

U. R. S. I.

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SUPPLEMENT : PROJECT WEST FORD

RÉUNIONS SCIENTIFIQUES DE L'U. R. S. I.

par E. HERBAYS,
Secrétaire Général de l'U.R.S.I.

(See English text p. 4)

Les vues qui sont exposées dans cet article ont pour but de définir la politique générale qu'il serait désirable de voir adopter pour toutes les réunions scientifiques de l'U.R.S.I. : symposia, colloques, réunions des Commissions et des Comités. Elles sont le fruit de l'expérience et d'opinions émises par diverses personnalités de l'U.R.S.I.

Il convient avant tout de souligner que le but de ces réunions n'est pas la simple présentation de communications qui pourraient être publiées dans un journal scientifique et lues par ceux qu'elles intéressent. Il importe que les réunions organisées par l'U.R.S.I. aient un but plus fécond ; constituées par des scientifiques de grande classe ayant un intérêt direct dans les sujets traités, elles devraient avant tout fournir aux assistants l'opportunité d'échanger leurs opinions sur les sujets faisant l'objet de la réunion.

Ces considérations impliquent les conditions suivantes qui, trop souvent, sont perdues de vue :

1. Les sujets traités doivent être bien définis et leur nombre limité. Il est généralement plus profitable de traiter un seul sujet pendant une ou deux séances que de consacrer le même laps de temps à la présentation de plusieurs questions.
2. Pour conserver la réputation scientifique de l'U.R.S.I., seules devraient être acceptées les communications ayant une réelle valeur scientifique. Et ici l'on pourrait se poser la question de savoir s'il ne serait pas préférable d'inviter des spécialistes à présenter une communication sur un sujet déterminé.
3. Pour permettre une discussion utile et féconde, seules devraient être présentées les communications dont un au moins des auteurs assiste à la réunion. Agir autrement ne permet pas une discussion fertile des communications, ce qui devrait constituer la partie la plus importante des réunions.

Si le compte rendu des réunions ne contient que les communications avec de très courtes discussions, il ne semble pas utile de les publier. Les auteurs de communications peuvent, dans ce cas, être invités à en solliciter la publication dans un des nombreux journaux scientifiques existants.

Il semble que si les organisateurs des réunions scientifiques et les éditeurs scientifiques qu'ils désignent veulent bien s'inspirer des considérations qui précèdent et observent les règles pour la rédaction et la publication des Monographies de l'U.R.S.I. (voir la brochure « Statuts et Règlements » qui peut être obtenue au Secrétariat Général de l'U.R.S.I.), la publication des comptes rendus ne représenterait pas seulement l'activité de l'U.R.S.I., mais aurait une réelle utilité pour les radio scientifiques. En outre, la réduction des matières publiées permettrait d'éditer des monographies dont le prix rendrait possible une plus large diffusion, principalement parmi les jeunes chercheurs.

On pourrait se demander ce qu'il conviendrait de faire des communications ne remplissant pas les critères imposés. Il y a deux solutions ; soit les écarter et les renvoyer à leurs auteurs, soit en publier un court résumé.

Il est probable, et l'auteur l'espère, que cet article suscitera des commentaires ; il est certain que ces commentaires, s'ils sont portés à la connaissance du Bureau de l'U.R.S.I., faciliteront sa tâche et permettraient à l'U.R.S.I. de conserver sa réputation scientifique.

U. R. S. I. SCIENTIFIC MEETINGS

by E. HERBAYS,
Secretary General of U.R.S.I.

The aim of this article is to define the general policy which would be desirable to apply to all categories of U.R.S.I. scientific meetings : symposia, colloquia, Commission and Committee meetings. The views hereunder set forth are based on experience, and on opinions expressed by U.R.S.I. personalities.

First of all, it should be stressed out that the aim of these meetings is not barely to present papers which could be published in a scientific journal and, in this way, be made available to those interested.

It is important that the meetings organized by U.R.S.I. serve a more fruitful objective. Composed by eminent scientists with direct interest in the topics on the agenda, those meetings should in the first place give the attendants the opportunity of exchanging their views on the subjects to which the meeting is devoted.

These considerations imply the following conditions which too often are being overlooked :

1. The topics must be well defined and restricted in number. It is generally more useful to treat just one subject during one or two sessions than to devote the same time to several questions.
2. In order to safeguard the scientific standard of U.R.S.I., only papers with real scientific value should be accepted. Here the question might arise whether it would not be preferable to invite specialists to submit papers on a defined subject.
3. To secure useful discussions, only papers whose at least one of the authors is attending the meeting should be submitted. Another procedure does not allow fruitful discussions of papers, which should be the most important part of the meeting.

If the proceedings of the meeting are to contain just papers with brief discussions, it then does not seem necessary to publish them at all. In that case, the authors may well be invited to ask for publication one of the numerous scientific journals existing.

It seems that if the organizers of scientific meetings and scientific editors are willing to take the above considerations as guide, and to adhere to the rules for drafting and publication of U.R.S.I. monographs (see the booklet « Statutes and Bylaws » available at the U.R.S.I. General Secretariat) the publication of proceedings would not only be one of U.R.S.I. activities, but would be of real interest to the radio scientists. Moreover, a reduction of the material published would allow to produce Monographs at prices more accessible for large distribution mainly among young scientists.

