scaling rules.

It was pointed out that stations and operators might be reluctant to take on these additional tasks unless they could be convinced of their scientific value.

4. World Ionosphere and Thermosphere Study (WITS)

INAG considered this program of such importance to the ionosonde network as to justify INAG representation on the WITS Steering Committee.

Second Meeting, 28 August 1987, 1300 - 1355

Reporters: H Rishbeth, K Bibl

Present: B W Reinisch (Acting Chairman) and 21 members

5. Election of Officers

Reinisch announced that the present officers

Chairman	J A Gledhill
Executive Secretary	R Haggard
Circulation Secretary	R Conkright

are available for re-election. No other nominations were made, and above individuals were elected by acclamation.

Reinisch agreed to report this vote to Commission G. (Later the same day, during the Commission G Business Meeting, the Chairman of Commission G, Dr J Aarons, nominated Gledhill, Haggard and Conkright to the positions of Chairman, Executive Secreatry and Circulation Secretary, respectively.)

6. WITS Representative

Rishbeth reported that Professor C H Liu, International Secretary of WITS, had agreed that a member of the WITS Steering Committee could represent INAG interests.

R Hanbaba and S Radicella were nominated for this post. A ballot was conducted, the votes counted by J K Olesen and the count verified by Reinisch. S Radicella was declared elected. It was noted that Dr Radicella is already a member of the WITS Steering Committee.

7. Timing of Ionograms

On the basis of the INAG discussion at Vancouver, it was recommended the UT be clearly marked on ionograms and/or tabulated data, together with the longitude of the station. LT may be added optionally.

8. Resolutions

The wording and content of the recommendations arsing from the Novgorod meeting were discussed at length. Another resolution concerned the desire of INAG to:

8.1 Keep the New Zealand network in operation;

8.2 Keep the De Bilt ionosonde and associated magnetic observatory in operation;

8.3 Encourage the establishment of a Chilean ionospheric station on Easter Island.

Reinisch agreed to get the above resolutions typed and to forward them on to the Commission G Resolution Committee (see Appendix, page 7).

9. WDC and Ionosondes

Rishbeth announced the that ICSU Panel for World Data Centres had undertaken the revision and modernization of the operating guidelines for the entire WDC system. The existing guidelines essentially dated back to the IGY and did not take account of today's conditions. The new "Guide to the World Data Centre System" was being published as an Overall Guide (Volume 1) together with individual guides for different disciplines (Volume 2 on waves).

Reinisch reported that copies of Volume 1 had been distributed by J Allen in Vancouver, however, no copies were available in Tel Aviv. Rishbeth had unbound copies of Volume 2 for distribution. He explained that this volume had been drafted at a WDC/INAG ad-hoc meeting in 1984. Subsequently, comments were received from several stations, and taken into account in producing the present version.

10. Network News

Portugal: Lisbon, new installation February 1987 with help of France. Data analyzed in Lannion. Second station planned in Azores.

Japan: Automatic scaling in use (Matuura).

China: Nine stations, two Digisondes, oblique sounding with Pakistan and Japan is planned (X Huang).

Australia: Automatic scaling with new sounders under development (Fox).

U S A: New stations (or new equipment) at:

Wallops Island, VA, August 1987 (Digisonde 256)

Millstone Hill, MA, June 1987 (Digisonde 256)

College, AK, October 1987 (Digisonde 256)

San Diego, CA, possibly 1988 (Advanced Ionospheric Sounder)

Pakistan:

Karachi, December 1986 (Digisonde 256)
Northern Pakistan, April 1988 (Digisonde 256)

Third Meeting, 1 September 1987, 1230 - 1340

Reporter: P Bradley

Present: B W Reinisch (Acting Chairman) and 16 members

11. WAGS (Worldwide Atmospheric Gravity Waves Study) campaigns offer an opportunity for the ionosonde network to contribute to the monitoring of large scale gravity waves. Ionograms should be recorded at least every five minutes during the campaign periods. It was agreed that R Hunsucker announce the dates of the campaigns in the next INAG Bulletin. Reinisch agreed to co-ordinate the Digisonde network for the WAGS campaigns.

12. General access to the data from the Digisonde 256 network was debated. Prof Reinisch distinguished between the US Air Weather Service network of 19 stations (to be complete in mid or late 1988) and the stations operated by other sponsors. The US AWS has in principle agreed to make the tape recorded Digisonde data available to World Data Center A in Boulder, Co. J. Buchau is liaison to the US AWS.

13. A Paul inquired whether the three Commission G Working Groups (INAG, Mapping and Modeling, Ionospheric Informatics) have overlapping tasks. After some discussion it was agreed that they are mutually supportive.

14. The Novgorod resolution on ionogram characteristics and electron density profiles was discussed again as requested by the Commission G Business Meeting. A revised formulation was drafted and approved. Reinisch agreed to forward this formulation to Commission G. There was consensus that providing the required E/F valley information is not the task of INAG, but should be dealt with by the Working Group on Ionospheric Informatics.

