
U. R. S. I.

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INFORMATION BULLETIN No 172

Because of additional work entailed by the XVI General Assembly in August, it will probably not be possible to publish the next issue of the *Information Bulletin* before October. The fourth issue for 1969 will appear in December.

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Etant donné le travail supplémentaire qui sera entraîné par la XVI^e Assemblée générale au mois d'août, le prochain numéro du *Bulletin d'Information* ne paraîtra probablement pas avant le mois d'octobre. Le quatrième numéro de 1969 paraîtra en décembre.

URSI SECRETARIAT

During the period 9 August-30 August 1969, the staff of the URSI Secretariat will be in Ottawa. Letters and other documents which relate to the General Assembly should be sent to Ottawa if they are likely to arrive between the above dates. Letters relating to other matters should be sent to Brussels where they will receive attention during September after the return of the staff.

* * *

Pendant la période allant du 9 au 30 août 1969, les membres du personnel du Secrétariat de l'URSI se trouveront à Ottawa. Toutes lettres ou documents relatifs à l'Assemblée générale sont à adresser à Ottawa durant cette période. Les lettres relatives à d'autres questions sont à adresser à Bruxelles où une suite leur sera donnée au cours du mois de septembre, après le retour des membres du personnel.

PRIX DE L'URSI 1969

Les Membres du Bureau de l'URSI ont décerné :

La Médaille d'Or Balthasar van der Pol, au D^r J. P. Wild,

Division de Radiophysique de la Commonwealth Scientific and Industrial Research Organisation, Australie, pour ses contributions aux recherches radioastronomiques et au développement de nouvelles techniques observationnelles.

La Médaille d'Or John Howard Dellinger, au Prof. H. E. M. Barlow, FRS, Professeur émérite de Génie électrique à l'Université de Londres, pour ses contributions à la théorie et aux applications de la propagation des ondes radioélectriques, et plus particulièrement à l'étude des ondes guidées.

Un Comité restreint comprenant des représentants de l'URSI et du Comité national de l'URSI au Royaume-Uni a décerné :

Le Prix Appleton, au Prof. W. I. Axford,

Département d'Electrophysique appliquée, Université de Californie, San Diego, pour ses contributions à l'étude de la physique de la haute atmosphère, y compris celles relatives à la théorie sur les cisaillements de vents dans la couche E sporadique de l'ionosphère.

La remise des Prix aux lauréats aura lieu à Ottawa, au cours de la XVI^e Assemblée générale de l'URSI, le 19 août 1969; elle sera suivie par la Conférence Appleton qui sera faite par le Prof. Axford.

XVI GENERAL ASSEMBLY OF URSI 18-28 August 1969

PROVISIONAL SCIENTIFIC PROGRAMME

The Chairmen of the eight Commissions of URSI have, in most cases, been responsible for the selection of the speakers who have been invited to contribute to the scientific sessions which will form an important part of the programme in Ottawa.

Most of the arrangements for these sessions are now complete and the names of the invited speakers are given in the following pages.

The organization of the programme differs slightly from one Commission to another. Attention is drawn to the fact that in Commissions I and VII

responsibility for the organization of each session has been delegated by the Chairman of the Commission to an active specialist in the subject under discussion. In Commissions III, V and VI the Chairmen of the sessions (or of special Working Groups) have been listed in Column 2.

Details concerning joint sessions of interest to several Commissions are given in the Section dealing with the programme of the Commission responsible for the selection of the speakers.

During Session S in all the Commissions the discussions at the Assembly will be summarised. New topics will be discussed at Session NT.

Delegates to the Assembly will receive the final version of the programme when they register in Ottawa.

COMMISSION I

Session	Organizer	Speakers
I-1 Standard Frequency Transmissions (VLF)	C. J. G. Åbom	C. J. G. Åbom, J. McA. Steele
I-2 Fieldstrength and Attenuation Measurements	C. Egidi	C. Egidi, J. McA. Steele
I-3 Measurements at Radio Frequencies and at Millimetre Wavelengths	R. W. Beatty	R. F. Clark, R. G. Fellers, M. E. Zhabotinskii, D. L. Hollway, R. W. Beatty, S. Okamura, M. C. Selby
I-4 Applications of Radio Measurements	J. T. Henderson	D. N. Langenburg, V. B. Braginski
I-S		J. McA. Steele
I-NT		W. Markowitz, L. Essen
I/V/VIII-1 Noise Measurements	L. Essen	H. Tanaka, J. Shakeshaft, M. G. Arthur, F. Horner
I/VII-1 Quantum Electronic Frequency Standards	L. Essen	P. Grivet, R. H. Bechler, J. Barnes

COMMISSION II

Session	Organizer	Speakers
II-1 Planetary Atmospheres	W. E. Gordon	J. V. Evans, G. H. Pettengill, J. W. Warwick, V. R. Eshelman
II-2 Scattering and Diffraction by Irregular Surfaces		R. K. Moore
II-3 Models of the Troposphere and Space and Terrestrial Propagation		J. Voge
II-4 Report on IUCRM Sym- posium on the Spectra of Meteorological Variables		B. R. Bean
II-5 Experimental Radiometry		P. Misme
II-S		
II-NT		
II/VI-1 Propagation at Frequencies Greater than 10 GHz		D. C. Hogg, H. G. Unger
II/VII-1 Theory of Radiometry		W. J. Welch

COMMISSION III

Session	Chairmen of Working Groups	Speakers
III-1 Incoherent Scattering	W. E. Gordon	J. V. Evans : Thomson scatter as a means of studying the ionosphere M. Petit : Recent results of Thomson-scatter studies of the ionosphere
III-2 Stratosphere-Ionosphere Coupling	E. A. Lauter	W. Dieminger : Review on stratosphere-ionosphere coupling J. S. Belrose : supporting paper
III-3 Extension of Ionospheric Research		
III-4 Radio Propagation (Unsolved Problems)	W. R. Piggott	H. G. Möller, W. F. Utlaut : Reviews on unsolved problems in ionospheric radio propagation now amenable to solution
III-5 F-region Dynamics	J. W. King	H. Rishbeth : Review on F-region dynamics G. A. M. King, H. Kohl, G. Vasseur, G. Haerendel : supporting papers
III-S		
III-NT		
III/VI/VII-1 Plasma Resonances	J. O. Thomas	J. P. Dougherty : The theory of plasma resonances F. W. Crawford : Plasma resonances in the laboratory D. B. Muldrew : Electron resonances in the ionosphere R. E. Barrington : Ion resonances in the ionosphere

COMMISSION IV

Session	Organizer	Speakers
IV-1 ELF Propagation and Emissions in the Magnetosphere		J. A. Jacobs
IV-2 Bounce Resonance and VLF Disturbances Including Stability of the Magnetopause		J. W. Dungey
IV-3 Unresolved Problems and Future Programmes		
IV-4 Quasi-DC Electric Fields		G. Haerendel
IV-5 Waves in Interplanetary Space and their Effects on the Magnetosphere		F. L. Scarf
IV-S		
IV-NT		
III/IV-1 Whistler Propagation Electron Density Distribution		D. Carpenter, S. J. Bauer
III/IV-2 VLF Emissions and Instabilities (Electrons)		I. Kimura

COMMISSION V

Session	Chairmen of Sessions	Speakers
V-1 Long Base-Line Interferometry	J. L. Yen	J. L. Yen, B. G. Clark : Techniques B. F. Burke : Astrophysical Results including OH interferometry
V-2 Mapping of the Sun and Particular Regions	D. McLean	D. McLean : Sun Mapping J. R. Shakeshaft : Particular regions
V-3 Spectral Observations of Galactic and Extragalactic Sources	A. H. Barrett	A. H. Barrett : OH recombination line, Zeeman effect L. Weliachew : Extragalactic line observations
V-4 Current Activity of Various Radioastronomy Groups	E. J. Blum	
V-5 Variations of Extragalactic Sources, Sources with Peculiar Spectra, Polarization	H. Van der Laan	H. Van der Laan
V-6 Observations at mm Wavelengths and at VLF	F. Low A. Hewish	F. Low : mm and infra-red observations (?) A. Hewish : Pulsars
V-S		
V-NT		

