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U. R. S. I.

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ALFRED DORSIMONT
1900-1972

Radio scientists who were associated with URSI 40 years ago, or during the years just after the Second World War, will regret to hear of the death in Brussels, on 16 May 1972, of Ing. Alfred Dorsimont, Professor Emeritus of the Ecole Royale Militaire in Belgium.

At the URSI General Assemblies in 1934 and 1938, Prof. Dorsimont assisted the Secretaries General : Dr. Goldschmidt and Prof. Philippson respectively. He was himself elected Secretary General at the first General Assembly after the War in 1946 and was reelected for the period 1948-1950.

Although he had been retired for some time, Prof. Dorsimont retained his interest in radio science and was an Honorary Member of the URSI National Committee in Belgium.

MEETING OF URSI BOARD OF OFFICERS MARCH 1972

All the members were present at the meeting of the Board of Officers held in Brussels on 23 and 24 March 1972. The principal matters discussed are summarised below.

XVII General assembly 1972

Prof. Groszkowski confirmed that the Polish Organizing Committee had made good progress with the arrangements for the Assembly and that many detailed questions had been decided during the visit of the Secretary General to Warsaw in 1971.

The Secretary General confirmed that copies of the *Review of Radio Science* would be available to all delegates on their arrival in Warsaw. There had been a long delay in the receipt of the contributions from several Chairmen but work was proceeding on the checking of the proofs and it was expected to complete the task by the end of April. The URSI printers will send the volumes to Warsaw in June.

URSI Awards 1972

The members gave further consideration to the merits of the candidates for the URSI awards and to the opinions expressed by the Chairmen of Commissions who had been consulted. There were 10 nominations for the Balth. van der Pol and the J. H. Dellinger Gold Medals, and 5 for the Appleton Prize. Details of the awards actually made are given elsewhere in this issue of the *Bulletin*.

Finances

Provisional approval was given to the accounts of income and expenditure for 1971 which had been audited by Gimson and Co. of London. The URSI Council will be asked to give formal approval to the accounts for the years 1969-1971 when it meets in Warsaw.

Decisions were made on the allocation of funds for the year 1972. Expenditure will be $ 45000 for the General Assembly, $ 18000 for other scientific activities in 1972, and $ 31000 on administration; these amounts follow the budget recommendations made by the XVI Assembly in 1969, after making allowance for the devaluation of the dollar.

It will be proposed to the XVII Assembly to limit expenditure on the XVIII Assembly to $ 30000 by cancelling the meeting of the Coordinating Committee in 1974 and by avoiding the cost of publication of an expensive volume such as *Progress in Radio Science* or *Review of Radio Science*. The funds saved will be used for other scientific activities during the years 1973-1975.

It was noted that the devaluation of the dollar implied a reduction of about 14 % in the income of URSI from the annual contributions paid by Member Committees. Some Committees had maintained their contributions for 1972 at the level envisaged by the XVI Assembly, that is assuming a unit contribution of 10000 Belgian francs; it was not known how many would wish to do so. On the recommendation of the Treasurer, it was agreed that this problem should be referred to the Council at Warsaw, since a decision would have to be made before deciding on the budget for the years 1973-1975.

Reorganization of URSI

The recommendations and suggestions received from various sources were reviewed. The members agreed that it would be improper for them to make any recommendation as to the relative merits of the different possible schemes under consideration. Responsibility for making decisions on the future international organization of radio science must lie with the Member Committees of the Union, and the Council will be invited to consider the question when it meets in Warsaw. Arrangements have been made also for an open meeting at which all interested delegates will have an opportunity of expressing their opinions.

The Secretary General was asked to prepare a comprehensive document for the Council and to send copies of it in advance to all Member Committees so as to give time for discussion at national level before the Assembly. (Document "Item Ce 6" dated 30 April was posted on 3 May).

The full text of the Minutes of the meeting of the Group on URSI/IUGG Relations and Structural Changes is reproduced elsewhere in this *Bulletin*.

Status of IUCSTP

On several recent occasions the Board has discussed the anomalous status of the Inter-Union Commission on Solar-Terrestrial Physics. This body was established as an Inter-Union Commission in 1966, but it developed into a *de facto* Committee of ICSU in 1967. The Board agreed that it was desirable to resolve the difficulty by asking ICSU to recognize the actual situation and to make a formal change in the status of the Commission, changing its title to that of a Special Committee. Only minor changes in the present Constitution would be needed since it was drafted using, as a model, the constitutions of other ICSU Committees.

Since it was understood that the IMS might be delayed, it was agreed to propose an extension of the life of the new committee to 1978 rather than 1977 as proposed by the URSI/IUGG Group.

The text of the Recommendation adopted by the Board is as follows :

The URSI Board of Officers,

recognising

(*a*) that the ICSU Unions alone should be responsible for making decisions on long-term programmes of research;

(*b*) that a Special Committee of ICSU is the appropriate type of body for the organisation of a closely coordinated short-term programme requiring the cooperation of several Unions and the direct participation of specially formed national groups;

considering

(*c*) that the organisation of the International Magnetospheric Study and other projects proposed by IUCSTP in March 1972 is an appropriate task for a Special Committee of ICSU;

(*d*) that IUCSTP already operates under Provisional Statutes that are based on those of such a Committee;

recommends

(1) that ICSU recognise IUCSTP as the Special Committee for the IMS and related projects;

(2) that the terms of reference of the Committee be limited to the planning and coordination of the IMS and a limited number of other short-term projects;

(3) that the Provisional Statutes be modified accordingly and that 31 December 1978 be specified as the date of termination of the Committee.

GROUP FOR THE DISCUSSION OF IUGG/URSI RELATIONS AND STRUCTURAL CHANGES

(Doc. IUGG/URSI — R220)

Minutes of Meeting held in Paris on 2 and 3 March 1972

All the members of the Group appointed by the Presidents of IUGG and URSI were present : W. Dieminger (URSI), V. A. Troitskaya (IUGG), G. D. Garland (IUGG), C. M. Minnis (URSI).

1. — Terms of Reference

It was agreed that the tasks of the Group were (*a*) to discuss the relative merits of the various schemes that had been suggested for changes in the structure of IUGG and URSI; (*b*) to submit a report, including recommendations, to the two Unions.

2. — Restructuring of IAGA

2.1. — Before commencing its discussions, the Group agreed to invite Dr. Roederer to attend part of the first session and to outline progress made in the proposed restructuring of IAGA. The resulting exchange of views is summarised in 2.2-2.9.

2.2. — Dr. Roederer referred to his discussions with numerous scientists and to a questionnaire that he had recently circulated. He noted the complications arising from the various ways of sub-dividing environmental science : by the technique used to obtain data, by the basic discipline or by the region studied. In the case of geomagnetism he felt that, in future, there would be greater emphasis on the use of ground-based measurements for investigating the external field. Prof. Dieminger agreed that, in general, the tide was turning as a result of the decrease in funding for future experiments in space vehicles.