APPENDIX 5 - I

INAG Resolutions

URSI Working Group G.1, INAG,

1. considering the importance of an operating world-wide ionosonde network,

resolves that

1.1 URSI, noting that the ionosonde stations of the New Zealand network have made important contributions in both the scientific and communications fields for many years, expresses its great concern at the proposed closing of these stations and urges the responsible authorities in New Zealand to reconsider this decision and to continue the operation of the stations.

1.2 URSI, noting that the ionosonde station at De Bilt, Netherlands, has made important contributions in both the scientific and communications fields for many years, expresses its great concern at the proposed closing of the station and urges the responsible authorities in the Netherlands to reconsider their decision and to continue the operation of the station and the associated observatory at Witteveen.

1.3 URSI notes that there is a possibility that the Chilean authorities may be prepared to install and operate an ionosonde on Easter Island. This would be a most valuable contribution to the world ionosphere/thermosphere study (WITS) and would also fill a notable gap in the world-wide network of ionosondes, thus providing essential input to the scientific and communications data base on which forecasts are made.

APPENDIX 5 - II

Attendance register was only circulated at the first of the three meetings held. The following participants attended the first meeting.

S Radicella	Argentina
M Fox	Australia
R Leitinger	Austria
L Bossy	Belgium
X Huang	China
J Olesen	Denmark
R Hanbaba	France
G Pillet	France
I Keroub	Israel
N Matuura	Japan
C Goncalves	Portugal
J Petricio (?)	Portugal
S Lambert	South Africa
R Vice	South Africa
M Bröms	Sweden
Y-N Huang	Taiwan
L Barclay	United Kingdom
H Rishbeth	United Kingdom
K Bibl	United States of America
R Hunsucker	United States of America
A Paul	United States of America
B Reinisch	United States of America

6. CCIR Communication - Opinion 22-4

Routine Ionospheric Sounding

(Study Programme 26C/6)

The CCIR,

considering

1. that the routine observations from the existing ground-based ionosonde network together with satellite and oblique sounding programmes provide the bases for continuing improvements in both long- and short-term ionospheric predictions;
2. that the increasing importance of space research and Earth-space communications will require continued collection of such information, derived as a matter of routine, together with possible increases and changes in the quantity and nature of the information;
3. that URSI Commission G has formed an Ionosonde Network Advisory Group (INAG) which is responsible for advising ionospheric sounding stations on scientific questions and for advising URSI on questions concerning the network as a whole,

is unanimously of the opinion

that administrations should make every effort:

1. to continue the operation of the ionosonde network and the interchange of basic data, for which there is much demand, through the World Data Centres;
2. to establish new ionosondes at, or transfer existing ionosondes to, places recommended by the CCIR in fulfilment of Study Programme 26C/6 or to support the organizations responsible for new and relocated ionosondes:
3. to consult URSI (INAG) on all questions relating to the establishment or closure of stations in the ionosonde network and proposed changes in the programme of operation or analysis of the ionograms;
4. to support the work under Study Programme 26C/6 concerning the use of ionospheric data from satellite programmes and to explore the use of such data as are now available at the World Data Centres, for ionospheric predictions.

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

7. International Workshop on Ionospheric Informatics Recommendations

The International Workshop on Ionospheric Informatics was held in Novgorod, USSR, from 25 to 29 May 1987. It was organized by the Academy of Sciences of the USSR and cosponsored by URSI and COSPAR.

The following Recommendations were adopted by the Workshop.

Recommendation 1

The Workshop on Ionospheric Informatics,

considering

- that the different measuring techniques aiming at obtaining information about the terrestrial ionosphere produce a very large amount of data;

- that collection, processing, storage and transfer of these, as well as their interchange with other disciplines, can now readily be executed with modern electronic computer methods;

- that international interchange of all relevant publications could be a very valuable help for the scientists working in this field,

recommends

1. that the concerned World Data Centres should make definitive efforts in view of elaborating a modern storage system for ionospheric data obtained by any observational method and also of managing and processing such data in a way that facilitates interdisciplinary interchange and co-operation;

2. that a computer accessible catalogue be also established for all material earlier obtained in classical recording techniques, eg on paper or microfilm;

3. that a computer accessible catalogue (complete references and key words) should be established for all relevant publications (past and current) in journals, books, proceedings and reports.

Recommendation 2

The Workshop on Ionospheric Informatics,

considering

- that the detailed spectral optical data of the solar emissions in the extreme UV and X-ray ranges are of primary importance for aeronomic investigations of all kinds;

- that satellite observations are the only means to gather relevant information, and

- that sufficiently advanced techniques for recording and calibrating relevant measurements are known for 15 years,

noting

that during that long time useful data were obatined for limited periods only and in often interrupted series,

urges

COSPAR to undertake efforts so that space agencies organize a satellite patrol yielding day-by-day intensity spectra over the whole wavelength range of aeronomical interest.

Recommendation 3

The Workshop on Ionospheric Informatics,

considering

- that empirical mapping of the peak parameters of the terrestrial ionosphere is of great interest for radio wave propagation predictions, for empirical modelling of the electron denisty in IRI and for aeronomic investigations, and

- that such maps could only recently be obtained via direct worldwide observation, eg with the Japanese ISS-b satellite and with the Soviet Intercosmos 19,

noting

that the maps obtained by one satellite cover a large time period so that seasonal and diurnal variations are inter-mixed,

urges

URSI and COSPAR to recommend to the space agencies the establishment of a satellite monitoring system that generates a global map within a short time interval.