COMMISSION VI

Session	Chairmen	Speakers
VI-1 Low-Loss Waveguides		H. M. Barlow, A. Oliner
VI-2 Coding with and without Feedback		Jakob Ziv, T. Kailath
VI-3 Communications at mm, sub-mm and optical wavelengths (a) in the Atmosphere, (b) with Guidance		B. Oguchi, C. Kao, C. Goubau
VI-4 Antennas	H. Meinke	U. Uchida, R. C. Hansen
VI-5 Information Theory	H. Takahashi	A. V. Balakrishnan, V. I. Siforov
VI-6 Optimization Techniques in Network Theory	S. J. Darlington	M. E. van Valkenburg, J. K. Skwirzynski
VI-7 Plasma Theory and Experiment	N. Marcuvitz	M. P. Bachynski, A. V. Gurevich, N. G. Denisov, P. E. Vandenplas
VI-S		
VI-NT		
VI/VII-1 Computers in Radio Science	L. D. Zadeh P. Clarricoats	S. Bellert, K. Yasuura, D. A. Calahan, M. R. Feix, B. Davies, A. Sarazin
VI/VII-2 Magnetic Recordings		

COMMISSION VII

Session	Organizer	Speakers
VII-1 Bulk Effects in Semi-Conductors	J. A. Copeland	
VII-2 Laser Transmitters and Receivers : Comparison of Various Systems	J. le Mézec	
VII-3 Superconducting Devices	J. E. Mercereau	
VII-S		
VII-NT		
I/VII-2 Measurements Using Lasers	G. Birnbaum	
VI/VII-2 Magnetic Recordings		

COMMISSION VIII

Session	Organizer	Speakers
VIII-1 Spectrum and Structure of Atmospherics		D. Llanwyn Jones
VIII-2 Location of Thunderstorms		A. G. Jean
VIII-3 Statistical Properties of Noise		T. Ishida
VIII-4 ELF Noise		E. Fellman
VIII-5 Man-made Noise		J. R. Herman
VIII-S		
VIII-NT		
III/VIII-1 Atmospherics, Including Whistlers in the Lower Ionosphere		M. Garnier, S. A. Bowhill

RÉUNION DU BUREAU DE L'URSI

MARS 1969

Le Bureau de l'URSI s'est réuni à Bruxelles les 18, 19 et 20 mars. Tous les membres étaient présents, ainsi que deux des Présidents d'Honneur de l'Union qui avaient été invités par le Président. Les décisions principales sont résumées ci-dessous.

1. — XVI^e ASSEMBLÉE GÉNÉRALE : JEUNES SCIENTIFIQUES

Le Bureau a approuvé la liste des 18 jeunes scientifiques qui bénéficieront de l'appui financier de l'URSI pour pouvoir assister à l'Assemblée d'Ottawa. Le nombre des demandes reçues a été de 34 mais, après délibération, il a été décidé de ne pas dépasser le montant de 10 000 dollars prévus à cet effet dans le budget de 1969. Préférence a été donnée aux candidats des pays de l'Amérique latine et des pays éloignés du Canada : Afrique du Sud, Australie, Autriche, Brésil, Finlande, Hongrie, Inde, Nigéria, Pérou, Pologne, Suède, Tchécoslovaquie.

Les résultats de ce plan, qui vise à encourager la participation de jeunes scientifiques aux travaux de l'Union, seront examinés à l'issue de l'Assemblée d'Ottawa et une décision sera alors prise concernant l'Assemblée de 1972.

2. — XVII^e ASSEMBLÉE GÉNÉRALE (1972)

Le Professeur Groszkowski, Président du Comité national polonais, a renouvelé l'invitation faite précédemment de tenir l'Assemblée de 1972 en Pologne. Aucune autre invitation n'a été reçue pour 1972 et le Bureau recommandera au Comité exécutif d'accepter l'invitation polonaise.

3. — XVIII^e ASSEMBLÉE GÉNÉRALE (1975)

Une invitation provisoire de tenir l'Assemblée de 1975 au Pérou avait été reçue en 1966, mais elle n'a pas été confirmée jusqu'à présent (1). Suivant la tradition, la XVIII^e Assemblée générale devrait en principe avoir lieu dans un continent extra-européen.

(1) Cette invitation a été confirmée depuis lors par le Président du Comité national péruvien de l'URSI.

4. — PROGRESS IN RADIO SCIENCE

Il a été décidé que l'URSI publierait au moins les exposés de synthèse qui seront présentés à Ottawa au cours des séances scientifiques des Commissions. La publication en sera assurée par le Secrétariat.

5. — CONFÉRENCES COMMÉMORATIVES DE L'URSI

La série des Conférences commémoratives fut inaugurée au cours de l'Assemblée de Londres en 1960, et poursuivie aux Assemblées de Tokyo (1963) et de Munich (1966). Une Conférence commémorative sera également organisée à Ottawa cette année.

L'ampleur prise par les activités des Commissions au cours des Assemblées générales empêche l'organisation des Conférences commémoratives pendant la journée. De ce fait, elles doivent avoir lieu dans la soirée et le nombre des auditeurs devient de plus en plus limité.

Etant donné l'importance attribuée aux contacts non-officiels des délégués au cours des Assemblées, et en vue de laisser le plus de temps libre possible à ces fins, il est envisagé de clôturer la série des Conférences commémoratives après l'Assemblée de 1969.

6. — CANDIDATS AU BUREAU 1970-1972

La procédure pour l'élection des membres du Bureau à l'Assemblée d'Ottawa a été fixée et les Comités nationaux ont reçu la liste des candidats proposés.

Selon une suggestion du Bureau, à l'avenir chaque candidat devra être appuyé par au moins deux Comités nationaux et chaque proposition devra être accompagnée d'un bref aperçu de la carrière et des travaux du candidat, ainsi que de ses contributions aux activités de l'URSI.

Antérieurement déjà, le Bureau avait exprimé l'opinion qu'il n'était pas nécessaire d'élire un Trésorier de l'URSI étant donné que toutes les questions financières étaient traitées, conformément aux Statuts, par le Secrétaire général. Il considère qu'il serait plus opportun de confier la supervision générale des finances à l'un des Vice-Présidents et a recommandé une modification dans ce sens aux termes des Statuts.

7. — PRIX DE L'URSI

Les règles qui régissent l'attribution des Médailles d'Or Balth. van der Pol et J. H. Dellinger et le Prix Appleton sont essentiellement analogues et la seule différence existante porte sur le critère à adopter pour la sélection

des lauréats. Il a été constaté que cette différence pourrait conduire, dans des circonstances données, à de sérieuses difficultés.

Il a été décidé d'examiner, en consultation avec les donateurs, la possibilité de réviser les règles de manière à les rendre uniformes pour les trois Prix de l'Union.

8. — RELATIONS AVEC D'AUTRES ORGANISATIONS

8.1. — FMOI.

Il a été noté que des contacts non-officiels avaient été établis avec la Fédération Mondiale des Organisations d'Ingénieurs récemment constituée.

8.2. — ENSEIGNEMENT DES SCIENCES.

L'actuelle Commission inter-Unions pour l'Enseignement des Sciences sera réorganisée sous peu pour devenir un Comité dépendant directement du CIUS. Considérant que l'URSI pourrait jouer un rôle actif dans les travaux du nouveau Comité, le Bureau a recommandé qu'elle en devienne membre. Il est estimé que l'enseignement des sciences, et plus particulièrement de la radioélectricité scientifique, revêt une importance toujours croissante.

Il a été décidé de demander aux Comités nationaux s'ils estimaient que l'Union pouvait apporter quelque contribution, sous forme de conseils ou autre, à l'enseignement des disciplines de la radioélectricité scientifique dans leurs pays.

8.3. — BUREAU DES RÉSUMÉS ANALYTIQUES DU CIUS.

Vu que l'on ne voit pas comment l'URSI pourrait contribuer de manière efficace aux travaux spécialisés du Bureau des Résumés analytiques, il a été décidé qu'elle n'adhérerait pas à cette organisation.

8.4. — AFFILIÉS SCIENTIFIQUES.

Il a été noté que le CIUS reconnaissait actuellement une nouvelle catégorie de membres, les « Affiliés scientifiques », qui sont admis à participer aux Assemblées générales, mais sans droit de vote. Etant donné que les Statuts de l'URSI autorisent le Président à inviter aux Assemblées générales de l'Union des observateurs qui ont les mêmes avantages que ceux offerts par le CIUS aux Affiliés scientifiques, il serait superflu d'inclure une nouvelle clause aux Statuts.

9. — FÉDÉRATION D'UNIONS

Les Comités nationaux français de l'URSI et de l'UGGI ont invité conjointement les Présidents des deux Unions à examiner les possibilités d'une nouvelle répartition des activités scientifiques, qui permettrait de réduire les recouvrements d'intérêts actuellement existants. La proposition envisage une Fédération de trois Unions qui grouperaient de manière plus adéquate les scientifiques intéressés par les différentes disciplines.