The question might arise as to what to do with papers not fulfilling the criteria. There are two solutions : either eliminate those papers and return them to the authors, or publish short abstracts of them.

It is most probable — and that is the author's wish — that this article will give rise to comments ; the author is convinced that such comments would facilitate the task of the U.R.S.I. Board of Officers and allow U.R.S.I. to maintain its scientific standing.

XIII^e ASSEMBLÉE GÉNÉRALE

Compte rendu

(See English text p. 7)

Le fascicule 3 (Commission III. — Radioélectricité Ionosphérique) du Vol. XII des Comptes Rendus est sorti de presse et a été distribué aux Comités Nationaux.

Ce fascicule contient des renseignements administratifs sur la Commission, les rapports des Comités Nationaux, les comptes rendus des séances et les résolutions adoptées par l'Assemblée Générale sur proposition de la Commission III.

Des exemplaires supplémentaires peuvent être obtenus au Secrétariat Général au prix de F. B. 350 (\$ 7.00 ou £ 2.10). Le prix pour les commandes envoyées par les Comités Nationaux est de F. B. 250 (\$ 5.00 ou £ 1.16).

Les références qui accompagnent le Rapport de la Sous-Commission III^e (Vol. XII, fasc. 3, p. 10) sont à compléter par le texte ci-dessous :

13. MINNIS et BAZZARD. — *J. Atmos. Terr. Phys.*, **13**, 1960, 306.
14. BAZZARD. — *J. Atmos. Terr. Phys.*, **21**, 1961, 193 et *U.R.S.I. Inf. Bull.*, n° 120, 1960, 10.
18. BAZZARD. — *J. Atmos. Terr. Phys.*, **13**, 1960, 290.
22. MINNIS et BAZZARD. — *J. Atmos. Terr. Phys.*, **13**, 1960, 297.
24. PIGGOTT. — Beynon(ed.) *Some Ionospheric Results obtained during the I.G.Y.* (Elsevier, 1960), p. 94.
25. PIGGOTT. — Beynon(ed.) *Some Ionospheric Results obtained during the I.G.Y.* (Elsevier, 1960), p. 116.

Les valeurs journalières du nombre caractéristique de la couche E pour 1960 ont été publiées dans le *Bulletin d'Information de l'U.R.S.I.*, n° 124, 1961, p. 47 et complètent celles des années précédentes (Ref. 14).

XIIIth GENERAL ASSEMBLY

Proceedings

Part 3 (Commission III on Ionospheric Radio), Vol. XII, of the Proceedings has been issued and distributed to National Committees.

This Part contains administrative information on Commission III, National Committee reports, minutes of the sessions and resolutions adopted by the General Assembly on proposal of Commission III.

Supplementary copies are available at the General Secretariat at the price of B. F. 350 (\$ 7.00 pr £ 2.10). For orders reaching the General Secretariat through National Committees, the price is of B. F. 250 (\$ 5.00 ou £ 1.16).

The references accompanying the Report of Sub-Commission III^e (Vol. XII, P. 3, p. 10) should be completed as follows :

13. MINNIS et BAZZARD. — *J. Atmos. Terr. Phys.*, **18**, 1960, 306.
14. BAZZARD. — *J. Atmos. Terr. Phys.*, **21**, 1961, 193 and *U.R.S.I. Inf. Bull.*, n° 120, 1960, 10.
18. BAZZARD. — *J. Atmos. Terr. Phys.*, **18**, 1960, 290.
22. MINNIS et BAZZARD. — *J. Atmos. Terr. Phys.*, **18**, 1960, 297.
24. PIGGOTT. — Beynon (ed.). Some Ionospheric Results obtained during the I.G.Y. (Elsevier, 1960), p. 94.
25. PIGGOTT. — Beynon (ed.). Some Ionospheric Results obtained during the I.G.Y. (Elsevier, 1960), p. 116.

Daily values of the E layer character figure for 1960 have been published in *U.R.S.I. Inf. Bull.*, n° 124, 1961, p. 47 and supplement those for earlier years (Ref. 14).

COMITÉS NATIONAUX

France

GROUPE IONOSPHERE DU C.N.E.T.

A dater du 1^{er} décembre 1961, le Groupe Ionosphère du C.N.E.T., 196, rue de Paris à Bagneux (Seine) a été remplacé par un Groupe de Recherches Ionosphériques (G.R.I.) formé en commun par :

- le Centre National d'Etudes des Télécommunications (C.N.E.T.);
- le Centre National de la Recherche Scientifique (C.N.R.S.);
- l'Institut de Physique du Globe (I. P. G.).

Ce Groupe fonctionne à l'adresse ci-après : 3, avenue de la République, Issy-les-Moulineaux (Seine). Tél. : LEC 40.00, poste 1919. Téléx : CNETELEC Issy n° 20.849.

Netherlands

MEMBERS OF THE NATIONAL COMMITTEE

President : Prof. B. D. H. TELLEGEN, Philips Research Laboratories, Eindhoven.

Secretary : Dr. A. D. FOKKER, University Observatory, Utrecht.