Recommendation 4

The Workshop on Ionospheric Informatics,

considering

the need for global mapping of the ionospheric electron density with high spatial and temporal resolution for radio wave propagation predictions,

noting

- that the incoherent scatter radars (ISR) are operating one day a month collecting electron density and temperature data;

- that a large number of vertical incidence (VI) ionosondes exists which can provide rapid sequences of electron density profiles which could be calibrated with the ISR profiles for colocated stations;

- that the effects of gravity waves on the electron density distribution require clarification, and

- that better EF valley information is required in support of the IRI modelling effort,

urges

URSI to organize world-wide campaigns, each covering 3 days around RWD's at suitably chosen times, with rapid (5 min) ionogram sequences and simultaneous incoherent scatter radar observations during three different seasons of a year.

Recommendation 5

The Workshop on Ionospheric Informatics,

considering

- that the characteristics determined by the traditional evaluation of ionograms are insufficient for modelling purposes;

- that, in view of these purposes, characteristics of the true height profile are needed, and

- that some experience already exists with synthesizing model electron density profiles from a small number of inputs, recommends

1. that the following parameters be added to the URSI ionogram (profile) evaluation rules:

   1.1 the frequency of the minimum virtual height at the base of the F region, f(h'minF),

   1.2 the EF valley depth,

   1.3 the height of minimum electron density in the valley and the upper valley boundary,

   1.4 the ratio of the F2 half peak density height to the peak height hmF2,

   1.5 possibly one more characteristic height in cases where F1 influences the latter parameter,

2. that URSI and COSPAR recommend to observers of D-region profiles obtained by any of the existing methods of observation that they should specify the height and electron density of the (log density) inflection point appearing almost regularly near 80 km;

3. that URSI should recognize the great importance of again comparing the different techniques for the EF valley true height computations, and of reaching an agreement on the best available method.

8. Obituary - Mr J A Ratcliffe

by H Rishbeth

J A Ratcliffe, CB CBE FRS, was born at Rawtenstall, Lancs, UK on 12 December 1902 and died on 25 October 1987, at the age of 84. His research career at Cambridge began under the tutelage of Edward Appleton, around the time of Appleton's historic experiments in 1924/5 which put beyond doubt the existence of the ionospheric layers, and was to last until 1960. During this period - broken by his distinguished wartime service in the field of radar - he made many notable contributions to the fields of radio wave propagation and ionospheric physcis. He is remembered, too, for his crucial role in establishing at Cambridge the new science of radio astronomy, under the leadership of Martin Ryle.

Ratcliffe was very conscious of the vast amount of information contained in ionograms. During a sabbatical in Washington around 1952, he devised a rough but quick way of estimating from ionograms the "integrated electron content" (up to the F2 peak), and used it in his pioneering investigations of F2 layer physics. He then set up, at the Cavendish Laboratory, a major computing effort for systematically deriving N(h) profiles from ionograms. This began with desk machines, but was later transferred to EDSAC, the new digital computer at Cambridge. The work produced a data set of "real height" N(h,t) data that has seldom been emulated. EDSAC was also used for early numerical calculations relating to long-wave propagation via the D-layer, another subject of interest to Ratcliffe. Radio-wave fading and the small-scale irregularity of the ionosphere was another field of research that he promoted at Cambridge.

His interest in incoherent scatter radar may be less widely known. Seizing on the report on Bowles' pioneering experiment in Illinois, Ratcliffe perceived the technique's potentiality for probing the entire ionosphere. He encouraged theorists at Cambridge to develop the theory of incoherent scatter, and took a keen interest in the UK experiments. After his retirement, he chaired a small official working party which helped to secure UK involvement in the EISCAT project.

From 1960 to 1966 he was Director of the Radio Research Station at Ditton Park, Slough. During this exciting period, his leadership brought the 45-year old Station into the rocket programme and the topside sounder project. He was quick to grasp the potentialities of satellites. The new developments were reflected in the new name Radio and Space Research Station, adopted in 1965. In retirement, he set his alert mind to new topics, such as computers and solid-state electronics. Conversation with him never failed to be stimulating.

Ratcliffe was a physicist first and foremost. He sought physical explanations and experimental proofs; he distrusted mathematical and computational results unless he could see the physics behind them. He would quote, as an historic example, the demolition by Lord Rayleigh of somebody's mathematical "proof" that radio waves diffract around a conducting sphere (which, if true, would have explained Marconi's experimental result without the need to postulate a "reflecting layer"). Having discounted the "proof" on physical grounds, Rayleigh remarked that he would doubtless be asked whether he had any complaints against the mathematical arguments, so he went on to expose the mathematical error. Ratcliffe's comment: "We should all do well to follow Rayleigh's example". It was fitting; that, in time, he became President of the Physical Society and of the Institution of Electrical Engineers, among the many other offices and distinctions that came his way.