Cette Fédération comprendrait :

- A. Union de Radioélectricité scientifique et de Géophysique externe (Commissions de l'URSI et les Commissions de l'IAGA concernées par l'aéronomie et le magnétisme externe).
- B. Union de Géodésie et de Géophysique interne (les Commissions de l'IAGA concernées par le magnétisme interne, IAG, IASPEI et IAVCEI).
- C. Union de Météorologie et de Physique de l'Hydrosphère (IASH, IAPSO, IAMAP).

Le Bureau a exprimé l'opinion qu'il était souhaitable d'explorer les méthodes qui permettraient de grouper, au sein d'une seule organisation, les chercheurs s'occupant d'une même discipline ou de disciplines apparentées. Il a été admis qu'il n'y avait pas de solution idéale aux difficultés actuelles et que l'objectif était de trouver un schéma qui apporterait une amélioration à la situation actuelle. Le bureau a relevé certains défauts dans la redistribution des disciplines entre les trois Unions proposées, mais il estime que l'ensemble de la question doit faire l'objet d'une étude approfondie en collaboration avec l'UGGI. Il a été noté que l'IUCSTP et le COSPAR étaient également intéressés par certaines disciplines ressortissant aux domaines de l'URSI et de l'UGGI.

10. — RÉVISION DES STATUTS DE L'URSI

Le Bureau a approuvé le Projet de révision des Statuts et a autorisé le Secrétaire général à le diffuser aux Comités nationaux pour commentaires (Doc. URSI-N6 (69)).

11. — FINANCES

Les comptes provisoires des recettes et dépenses pour 1968 ont été présentés aux membres du Bureau. Les comptes certifiés pour la période 1966-1968 seront soumis à l'approbation du Comité exécutif au cours de l'Assemblée générale d'Ottawa.

Les activités de l'URSI au cours des quelques années à venir, ainsi que l'accroissement du coût des voyages et frais de séjour entraînés par les activités scientifiques de l'Union ont fait l'objet d'un examen préliminaire. Le Comité exécutif sera invité à considérer le budget pour la période 1970-1972 et à recommander, si nécessaire, une augmentation de l'unité de contribution annuelle versée par les Comités nationaux à l'URSI.

12. — Le 19 mars, un dîner amical a réuni à Bruxelles les membres du Bureau et leurs invités : M^{me} Herbays, M. et M^{me} le Corbeiller, M. Decaux et le D^r Smith-Rose.

M^{me} Le Corbeiller a eu la générosité de fournir les Médailles d'Or Balth. van der Pol pour 1969 et 1972. Le Fonds de la Médaille d'Or Balth. van der Pol qu'elle institua voici quelques années demeure ainsi intact.

Les membres du Bureau ont également apprécié le geste de M. Decaux qui a bien voulu remettre à l'URSI deux médailles de bronze à l'effigie du Général Ferrié, dont l'une frappée récemment pour commémorer le centenaire de la naissance du Général Ferrié (*Bulletin d'Information* n^o 170, p. 5) et l'autre frappée il y a une quarantaine d'années à l'initiative de l'URSI et portant l'inscription suivante : « L'Union Radio-Scientifique Internationale reconnaissante à son éminent Président ».

MEETING OF URSI BOARD OF OFFICERS, MARCH 1969

The URSI Board of Officers met in Brussels on 18, 19 and 20 March. All members were present and also two of the Honorary Presidents at the invitation of the President. The principal decisions are summarised below.

1. — XVI GENERAL ASSEMBLY : YOUNG SCIENTISTS

The Board approved the list of names of 18 young scientists who will receive financial support from URSI to enable them to attend the Assembly in Ottawa. Although a total of 34 applications had been received, it was decided not to increase the total amount (\$ 10,000) provided for this purpose in the 1969 budget. Preference was given to applications from Latin American countries and from countries far from Canada : Australia, Austria, Brazil, Czechoslovakia, Finland, Hungary, India, Nigeria, Norway, Peru, Poland, South Africa, Sweden..

The success of this scheme for encouraging young scientists will be reviewed after the Ottawa Assembly before a decision is made regarding a similar scheme for the 1972 Assembly.

2. — XVII GENERAL ASSEMBLY (1972)

Professor Groszkowski, President of the Polish National Committee, renewed the earlier invitation to hold the 1972 Assembly in Poland. No other invitation for 1972 has been received and the Board will recommend to the Executive Committee in Ottawa to accept the invitation from Poland.

3. — XVIII GENERAL ASSEMBLY (1975)

A tentative invitation to hold the 1975 Assembly in Peru was received in 1967 but it is not yet known whether this invitation is still open ⁽¹⁾. In accordance with recent tradition the 1975 Assembly ought, in principle, to be held outside Europe.

4. — PROGRESS IN RADIO SCIENCE

The scientific review papers, at least, presented at Ottawa during the sessions organised by the Commissions will be published by URSI under arrangements to be made in the Secretariat.

5. — URSI MEMORIAL LECTURES

This series of lectures began at the 1960 Assembly in London. Further lectures were given in 1963 (Tokyo) and 1966 (Munich) and the series will be continued in 1969 (Ottawa).

The pressure of work in the Commissions during an Assembly is now so great that it is not possible to find time during the day for Memorial Lectures. In consequence, the lectures must be held during the evening and attendance tends to be poor.

It is considered important to leave as much time as possible for delegates to meet informally during Assemblies and consideration will be given to the termination of the series of Memorial Lectures after the 1969 Assembly.

⁽¹⁾ This invitation has since been confirmed by the President of the URSI National Committee in Peru.

6. — NOMINATIONS FOR THE BOARD OF OFFICERS 1970-1972

The procedure for the election of the members of the Board of Officers in Ottawa was agreed and National Committees have already received the list of candidates for election.

It is proposed that, in future, each candidate should be supported by at least two National Committees and that his nomination should be accompanied by a summary of his career and work and his past contributions to the activities of URSI.

It was noted that the Board has earlier agreed that a separate Treasurer of URSI was not necessary since all financial matters were handled by the Secretary General in accordance with the Statutes. It was agreed that general supervision of the finances by one of the Vice-Presidents would be adequate and that the revised Statutes should make provision for this change.

7. — URSI AWARDS

The awards of the Balth. van der Pol and the J. H. Dellinger Gold Medals and the Appleton Prize are made in accordance with rules which are basically similar but which, nevertheless, contain important differences in the criteria to be used in selecting the winners. These differences are inconvenient and could, in certain circumstances, lead to difficulties in the selection of the winners.

It was agreed to investigate the possibility of revising the rules for all three awards, in consultation with the donors, so that the same rules would apply to all three awards.

8. — RELATIONS WITH OTHER BODIES

8.1. — WFEO.

It was noted that informal contact had been established with the recently formed World Federation of Engineering Organisations.

8.2. — SCIENCE TEACHING.

The present Inter-Union Commission on Science Teaching will soon be reconstituted as a Committee directly responsible to ICSU. The Board recommended that URSI should become a member and that the Union should play an active part in the work of the new Committee; the teaching of science, and especially of subjects related to radio science, is considered to be of growing importance.

It was agreed that National Committees of URSI should be asked whether the Union could offer advice or give some other form of assistance with regard to the teaching of radio science in their countries.

8.3. — ICSU ABSTRACTING BOARD.

URSI will not apply for membership of the ICSU Abstracting Board since it is not clear what positive contribution could be made by the Union to the specialised work of the Abstracting Board.

8.4. — SCIENTIFIC AFFILIATES.

It was noted that ICSU now recognised "Scientific Affiliates" which could adhere to ICSU and participate in General Assemblies but without voting power. The URSI Statutes already authorise the President to invite observers to General Assemblies of the Union and it was agreed that it was unnecessary to make further provision in the Statutes since the observers had the advantages offered by ICSU to Scientific Affiliates.

9. — FEDERATION OF UNIONS

The French National Committees for URSI and IUGG have jointly invited the Presidents of URSI and IUGG to consider a redistribution of their scientific activities in such a way as to reduce the present overlap of interests between component bodies of the two Unions. Three new Unions are proposed, together making a Federation, and it is suggested that, as a result, scientists interested in certain fields would be grouped together in a better manner than at present.

The Unions within the Federation would be :

- A. Union of Radio Science and External Geophysics (the Commissions of URSI and those of IAGA concerned with aeronomy and external geomagnetism).
- B. Union of Geodesy and Internal Geophysics (Commissions of IAGA concerned with internal geomagnetism; IAG, IASPEI and IAVCEI).
- C. Union of Meteorology and the Physics of the Hydrosphere (IASH, IAPSO, IAMAP).