2.3. — Dr. Roederer referred to the need for the Unions to appeal more to younger scientists who, in many cases, were not involved in international activities except through regional groups or direct links between institutes. The chief appeal to them at present in most ICSU bodies lay in the scientific meetings arranged by these bodies. In this regard, however, they tended to be confused by the multiplicity of ICSU bodies. Moreover they did not understand the need either for broad geographical distribution of membership of scientific committees, or for international endorsement of programmes.

2.4. — Prof. Garland noted the resurgence of interest in internal geomagnetism, as witnessed by current investigations of the magnetic field of the ocean floor, rock magnetism, and dynamo theory, and recent induction studies. Drs. Roederer and Troitskaya agreed that work on geomagnetism could not be divided into separate studies of the internal and external fields. In addition it was necessary to maintain the present connections between geomagnetism and other branches of geophysics.

2.5. — The discussion then turned to the size and frequency of meetings on external geomagnetism and related matters. The IAGA Scientific Assembly in 1971 was regarded as a special case; in future, IAGA intended to stress interdisciplinary symposia at General Assemblies of the Union and to reserve the scientific meetings of its Commissions for separate Scientific Assemblies of the Association.

2.6. — It was agreed that it would be desirable for URSI and IAGA jointly to arrange meetings on the broad aspects of solar-terrestrial physics, but the interval between these meetings should be not less than two years. It was noted that, for practical reasons, URSI could not become a co-sponsor of the scientific meetings arranged by IAGA for 1973 and to be held in Kyoto.

2.7. — Dr. Roederer enquired about the reactions of the other IUGG Associations to proposed reorganisation schemes that would involve URSI and IUGG. Prof. Garland noted that the Associations had been represented on the Working Group on Problems of Structure of IUGG and that they had accepted the proposals made. However, there was still uncertainty about the meaning of the "federation" used in describing one of the schemes put forward. (See *URSI Inf. Bull.* No 178, 18 and 35).

2.8. — Prof. Dieminger referred to possible criticism of the size of a new Union including both IUGG and URSI. Dr. Minnis pointed out that it was incorrect to criticize the size of a Union by referring to the number of participants at its General Assemblies. URSI deliberately limited the size of its Assemblies to about 700 participants. Rules of operation could be drawn up to discourage unduly large Assemblies and both IUGG and URSI had such rules in mind. It was estimated that a single Assembly involving all the people who normally attend IAGA and URSI Assemblies would not exceed 1200 participants.

2.9. — It was agreed that it would not be possible to complete the formalities of a major reorganisation before 1975; both IUGG and URSI would have General Assemblies in that year and these seemed to offer the first available occasions for the final adoption of new Statutes. Dr. Roederer referred to the action being taken in some countries to bring the national URSI and IUGG Committees together. The Group had no information on whether this was likely to become a general trend. It was agreed that cooperation between the national Committees was very desirable but the precise action taken and the results would differ from one country to another.

3. — General Principles

3.1. — The Group decided to discuss a number of general principles and policies before considering the specific schemes for reorganisation. It was agreed that ICSU scientific activities of a long-term nature were the responsibility of the Unions and not of other ICSU bodies, except in a few special cases where it was generally agreed that a Scientific Committee of ICSU was essential.

3.2. — The Unions are jointly responsible for covering the whole field of the exact and natural sciences within the competence of ICSU. In practice it is often impossible to define precisely the boundaries between the different branches of sciences and thus, in some cases, a degree of overlap between the responsibilities of two or more Unions may be unavoidable. It was agreed that in these circumstances the interested Unions should jointly decide how to minimise the inconvenience caused by the overlap. They should bear in mind the possibility of setting up either Inter-Union Commissions or informal inter-Union working groups for the discussion of short-term problems requiring joint action by the Unions.

3.3. — When several Unions wish to organise a short-term scientific programme requiring the active participation of national scientific institutions, a Special Committee of ICSU should be formed if the Unions themselves cannot alone support the programme. In accordance with ICSU rules, such a Committee must have a clearly defined terminating date.

3.4. — It was recognized that the creation, by ICSU, of Scientific and Special Committees implied the presentation of additional demands to the Academies of Science and similar national bodies, both for financial support and for the active cooperation of scientists in the projects. In view of this, it is clear that ICSU and the Unions have a responsibility for limiting the creation of Special and Scientific Committees to cases where no other solution is possible.

3.5. — It was agreed that the principal objective of the proposals that envisaged the joint reorganisation of IUGG and URSI was to eliminate the present difficulties caused by the overlap in the field of ionospheric and magnetospheric physics and to provide, within ICSU, a single Union which would be the principal forum for discussion of work in this field.

4. — Scientific Objectives of URSI and IUGG

4.1. — Discussion was limited mainly to the fields of common interest to both Unions. It was noted that, in URSI, the central theme of all the scientific activities of the Union was the study of the propagation of electromagnetic radiation in various media (ionized and non-ionized media, waveguides, antennas, etc.) and related questions connected with the generation, detection and measurement of radiation, and the communication of information. The investigations just mentioned are not directly responsible for the overlap referred to in Sect. 3 since their primary objective is to understand how the various media affect the waves propagated through them.

4.2. — On the other hand when radio waves provide one of the methods, or the only method, of investigating the physical characteristics of a medium, then the radio scientist often becomes interested in the medium for its own sake and uses radio as a technique for obtaining information. It is this aspect of URSI's activities which overlaps with those of IUGG in the magnetosphere and ionosphere and, to a smaller extent, in the troposphere.

4.3. — It was noted, however, that in URSI there was a notable cohesion between the scientists interested primarily in radio wave propagation and those who developed and used radio techniques for geophysical and astronomical research. For this reason URSI is opposed to reorganisation schemes which envisage the separation of these two groups and their attachment to two or three different Unions.

4.4. — In IUGG, ionospheric and magnetospheric studies are now regarded as a single field of research since the interaction between the two regions is strong. The external geomagnetic field is an essential element in these studies and, for the reasons briefly mentioned in 2.4, the external and internal fields must be the responsibility of the same body. Thus the ionosphere, the magnetosphere and the two components of the geomagnetic field are together regarded as a field for investigation in a single Union, rather than in URSI and IUGG as at present.

5. — Comments on Suggested Schemes

5.1. — *Scheme No 1.* IUGG and URSI would disappear and would be replaced by a single Union concerned with radio science and the physics of the environment. This Union would comprise separate components dealing with radio wave propagation and related topics; geomagnetism and aeronomy; meteorology; and others concerned with the solid and fluid Earth.

5.2. — This scheme was considered to be preferable to the others, mentioned below, involving the creation of one or more new Unions.

It was noted that URSI had reservations concerning the risk that radio science might be submerged in a Union dealing with the environment. However, it is believed that the autonomous status of the various components of the proposed Union, including that concerned with radio science, would provide adequate safeguards. Each component would be autonomous in matters concerning scientific research and programmes, and it would have its own bugdet and funds; it would nominate a member on the main representative body which would report to the Officers of the Union. The Union would be responsible for overall financial and administrative policy, and for relations with ICSU and with other Unions.