His lectures and expositions amply demonstrated his great gifts of clear thinking and clear writing. For many, his lectures provided a first introduction to radio propagation and the ionosphere. He had a great interest in the physics of waves and Fourier analysis, and there are many former students who treasure his excellent lecture notes on the subject. One meets many people who appreciated his classics, "The Physical Principles of Wireless" and the "Magneto-Ionic Theory", besides his works on ionospheric physics. A paperback published in 1970, "Sun, Earth & Radio", gave a very readable account of solar-terrestrial physics and the ionosphere. For ten years he edited the Journal of Atmospheric and Terrestrial Physics, originally founded by Appleton.

Colleagues, students and friends in many countries will cherish his memory, with gratitude for his influence on their lives.

Why was it formed?

9. Minutes: URSI Commission G Working Group G.4, Ionospheric Informatics, Tel Aviv, Israel, 2 September 1987

by B Reinisch

The first Business Meeting of the newly formed Ionospheric Informatics Working Group (IIWG) took place during the URSI General Assembly in Tel Aviv. The meeting was attended by 16 scientists.

1. Terms of Reference of the IIWG

   To promote the application of information technology to the acquisition, processing, archiving and distribution of ionospheric data (formulation by Chairman of commission G, Dr H Rishbeth).

2. Membership

   The Working Group is chaired by Reinisch (USA), with Gulyaeva (USSR) as Vice Chair.

   The following members were nominated:

Abdu	(Brazil)
Bilitza	(USA)
Bossy	(Belgium)
Bradley	(United Kingdom)
Hanbaba*	(France)
Huang	(PRC)
Kroehl*	(USA)
Matuura	(Japan)
McNamara*	(Australia)
Papitashvili*	(USSR)
Rawer	(FRG)
Titheridge*	(New Zealand)
Willis*	(United Kingdom)

   (* = not confirmed)

3. Immediate Tasks

   3.1 Recognizing that little information exists on the E-F valley in electron density profiles, the meeting agreed to make establishment of an appropriate data base for E-F valley data the first priority. The available measuring techniques are rocket probes, incoherent scatter radar (ISR) and ionosonde techniques that are calibrated with ISR. Rawer stated that mid-latitude ISR's, like Millstone Hill and Arecibo, are most important for the initial phase. Reinisch mentioned that the Digisonde at Millstone Hill will conduct Ne(h) studies in conjunction with ISR measurements.

   3.2 Bradley proposed to make pulsed HF oblique propagation studies (POPS) a prime topic of the IIWG, with emphasis on scaling rules, data formatting dissemination, and the coordination of POPS projects. The idea was well received. Bradley promised to submit a write-up specifying an HFPOPS initiative.

   3.3 The global network of modern digital ionosondes is growing rapidly. Appproximately forty Digisondes 256 will be operating by the end of next year. Data formats, data exchange and data archiving in the World Data Centres must be discussed. Reinisch agreed to co-ordinate.

4. Next Meeting

   It was agreed to hold the next meeting during the XXVII Plenary Meeting of COSPAR in Helsinki, on July 19 or 20, 1988.

10. Network News

De Bilt, Netherlands

The Minister of Transport and Public Works of the Netherlands decided that the Royal Netherlands Meteorological Institute has to stop the ionospheric observations.

The Dutch ionosonde at De Bilt ceased operations on 1 October 1987, after a period of forty years of activity.

Drs A R Ritsema and H Kelder regret the closing of their station, but constraints are such that they are unable to continue the work previously performed.

MIT Haystack Observatory

News from Bodo Reinisch of the University of Lowell is that they have finally succeeded in setting up their own Digisonde 256 station at the site of the MIT Haystack Observatory, 42.61° N, 71.5° W geographic. The station produces quarter hourly ionograms, with tilt and drift measurements in between. Co-operation with the Millstone Hill Incoherent Scatter radar is planned to study mid-latitude gravity waves, tilts (structure), drift and electron density profiles (E-F valley).

Indonesian Stations

We have been informed by the Aerospace Research centre of Lapan / The Indonesian National Institute of Aeronautics and Space that they have an additional ionospheric observatory, which has been in operation since 1985, viz Pontianak, East Kalimantan situated 0° 0' S and 109° 20' E. See INAG 46, page 4.

College (Fairbanks)

Robert Hunsucker reports that the C3/C4 Ionosonde continued to operate at quarter hourly intervals with real time data telemetered to Eielson AFB on the hour and that they decided to replace this equipment with a Digisonde 256 system during the summer of 1987.

The College Ionosonde Observatory has been operating continuously since about 1942.