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Mr. M. L. TOPPINGA, Defence Research Organization, The Hague.
Prof. J. VELDKAMP, Royal Netherlands Meteorological Institute,
De Bilt.
Mr. J. J. VORMER, Central Direction of the Netherlands P.T.T.,
The Hague.
Mr. L. R. M. VOS DE WAEL, Dr. Neher Laboratory of the Nether-
lands PTT, Leidschendam.

U. S. A.

COURSE IN RADIO PROPAGATION

Central Radio Propagation Laboratory, Boulder, Colorado

This course, to be held from July 16 to August 3, 1962 is designed to provide a discussion of the fundamentals of radio propagation, the latest advances in the state of the art, and the application of this knowledge to the design and development of communication systems.

The 1962 course will employ a unified approach to both ionospheric and tropospheric propagation. This unification permits adoption of the experience and suggestions obtained from the 1961 course. In particular, increased emphasis will be given to both fundamental physics and to systems applications. An integrated development of tropospheric and ionospheric propagation will stress similarities and differences of the two.

The course will consider communication via the entire range of useable frequencies in the atmosphere, space, underground, and underwater, and will extend into the modes of propagation which are being explored for future use.

Lectures will be supplemented by regularly scheduled informal discussions conducted by all lecturers within a particular topic group.

Prerequisites : A bachelor's degree in Electrical Engineering, Physics, or other suitable academic or practical experience.

Tuition : Entire course : \$ 300.

Dates : July 16 through August 3, 1962.

Registration will be limited and early applications should be made to ensure consideration. To facilitate local arrangements, registration will be closed July 1, 1962. Further details of the course and registration forms are available February 1, 1962, from Edmund H. Brown, Education Director, Boulder Laboratories, National Bureau of Standards, Boulder, Colorado.

N. B. S. REPORT

The Boulder Laboratories of the NBS have issued the « Seventh Summary of Research at Boulder Laboratories for year ending June 30, 1961 ».

COMMISSIONS AND COMMITTEES

The Netherlands

COMMISSION MEMBERS

COMMISSION I :

Official member : Mr. L. R. M. VOS DE WAEL, Dr. Neher Laboratory of the Netherlands P.T.T., Leidschendam.

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Member : Prof. H. BREMMER, Philips Research Laboratories, Eindhoven.

COMMISSION IV :

Official member : Mr. J. J. BLOEMSMA, Mient 551, The Hague.

Member : Mr. A. HAUER, Royal Netherlands Meteorological Institute, De Bilt.

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Official member : Prof. J. H. OORT, University Observatory, Leiden.

Members :

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Prof. H. C. VAN DE HULST, University Observatory, Leiden.
Prof. M. G. J. MINNAERT, University Observatory, Utrecht.
Prof. C. A. MULLER, Radio astronomical observatory, Dwingeloo.

COMMISSION VI :

Official member : Dr. F. L. STUMPERS, Philips Research Laboratories, Eindhoven.

Members :

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Prof. J. P. SCHOUTEN, University of Technology, Delft.
Prof. B. D. H. TELLEGEN, Philips Research Laboratories, Eindhoven.
Prof. A. A. T. M. VAN TRIER, University of Technology, Eindhoven.

COMMISSION VII :

Official member : Prof. J. L. H. JONKER, University of Technology, Eindhoven.

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Dr. H. J. DIRKSEN, Defence Research Organization, The Hague.
Mr. P. H. J. A. KLEYNEN, Philips Industries, Eindhoven.
Prof. K. S. KNOL, University of Technology, Eindhoven.
Prof. C. E. MULDER, University of Technology, Eindhoven.
Prof. A. A. T. M. VAN TRIER, University of Technology, Eindhoven.

Commission II. — Radioélectricité et Troposphère

CIRCULAIRE AUX MEMBRES OFFICIELS DE LA COMMISSION II

Le Comité de Coordination de l'U.R.S.I. doit se réunir à Bruxelles en avril 1962. A cette occasion, un avant-projet de programme doit être établi pour les réunions des diverses Commissions lors de la prochaine Assemblée Générale qui aura lieu à Tokyo, sans doute en septembre 1963.

A la suite d'un échange de correspondance avec le Vice-Président de la Commission II, le Dr. J. B. Smyth et les Secrétaires, le Dr. J. Saxton et M. F. du Castel, et après avoir consulté notre ancien Président, le Dr. R. L. Smith-Rose, je vous propose la liste suivante de sujets qui pourraient être abordés à Tokyo.

1) Modèles de troposphère (et particulièrement de la structure fine de la troposphère) que l'on peut considérer comme satisfaisants en se basant :

- a) sur des données de mesures météorologiques ;
- b) sur des données de propagation radioélectrique (1 séance).

On peut envisager une discussion sur l'existence et les caractéristiques de la turbulence, des couches stratifiées, des irrégularités troposphériques à différentes échelles et de différentes durées.

2) Problèmes de radioclimatologie (1 séance).

Il s'agit des corrélations observées ou prévues entre les variations diurnes, saisonnières et climatiques de la propagation troposphérique et celles des paramètres météorologiques.

3) Problèmes de propagation troposphérique affectant les communications spatiales (1 séance).

Ceci concerne les effets d'absorption, de réfraction, de scintillation, et les bruits d'origine atmosphérique (influence des gaz de l'air et des pluies). Une attention particulière pourrait être portée à la propagation des ondes millimétriques.