5.3. — It was recognised that the proposed Union would be "larger" than IUGG but it was agreed that the size of a Union should not be measured in terms of the number of participants at its General Assemblies. It was recommended that the present policy agreed by both IUGG and URSI should be adopted, namely that the scientific meetings held during Assemblies should deal with subjects of interdisciplinary interest and not with specialised topics.

5.4. — Both IUGG and URSI have separate votes in the ICSU Executive Committee and in the Assembly. It was felt that a single Union replacing these should have 2 votes in the Executive Committee and 6 in the Assembly in the absence of major changes in the structure of ICSU or of the other Unions.

5.5. — *Scheme No 2.* A federation of three Unions, each of which would have its own national members. One of the Unions would be concerned with radio science, geomagnetism and aeronomy and would have appropriate internal structure.

5.6. — This scheme has two serious disadvantages :

(*a*) The "federal council", or some such body, would exist separately from the Councils of the three Unions. It would, therefore, represent the introduction of an additional administrative body, the main function of which would be to represent the federation in ICSU.

(*b*) The formation of three Unions in the place of IUGG and URSI would create difficulties at the national level. New national committees would have to be established and there would be problems concerning the redistribution of the present annual contributions to URSI and IUGG among the three new Unions.

5.7. — *Scheme No 3.* This scheme is the same as Scheme No 2 (see 5.5) except that internal and external geomagnetism would not be in the same Union. For the reasons given in 2.4, this subdivision is unacceptable and Scheme No.3 is not recommended.

5.8. — *Scheme No 4.* IUGG and URSI would retain their present separate identities but URSI would no longer have responsibilities for the ionosphere and the magnetosphere.

5.9. — IUGG would not object to this transfer of responsibilities, but URSI is unwilling to agree to any scheme that would destroy the cohesion between the various groups of scientists in URSI which are engaged in studies of wave propagation or in the applications of radio techniques in geophysical and astronomical research.

5.10. — It was considered that the desired cohesion could be maintained under Scheme No. 1 (Sect. 5.1) since the links between the components of the new Union would be sufficiently strong.

6. — Interim Cooperative Arrangements between IUGG and URSI

6.1. — As stated in Sect. 2.9, any reorganisation agreed by the Unions could probably not be formally approved before 1975. It is recommended that the Unions should study means whereby appropriate interim working relations could be established. These should include the coordination of both specialised symposia and meetings on interdisciplinary questions, where they were of interest to both Unions, and also the coordination of short-term scientific projects such as certain aspects of the International Magnetospheric Study (IMS).

7. — Future Action

7.1. — If IUGG and URSI accept, in principle, the main recommendations of the present Group, it is recommended further that the Unions enter into discussions on matters of detail which have not been considered in this report. These include

(*a*) the choice of titles for the new Union and for its components;

(*b*) the determination of financial policy;

(*c*) the preparation of the Statutes of the Union.

7.2. — The financial policy of the Union should be designed so that the present components of IUGG and URSI do not suffer financially as a result of their incorporation in the new structure. It is recommended that each country adhering to the new Union should make an annual contribution equal to the sum of its present contributions to IUGG and URSI.

Acknowledgement

On behalf of IUGG and URSI, the Group expressed its appreciation of the facilities for the meeting provided by the Director of the Institut Géographique National (Ing. Gén. G. Laclavère) and of his hospitality.

Recommendations

I. — The IUGG/URSI Group,

recognizing

(*a*) that, within ICSU, the Unions must carry the main responsibility for the stimulation and coordination of long-term research requiring international cooperation;

(*b*) that when several phenomena in science are closely interrelated, they should be jointly investigated within a single Union;

(*c*) that, in consequence of *b*), studies of phenomena relating to the following branches of science should each be concentrated in one Union :

A. Both the internal and external geomagnetic fields, the study of which cannot be separated from the physics of the solid and fluid Earth; the gaseous environment of the Earth including both the ionosphere and the magnetosphere;

B. The generation, propagation and detection of electromagnetic radiation in ionized and non-ionized media and in mechanical structures;

(*d*) that certain aspects of A and B are themselves closely interconnected;

recommends

that, in consequence of *d*), the stimulation and coordination of research in the fields referred to in A and B should be the responsibility of the same Union.

II. — The IUGG/URSI Group,

recognizing

(*a*) that responsibility for the fields referred to in Recommendation I is at present divided between IUGG and URSI,

recommends

1. that IUGG and URSI should jointly agree to establish a new Union with responsibility for :

A. both the internal and external components of the geomagnetic field and the gaseous environment of the Earth, including both the ionosphere and the magnetosphere;

B. the generation, propagation and detection of electromagnetic radiation in ionized and non-ionized media and in mechanical structures;

C. the branches of geophysics that are not covered by A, but are at present the responsibility of IUGG;

recognizing further

(*b*) that the range of subjects covered by A, B and C is very broad, that the methods used to study them differ greatly from one field to another and that, in consequence, the components of the Union should be autonomous;

recommends

2. that provision be made in the Statutes of the new Union for appropriate autonomy to be given to the components of the Union.

III. — The IUGG/URSI Group,

recognizing

(*a*) that many of the studies covered by A, B and C are related to each other and to the physics of planets other than the Earth;

(*b*) that studies relating to B have applications in branches of science other than geophysics and astronomy, as at present;

recommends

that the new Union referred to in Recommendation II should establish the necessary internal structure, and also appropriate relations with groups of scientists outside the Union, with the objective of encouraging new developments and extensions of its activities.

IV. — The IUGG/URSI Group,

recognizing

(*a*) that there is a need to make one ICSU body responsible for the organization of all international meetings concerned with A and B;

recommends

1. that this responsibility be given to the Union referred to in II which should act as necessary in consultation with IAU and IUPAP;
2. that the interval between meetings designed to cover the broad aspects of A and B should not be less than two years;
3. that, when necessary, meetings on more specialised subjects should be organised between the meetings mentioned in IV.2.

V. — The IUGG/URSI Group,

recognizing

(*a*) that the ICSU Unions alone should be responsible for making decisions on long-term programmes of research;

(*b*) that a Special Committee is the appropriate ICSU body for the organization of a closely coordinated short-term programme requiring the cooperation of several Unions and the direct participation of specially formed national bodies;

recommends

1. that IUCSTP be recognized by ICSU as the Special Committee for the IMS;

2. that its terms of reference be limited to the planning and coordination of the IMS;

3. that the present Provisional Statutes of IUCSTP be modified accordingly, including the specification of 31 December 1977 as the date on which the Special Committee will be terminated.

URSI AWARDS 1972

1. — The URSI Board of Officers has made the following awards for particularly valuable achievements in branches of science covered by the Commissions of URSI :

Balth. van der Pol Gold Medal.

Dr. B. D. Josephson, University of Cambridge, UK, for his studies of electronic effects in superconductors.

J. Howard Dellinger Gold Medal.

Prof. A. Hewish, University of Cambridge, UK, for his contributions to advances in radioastronomy.