The Board expressed the opinion that it was desirable to investigate possible methods of bringing together, within the same body, scientists who were working on the same or related subjects. It was agreed that there was no ideal solution to the present difficulties and that the aim should be to devise a scheme which would improve the present situation. The Board recognised that there were defects in the redistribution implied by the three

Unions suggested above but it was agreed that the whole question should receive further serious study in collaboration with IUGG. It was noted that IUCSTP and COSPAR were both interested in parts of the work of URSI and IUGG.

10. — REVISION OF STATUTES OF URSI

The Board approved the circulation to National Committees, for comments, of the Draft Revised Statutes contained in URSI-N6 (69).

11. — FINANCES

The provisional accounts of income and expenditure for 1968 were noted. The audited accounts for the period 1966-1968 will be submitted for approval to the Executive Committee at the General Assembly.

Preliminary consideration was given to the activities of URSI over the next few years and the increasing cost of the travel and subsistence allowances incurred in connection with the scientific activities of the Union. It was agreed that the Executive Committee should be asked to give examination to the budget for the period 1970-1972 and, if necessary, to recommend an increase in the unit contribution applicable to National Committees of URSI.

12. — At an informal dinner, held in Brussels on 19 March, the guests of the Board were Mme Herbays, M. and Mme Le Corbeiller, M. Decaux and Dr. Smith-Rose.

Mme Le Corbeiller has very generously provided the Balth. van der Pol Gold Medals for 1969 and 1972 and thus the Fonds Médaille d'Or Balth. van der Pol which she established some years ago remains intact.

It is appropriate to record also the appreciation of the Board of Officers of the gesture made by M. Decaux who has presented to URSI copies of two bronze medals bearing the effigy of General Ferrié. One of these is the medal struck to commemorate the centenary of the birth of General Ferrié (*URSI Inf. Bull.* No. 170, p. 5). The other medal was struck about 40 years ago on the initiative of URSI and bears the inscription : "L'Union Radio-Scientifique Internationale reconnaissante à son éminent Président".

RADIO ASTRONOMY AND SPACE RESEARCH REVIEW OF REQUIREMENTS FOR ALLOCATIONS OF FREQUENCIES

(Document IUCAF/142 dated 24 March 1969)

This Review was prepared at the meeting of the Inter-Union Commission on Frequency Allocations (IUCAF) held in Brussels on 18 and 19 February 1969.

A. — REVIEW OF THE REQUIREMENTS OF RADIO ASTRONOMY AND SPACE RESEARCH FOR ALLOCATIONS OF FREQUENCY BANDS

The present allocations of frequency bands for scientific purposes have been made at World Administrative Radio Conference (WRAC) of the ITU in response to specific requests by national administrations. In the fields of radio astronomy and space research the relevant conferences are guided by advice from IUCAF, which represents the scientific interests of URSI, IAU and COSPAR. A representative of IUCAF attended the WRAC in 1963, acting as observer, and it is expected that similar representation will again be invited for the next relevant Conference in 1970 or 1971.

IUCAF has prepared this report on the additions and changes which are required for the development of space research and radioastronomy, and which the Commission would wish national administrations to consider in formulating their own proposals for the forthcoming WRAC. Since the two services differ in nature, the report is in separate parts for each service.

Summaries of the proposed additions and changes, and more detailed discussion of the most substantial issues are discussed in Sections B & C. This review of requirements for radio astronomy and space research will form the basis of the IUCAF submissions to ITU for consideration at the WRAC, in accordance with Recommendation N° 11A (Geneva 1963).

B. — REVIEW OF FREQUENCY ALLOCATIONS FOR RADIO ASTRONOMY

Radio astronomy has continued to advance during recent years, both in the range of astronomical objects which can be studied, and in the techniques which are available at radio observatories throughout the world. The

frequency bands assigned to radio observatories exclusively for the radio astronomy service have enabled the most sensitive observations to be made free of any interference. Shared bands have also proved to be very useful when suitable arrangements can be made by national administrations to achieve protection criteria comparable with those in CCIR Report No. 224. Such arrangements have been facilitated by the policy adopted by radio astronomers, of making observations at only a few locations sited as far as practicable from potential sources of interference.

Notable advances in observation have involved measurements of the spectra of radio sources both at the low and high frequency extremes of the spectrum. A most important development has been the use of very long baselines in interferometric observations, in which observatories in two widely separated countries make simultaneous observations of a radio source at the same radio frequency. Many new radio spectral lines have been discovered, and increasing importance is attached to the hydrogen line at 1,400-1,427 MHz and to the OH lines near 1,666 MHz.

These developments emphasise the continuing need for two types of frequency allocations :

- (a) A series of bands throughout the spectrum, with a bandwidth of the order of one per cent of the centre frequency. These bands are required to define the spectrum of the continuum emission of galactic and extra-galactic radio sources.
- (b) Frequency bands whose positions are determined by natural line emission, such as that of neutral hydrogen.

Improvements to existing allocations, which are required for new radio astronomical work and which are recommended in this report, arise in three ways : (i) from the considerable advantages which would accrue if at least part of each frequency band could be made an exclusive allocation which is the same throughout the world; (ii) from the requirement to improve and complete the series of bands throughout the spectrum; (iii) from a requirement to provide wider bandwidths for observations in the bands at 2,690-2,700 MHz and above, and thus achieve higher sensitivities. Although it would be unrealistic to expect many wider-bandwidth allocations on an exclusive basis, it is considered that some extension of the bands on the basis of sharing with services using low power transmissions, coupled with some local protection, would be acceptable. It has already been demonstrated that such procedures are practicable.

The frequency bands are now discussed in order of ascending frequency.

1. — The Guard Bands at 2.5, 5, 10, 15, 20 and 25 MHz. — The use of these bands for radio astronomy and for space research has been considered in some detail by IUCAF. It is now suggested that they should no longer be allocated to the radio astronomy service, and that different allocations should be requested at frequencies near 10 MHz and 20 MHz so as to complete the series of observing bands in a more useful way.

Bearing in mind the great distances over which waves at these frequencies can travel, IUCAF suggests specifically that an allocation for radio astronomy of a 20 kHz band at a frequency within the range 17-23 MHz should be made on a primary and world-wide basis at the earliest opportunity.

2. — 37.75-38.25 MHz. — IUCAF notes that Recommendation No. 32 (Geneva 1959) was met only partially by the allocation of this band to radio astronomy on a secondary basis. Bearing in mind that transmissions at these frequencies can travel over great distances in certain ionospheric conditions, IUCAF now recommends that this allocation should be improved so that as much as possible of the band is allocated to radio astronomy on a primary and world-wide basis.

3. — 73 (Region 2), 79.75-80.25 MHz (Region 1, Footnote 261).

No change is recommended for these bands, because there seems little chance that a world-wide allocation, although desirable, could be acquired.

4. — 150.05-153.00 MHz (Region 1, Footnotes 286 and 286A).

This frequency band occupies a prominent position in the sequence of bands required for observations of the continuum spectrum of radio sources. Experience has shown that useful observations can be made even when the band is shared, provided that radio observatories are situated at reasonable distances from any transmitters operating in the band and that such transmitters are of low power, as for example for fixed and land-mobile purposes. It is therefore recommended that this band be allocated to radio astronomy on a shared basis and that the services which share the band be developed in a way which will not be harmful to radio astronomy on designated sites. The need to avoid interference would usually exclude the use of high-power ground transmissions or for airborne transmitters in a considerable area around the observatories.

5. — 320-327 MHz (Footnote 310, (1959)).

No change is recommended.

6. — 404-410 MHz (Footnote 317, (1963)).

Attention is drawn to the difference in allocations in Region 2 (404-410) and in Regions 1 and 3 (406-410). It is now recommended that the frequency

band 406-410 MHz be allocated to radio astronomy on a world-wide basis, and that as much of the band as possible, and at least 2 MHz be an exclusive allocation.

7. — 606-614 MHz.

After noting the difference in allocation in Region 1 (606-614), 2 (608-614) and 3 (610-614), it is now recommended that the frequency band 608-614 MHz be allocated to radio astronomy on an exclusive and world-wide basis.

8. — 1,400-1,427 MHz.

IUCAF noted that improvements of observing techniques at some observatories now permit the observation of hydrogen line emission from distant extragalactic sources, when the Doppler-shifted line frequency falls below the allocated band. The Commission suggests that national administrations should be asked to take all practicable steps to avoid interference to observations of this kind within the band 1,390-1,400 MHz, in addition to recognising the exclusive allocation of the band 1,400-1,427 MHz to radio astronomy.

9. — (a) 1,660-1,670 MHz.