11. Solar Eclipses in 1988

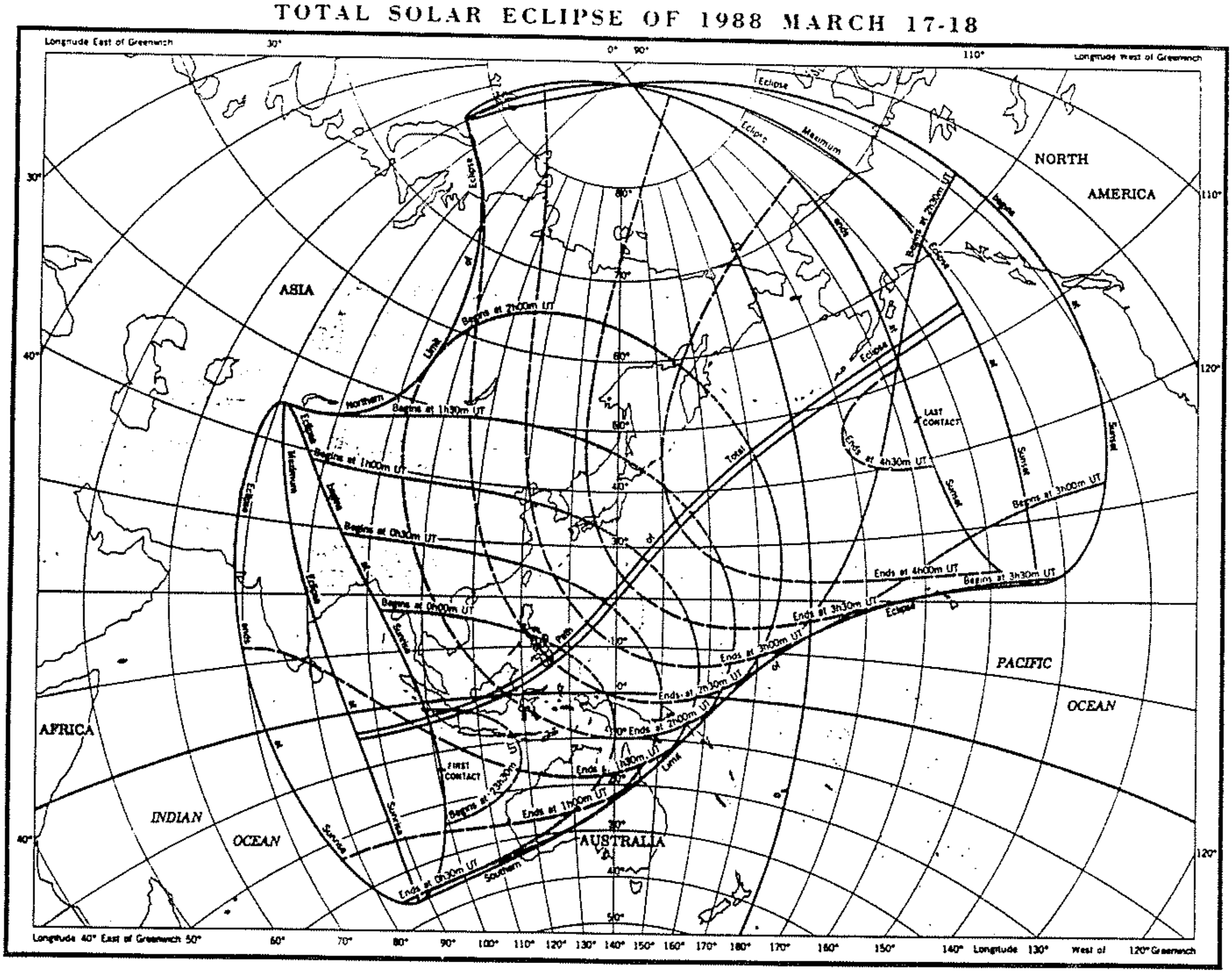
A total eclipse of the Sun on March 17-18.

The path of totality begins in the Indian Ocean to the west of Sumatra, crosses Sumatra, Borneo and the southern part of the Philippine Islands, passes close to the Mariana Islands and south of the Aleutian Islands and ends in the Gulf of Alaska. The partial phase is visible from eastern Asia, Indonesia, north-western Australia, New Guinea, Micronesia, the extreme north-west of North America and the western Hawaiian Islands. The eclipse begins on March 17 at 23 24 UT and ends on March 19 at 04 32 UT; the total phase begins on March 18 at 00 23 UT and ends at 03 32 UT. The maximum duration of totality is 3 minutes 51 seconds.