2. — The Council of the Royal Society of London, following consultation with the URSI Board of Officers, has made the following award for an outstanding contribution to studies in ionospheric physics :

Appleton Prize.

Prof. R. A. Helliwell, Stanford University, California, USA, for his investigations of radio wave propagation in the magnetosphere.

INCOHERENT SCATTER STUDIES OF THE IONOSPHERE : A STATUS REPORT

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Editor's Note. — At the XVI General Assembly of URSI in 1969, Commission III gave particular attention to developments in the applications of incoherent scatter sounding to investigations of the ionosphere. Recommendations III. 15 — III. 21 (URSI, 1969) were all concerned with different aspects of this subject.

Abstract. — The principal characteristics, observing program, funding situation, and prospects for the future of the eight existing incoherent scatter observatories are briefly outlined. Proposals for two major new facilities, one in North America and one in northern Scandinavia, are also described.

1. — INTRODUCTION

This report presents a brief review of the current status and future prospects of the world-wide network of incoherent scatter observatories. In many respects the material presented here is simply a revised and up-dated version of that given in an earlier paper (Farley, 1970). We shall not, therefore, review the various measurement techniques and observations in any detail, and for further information the reader should consult recent review articles (Evans, 1969, 1972; Farley, 1970, 1971) and other original references, some of which are listed at the end of this report. We will begin, nevertheless, with a short general discussion of incoherent scattering before going on to consider the observatories now in operation and finally the new facilities which are in the planning stage.

2. — THEORY AND APPLICATION OF INCOHERENT SCATTERING

The power, frequency spectrum or auto-correlation function, and polarization of the signal scattered from the ionosphere can all be measured and analyzed so as to determine most of the important parameters of the ionosphere. Those most routinely measured are the electron density and electron and ion temperatures. Somewhat more difficult to measure are the ionic composition, the plasma drift velocity, the ion-neutral collision frequency, and the photoelectron velocity distribution. It is in principle possible to measure current strengths also, and at Jicamarca magnetic field measurements have been made. Usually only a few of these parameters are significant for a particular measurement at a particular altitude, and thus some of them (e.g., collision frequency and composition variations) can be studied only over limited altitude ranges. The theory of the scattering process has been worked out in great detail by numerous authors and is now well understood.

The easiest region of the ionosphere to study is the F region near the peak (200-500 km, say), and all observatories are now able to make quite accurate measurements of N_e, T_e, and T_i in this range. In the E region and upper F region the measurements are more difficult because the ionic composition varies with altitude; at high altitudes, of course, the strength of the returned signal drops off rapidly because of decreasing electron density and increasing range. Near the magnetic equator (Jicamarca) strong coherent echoes from unstable plasma waves completely mask the incoherent scatter signal from the E region. At some observatories measurements extend down into the D region during the day. At altitudes below 75-80 km, however, ground clutter and echoes from strong irregularities, probably associated with atmospheric turbulence, usually cause a severe interference problem. At Arecibo and Jicamarca it is possible to make measurements well into the protonosphere, and at Jicamarca a few measurements of electron density have extended to almost 10^4 km.

In recent years there has been a steadily increasing emphasis on drift velocity measurements at several observatories. Early attempts of this sort were plagued by systematic experimental errors, but now the difficulties have been largely overcome, at least for F-region measurements, and high quality data are being obtained (see Evans' 1972 review).

The question of the discrepancy in values of electron temperature obtained from incoherent scatter and from simultaneous rocket and satellite observations is still not completely resolved. The majority of the evidence points, I believe, to the correctness of the incoherent scatter results (see, for example, Carlson and Sayers, 1970); Carlson and Wrenn (private communication) have shown that measurements made with a very rapidly swept Langmuir probe do agree well with incoherent scatter results. In any event, workers in the incoherent scatter field do not seem to be much concerned with the problem any longer and feel that the burden of proof lies with the satellite and rocket observers.

In summary, because of the large number of important parameters that can be simultaneously measured with the technique, incoherent scatter is proving to be an enormously powerful tool for studying the ionosphere over a wide range of altitudes. Measurements to date have led to considerable improvements in our understanding of E- and F-region photochemistry, thermal transport processes, coupling between the F region, protonosphere, and conjugate hemispheres, the effects of solar flares, the characteristics of traveling disturbances, tides, gravity waves, etc. By studying the behavior of the charged particles in the ionosphere, a considerable amount of information about the temperature and density variations of the neutral atmosphere can also be deduced. The incoherent scatter measurements, which tell us a great deal about the upper atmosphere at one location, complement satellite observations which give less detailed information but cover a large geographical area.

3. — Observatories now in operation

3.1. — General comments.

Many of the important parameters of the incoherent scatter facilities currently operating are summarized in Tables 1-3, which are similar to those previously given by Evans (1969) and Farley (1970). Evans also compared the sensitivities of the various observatories, using as a figure of merit the product (peak power) × (effective antenna area) × (pulse repetition rate) $^{1/2}$ × (system noise temperature)$^{-1}$, and taking a repetition rate of 50 sec^{-1} as typical for most pulsed radars. This calculation ignores the important effect of receiver bandwidth, which in turn depends on radar frequency, pulse length, and altitude (i.e., the "bandwidth" of the medium); also it does not take into account the possible use of techniques such as pulse compression or frequency stepping. As a result the comparisons in some cases may be misleading. Since making proper comparisons between widely differing systems seems to be a complicated task, we have taken the easy way out and omitted direct comparisons.

The pulsed transmitters listed in Table 2 have maximum duty cycles of typically 3-6 %. Drift velocity measurements (Table 3) are made at most, but not all, observatories and usually cover a smaller range of altitudes than the temperature and density measurements. Typical error limits for the measurements listed in Table 3 are 5-10 % or less for F-region temperatures and density and 1-10 m/s for velocity. The time and altitude resolution achieved in this region is usually 5-10 min or better and 10-20 km

TABLE 1. Location of incoherent scatter facilities

Facility	Affiliation	Location	Geographic		Magnetic dip angle
			latitude	longitude	
Radio Observatorio de Jicamarca	Instituto Geofísico del Perú	Near Lima, Perú	11.95° S	76.87° W	2.0°
National Astronomy & Ionosphere Center	Cornell University	Near Arecibo, Puerto Rico	18.3° N	66.75° W	51.7°
St. Santin	Centre National d'Études des Télécommunications	*Transmitter* St. Santin de Maurs, France	44.65° N	2.19° E	61 0°
		Receivers Nançay (300 km S)			
		Monpazier (100 km E)			
		Mende (100 km W)			
RRE Ionospheric Radar	Royal Radar Establishemnt	*Transmitter* Great Malvern, Worcs, UK	52.13° N	2.33° W	67.7°
		Receivers Chilbolton, Hampshire, UK	51.14° N	1.43° W	
		Wardle, Cheshire, UK	53.11° N	2.60° W	
		Aberystwyth, Cardiganshire, UK	52.42° N	4.00° W	
USSR Observatories	——	Mid-latitude USSR	?	?	
Randle Cliff Radar	Naval Research Laboratory	Near Washington, DC, USA	38.60° N	76.54° W	70°
Millstone Hill Ionospheric Radar	Lincoln Laboratory M. I. T.	Westford. Mass., USA	42.6° N	71.5° W	72.0°
Chatanika Observatory	SRI — U. Alaska	Near College, Alaska	65.103° N	147.451° W	77°