It is proposed that the protection given to observations of the OH spectral lines by Footnote 353A now be improved so as to provide an allocation to radio astronomy over the band 1,660-1,670 MHz in some way which will provide the best possible protection for observations of the OH line emissions.

(b) 1,612 MHz and 1,720 MHz.

Other spectral lines emitted by OH at or near these frequencies appear to have great significance in astrophysics, but the future requirements for protection of observations of these lines cannot yet be assessed. It is suggested that national administrations be asked to give all possible protection to observations of these lines within the bands 1,611.5 to 1,612.5 and 1,720 to 1,721 MHz.

10. — 2,690-2,700 MHz.

This band, and others at higher frequencies, have been discussed by IUCAF in some detail; and it is now recommended that the protection given to the radio astronomy service be improved by an additional allocation of the band 2,670-2,690 MHz on a shared basis.

11. — 4,990-5,000 MHz.

Here IUCAF recommends that the protection given to the radio astronomy service be improved by an additional allocation of the band 4,950-4,990 MHz on a shared basis.

IUCAF notes that second-harmonic radiation from industrial equipment operating in the allocated band 2,400-2,500 MHz is a potential source of interference to radio astronomy, but does not propose any consequential change in the allocations to radio astronomy.

12. — 10.68-10.70 GHz.

In this part of the spectrum IUCAF recommends that the protection given to the radio astronomy service be improved by an additional allocation of an adjacent band or bands on a shared basis, so as to increase the total allocated bandwidth to 100 MHz. A suitable additional band would be 10.60-10.68 GHz.

13. — 15.35-15.4 GHz, 19.3-19.4 GHz, 31.3-31.5 GHz.

While the Commission considered that these three allocations are satisfactory for the present, the bands might need to be increased in width to facilitate the investigation of the effect of both water (H_2O) and ammonia (NH_3) in this part of the spectrum. It was considered that at present little more could be done than to note the discovery of these natural radiations. With the benefit of more precise knowledge in the future, it is expected that a detailed statement will be available for the World Administrative Radio Conference (WARC) in 1970/71.

14. — Frequencies above 40 GHz.

While the present Radio Regulations define Radio Waves as “Electromagnetic Waves of frequencies lower than 3,000 GHz...”, it was noted that the Frequency Allocation Tables are limited to the range 10 kHz to 40 GHz.

Attention was drawn to the fact that the CCIR are already studying the absorption by oxygen and water vapour of radio waves at frequencies up to 100 GHz (corresponding to a wavelength of 3 mm). It was considered to be reasonable to expect that some Administrations might be encouraged to initiate a request for the extension of the range of frequencies beyond 40 MHz; and IUCAF should therefore be prepared to make a claim on behalf of radio astronomers for one or more bands to be protected in the part of the spectrum between 40 and, say, 300 GHz.

C. — FREQUENCY REQUIREMENTS
FOR SPACE RESEARCH TO BE CONSIDERED IN CONNECTION
WITH THE WORLD ADMINISTRATIVE RADIO CONFERENCE

1. — INTRODUCTION.

COSPAR has made representations to IUCAF regarding the possible allocation of additional frequencies for space research. IUCAF has discussed these at various meetings, most recently in February 1969, and its present views are discussed below. Only proposed changes and additions are discussed; otherwise it is assumed that the requirements are met by the present allocations. The suggested policies are those to be followed in the preparations for the World Administrative Radio Conference (WARC), planned for 1970 or 1971.

2. — THE STANDARD FREQUENCY BANDS.

Space research has secondary allocations in the standard frequency bands at 10 and 20 MHz, and a requirement has been expressed for similar access to the other bands at 2.5, 5, 15 and 25 MHz. IUCAF supports this application, but notes that possible new developments in the standard frequency service may make the bands unusable for space research. If this should happen, it is assumed that alternative frequencies would be required, say at least one near 10 MHz and one near 20 MHz, but that these would not need to be harmonically related.

3. — FREQUENCIES FOR DOPPLER AND FARADAY MEASUREMENTS.

IUCAF supports the proposal that in addition to the band at 20 MHz, space research should have allocations in a band at 40 MHz, in harmonic relation, and also at a frequency of the order of 1 MHz different from 40 MHz, for Doppler and Faraday measurements. Frequencies so far used for this purpose on a non-interference basis (20.005, 40.010 and 41.010 MHz) would be satisfactory. Additionally, a higher harmonic of the 20 MHz allocation is desirable. This should not be 80 MHz owing to the risk of interference to radio astronomy. It seems unlikely, in fact, that a suitable world-wide allocation could be obtained below 400 MHz, even on a secondary basis. However IUCAF considers that sufficient freedom from interference at receiving sites might be obtained through a footnote urging administrations to give all practicable protection to the sites where measurements are carried out. It may be more difficult to obtain agreement for the satellites to transmit, although the low powers involved may be found acceptable. These possibilities will be explored. Furthermore, any proposal

for a secondary allocation which may be made by an administration will have the strong support of IUCAF.

4. — FREQUENCIES FOR GEODETIC MEASUREMENTS.

There seems little chance that any firm allocations could be obtained for geodetic work on the harmonically related series 162, 324 and 972 MHz. A more promising course would be to seek formal recognition for space research in the 150 and 400 MHz radio navigation bands, on a shared basis. If a higher, harmonically-related frequency is required, it seems unlikely that a satisfactory allocation could be obtained below 1,000 MHz. However, 1,000 and 1,200 MHz are possibilities which could be pursued. An allocation at 1,400 MHz for this work would be likely to interfere with radio astronomy.

5. — FREQUENCIES ABOVE 40 GHz.

There are at present no allocations at frequencies higher than 40 GHz, but it is possible that some will be made at the WARC. If so, it is proposed that a series of bands be requested for space research, chosen in relation to the locations of absorption and transmission bands. For example, a satisfactory series could be selected from the following bands (all in GHz).

For reception only (these could be shared with radioastronomy) : 52-56, 58-59, 64-65, 88-92, 101-102, 130-136, 182-185 and 230-236.

For space-to-space communication : 62-63, 110-112.

These are preliminary proposals and the technical requirements need to be described in greater detail in the near future.

FIRST IUCSTP GENERAL MEETING

The first General Meeting of IUCSTP was held at the Royal Society, London, from Monday 27 January to Friday 31 January 1969. About 130 delegates attended from 23 countries, and international organizations represented included UNESCO, ICSU, WMO, URSI, IUGG, COSPAR and ESRO.

Apart from opening and closing plenary sessions, the main business of the conference consisted of individual and combined meetings of the twelve Working Groups representing the topics in solar-terrestrial physics identified for cooperative study during the next few years. Several of these topics are concerned directly or indirectly with radio science, in particular Working

Groups 1 (monitoring of the solar-terrestrial environment), 4 (dynamic characteristics of the magnetosphere), 5 (conjugate point experiments), 6 (electric fields in the magnetosphere), 10 (dynamics of the upper atmosphere), 11 (ion chemistry of the D and E regions), and 12 (sudden ionospheric disturbances). In addition to these discussions, a special one-day meeting of representatives of ionospheric vertical soundings stations was held on 30 January 1969, under the auspices of the URSI-STP Committee, to consider the future of the ionosonde network and general problems associated with the operation of these stations. This meeting was attended by 27 representatives. In addition there had been several meetings of ad hoc groups in the week prior to the meeting to prepare for it, organized as a sub-committee of IUCSTP Working Group 1. The full report of these meetings and the recommendations agreed will be published separately.

At the closing plenary session, each Working Group leader gave a brief summary of the programme and activities of his group, together with the presentation of the recommendations in draft form. Comments on these were invited at the plenary sessions. The final versions will be agreed later following discussions with other Working Groups. Some comments are given below, which are selected as being of interest to URSI, but it must be stressed that they are based entirely on verbal communications of an interim nature.

Working Group 1 reported that the Guide for data exchange should be ready in the spring of 1969. The many topics discussed by this Working Group included a review of the ionosonde network (in collaboration with the URSI-STP Committee). Proposals include the suggestion that visiting experts be appointed to help monitoring stations.

Working Group 5 recommends that the existing ionosonde network continue, with particular emphasis on conjugate pairs of stations. Working Group 9 (basic structure of the upper atmosphere) has recommended that radar meteor wind measurements and Thomson scatter measurements should be used to give information on the properties of the atmosphere. Working Group 10 has now defined four main topics for long-term study; it was considered that, as for the meteorological discipline, studies of the dynamics of the upper atmosphere do not impose pressing demands for the period of the IASY as such. The four areas of investigation are to be : (i) atmospheric waves, (ii) dynamic coupling from below, (iii) turbulence, (iv) global circulation. Working Group 11 stressed the need for improving the quality of radio-sensing devices of all kinds, particularly ionosondes. They also recommended that rocket, airglow, etc. measurements should always be accompanied by the highest quality radio-sensing measurements. Working

Group 12 has agreed ten recommendations on sudden ionospheric disturbance observations.