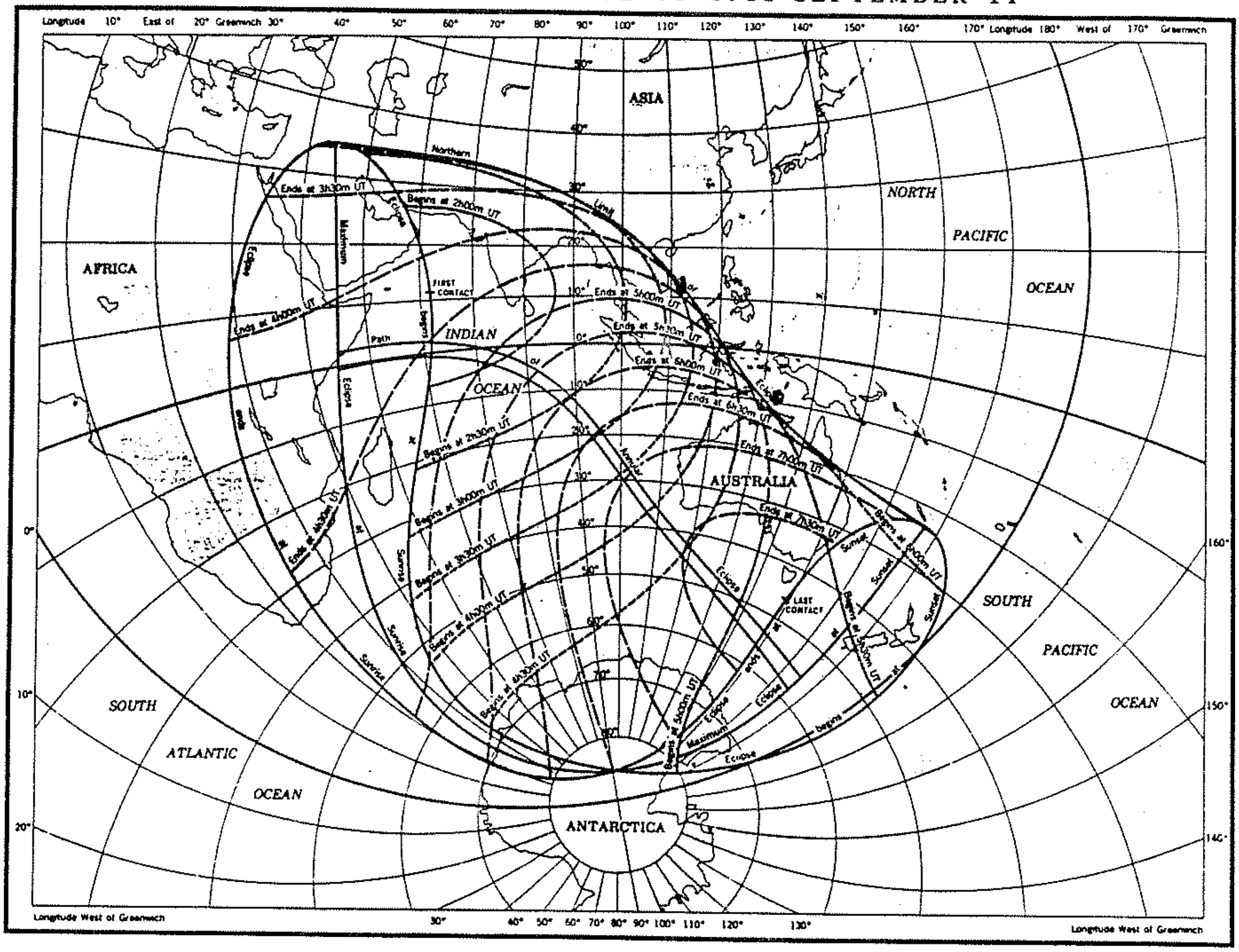
An annular eclipse of the Sun on September 11.

An annular eclipse of the Sun is visible as a partial eclipse from the eastern part of Africa (except for most of Egypt and Western Sudan), the southern part of Asia, the Indian and Southern Oceans, Indonesia, Australia (except for the extreme north-east), New Zealand and part of Antarctica. The eclipse begins at 01 46 UT and ends at 07 41 UT. The annular phase begins at the coast of Somalia at 02 59 UT, crosses the Indian and Southern Oceans and ends at 06 28 UT between New Zealand and Antarctica. The maximum duration of the annular phase is 6 minutes 52 seconds.

TOTAL SOLAR ECLIPSE OF 1988 MARCH 17-18



ANNULAR SOLAR ECLIPSE OF 1988 SEPTEMBER 11



12. International Geophysical Calendar 1988

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

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

S	M	T	W	T	F	S	
					1	2	
3	4	5	6	7	8	9	
10	11	(12)+	(13)**	(14)*	15	16	JULY
17	18	19	20	21	22	23	
24	25	26	27	28	29	30	
31	1	2	3	4	5	6	
7	8	9	10	11	12	13	AUGUST
14	15	(16)*	(17)*	(18)	19	20	
21	22	23	24	25	26	27	
28	29	30	31	1	2	3	
4	5	6	7	8	9	10	
[11]	12*	(13)**	◇14*	(15)	16	17	SEPTEMBER
18	19	20	21	22	23	24	
25	26	27	28	29	30	1	
2	3	4	5	6	7	8	
9	10	(11)*	(12)*	(13)	14	15	OCTOBER
16	17	18	19	20	21	22	
23	24	25	26	27	28	29	
30	31	1	2	3	4	5	
6	7	(8)	(9)**	(10)**	11	12	NOVEMBER
13	14	15	16	17	18	19	
20	21	22	23	24	25	26	
27	28	29	30	1	2	3	
4	5*	6*	7*	8*	9*	10*	
11	12	(13)*	◇14*	(15)	16	17	DECEMBER
18	19	20	21	22	23	24	
25	26	27	28	29	30	31	
1	2	3	4	5	6	7	
8	9	10	11**	12*	13	14	1989 JANUARY
15	16	(17)	(18)	(19)	20	21	
22	23	24	25	26	27	28	
29	30	31					
S	M	T	W	T	F	S	

(19) Regular World Day (RWD)