TABLE 2. Parameters of incoherent scatter radars

Facility	Operating frequency (MHz)	Type	Antenna	System temperature (°K)	Peak power (MW)
Jicamarca	49.92	Vertical pulse	290 × 290 m array	6000	4.0
NAIC (Arecibo)	430.0	Vertical pulse	300 m spherical reflector	300	2.5
St. Santin	935.0	Multistatic CW Transmitter (vert.)	20 × 100 m reflector	—	0.150
		Receivers (oblique) Nançay	40 × 200 m reflector	110	
		Monpazier	25 m parabola	50	
		Mende	25 m parabola	50	
Great Malvern	I 400.5	Vertical pulse	42.7 m parabola	150	8.0
	II 400.5	Multistatic CW Transmitter (vert.)	42.7 m parabola	150	0.040
		Receivers (oblique) Chilbolton	25 m parabola		
		Wardle	25 × 36 m parabola		
		Aberystwyth	25 × 12 m troughs		
Russian Observatories	?	Monostatic and multistatic	?	?	?
Randle Cliff	138.6	Vertical or oblique pulse	46 m parabola	1590	5.0
Millstone	I 440.0	Vertical pulse	68 m parabola	200	3.0
	II 1295.0	Oblique pulse	25 m parabola	150	4.0
Chatanika	1290	Vertical or oblique pulse	27 m parabola	110	5.0

TABLE 3. Altitude Coverage

Facility	Electron Density	Temperature, Composition, (Drift Velocity)
	km	km
Jicamarca	200-3000 (150-8000)[a]	200-1200
Arecibo	80-2000	95-1800
St. Santin	95-700	95-700
Great Malvern (pulsed) .... (CW)	90-1000 100-400	(200-750)[a] 100-400
U S S R	150-1000	200-500
Randle Cliff	100-300 oblique 200-600 vertical	(200-600)[a]
Millstone	90-1000	105-900
Chatanika	80-700	100-600

[a] Not done on a routine basis.

or better. In general the CW multistatic systems have an advantage over the pulsed systems for temperature, composition, and particularly drift velocity measurements at a particular altitude. However, the CW systems can examine only one, or at most a few, altitudes at a time, whereas the pulsed radars can make measurements at all altitudes simultaneously. Various systematic errors associated with pulsed systems (e.g., unavoidable frequency chirping) are especially troublesome for drift velocity measurements. The errors can be compensated for, but it is not a simple task.

Additional miscellaneous comments concerning the individual observatories are listed below.

3.2. — RADIO OBSERVATORIO DE JICAMARCA.

The Jicamarca Observatory is now operated by the Peruvian government under the auspices of the Instituto Geofisico del Peru. An active program of research is presently being carried out by the Peruvian staff members and by a number of visiting scientists. The main emphasis of the program continues to be on incoherent scatter measurements and the study of plasma instabilities in the equatorial E and F regions, but a number of other projects are also underway. Jicamarca is still the only observatory operating at a frequency low enough (50 MHz) to permit measurements at very high altitudes. At higher frequencies, such as 400 MHz, the Debye length becomes comparable to $\lambda/4\pi$ at altitudes above 2000 km or so and measurements become impractical.

The financial situation at Jicamarca continues to be precarious. About 50-70 % of the funds are currently supplied from United States agencies, with the remainder coming from the Peruvian government and the Organization of American States. In spite of some reluctance on the part of the U.S. sources, it is hoped that this arrangement will continue, since the Peruvian government is unable to assume the full cost of operating the facility.

3.3. — National Astronomy and Ionosphere Center (Arecibo Observatory).

A number of substantial improvements have been made recently tot he facilities at Arecibo. The radar is now certainly the most powerful in existence for incoherent scatter measurements at all but the highest altitudes, where Debye length considerations are important. The original 430 MHz line feed, which never worked properly, has been replaced by new feed which has improved the signal-to-noise ratio for scatter measurements by about 8 dB. In addition, several special purpose high speed digital data processing devices have been constructed. These improve the efficiency of auto-correlation function measurements, particularly at high altitudes, by more than an order of magnitude, and also permit the use of pulse compression techniques at low altitudes. It is now possible to obtain high quality auto-correlation functions well into the protonosphere, and to make electron density measurements with an altitude resolution of less than 1 km with a signal-to-noise ratio (after decoding the compressed pulses, but before integrating) of better than one to one. Increased emphasis is being placed on measurements of ionospheric motions. The vector drift velocity has been measured in the F region by swinging the beam, and some measurements have been made looking simultaneously in two directions using two beams, each with half the total transmitted power.

The 40 MHz radar which was operated at Arecibo for some time never gave satisfactory data for high altitude studies. This radar is now being rebuilt for operation at 50 MHz. The transmitter will be similar to that used at Jicamarca, but will have less sensitivity.

The antenna at Arecibo will be resurfaced in the next two years to permit operation at much higher frequencies. This will greatly benefit the astronomers, but will have little effect on the quality of the incoherent scatter data. The principal effect will, in fact, probably be negative, in that the astronomers will press harder for observing time in order to take advantage of the increased capabilities of the telescope.

The prospects for continued funding of the incoherent scatter program for at least the next few years appear to be excellent, since the observatory is now a National Center supported by the National Science Foundation.

3.4. — St. Santin.

The French facility has been upgraded with the doubling of the transmitter power and the installation of two new receiving sites. The Monpazier (Dordogne) site, with a steerable 25 m dish, should begin operation in the summer of 1972, while the Mende (Lozère) site, with a similar antenna, should be ready in early 1973. For several years now the French facility has made very accurate spectral measurements which have yielded excellent temperature, composition, and drift velocity data for the E and F regions. The two new receiving sites will make possible the measurement of the *vector* drift velocity. There are no plans at present to discontinue the French observations; presumably the program will continue for at least the next several years. The facility is being operated jointly by the Centre National d'Etudes des Télécommunications and the Centre National de la Recherche Scientifique.

3.5. — RRE Ionospheric Radar.

The accuracy of the measurements over the range of altitudes specified in Table 3 is of the order of ± 150 °K for T_e and T_i and ± 3 % or better for N_e. The design of the pulsed transmitter is inflexible; the longest pulse length is 200 μsec, and double or multiple pulse measurements are not possible. As a result, drift velocities cannot be measured and spectral measurements at low altitudes are not possible. Regular F-region and some E-region data were taken from mid-1968 until mid-1970. The experiment was never intended to be of more than limited duration, and a shortage of staff has led to the termination of the regular runs. The pulsed equipment is being kept operational until at least the end of 1972.