At the termination of the meeting national representatives gave brief reports on STP work in their countries, together with any recommendations for the attention of the Commission. Proposals included one that the IASY be designated as a three-year period, rather than two, and also that an international union for solar-terrestrial physics be formed.

5 March 1969

Geoffrey M. Brown.

INTERNATIONAL SYMPOSIUM ON INFORMATION THEORY

ELLENVILLE, NEW YORK, 28-31 JANUARY, 1969

This Symposium was sponsored by the Information Theory Group of the IEEE and the International Union of Radio Science. The Symposium co-chairmen were Mr. J. K. Wolf and Mr. A. D. Wyner, both USA. In the Symposium Committee URSI was represented by the Chairman of Commission VI, Dr. Stumpers.

The Symposium was held in the spacious surroundings of the Nevele Country Club, a holiday resort with facilities for skating, skiing, swimming and indoor sports. The 325 participants in the Symposium, many with their wives, still left room for many other guests. The attraction of having all Symposium participants so near to each other all the time is that exchanges of ideas are made so easy. Even in San Remo, where the participants were spread over many hotels, this was much less the case, and in a Symposium held in a large city, all contacts are lost outside the times of the meetings.

The technical programme had fifteen sessions : three on coding, two on noise, and one each on : adaptive systems and pattern recognition; detection theory, channel coding and error bounds; estimation; source coding; estimation, tracking and radar; pattern recognition; communication systems. Half sessions were devoted to : two-dimensional processing; feedback communications; optical systems; and non-parametric detection.

The large majority of the participants were from the USA and all the authors mentioned below are from USA, unless otherwise indicated; Australia, Belgium, Brazil, Canada, Denmark, Israel, Japan, the Netherlands, Rumania, the United Kingdom, Sweden and the USSR were also represented.

Abstracts of all papers were available at the start of the Symposium.

Each technical session had ten papers. Most authors had only 12 minutes for their introduction, three minutes were then available for discussion. A very limited number of papers were allowed double this time interval. These papers were :

T. M. Cover and M. E. Hellman : A theory of learning with finite memory.

T. J. Wagner and J. T. Cordato : Intersymbol interference on a time continuous gaussian channel.

D. Sakrison : The rate of distortion function for a class of sources.

R. F. Pawula and Y. C. Tsai : Theoretical and experimental results for the distribution of a certain nonlinear functional of the Ornstein-Uhlenbeck process.

T. Berger : Information rates of Wiener processes.

J. Ziv and M. Zakai (Israel) : Some lower bounds on signal parameter estimation.

R. E. Curry : Nonlinear estimation with quantized measurements : PCM, predictive quantization and data compression.

G. D. Forney : Algebraic structure of convolutional codes.

The Symposium was opened on Tuesday morning with a welcoming speech by the Chairman, J. K. Wolf, and a keynote address by Prof. Elias entitled "Coding theory made easy" (A tutorial presentation of a variety of schemes for communicating reliably over unreliable channels can be made trivial by restricting the discussion to the erasure channel). On Tuesday afternoon, Wednesday and Thursday we had three parallel sessions, these were kept well synchronized and it was possible to go from one session to another one without missing a paper since the rooms were quite near to each other. Most lecturers made the best of their 12 minutes, and managed to give as good a survey of their work as could be expected under these conditions.

A banquet was given on Thursday evening with A. D. Wyner as Chairman, and a fascinating after-dinner speech by Mr. David Kahn, who is well known for his book "The Codebreakers".

Finally, the Friday morning session had five invited long papers (up to 45 minutes) :

R. Gallager : Coding and information theory.

B. S. Tsybakov (USSR) : ϵ -Information and coding.

Th. Kailath : The innovations concept in detection and estimation theory.

T. Cover : Pattern recognition and learning.

K. Zigangirov (USSR) : Certain questions on the choice of metric in problems of sequential decoding.

The quality of the papers was in general quite good and, as already mentioned, the numerous possibilities for exchanges of views made it a very successful Symposium.

The next Symposium in this series will be held in the Netherlands or Belgium in June 1970. We hope to make it a worthy successor to the one just finished.

Dr. F. L. Stumpers.

THIRD INTERNATIONAL SYMPOSIUM ON EQUATORIAL AERONOMY

AHMEDABAD, INDIA
February 3-10, 1969

NOTE BY ACTING SECRETARY GENERAL. — *Recommendation 32, below, points out that most of the ground stations in the equatorial regions are in developing countries where there is a need to encourage scientific research and to provide local scientists with opportunities to meet their colleagues from other parts of the world. Even though satellites are now capable of obtaining data referring to both equatorial and other regions, it is considered that there are still good reasons for drawing attention to the special features of the upper atmosphere in equatorial regions. These are the main reasons for the proposed continuation of the series of Symposia on Equatorial Aeronomy and for the preparation of the recommendations referring to aspects of equatorial aeronomy which require special study.*

* * *

During the course of the meetings of the International Union of Geodesy and Geophysics (IUGG) held in Switzerland (Sept. 1967) it was agreed that the Third Symposium on Equatorial Aeronomy be held in India, where there is an International Equatorial Rocket Launching Station at Thumba and increasing activity in the study of the Earth's Atmosphere and its environs by balloons, rockets and satellites supported by ground-based observations. The first Symposium on Equatorial Aeronomy was held in Peru in 1962, and the second at Sao Paulo in Brazil in 1965.

The Indian National Committee for Space Research (INCOSPAR) of the Indian Department of Atomic Energy agreed to act as the local host

for the symposium, at the Physical Research Laboratory and ATIRA, Ahmedabad, from 3 February to 10 February, 1969.

The Symposium was sponsored by the International Union of Radio Science (URSI) and the International Association of Geomagnetism and Aeronomy (IAGA). The newly created Inter-Union Commission for Solar Terrestrial Physics (IUCSTP) also gave its approval.

Financial support was given towards delegates' fares and the conference expenses by a wide variety of organisations including the Indian National Committee for Space Research, the US Agency for International Development (AID) Organization, the US Air Force Cambridge Research Laboratories, and the US Voice of America.

Over 60 scientists from outside India attended from a wide variety of 21 countries, as follows :

Australia	Ghana	Peru
Brazil	Hong Kong	Puerto Rico
Canada	Italy	Tanzania
Ceylon	Jamaica	Thailand
France	Japan	UK
Germany (East)	Kenya	USA
Germany (West)	Nigeria	USSR.

In addition there were at least an equal number of the leading Indian scientists in this field attending.

The Symposium centred its attention on the detailed study of the constitution, morphology and behaviour of the upper atmosphere above the Equatorial belt, with particular reference to the region between 50 km and 1,000 km above the earth's surface. The electrical properties, chemical and photochemical processes, optical emissions and their relation to solar and other extra-terrestrial phenomena were included.

About fifteen separate technical sessions were held with the use of parallel sessions. Each session was opened by an invited survey paper and it was followed by very brief summaries of new and recent work in the field by the participants. Emphasis was placed upon attempts to get discussions going in the sessions with the intention of stimulating ideas for future activities.

It was generally felt that the symposium was successful, although because the meeting was compressed into one week when previous meetings have lasted two weeks, the time allowed was somewhat stultifying. The climate in Ahmedabad at the time was perfect for the meeting, and the facilities for the meeting very good.

Holding the symposium in India allowed the overseas participants to appreciate the very considerable amount of work going on in this field

throughout India. A large number of young Indian scientists are working in the field with a wide range of sophisticated electronic and instrumental technology.

The symposium adopted a series of recommendations for future work and activities in the field of equatorial aeronomy (see below) including the final one urging the organisation of a Fourth Symposium on Equatorial Aeronomy some time in 1971/72 at an equatorial location.

Extended abstracts, together with diagrams, of the new work presented at the meeting will be published as a collection in a single volume by the Physical Research Laboratory at Ahmedabad. This is intended to serve as rapid publication of the new results. At the same time the full scientific papers based upon the new and original work presented at the symposium are being collected together for group publication in the international scientific journal "Radio Science".

R. W. H. Wright.

Chairman, Organising Committee

RECOMMENDATIONS

D-REGION AND ABSORPTION.