4) Radar météorologique et Physique des nuages (« Weather Radar and Cloud Physics ») (1 ou 2 séances).

C'est un sujet qui a été demandé expressément à notre Commission lors de la réunion à Paris en avril 1961 de la Commission Inter-Unions de Radiométéorologie. Je souhaiterais avoir votre avis sur le nombre de séances à consacrer à ce sujet (une ou deux).

5) Influence sur la propagation des irrégularités de terrain et de la végétation (1 séance).

Ce sujet a été proposé lors de la séance finale de la Commission II à Londres en 1960.

6) Problèmes de guidage dans la troposphère, l'ionosphère et l'exosphère (1 séance, en commun avec les Commissions III et IV).

Compte tenu de l'expérience des précédentes Assemblées Générales, je crois que nous devons limiter nos réunions en principe à six séances de travail (non comprise une séance administrative).

En ce qui concerne la séance administrative, je voudrais vous soumettre dès maintenant pour examen une proposition des membres de la Commission II du Comité National des Etats-Unis, qui m'a été transmise par le Dr A. T. Waterman, Président de cette Commission, et que je crois intéressante, bien qu'elle n'ait pas encore été approuvée par le Comité des Etats-Unis. Je reproduis ci-après la lettre du Dr Waterman.

« The United States members of Commission 2 have given consideration to the fields of interest which would be appropriate in the future developments of U.R.S.I. to include a greater portion of the solar system. They have favored a change in name of the commission to « Propagation in Non-Ionized Media », and have asked that I send you the following paragraph by way of clarification.

The membership of U.S. Commission 2 has considered a revised definition of its fields of interest within U.R.S.I. These fields transcend the troposphere. Broadly, they include all natural non-ionized media as related to the propagation of electromagnetic waves. Thus in addition to the refraction, absorption and scintillation of radio waves within line of sight, and the diffraction and scattering of waves beyond line of sight, they cover propagation along and below the earth's surface as well as backscattering from that surface. They overlap the fields of radiometeorology, satellite communications and signal statistics insofar as these subjects

pertain to propagation and its mechanisms. All the above areas apply equally well to non-terrestrial environments - - e.g., backscatter from lunar and planetary surfaces, refraction and absorption in non-ionized planetary atmospheres. These fields are distinguished from those of Commissions 3 and 4 by excluding ionized media ; from Commission 5 by emphasizing the propagation of the wave rather than its source ; and from Commissions 1, 6 and 7 by dealing with natural media rather than man-made circuitry.

Since the U.S. National Committee has not as yet approved any changes of this sort, the above statement is to be considered as an expression of interest on the part of U.S. members of Commission 2. »

Je vous remercie à l'avance de toute suggestion ou remarque que vous pourriez me faire concernant ces propositions. Je serais heureux d'avoir votre réponse avant le 18 avril 1962, date de la réunion à Bruxelles du Comité de Coordination.

12 février 1962.

Le Président de la Commission II,

J. VOGÉ,

Centre National d'Etudes des Télécommunications

3, avenue de la République

Issy-les-Moulineaux (Seine) — France

Téléphone : LECourbe 40-00 à Paris

Commission III — Radioélectricité Ionosphérique

BIBLIOGRAPHIE — BIBLIOGRAPHY

M. D. Lépéchinsky, Secrétaire de la Commission III a réuni, pendant l'Assemblée Générale de Londres, des bibliographies se rapportant aux discussions qui ont eu lieu au cours des séances scientifiques de la Commission. Ces bibliographies n'ayant été publiées ni dans le fascicule 3 du Volume XII des Comptes Rendus des Assemblées Générales, ni dans la Monographie « On Ionospheric Radio » nous avons jugé utile de les publier dans le *Bulletin d'Information*.

* * *

Mr. D. Lépéchin'sky, Secretary of Commission III, collected during the London General Assembly, bibliographies relevant to discussions held during scientific sessions of Commission III. These bibliographies are not published neither in Part 3 of Volume XII of the General Assembly Proceedings nor in the Monograph on Ionospheric Radio and we thought suitable to publish them in the *Information Bulletin*.

I^{re} SÉANCE — RÉPARTITION DE L'IONISATION EN FONCTION DE L'ALTITUDE
PROFILS DE HAUTEURS VRAIES

1st SESSION ON IONIZATION DENSITY VS HEIGHT N (h) PROFILES

- S. A. CROOM, A. R. ROBBINS, J. O. THOMAS. — Two anomalies in the behaviour of the F2 layer of the ionosphere. *Nature*, **184** (1959), p. 2003.
- S. A. CROOM, A. R. ROBBINS, J. O. THOMAS. — Variation of electron density in the ionosphere with magnetic dip. *Nature*, **185**, (1960) p. 902.
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3^{me} SÉANCE. — L'IONISATION E-SPORADIQUE

3rd SESSION. — ON ES IONIZATION

- K. L. BOWLES, R. COHEN, G. R. OCHS, B. B. BABSLEY. — Radio echoes from field-aligned ionization above the magnetic equator and their resemblance to auroral echoes. *J. Geoph. Res.*, **65** (1960), pp. 1835-1855.
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U.R.S.I.-C.I.G. Committee

U.R.S.I. SYMPOSIUM ON IONOSPHERIC SOUNDINGS IN THE I.G.Y./I G.C.

by G. M. BROWN,
Secretary U.R.S.I.-C.I.G. Committee

At the first meeting of the U.R.S.I.-C.I.G. Committee, held in London in September 1960 during the XIIIth General Assembly of U.R.S.I., a proposal was received from the World Wide Soundings Sub-Committee recommending that a symposium to discuss vertical incidence sounding results should be held. The matter was referred to the Chairman of the U.R.S.I.-C.I.G. Committee and the Chairman of the W.W.S.C. for further discussion, and it was subsequently agreed that ionospheric absorption and drifts results obtained during the I.G.Y. and I.G.C. should be discussed, in addition to those in vertical soundings.