The quadristatic installation was designed to overcome some of the limitations of the monostatic equipemnt. The accuracy of the temperature measurements has been greatly improved over that achieved with the pulsed radar, and E- and F-region velocity measurements are now also being made. The first quadristatic measurements using all the new receiving sites were made in late March, 1972. The work is being done cooperatively by the RRE, the Radio and Space Research Station, Slough, and the University College of Wales, Aberystwyth. Funding is assured until the end of 1972.

3.6. — OBSERVATORIES IN THE USSR.

Incoherent scatter observations have been made in the USSR since about 1965. Several facilities are apparently in operation, but little information about them is available. They are located at middle latitudes and perform most of the usual types of incoherent scatter measurements. According to a preprint from the Moscow IUGG General Assembly (Misyura *et al.*, 1971), vertical and oblique observations, both monostatic and bistatic, are made, Faraday rotation of the scattered signal is sometimes used for normalization of the density profiles, and spectral and autocorrelation function measurements are used to obtain temperatures. From this information it might be inferred that at least one radar probably operates at a frequency of 200 MHz or less (for Faraday data), and that one operates at 400 MHz or more (for spectral measurements and/or bistatic operation); however, this conclusion is speculative. The published density and temperature data suggest that the sensitivity of the Russian facilities is comparable to or slightly less than that of the Millstone Hill radar.

3.7. — RANDLE CLIFF RADAR.

This relatively new facility is supported by the Naval Research Laboratory and has been making regular observations since 1970. It is the only observatory other than Jicamarca that uses the Faraday rotation technique in the measurement of electron density profiles. Such measurements are quite practicable at the operating frequency of 139 MHz and make possible direct absolute measurements of electron density without the need for subsequent normalization and correction for the effect of T_e/T_i, as must be done with power profile measurements. The altitude resolution achieved at Randle Cliff is of the order of 25 km near the F-region maximum, and worse elsewhere. The errors in electron density are estimated to be of the order of $\pm$ 5-10 %.

Most emphasis now is being placed on regular electron density profile measurements. In the coming year more effort will probably be devoted to the study of TID's and F-region drift velocity studies. The prospects for continued operation as an incoherent scatter facility beyond the immediate future are unclear at present.

3.8. — Millstone Hill Ionospheric Radar.

The Millstone facility is continuing its regular program of observations, the results of which have been described in numerous publications. About 72 hours per month are devoted to incoherent scatter measurements. Measurements now extend down to the D region, and there has been an increase in emphasis on drift velocity observations. It is believed that financial support for the observatory will continue for at least another year, although no formal commitment has been made as yet.

3.9. — Chatanika Observatory.

The L-band incoherent scatter radar previously located at Stanford has been moved to a site close to the Geophysical Institute of the University of Alaska, and it is now being operated jointly by Stanford Research Institute and the Geophysical Institute. The location allows incoherent scatter observations to be made in the auroral zone for the first time, and also should permit studies of conditions on both sides of the plasma trough. The radar has been in operation at its new location only since August 1971, and so only preliminary results are available at present (March 1972). Observations have been made directly into the aurora and no clutter problems have been encountered. Some of the early measurements have shown exceedingly unusual electron density profiles, particularly during disturbed conditions. During auroral precipitation, thick auroral E layers have been observed with densities that sometimes exceed that of the F layer by an order of magnitude. Precipitation increases E-region densities by as much as two orders of magnitude and F-region densities by as much as one order.

There seems to be little doubt that the observatory will receive adequate financial support at least through 1973.

4. — Proposed new facilities

4.1. — General comments.

Detailed proposals have been made for two new major incoherent scatter facilities. The Upper Atmosphere Observatory (UAO) is to be located near the United States-Canadian border at an L value of roughly 4 and the European Incoherent Scatter Facility (EISCAT) is to be located in northern Scandinavia at $L \approx 6.3$. Both of these observatories appear to have a realistic chance of being funded and constructed within the next 3-5 years, and both are somewhat similar in design in that they will be able to operate both in a monostatic mode for good altitude coverage and resolution, and in a tristatic (one transmitting site, three receiving sites) mode, for vector velocity measurements. Although both are to be located at fairly high latitudes, the *L* values are quite different and the observatories will in no sense duplicate each other. In view of these plans, the feasibility study of a mobile facility, which was discussed at the 1969 URSI General Assembly in Ottawa (URSI, 1969), has been abandoned, at least for the present (URSI, 1970).

4.2. — Upper Atmosphere Observatory.

The actual site for the North American facility has not yet been selected, and various proposed locations are under study. A preliminary engineering report suggested one possible location in the New York State-Ontario-Quebec area, but the final choice may well turn out to be elsewhere. In designing the observatory, particular attention has been given to drift velocity measurements, both in the E and F regions. From the F-region measurements, the ionospheric electric fields and the plasma transport along the magnetic field lines can be deduced; the E-region capability will permit the study of traveling disturbances associated with gravity waves, etc. The location near $L = 4$ will allow regions on both sides of the plasmapause to be explored, since the various antennas will be steerable.

An outline of the major parameters of the facility, as currently proposed, is given in Table 4. It is estimated that the observatory can be built and brought to full operational status in less than four years at a cost of $13 million. The proposal is still being actively debated, and no funding commitments have yet been made by either United States or Canadian agencies.

4.3. — European Incoherent Scatter Facility (EISCAT).

Representatives from Finland, France, F. R. Germany, Norway, and Sweden have proposed the establishment of EISCAT in the auroral zone (URSI, 1972). The main transmitting site would be located near Tromsø, Norway, and the two auxiliary receiving sites would be located near Kiruna, Sweden and Sodankylä, Finland. All of these sites are well north of the Arctic circle and near the northern edge of the auroral zone ($L = 6.3$ at Tromsø). Operation at two frequencies (958 MHz and 240 MHz) is planned. The UHF system will yield good altitude resolution for tristatic measurements in the E region, while the VHF system will permit monostatic observations at well above 1000 km without any Debye length limitations. The location and capabilities of the observatory should permit extensive studies of a wide variety of auroral and polar cap phenomena. An additional attractive feature is that a number of complementary measurements can be made at the geophysical observatories which already exist at the three locations. There are also two sounding rocket ranges in the vicinity.