1. — The Symposium notes that there are at present only a few electron-density versus altitude profiles of the D-region at low latitudes. While there is a considerable improvement over the situation as it existed at the last equatorial aeronomy conference held in 1965, it is recommended that every effort be made to obtain more electron density profiles on an extended basis and under as many different circumstances as possible. The recommended techniques are :

- (a) Rocket propagation and probe experiments;
- (b) Multi-frequency absorption studies, and
- (c) The development of new facilities such as wave interaction, partial reflection, etc.

2. — The Symposium draws attention to the apparent geomagnetic control of low-latitude absorption as manifested in a reduced absorption near the magnetic dip equator, and recommends that a special effort be made to obtain accurate and reliable absorption measurements at a number of sites occupying a magnetic dip range from 0° to 30° in the same longitude zone.

3. — The Symposium recommends that measurements which give a convenient indication of changes in the lower ionosphere, for example, single-frequency absorption and oblique-incidence LF and VLF signal strength observations, should be encouraged at more stations. It also recommends that new techniques such as the study of VLF transmissions at short range should be initiated at equatorial latitudes because they can give considerable information about the structure of the D-region.

4. — The Symposium notes the importance of a knowledge of meteorological parameters, such as the temperature and pressure in the D and E regions, for the interpretation of absorption measurement, in particular the anomalous seasonal variations observed at low latitude. It recommends that every effort be made to obtain synoptic measurements of these parameters with the aid of balloons and rockets.

5. — The Symposium recommends that rocket studies of positive and negative ion composition and density should be carried out at equatorial latitudes, under a variety of conditions, because of their importance to a better understanding of the chemistry of the D and E region.

6. — The Symposium recommends that efforts should be directed towards the study of those atmospheric minor constituents which are known to play a dominant role in mesospheric ionisation. Such constituents are many : those requiring urgent attention are NO, O, O₃, H₂O, OH, CO₂, and O₂(Ag). It is desirable to employ rocket techniques currently in use elsewhere at several equatorial stations. An equally important approach would be the use of appropriate air-glow studies. The study of minor constituents should be carried out at stratospheric altitudes as well. Equatorial investigations have an important bearing on the understanding of the neutral atmosphere as a whole.

ELECTRIC FIELDS AND CURRENT SYSTEMS IN THE IONOSPHERE.

7. — The Symposium supports the need for more studies of current systems and electric fields based upon the geomagnetic data from the worldwide network of magnetic stations. More theoretical studies of the equatorial electrojet models should also be encouraged.

8. — The Symposium draws attention to the need for studies of the disturbance effects in the earth's magnetic field which may be observed on apparently quiet geomagnetic variations. The possible existence of a reverse equatorial electrojet with a region of reverse Sq currents needs further study.

9. — The Symposium urges the need for more direct observations of the currents and electric fields by various techniques such as radio waves, rockets, satellites and the studies of ion clouds produced by chemical release. The Symposium notes the possibility of the use of small satellites released from a mother satellite for global observations at different altitudes. It recommends further investigations of this method together with the development of more sensitive probes for the measurement of DC fields.

10. — The Symposium notes the reports of measurements of magnetic field by satellites passing over the equatorial region and the difference between the observed values and the expected values. It is recommended that measurement of magnetic variation be made at several stations along a line of longitude across the equator — and if possible that rocket measurements be made in the vicinity as well — during days when a polar orbiting satellite carrying a magnetic field sensor is passing overhead near local noon.

E LAYER AND Es LAYER.

11. — The Symposium notes that ground-based studies of the E layer and the irregularities in the E layer or Es continue to be very useful and should be encouraged. The Symposium recommends that more efforts be made to tie together ground-based observations, including synoptic studies, with rocket and other in-situ studies.

12. — The Symposium draws attention to the need to re-examine many of the conventions which have been adopted in connection with Es as seen on ionograms, in the light of the increased knowledge in this area. The URSI conventions concerning the different types of Es urgently need revision.

13. — The Symposium points out the need for more studies of irregularities in the E layer and Es of types other than Esq such as blanketing Es, slant Es etc., and their behaviour at low latitudes.

14. — The Symposium indicates that incoherent scatter techniques could be extended to the E region and expresses the hope that such studies would occur at or near the equator.

F REGION STUDIES IN LOW LATITUDES.

15. — The Symposium recommends that more attention be paid to making simultaneous measurements of F region parameters in different longitudes. This could most easily be achieved by the wide-spread observance of Quarterly World Days and Regular World Days.

16. — The Symposium notes that there is a continuing lack of information on large-scale *electric fields* in the ionosphere, and also on neutral air winds.

17. — The Symposium notes with satisfaction the successful use of the chemical release technique by Indian rocket scientists, and strongly recommends that these experiments be continued and extended.

18. — The Symposium also notes the successful measurements of plasma drift motions by the incoherent scatter technique. The Symposium recommends that measurements be made simultaneously of *vertical* and *horizontal* motions, preferably over a range of heights.

19. — The Symposium recommends that theoretical work be carried out on the following topics :

- (a) The uniformity of the large-scale electric field in tropical regions, particularly as regards the east-west component which is important for the production of the F2 layer equatorial anomaly.
- (b) The cause of the striking longitudinal variations of the F2 layer in low latitudes.
- (c) The cause of the variations of the F2 layer near sunset.
- (d) The interaction of plasma and neutral air motions in low latitudes.

F REGION IRREGULARITIES.

20. — The Symposium stresses the need for further exploration of the scale sizes, or better the wave number spectrum of F-region irregularities, during the post sunset period. Associated measurements of electric fields at various wavelengths would be particularly useful.

21. — The Symposium notes that there is a need for more theoretical studies of the methods by which F-region irregularities can be formed. It indicates that it would be useful to have a catalogue of such methods which have been described, together with the necessary conditions for instabilities to exist as well as the scale sizes that may be expected to result from the mechanisms.

22. — The Symposium recommends that more attempts be made to measure vertical movements in the F region during the development and occurrence of spread-F conditions.

23. — The Symposium points out that an ionosonde can be used in a variety of ways to undertake special studies particularly in connection with irregularities. Fixed frequency operation can, for example, provide informa-

tion about irregularities, their development and occurrence. There is also need for a study of the occurrence of the TID phenomenon at low latitudes.

IONOSPHERIC DRIFTS.

24. — The Symposium urges the need to undertake drift studies with greater flexibility, using more than one frequency, so that a range of heights may be studied, and using more than 3 antennae.

25. — The Symposium notes that there is world-wide concern over exactly what the physical significance is of the data from the close-spaced receiver technique. It suggests that equatorial conditions may, in some cases, be simpler than elsewhere and urges a full study of the significance of the method as compared with measurements by other, possibly more direct, methods in equatorial regions.

26. — The Symposium supports the view that groups of workers in low latitudes should attempt to coordinate their drift studies. Such work could give valuable information including the variation of elongation of irregularities with height.

27. — The Symposium recommends that the drifts as measured by the close-spaced receiver technique near the equator should be compared with the average electron-drift velocity as measured by a variety of methods.

SATELLITE STUDIES.

28. — The Symposium notes that synchronous satellite beacons can be used to great advantage by carefully located groups of ground stations to study the morphology of the equatorial ionosphere. Furthermore the continuous recording possible with such beacons is of value for the study of magnetic effects on the ionosphere. The Symposium therefore supports the view that the establishment of other synchronous satellites should be given high priority.

29. — The Symposium notes with satisfaction

- (a) the establishment of a widespread network of stations capable of recording signals, with their Faraday fading, from the BE-B satellite transmitters, and
- (b) the many groups of workers who have consequently turned their attention to a study of the ionosphere, particularly at low latitudes. The Symposium therefore urges the need for a follow-up beacon satellite to replace BE-B when it ceases operation. The Symposium also urges that full use should be made of the transmitters on BE-B for these studies, whilst it is operational.

30. — The Symposium notes that a satellite in equatorial orbit and carrying close-spaced frequency beacons would be of value for the study of longitudinal variations in the ionosphere.

MICROPULSATION STUDIES.

31. — The Symposium recommends that equatorial observatories make special efforts to study the following three aspects of geomagnetic micropulsations :

- (i) the statistical distribution of occurrences of pi and pc type pulsations for daily, seasonal, and solar cycle intervals;
- (ii) the relative amplitudes, wave polarization, dispersion and attenuation of selected events at a world-wide distribution of surface stations and at satellite locations;
- (iii) the difference to be theoretically expected in the signal characteristics for processes in which the micropulsations arrive at the equatorial region (*a*) directly from the magnetosphere, (*b*) via ionospheric current systems, or (*c*) through propagation parallel to the earth's surface from other geographic locations.

GENERAL.