The detailed arrangements for the meeting were entrusted to the members of the W.W.S.C., in consultation with the Chairman, Professor W. J. G. Beynon. Particular reference should be made to the work done by Mr. A. H. Shapley, Dr. R. W. Knecht, Dr. K. Rawer, and Mr. W. R. Piggott. The symposium was held in Nice, at the Centre Universitaire Méditerranéen, over the period 11-16 December, 1961, by kind invitation of the French National Committee of U.R.S.I., and the local arrangements were made by Professor E. Vassy. A total of about 60 delegates representing 19 countries participated, and there was a very full programme. By holding a few sessions in parallel some 80 papers were accommodated with adequate time for discussion. Vertical soundings results and discussions occupied 13 different sessions, and drifts and absorption 5 each. The main topics discussed in the vertical soundings sessions included regional studies, F-region studies, $N(h)$ methods and applications, Es statistics and mapping, effects of disturbances, and spread F. In the sessions devoted to absorption and drifts, high, medium and low latitude phenomena and morphology were discussed. In addition, a meeting of the U.R.S.I.-C.I.G. Committee was held on the last day of the Symposium.

The main purpose of the symposium in Nice was to review critically the results obtained and experience gained during the I.G.Y.

and I.G.C. and the bearing of these on ionospheric work to be carried out during the forthcoming International Quiet Sun Year (I.Q.S.Y.). Separate discussions on I.Q.S.Y. were held under the chairmanship of the sub-reporters for vertical soundings (Mr. A. H. Shapley), drifts (Dr. K. Rawer), and absorption (Mr. W. R. Piggott).

A full report of the scientific sessions, including the main points from the discussions, will be published as an U.R.S.I. Monograph. This will form a companion volume to that previously published which contained the proceedings of the 1959 Symposium on I.G.Y. ionospheric results, organised by the U.R.S.I.-A.G.I. Committee.

Comité de l'U.R.S.I.
pour les Recherches Radioélectriques dans l'Espace

Nous attirons l'attention des membres du Comité sur les deux articles suivants :

« Le projet Advent », par le Général W. M. THAMES, publié dans le *Journal des Télécommunications*, vol. 29, n° 1 ; janvier 1962, p. 9, et

« Les Communications Spatiales de la prochaine génération », par A. G. HALEY, publié dans le *Journal des Télécommunications* vol. 29, n° 2, février 1962, p. 39. Il s'agit d'un exposé présenté à la Conférence sur le droit et la sociologie de l'espace, dans le cadre de l'élaboration du rapport de l'American Rocket Society sur les vols spatiaux (New-York, octobre 1961).

U.R.S.I. Committee on Space Radio Research

The attention of the members of the Committee is called to the following articles :

« Project Advent » by Brigadier General W. M. THAMES, published in the *Telecommunication Journal*, Vol. 29, n° 1, January 1962, p. 9, and

« Space Communications of the next generation » by A. G. HALEY, published in the *Telecommunication Journal*, Vol. 29, n° 2; February 1962, p. 39, and presented at the Space Law and Sociology Session of the American Rocket Society Space Flight Report to the Nation (New York, October 1961).

PERMANENT SERVICES

Joint informal meeting of the C.C.U. and W.P.R.C.U.

held on September 8 and 11, 1961, at Kyoto, Japan,
during the International Symposium on Cosmic Rays
and Earth Storms

Were present :

- a) for C.C.U. : UYEDA (*convenor*), SHAPLEY, PUSHKOV and BEYNON (representing SMITH-ROSE);
- b) for W.P.R.C.U. : COOK and TAKIGUCHI (*secretary*);
- c) as consultants to W.P.R.C.U. : MARTYN, AONO, HATANAKA, MIYA;
- d) as observers : FUJIKI, KASUYA, SINNO and DE FEIRTER; during the second session also : MIYAZAKI and YOSHIMATU.

At the invitation of the convenor, Shapley took the chair.

Beynon read a message from Smith-Rose, President of U.R.S.I. and Chairman of the E.R.C.U., regretting his inability to be present and wishing the meeting every success. Messages of prevention were also read from : Dr. Fung Chien (Taipei) and Dr. Watts (Hongkong). }

Introductory Review. — In order to facilitate later discussion and for the benefit of non-members of C.C.U. and W.P.R.C.U., Shapley gave a short outline of the present relationship between C.C.U. and I.W.D.S.