Further details of this proposed facility are given in Table 5. The timetable plans completion of the UHF system in about 3.5 years and the full

TABLE 4. Parameters of the proposed North American facility

Frequency : 430 MHz

Transmitter
- peak power : 5 MW or more
- average power : 300 kW or more
- pulse length : 10 μs — 2 ms

Main antenna : 100 m diameter parabola
steerable in magnetic N-S direction only

Remote antennas (2) : 46 m fully steerable parabolas
with multiple feeds (10) for E-region studies

A possible location (other locations are also under study)
- main site : near Lake George, N. Y., USA
- east remote site : near Quebec, Que., Canada
- west remote site : near Algonquin Radio Obs., Ont., Canada
- *L* value : about 4

Estimated cost : $13 million

TABLE 5. Parameters of the proposed European facility

	UHF	*VHF*
Frequency	958 MHz	240 MHz
Transmitter (Tromsø)		
peak power	2 MW	5 WM
average power	250 kW	100 kW
pulse length	10 μs — 10 ms	10 μs — 2 ms
Tromsø antenna	50 m parabola, fixed	100 m × 100 m array, steerable
Kiruna antenna	25 m parabola, steerable	
Sodankylä antenna	30 m parabola, steerable	
Estimated cost : $9.5 million		

facility in five years. The construction costs are estimated to be about $ 9.5 million, and would be shared among the five initiating countries and perhaps others that have expressed interest in the project. Definite plans to go ahead have not been made as yet, but the prospects for approval appear to be good.

Summary

Incoherent scatter observations have contributed greatly to our understanding of the ionosphere, and there is every indication that these measurements will continue to play a very important role in ionospheric research. The network of observatories is small but reasonably healthy at present. Because of the complexity and expense of the measurements, it is unrealistic to expect that there will ever be a large number of observatories, comparable with the ionosonde network for example. Two well conceived proposals for major new facilities, one in North America and one in Europe, are currently under discussion. If and when these new observatories begin operation, they should vastly improve our understanding of high latitude ionospheric and magnetospheric phenomena. The North American observatory will explore the plasmapause region and perhaps the southern edge of the auroral zone, while the European observatory will cover the polar cap and auroral regions. Hopefully these proposals will be strongly supported by URSI.

Acknowledgments

Helpful information and comments received from scientists at each of the observatories discussed contributed substantially to this report.

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The references listed below have been divided into various categories, in accordance with the primary emphasis of the paper. Papers reporting observational data are grouped by observatory. With papers that fall into more than one category, an arbitrary choice has been made. In order to keep the list to a manageable size, we have (with a few exceptions) listed only papers published since 1969 in readily available journals.

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FREQUENCIES ALLOCATED TO SPACE RESEARCH FROM 1 JANUARY 1973

(Document IUCAF/183 dated 10 May 1972)

Reference or Footnote	*Frequencies* (kHz)
203 A (Adjacent to Standard Frequency Bands)	2501 — 2502
	5003 — 5005
	10003 — 10005
	15005 — 15010
	19990 — 19995
	20005 — 20010
	25005 — 25010

Reference or Footnote	(MHz)
	18.052 — 18.068
	30.005 — 30.010
	39.986 — 49.020
	136. — 137.
	137. — 138.
Space to Earth — Regions 2 and 3	138. — 143.6
	143.65 — 144.
Radio navigation satellite service; for use also in space research	149.90 — 150.05
	399.90 — 400.05
For telemetering and tracking	400.15 — 401.
354 D	1700 — 1710
	2290 — 2300
For Earth to Space transmissions	7145 — 7235
For Space to Earth transmissions	8400 — 8500
	(GHz)
For Earth to Space transmissions	13.25 — 14.2
For Space to Earth transmissions	14.4 — 15.35
	31.0 — 31.3
	31.0 — 31.3
Passive	58.2 —59.
Passive	64 — 65
	65 — 66
Passive	86 — 92
Passive	101 — 102
Passive	130 — 140
Passive	230 — 240

ÉCHELLES DE TEMPS

Note de la Rédaction. — Le document suivant nous a été communiqué par le Directeur du BIPM le 30 novembre 1971.

La 14e Conférence Générale des Poids et Mesures, réunie à Paris en octobre 1971, a approuvé la définition suivante du temps atomique international (TAI), préparée par le Comité International des Poids et Mesures :

« Le Temps Atomique International est la coordonnée de repérage temporel établie par le Bureau International de l'Heure sur la base des indications d'horloges atomiques fonctionnant dans divers établissements conformément à la définition de la seconde, unité de temps du Système International d'Unités. »

Jusqu'en 1969 le Comité International des Poids et Mesures s'est abstenu d'étudier la définition des Echelles de Temps, car celles-ci étaient par tradition du domaine des astronomes. Toutefois l'échelle de temps atomique établie de façon expérimentale par le Bureau International de l'Heure depuis 1955 s'avéra utile dans des domaines d'activité autres que l'astronomie et plusieurs organisations nationales et internationales demandèrent au Comité International des Poids et Mesures de définir TAI et de prendre part à sa constitution. Cette situation aboutit aux Résolutions 1 et 2 (voir annexe) adoptées à l'unanimité par la 14e Conférence Générale.

En dépit des décisions ci-dessus, la nécessité permanente d'avoir des échelles de temps fondées sur les mouvements célestes ne permet pas de généraliser dans un avenir proche l'usage de TAI pour tous les domaines de l'activité humaine. Les renseignements qui suivent résument le rôle des différentes échelles de temps et les relations qui existent entre elles.

Le Temps Atomique International est maintenant la référence officielle pour dater les événements scientifiques. Son degré élevé d'uniformité en fait l'échelle de temps la plus convenable comme base de synchronisation des horloges et la meilleure représentation du paramètre temps en mécanique

Le Temps Universel (TU) est une fonction de la position de la Terre autour de son axe. Il n'existe aucune relation théorique entre TU et TAI. En conséquence la différence TU-TAI varie de façon imprévisible et cette différence n'est connue qu'après étude des observations astronomiques.

On a choisi l'origine et l'unité de l'échelle TAI de façon que TU — TAI soit petit. Toutefois TU — TAI, qui était égal à 0 au 1 janvier 1958, atteindra — 10 s le 1 janvier 1972 et variera en 1972 au rythme de — 1 s par an.

Les navigateurs ont besoin de façon immédiate de TU pour calculer leur position à partir d'observations astronomiques, mais, comme la précision dont ils ont besoin n'est que de quelques dixièmes de seconde, l'émission de signaux horaires dans le système TUC décrit ci-après est suffisante.

Il convient de noter que dans la plupart des pays l'heure légale diffère de TU d'un nombre entier d'heures.

Le Temps Universel Coordonné (TUC) est un système qui constitue un compromis entre TU et TAI. Les différentes unions scientifiques et le Comité International des Radiocommunications (CCIR) se sont mis d'accord sur la définition suivante du TUC, qui doit entrer en vigueur à partir du 1 janvier 1972.

Le TUC diffère de TAI d'un nombre entier *N* de secondes. *N* peut être modifié par sauts de 1 s (de préférence le 1 janvier ou le 1 juillet) de façon à maintenir TUC — TU inférieur à 0,7 s. Le Bureau International de l'Heure est chargé de la coordination de TUC. Le CCIR fournit les instructions détaillées pour la mise en œuvre de ce système.

Les horloges des grands laboratoires sont réglées sur TUC et les signaux horaires diffusent TUC.

La question se pose maintenant de savoir s'il faut considérer TUC ou TU comme base pour l'heure légale. Cette question n'est pas encore résolue et fera l'objet d'étude au cours des prochaines réunions des unions et des comités. Mais en pratique les horloges officielles suivent les signaux de temps et dépendent par conséquent de TUC.