32. — The Symposium notes that studies in equatorial aeronomy are now much more integrated into the work in Aeronomy world wide, particularly with the advent of satellites which rapidly provide measurements over wide ranges of latitudes. Nevertheless the Symposium strongly urges the need for another symposium on equatorial aeronomy probably in 1971/2. The delegates particularly stress the need for such a meeting, not only in order to orient attention to the special properties of equatorial aeronomy, but also because of the difficulties which face many of the workers in equatorial aeronomy. Most of the ground stations in the equatorial regions are in developing countries which usually have poorly developed scientific services. Scientists cooperating and playing an indispensable role in this work need particular encouragement, and a special symposium such as this offers them the chance to meet their colleagues, including those working under similar conditions as well as those from the metropolitan countries with much better developed facilities. The Symposium once again urges the continuation of the idea of holding the symposium at a low-latitude site which leads to particular assistance to the scientists working in that area.

INFLUENCE DU PLASMA DANS LES LIAISONS AVEC DES ENGINES SPATIAUX

(Présenté par l'URSI à la Commission d'Etudes IV, Genève 1969)

QUESTION 6/IV DU CCIR

1. — La première partie de la Question 6/IV se rapporte aux influences du plasma environnant sur le fonctionnement des antennes à bord d'engins spatiaux. Le rapport 222-1 fait brève mention du comportement de l'antenne dans telles conditions, cependant que le Projet de revision de ce Rapport (Document IV/170) fournit quelques données sur des résultats expérimentaux obtenus au moyen de fusées en vol.

2. — Les travaux expérimentaux récemment effectués en laboratoire sur le comportement des antennes dans un milieu de plasma, ainsi que la théorie formulée à l'appui de ces travaux, sont susceptibles de contribuer au développement des antennes à bord d'engins spatiaux et semblent mériter d'être poursuivis. Il apparaît néanmoins que des progrès plus rapides pourraient être réalisés grâce à une étude conjointe, à la fois par les physiciens spécialistes du plasma et par les ingénieurs des télécommunications, de l'application des résultats des expériences de laboratoire à la solution des problèmes posés par les liaisons radioélectriques avec les engins spatiaux.

3. — Messiaen et Vandenplas [1] ont placé une antenne sphérique à excitation dipolaire dans un tube à décharge sphérique contenant de la vapeur de mercure et où la densité électronique pouvait être variée dans la gamme approximative de 10^9 - 10^{10} cm^{-3} . Le potentiel de l'antenne pouvait être varié relativement à celui de la cathode, permettant ainsi de changer l'épaisseur de la gaine ionique environnante. L'antenne était excitée au moyen d'un générateur extérieur fonctionnant sur 300 MHz et le champ mesuré au moyen d'une petite sonde réceptrice. Au cours de l'expérience, le champ rayonné a été mesuré en fonction de la densité du plasma pour différentes valeurs du potentiel continu de l'antenne et, partant, de l'épaisseur de la gaine ionique. Des augmentations sensibles du champ rayonné (résonances) ont été enregistrées à certaines densités du plasma; elles étaient dues à deux causes différentes :

- A) les phénomènes de résonance entre le plasma électronique et le milieu environnant,
- B) les phénomènes de résonance entre la gaine ionique et le plasma électronique.

Les résonances du type A n'étaient que légèrement influencées par les variations de l'épaisseur de la gaine ionique, alors que les résonances du type B se montraient très sensibles vis-à-vis de cette épaisseur. Lorsque la gaine ionique atteignait un degré d'épaisseur suffisant, la résonance du type B était prédominante. Dans une série de conditions, à une fréquence égale à environ un tiers de la fréquence du plasma, la puissance rayonnée a été 400 fois plus élevée que la puissance rayonnée en l'absence du plasma électronique. Des résonances analogues se produisent lorsque l'antenne est employée en réception; toutefois les influences du bruit en provenance du plasma pourraient en limiter l'utilité.

Les résultats expérimentaux décrits ci-dessus ont vérifié la théorie de Messiaen et Vandenplas [1].

4. — L'influence d'un champ magnétique continu sur les résonances a également fait l'objet de recherches, mais la complexité des résultats en a rendu l'interprétation théorique difficile jusqu'à présent en raison, surtout, du fait que la théorie ne tient pas compte des inhomogénéités et de l'asymétrie dans la distribution de la densité électronique du plasma.

Des travaux ultérieurs par Messiaen, Vandenplas et Peter [2] ont démontré que lorsque des puissances plus élevées venaient alimenter l'antenne, le plasma électronique pouvait être maintenu en l'absence de décharge électrique. Dans ces mêmes conditions, on a enregistré à certaines fréquences une hausse sensible dans le champ rayonné, ainsi que la génération d'harmoniques surtout si la fréquence fondamentale n'est pas trop élevée.

5. — L'existence de résonances qui peuvent être contrôlées par l'épaisseur de la gaine ionique ainsi que par la densité laisse entrevoir la possibilité d'accorder les antennes à bord d'engins spatiaux même dans le cas où leurs dimensions seraient inférieures à la longueur d'onde. Les expériences reproduisent également les phénomènes de « blackout » qui interviennent lorsque la fréquence du plasma est égale à celle du générateur.

RÉFÉRENCES

1. Messiaen, A. M. et Vandenplas, P. E. — Rayonnement fortement accru présenté par une antenne enrobée d'une gaine diélectrique et d'une couche de plasma. *Can. J. Phys.*, **45**, 3367 (1967).
2. Messiaen, A. M., Vandenplas, P. E. et Peter, G. — Resonantly H. F.-sustained plasma around an antenna. *Electronics Letters*, **4**, No. 2 (1968).

NOTE DU SECRÉTAIRE GÉNÉRAL P.I. DE L'URSI. — *Comme suite à la lettre circulaire adressée aux Comités nationaux en décembre 1968 (URSI-N23 (68)), le Comité belge a attiré l'attention du Secrétaire général p.i. sur certaines expériences susceptibles d'intéresser la Commission d'Etudes IV du CCIR dont les discussions porteront notamment, en septembre 1969, sur les liaisons radioélectriques avec des engins spatiaux. Le document URSI-R2 (69), reproduit ci-dessus, donne un résumé de ces expériences et a été transmis au Directeur du CCIR.*

WESTERN PACIFIC REGIONAL COMMITTEE OF IUWDS

The establishment of the above Committee, under the Chairmanship of Dr. H. Uyeda, was announced in *URSI Information Bulletin*, No. 169, p. 43. Dr. Uyeda resigned in March 1969 as Chairman and the Committee has appointed Dr. Kasuya as his successor.

COMPOSITION OF AUSTRALIAN AND ANTARCTICA REGIONAL COMMITTEE OF IUWDS

- Mr. C. G. McCue, *Chairman* : Ionospheric Prediction Service, Sydney.
Prof. W. N. Christiansen : Department of Electrical Engineering, University of Sydney.
Prof. G. R. A. Ellis : Department of Physics, University of Tasmania.
Prof. C. D. Ellyett : Department of Physics, University of Newcastle, N. S. W.
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Mr. R. E. Loughhead : CSIRO Division of Physics, Solar Physics Section, Sydney.
Mr. D. F. Styles : Antarctic Division, Department of Supply, Melbourne.
Mr. F. E. Cook, *Secretary* : Ionospheric Prediction Service, Sydney.

ELECTROMAGNETIC WAVES

More than 75 papers presented at the Stresa Symposium on Electromagnetic Waves will be published in English or French in a special 400 page issue of *Alta Frequenza* in May 1969. The principal subjects discussed at the Symposium were :

1. Wave propagation in inhomogeneous and isotropic media
2. Propagation in random media
3. VLF propagation
4. Non-linear phenomena in wave propagation
5. Antennas

6. Application of computers and numerical methods

7. Diffraction.

The titles of the papers were published in *URSI Information Bulletin*, No. 169, p. 15.

A copy of the volume will be sent free of charge to all those who were present at the Symposium. Copies may be purchased from :

AEI, 10 via San Paolo, 20121 Milano, Italy.

The price is \$ 10.00 or 6,000 lire, for delivery by surface mail, or \$ 13.00 by air mail.

SYNOPTIC CODES FOR SOLAR AND GEOPHYSICAL DATA

The second Revised Edition 1969 was published in April by the Secretariat of the International Ursigram and World Days Service. The new codes are applicable as from 1 May 1969.

Copies of the booklet can be obtained from : Dr. P. Simon, Ursigrammes, Observatoire, 92 Meudon, France, or from Miss J. V. Lincoln, Deputy Secretary, IUWDS Steering Committee, ESSA, Boulder, Colo. 80302 USA.

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