(20) Priority Regular World Day (PRWD)

◇16 Quarterly World Day (QWD) also a PRWD and RWD

6 Regular Geophysical Day (RGD)

[14 15] World Geophysical Interval (WGI)

12* Incoherent Scatter Coordinated Observation Day and Coordinated Tidal Observation Day

[11] Day of Solar Eclipse

[13 14] Airglow and Aurora Period

20* Dark Moon Geophysical Day (DMGD)

NOTES:

1. Days with unusual meteor shower activity are: Northern Hemisphere Jan 3-4; Apr 21-22; May 3-4; Jun 8-12; Jul 27-29; Aug 10-13; Oct 20-21; Nov 1-4, 16-18; Dec 12-15, 21-22, 1988; Jan 2-4, 1989. Southern Hemisphere May 3-4; Jun 8-12; Jul 26-30; Oct 20-21; Nov 1-4, 16-18; Dec 5-7, 12-15, 1988.

2. Middle Atmosphere Cooperation (MAC) began 1 Jan 1986 and runs through 1988.

3. Day intervals that IMP 8 satellite is in the solar wind (begin and end days are generally partial days): 30 Dec 1987-5 Jan 1988; 11-18 Jan; 24-31 Jan; 6-13 Feb; 19-25 Feb; 2-9 Mar; 15-21 Mar; 27 Mar-3 Apr; 9-16 Apr; 21-28 Apr; 3-11 May; 16-24 May; 29 May-6 Jun; 11-18 Jun; 24 Jun-1 Jul; 6-14 Jul; 18-26 Jul; 31 Jul-7 Aug; 12-20 Aug; 25 Aug-1 Sep; 6-14 Sep; 19-27 Sep; 2-10 Oct; 14-22 Oct; 26 Oct-4 Nov; 8-16 Nov; 20-28 Nov; 3-11 Dec; 16-24 Dec; 29 Dec-5 Jan 1989.

   There will not be total IMP 8 data monitoring coverage during these intervals. (Information kindly provided by the WDC-A for Rockets and Satellites, NASA GSFC, Greenbelt, MD 20771 U.S.A.).

4. + Incoherent Scatter programs start at 1600 UT on the first day of the intervals indicated, and end at 1600 UT on the last day of intervals.

5. Incoherent Scatter world days: 880112-16 GISMOS (GITCAD, WAGS); 880316-20 GITCAD (SUNDIAL, WAGS); 880412-13 WAGS; 880613-14 WAGS; 880712-13; 880912-13; 881109-10 WAGS; 881205-10 LTCS (SUNDIAL, GITCAD).

   GISMOS - Global Ionospheric Simultaneous Measurements of Substorms;
   GITCAD - Global Ionosphere-Thermosphere Coupling and Dynamics;
   LTCS - Lower Thermosphere Coupling Study;
   SUNDIAL - Coordinated study of the ionosphere/magnetosphere;
   WAGS - Worldwide Acoustics Gravity Wave Study.

EXPLANATIONS

This Calendar continues the series begun for the IGY years 1957-58, and is issued annually to recommend dates for solar and geophysical observations which cannot be carried out continuously. Thus, the amount of observational data in existence tends to be larger on Calendar days. The recommendations on data reduction and especially the flow of data to **World Data Centers (WDCs)** in many instances emphasize Calendar days. The Calendar is prepared by the **International Ursigram and World Days Service (IUWDS)** with the advice of spokesmen for the various scientific disciplines.

The **Solar Eclipses** are:

a.) ****17-18 March (total)**** beginning in Indonesia (totality lasts 3 minutes 46 seconds in parts of Indonesia, the Southern Philippines, and a track 109 miles wide across the N. Pacific Ocean ending off the south coast of Alaska), moving across E. Asia, N.W. Australia, New Guinea, Micronesia, W. Hawaiian Islands and ending in the extreme NW of N. America.

b.) *11 September (annular)* beginning in extreme E. Africa (Somalia), moving across S. Asia, Indonesia, Australia (except extreme NE), New Zealand and part of Antarctica. Annular eclipse path over Indian Ocean lasts 7 minutes.

Meteor Showers (selected by P.M. Millman, Ottawa) include important visual showers and also unusual showers observable mainly by radio and radar techniques. The dates for Northern Hemisphere meteor showers are: Jan 3, 4; Apr 21-22; May 3-4; Jun 8-12; Jul 27-29; Aug 10-13; Oct 20-21; Nov 1-4, 16-18; Dec 12-15, 21-22, 1988; and Jan 2-4, 1989. The dates for Southern Hemisphere meteor showers are: May 3-4; Jun 8-12; Jul 26-30; Oct 20-21; Nov 1-4, 16-18; and Dec 5-7, 12-15, 1988.

Definitions:

Time	= Universal Time **(UT)**;
Regular Geophysical Days **(RGD)**	= each Wednesday;
Regular World Days **(RWD)**	= Tuesday, Wednesday and Thursday near the middle of the month (see calendar);
Priority Regular World Days **(PRWD)**	= the Wednesday **RWD**;
Quarterly World Days **(QWD)**	= **PRWD** in the **WGI**;
World Geophysical Intervals **(WGI)**	= 14 consecutive days each season (see calendar);
ALERTS	= occurrence of unusual solar or geophysical conditions, broadcast once daily soon after 0400 UT;
STRATWARM	= stratospheric warmings;
Retrospective World Intervals **(RWI)**	= intervals selected by MONSEE for study.