Le Temps des Ephémérides (TE) est une échelle de temps uniforme fondée sur le mouvement gravitationnel de la Terre autour du Soleil; elle sert en mécanique céleste.

ANNEXE

Résolutions adoptées par la 14e Conférence Générale des Poids et Mesures sur le Temps Atomique internationale

Rôle du Comité International des Poids et Mesures concernant le Temps Atomique International

Résolution 1

La Quatorzième Conférence Générale des Poids et Mesures, *Considérant*

que la seconde, unité de temps du Système International d'Unités, est définie depuis 1967, d'après une fréquence atomique naturelle, et non plus d'après des échelles de temps fournies par des mouvements astronomiques,

que le besoin d'une échelle de Temps Atomique International (TAI) est une conséquence de la définition atomique de la seconde,

que plusieurs organisations internationales ont assuré et assurent encore avec succès l'établissement des échelles de temps fondées sur des mouvements astronomiques, particulièrement grâce aux services permanents du Bureau International de l'Heure (BIH),

que le Bureau International de l'Heure a commencé à établir une échelle de temps atomique dont les qualités sont reconnues et qui a prouvé son utilité,

que les étalons atomiques de fréquence servant à la réalisation de la seconde ont été considérés et doivent continuer de l'être par le Comité International des Poids et Mesures assisté d'un Comité Consultatif, et que l'intervalle unitaire de l'échelle de Temps Atomique International doit être la seconde réalisée conformément à sa définition atomique,

que toutes les organisations scientifiques internationales compétentes et les laboratoires nationaux actifs dans ce domaine ont exprimé le désir que le Comité International et la Conférence Générale des Poids et Mesures donnent une définition du Temps Atomique International, et contribuent à l'établissement de l'échelle de Temps Atomique International,

que l'utilité du Temps Atomique International nécessite une coordination étroite avec les échelles de temps fondées sur des mouvements astronomiques,

Demande au Comité International des Poids et Mesures

1° de donner une définition du Temps Atomique International (1);

2° de prendre les mesures nécessaires, en accord avec les organisations internationales intéressées, pour que les compétences scientifiques et les moyens d'action existants soient utilisés au mieux pour la réalisation de l'échelle de Temps Atomique International, et pour que soient satisfaits les besoins des utilisateurs du Temps Atomique International.

(1) En prévision de cette demande, le Comité International des Poids et Mesures avait chargé le Comité Consultatif pour la Définition de la Seconde de préparer une définition du Temps Atomique International. Cette définition, approuvée par le Comité International à sa 59e session (octobre 1970), est la suivante :

« Le Temps Atomique International est la coordonnée de repérage temporel établie par le Bureau International de l'Heure sur la base des indications d'horloges atomiques fonctionnant dans divers établissements conformément à la définition de la seconde, unité de temps du Système International d'Unités ».

Arrangements avec le Bureau International de l'Heure
concernant le Temps Atomique International

RÉSOLUTION 2

La Quatorzième Conférence Générale des Poids et Mesures,

Considérant

qu'une échelle de Temps Atomique International doit être mise à la disposition des utilisateurs,

que le Bureau International de l'Heure a prouvé qu'il est capable d'assurer ce service,

Rend hommage au Bureau International de l'Heure pour l'œuvre qu'il a déjà accomplie,

Demande aux institutions nationales et internationales de bien vouloir continuer, et si possible augmenter, l'aide qu'elles donnent au Bureau International de l'Heure, pour le bien de la communauté scientifique et technique internationale,

Autorise le Comité International des Poids et Mesures à conclure avec le Bureau International de l'Heure les arrangements nécessaires pour la réalisation de l'échelle de Temps Atomique International à définir par le Comité International.

SAUT DE TEMPS DE TUC LE 1er JUILLET 1972

Le Directeur du BIH a diffusé le communiqué suivant par la Circulaire E 1 :

En accord avec la Recommandation 460 du CCIR (New-Delhi, 1970), la Recommandation 1 de la Commission 31 de l'UAI (Brighton, 1970) et le Rapport 517 du CCIR (Genève, 1971), nous annonçons que :

une seconde intercalaire positive sera introduite à la fin de juin 1972. La séquence des dates des repères de secondes de TUC sera selon l'Annexe I du Rapport 517 du CCIR :

— 30 juin 1972, 23 h 59 m 59 s
— 30 juin 1972, 23 h 59 m 60 s
— 1er juillet 1972, 0 h 0 m 0 s.

UTC TIME STEP 1 JULY 1972

The Director of the BIH has made the following announcement in Circular E 1 :

According to the CCIR Recommendation 460 (New-Delhi, 1970), to the IAU Recommendation 1 of Commission 31 (Brighton, 1970) and to the CCIR Report 517 (Geneva, 1971), notice is hereby given that a positive leap second will occur at the end of June 1972. The sequence of dates of the UTC second markers will be, as recommended by Annex I of the CCIR Report 517 :

— 30 June 1972, 23 h 59 m 59 s
— 30 June 1972, 23 h 59 m 60 s
— 1 July 1972, 0 h 0 m 0 s.

LIGHTNING SOURCES

At the invitation of the Naval Research Laboratory, USA, the International Commission on Atmospheric Electricity (IUGG-IAMAP) has agreed to be a sponsoı of a Conference on Long-Range Geographic Estimation of Lightning Sources. The Conference will be held near Washington, DC, USA, from 11 to 16 September 1972. Further information is available from :

Waldorf Conference Programme Committee,
c/o H. Dolezalek,
1812 Drury Lane,
Alexandria (Va.), 22307, USA.

ATMOSPHERIC ELECTRICITY

The V International Conference on Atmospheric Electricity will be held from 2 — 7 September 1974 at Garmisch-Partenkirchen (near Munich), F. R. Germany. The sponsoring organisation is the International Commission on Atmospheric Electricity of IAMAP (IUGG), formerly the Joint Committee on Atmospheric Electricity of IAGA and IAMAP.

The details of the programme have not yet been decided but the provisional topics were given in *URSI Inf. Bull.* No. 180, p. 9.

1973 EUROPEAN MICROWAVE CONFERENCE

4-7 September 1973, Brussels, Belgium

The Third European Conference on Microwaves will be held at Brussels University from 4 to 7 September 1973. It is organized with the support of Fabrimetal and the cooperation of the Institution of Electrical Engineers (United Kingdom), the Institute of Electrical and Electronic Engineers (IEEE Region 8, Professional Groups MMT, AP, ED), and the Belgian Committee of URSI. The main topics of the Conference will be

— Passive components for microwaves (millimetre and optical waves included) and their computer optimization.
— Active semi-conductor elements and integrated sub-systems.
— Components and systems for communication purposes.
— Microwave acoustics.
— Industrial applications of microwaves.
— Microwave tubes.

Conference address :

Dr. ir. Gh. Hoffman, Secretary General
1973 European Microwave Conference
St. Pietersnieuwstraat 41
B — 9000 GENT, Belgium.