C.C.U. has been organized during the 12th General Assembly of U.R.S.I. (1957, Boulder) together with the Regional Committees on Ursigrams. C.C.U. is composed of the Chairmen of the Regional Committees and *ex officio* the Secretary General of U.R.S.I. Dr. Coutrez joined this Committee as the secretary and as a repre-

sentative of Commission V. A proposal of the U.R.S.I. Executive Board to incorporate the Ursigram-service as one of the permanent services in F.A.G.S. through C.C.U. was effectuated at the beginning of 1959. For the terms of reference of C.C.U. the reader is referred to *U.R.S.I. Information Bulletin*, n° 115, p. 35, 1959.

On the recommendation of the Executive Board of I.C.S.U. the Eighth General Assembly (1958, Washington) agreed that the World Days Service of C.S.A.G.I. should be organized as an International Service under U.R.S.I. At this moment, I.W.D.S. consists of representatives of U.R.S.I. (Shapley), I.A.U. (Denisse), I.U.G.G. (Nicolet) and a secretary (Coutrez). This service is assisted by a panel of consultants representing various scientific disciplines. This advisory committee serves both I.W.D.S. and C.C.U. (further see *Information Bulletin*, n° 115, p. 35, 1959).

A third organization, dealing with almost the same material is the network through which information on satellite-launchings and orbital elements are released. This network, SPACEWARN, was organized at the invitation of C.O.S.P.A.R. and makes use of several Ursigram-links.

After this introduction the discussions proceeded according to the agenda.

1. Uyeda proposed a correction on the minutes of the last meeting (London, 1960), where in Section 8 the distinction between members, unofficial members and consultants should be made more clear. According to Uyeda Section 3 of the Draft Terms of Reference for Regional Groups (*Information Bulletin*, n° 119, p. 52, 1960) should read as follows :

« 3. Membership of a Regional Committee is as follows :

- (a) *Members*, representatives of a Country adhering to U.R.S.I..., etc.
- (b) *Unofficial Members*, representatives of a Country not adhering to U.R.S.I.
- (c) *Consultants* appointed by the Regional Committee. »

After some discussion, during which it was remarked that the Regional Committees are entirely free to invite participants from countries not adhering to U.R.S.I. to take part in the Ursigram service, it was agreed that Uyeda's amendment should be incorporated in the terms of reference as a guiding principle.

2. *Present Status of C.C.U.*

2.1. Detailed reports of the activities of the Western Pacific and Western Hemisphere Regional Committees were distributed. From Western Europe and Eurasia no official report was received.

2.2. General schedules of interchange messages were outlined by Shapley, De Feiter, Takiguchi and Cook, representing Regional and Associate Region Centers.

2.3. Indicator 26, will be used for Taipei. According to Pushkov the indicator 98 (Pirculi) can be disposed of, as this station is not active any more. Further amendments can be handled by correspondence with the prospective administrative secretary. Uyeda presented the codes PRJ and ADJ (see appendix), for giving quality-figures of radio propagation circuits and weekly forecasts of radio propagation conditions respectively. After some discussion these codes were accepted as regional codes. The revision of the Japanese cosmic ray code was accepted, as were the amendments Dr. Beckmann communicated to Beynon on the UABSB, URANA and URANP (see appendix).

2.4. After a lengthy discussion the meeting agreed that, with some uncertainty as to how much it represents all users, predicted SWI's for M-type geomagnetic storms should be given in the next future. It was further decided to indicate only the first few days of a recurrent storm with a SWI.

3. It has been felt that appropriate steps should be taken to give a more general publicity of the work of C.C.U. and I.W.D.S. There should be some means for distributing this information, e.g. to the editors of scientific journals, especially to reach prospective users. Moreover a more regular reporting to U.R.S.I. was asked for. It was agreed that the secretary of the proposed combined body should take the necessary steps to reach these demands.

4. After some discussion the meeting agreed on the following resolutions :

4.1. Considering :

- (a) The terms of reference given for I.W.D.S. by I.C.S.U. at its VIIIth General Assembly in Washington, Sept.-Oct. 1958 ;
- (b) The terms of reference given for C.C.U. by U.R.S.I. at its XIIth General Assembly in Boulder in Sept. 1957 ;

The meeting agreed that :

C.C.U. and I.W.D.S. should be combined to form one body, known as I.W.D.S. It is to be understood that this new body is to operate along the general lines of Permanent Services of F.A.G.S. ;

that the present type of representation should be maintained, i.e. the Regional Committees should be represented ;

that the new Committee should have a Chairman, a Secretary and an Administrative Secretary.

4.2. The meeting accepted with regret the resignation of Dr. Coutrez as Secretary of I.W.D.S. and C.C.U., contained in his letter of August 17, 1961 to Mr. Shapley.

4.3. The meeting recommended, in accordance with a proposal of Coutrez and Herbays,
that L. D. De Feiter be appointed as Secretary,
that J. V. Lincoln be appointed as Administrative Secretary.

5. Shapley gave an outline of the work of SPACEWARN. The main results of the discussions are :

- (a) In each region broadcasts of SPACEWARN-bulletins have started by now ;
- (b) It was felt that SATOR is the code most suitable to give current orbital elements ;
- (c) It was remarked that « SPACETRACK » messages are direct messages from computing centers to tracking stations, sent by private arrangements ;
- (d) It would be very helpful if the launching-announcements were to contain some information on institutions or individuals concerned with the experiments being flown, so that interested people could make direct contact.