For more detailed explanations of the definitions, please see one of the following or contact H. Coffey (address below): *Solar-Geophysical Data*, November issue; *URSI Information Bulletin; COSPAR Information Bulletin; IAGA News; IUGG Chronicle; WMO Bulletin; IAU Information Bulletin; Solar-Terrestrial Environmental Research in Japan; Journal of the Radio Research Laboratories* (Japan); *Geomagnetism and Aeronomy* (USSR); *Journal of Atmospheric and Terrestrial Physics* (UK); *EOS Magazine* (AGU/USA).

Priority recommended programs for measurements *not made continuously* — (in addition to unusual **ALERT** periods):

Aurora and Airglow — Observation periods are New Moon periods, especially the 7 day intervals on the calendar;

Atmospheric Electricity — Observation periods are the **RGD** each Wednesday, beginning on 6 January 1988 at 0000 UT, 13 January at 0600 UT, 20 January at 1200 UT, 27 January at 1800 UT, etc. Minimum program are **PRWDs**.

Geomagnetic Phenomena — At minimum, need observation periods and data reduction on **RWDs** and during **MAGSTORM Alerts**.

Ionospheric Phenomena — Quarter-hourly ionograms, more frequently on **RWDs**, particularly at high latitude sites; f-plots on **RWDs**; hourly ionograms to **WDCs** on **QWDs**; continuous observations for solar eclipse in the eclipse zone. See Airglow and Aurora

Incoherent Scatter — Observations on Incoherent Scatter Coordinated Days; also intensive series on **WGIs** or Airglow and Aurora periods. **Special programs**: Dr. V Wickwar, SRI International, 333 Ravenswood Ave., Menlo Park, CA 94025 U.S.A., URSI Working Group G.5.

Ionospheric Drifts — During weeks with RWDs.

Traveling Ionosphere Disturbances — special periods, probably **PRWD** or **RWDs**.

Ionospheric Absorption — Half-hourly on **RWDs**; continuous on solar eclipse days for stations in eclipse zone and conjugate area. Daily measurements during Absorption Winter Anomaly at temperate latitude stations (Oct-Mar Northern Hemisphere; Apr-Sep Southern Hemisphere).

Backscatter and Forward Scatter — **RWDs** at least.

Mesospheric D region electron densities — **RGD** around noon.

ELF Noise Measurements of earth-ionosphere cavity resonances — **WGIs**.

All Programs — Appropriate intensive observations during unusual meteor activity.

Meteorology — Especially on **RGDs**. On **WGIs** and **STRATWARM** Alert Intervals, please monitor on Mondays and Fridays as well as Wednesdays.

Middle Atmosphere Cooperation (MAC) — **RGDs**, **PRWDs** and **QWDs**. For planetary waves and tides monitor at least 10 days centered on **PRWDs** and **QWDs**.

Solar Phenomena — Solar eclipse days, **RWDs**, and during **PROTON/FLARE ALERTS**.

Study of Traveling Interplanetary Phenomena (STIP) — XV = 12-21 Feb 1984 solar GLE; XVI = 20 Apr-4 May 1984 Forbush decrease; XVII = 15 May-30 Jun 1985 alignment of Venus magnetotail with satellites VEGA 1, VEGA 2, MS-T5, PVO, and ICE; XVIII = Sep 1985 Giacobini-Zinner Comet fly-by by ICE; XIX = March 1986 International Halley Watch.
STIP (now in COSPAR's Commission D.1) is reorganizing into disciplinary subgroups. New Intervals will be chosen in cooperation with other international programs, e.g., the International Heliospheric Study (IHS) and the Study of the Transfer of Energy in Plasmas (STEP).

Space Research, Interplanetary Phenomena, Cosmic Rays, Aeronomy — **QWDs**, **RWD**, and Airglow and Aurora periods.

URSI/IAGA Coordinated Tidal Observations Program (CTOP) — Dr. R. G. Roper, School of Geophysical Sci., Geophysical Sci., Georgia Inst. of Tech., Atlanta, GA 30332 U.S.A. has the 1988 CTOP calendar.

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

This Calendar for 1988 has been drawn up by H.E. Coffey, of the IUWDS Steering Committee, in association with spokesmen for the various scientific disciplines in SCOSTEP, IAGA and URSI. Similar Calendars have been issued annually beginning with the IGY, 1957-58, and have been published in various widely available scientific publications.

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Additional copies are available upon request to IUWDS Chairman, Dr. R. Thompson, IPS Radio and Space Services, Department of Science, P.O. Box 702, Darlinghurst, NSW 2010, Australia, or IUWDS Secretary for World Days, Miss H.E Coffey, WDC-A for Solar-Terrestrial Physics, NOAA, E/GC2, 325 Broadway, Boulder, Colorado 80303, USA.