6. Notes on the Paris meeting of C.I.G., concerning the plans for I.Q.S.Y. (1964-1965) were circulated :

- (a) From several directions it was asked to arrange and distribute the I.Q.S.Y.-Calendar at earliest convenience ;

(b) On the communications with the Antarctic during I.Q.S.Y. the following resolution was adopted :

« This meeting requests the cooperation of S.C.A.R. in arranging for interchange of brief messages concerning current magnetic auroral and ionospheric observations among Antarctic stations using meteorological communications facilities. It is recommended that there should be a reliable link between the Antarctic and Agiwarn (possibly via Australia) ».

Cook will enquire after such a possibility.

7. Cook suggested that information on plages and sudden disappearances of prominences be included in the data interchange.

Shapley reported that I.A.U. Commission X has agreed with the proposal expressed in R.W.C. circular Memorandum n° 59. By now the importance 1 + flares and above are less abundant than were the class 2 and above flares during the I.G.Y. It was agreed unanimously that the standards for flare-reporting be lowered to : 1 + and above, and for S.I.D.'s to : 1 and above.

8. Uyeda pointed out that we lack clear definitions of the functions of the World Warning Agency and the Western Hemisphere Regional Warning Center respectively. It is necessary to distinguish between these two bodies.

After some discussion it was agreed : « C.C.U. notes with satisfaction the work done by Western Hemisphere Regional Warning Center as the World Warning Agency, recommended by I.W.D.S., and it hopes that this Regional Warning Center will continue these activities ».

9. A suggestion by Shapley to express the wish for a speedy recovery of Mr. A. Delouf, who had operated the Paris center for a very long time, and who had been taken seriously ill, on behalf of the meeting was agreed to unanimously.

Complementary note from the Secretary General of U.R.S.I.

The above report has been submitted to the members of C.C.U. and of the Steering Committee of I.W.D.S., and also to the Secretaries General of I.A.U. and I.U.G.G. They all agreed :

- (i) to the recommendations included in the report,
- (ii) to name the Permanent Service resulting from the merging of the two previous services « International Ursigrams and World Days Service » (I.U.W.D.S.),
- (iii) to constitute the new Steering Committee as follows :
1. the members of the previous Central Committee on Ursigrams, i.e. the Chairmen of the Regional Committees on Ursigrams, namely : Dr. R. L. SMITH-ROSE, Europe ; Mr. A. H. SHAPLEY, Western Hemisphere ; Mr. H. UYEDA, Western Pacific ; Mr. N. V. PUSHKOV, Eurasia, and *ex officio* the Secretary General of U.R.S.I. ;
 2. the members of the previous Steering Committee of the I.W.D.S., namely Mr. A. H. SHAPLEY (U.R.S.I.), Dr. J. F. DENISSE (I.A.U.) and Dr. M. NICOLET (I.U.G.G.) ;
 3. *Secretary* : Mr. L. D. DE FEITER,
Administrative Secretary : Miss J. V. LINCOLN.

Manuel des Codes d'Ursigrammes

Le deuxième supplément au Manuel des Codes d'Ursigrammes est sorti de presse et a été envoyé à tous ceux qui avaient retourné au Secrétariat Général de l'U.R.S.I. le formulaire annexé au Manuel.

Les possesseurs du Manuel qui n'auraient pas reçu ce second supplément sont priés d'en informer le Secrétaire Général de l'U.R.S.I.

Manual of Ursigram Codes

The second supplement to the Manual of Ursigram Codes has been issued and forwarded to those who had returned to U.R.S.I. General Secretariat the form enclosed in the Manual containing the Codes.

Owners of the Manual who did not receive the supplement are kindly requested to inform the Secretary General of U.R.S.I.

ATTRIBUTION DE FRÉQUENCES

(See English text p. 34)

Nous attirons l'attention des membres du Comité Inter-Unions pour l'Attribution de Fréquences pour la Radioastronomie et la Science Spatiale et du Comité de l'U.R.S.I. pour l'Attribution de Fréquences pour des buts scientifiques sur un article publié dans le *Journal des Télécommunications*, Vol. 29, n° 1, janvier 1962, p. 17 : « Les Résultats de la Première Session du Groupe d'Experts » par C. Nunez Arellano, dont nous reproduisons un extrait.

« Le Groupe d'experts avait pour mission de préciser le mieux possible les principes à suivre et les mesures à prendre pour diminuer l'encombrement des bandes d'ondes décimétriques. Ces principes et ces mesures devaient pouvoir être effectivement applicables et les recommandations du Groupe devaient permettre d'élaborer un programme que les administrations puissent respecter, ce dernier point étant directement lié aux conséquences économiques découlant de l'ampleur du programme.

A cette réunion ont participé, non seulement les experts élus par le Conseil d'administration et venant de toutes les parties du monde, mais des représentants des organismes permanents de l'Union, ce qui a permis de fondre les objectifs techniques de ces organismes en une tâche unique d'importance essentielle pour l'Union. Pendant sa première session et pour la période suivante, le Groupe leur a confié certaines missions ; il en résultera des échanges de vues auxquels participeront les spécialistes des Membres de l'Union.

La réunion des experts avait pour but d'élaborer un programme qui, grâce à l'action appropriée des Administrations et de l'U.I.T.,

- a) assure une meilleure utilisation du spectre dans la région des ondes décimétriques, par le recours à des moyens techniques mieux appropriés,

- b) encourage l'emploi de moyens de communication autres que les ondes décimétriques, à titre de moyens complémentaires ou de remplacement permettant d'apporter à long terme des solutions satisfaisantes,
- c) élabore un projet d'assistance technique, plus particulièrement économique, de caractère mondial et directement lié au programme technique. »

FREQUENCY ALLOCATION

We draw the attention of the members of the Inter-Union Committee on Frequency Allocation for Radio Astronomy and Space Science and of the U.R.S.I. Committee on Frequency Allocation for Scientific Purposes to a paper published in the *Telecommunication Journal*, Vol. 29, n° 1, January 1962, p. 17 « Results of the First Meeting of the Panel of Experts » by C. Nunez Arellano of which an abstract is published hereunder :

« The mission of the Panel of Experts is to establish principles and measures as quickly as possible to be adopted to reduce congestion in the use of high frequencies. The principles and measures concerned must be viable, and the recommendations based on them should enable a programme to be prepared which the Administrations would be ready to back. This last fact, directly related to the economic repercussions which such a programme is bound to have, must condition the range and depth of the latter.

The Meeting brought together representatives of the permanent organs of the Union, in addition to the experts chosen by the Administrative Council from the various regions of the world. This structure provides the necessary opportunity lending a certain unity to the technical objectives of the said organs in a task of capital importance for the I.T.U. ; in this way, the first meeting set them certain tasks during the meeting itself and also for the period between meetings, resulting in a very necessary exchange between the various specialized interests of the Members of the Union.

The objectives of the Meeting of Experts are basically intended, through appropriate action by the Administrations and the I.T.U., to lead rapidly to a programme which will

- (a) enable the best possible use to be made of the high frequency radio spectrum by applying the most suitable technological means ;
- (b) promote the introduction of means of telecommunication other than by high frequencies, to serve as substitutes or complementary systems providing satisfactory long-term solutions ;
- (c) enable a world technical assistance project to be worked out, together with a financial project to serve as a basis. »

Preparation of a conference on spatial radio communications

(Reprint from the *E.B.U. Review*, n° 70-A, December 1961)

The International Radio Conference (Geneva, 1959) made provision for calling an Extraordinary Administrative Radio Conference to deal with the allocation of frequency bands for spatial radio communications. In the terms of Recommendation n° 36, that conference is to be held towards the end of 1963 and will last about one month.

It will be recalled that it is the I.F.R.B. that has been charged with the technical preparation of radio conferences. That Board therefore sent to the Administrations a circular letter on 26th October, 1961 requesting them to let it have information on the utilization by all services of the frequencies between 1000 Mc/s and 10 000 Mc/s. It requested that it be notified of all the frequencies assigned or planned to be assigned in the bands concerned. The notice forms concerning future needs should be marked « E.A.R.C. Space ». This information must reach the I.F.R.B. by 15th April, 1962.

The circular letter moreover states that the future conference on spatial radio communications will be informed by the international scientific organizations of a request for the allocation of frequency bands for radio astronomy services.

INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

Resolutions

THE NINTH GENERAL ASSEMBLY OF THE INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

meeting in London from September 25 to 28, 1961,
made the following resolutions :

1. — ADMISSION OF NEW MEMBERS

The General Assembly resolved

(a) to admit the International Union of Geological Sciences as a General Union.

(b) to admit the following as National Members :

The Hungarian Academy of Sciences ;

The Academy of Sciences of the Democratic Peoples Republic of
Korea, Phyongyang ;

The Korean Academy of Sciences, Seoul ;

Ghana Academy of Learning ;

Ceylon Association for the Advancement of Science ;

German Academy of Sciences in Berlin.

2. — RECLASSIFICATION OF THE INTERNATIONAL GEOGRAPHICAL UNION

The General Assembly resolved to re-classify the International Geographical Union as a General Union.

3. — FUTURE STRUCTURE OF I.C.S.U.

The General Assembly

noting that international scientific activity is rapidly expanding in scope and complexity and placing ever greater demands on the International Council of Scientific Unions and its Unions ;

noting further that the present structure and financing of the I.C.S.U. organisation are no longer sufficient to cope with these demands ; and

desiring to meet its responsibility to serve the growing needs of international co-operation in science, to provide leadership, and to furnish an adequate framework for international collaborative undertakings of scientists ;

resolves to establish a Committee to examine the organisation of I.C.S.U., to design a new structure and prepare draft statutes for consideration by the total membership.

In carrying out this assignment the Committee shall be guided by the views expressed at the Ninth General Assembly when the matter of future structure was discussed, and shall give attention to the expressed need for substantially greater financial support, for increased participation of national members in the executive bodies of I.C.S.U., and for a strengthened secretariat.

The Committee shall have regard for promoting the interests of science as a whole, preventing its organisational fragmentation and encouraging interdisciplinary activities, avoiding structural arrangements, such as bicameral governing bodies, that tend to inhibit close working relations between National and Scientific Members.

The Committee shall distribute its report to all National and Union Members at the earliest possible date, but not later than 30 June 1962, together with an analysis of the financial requirements to implement the proposed new structure.

The Committee shall consist of nine members. Six of these members shall be

Dr. E. W. R. STEACIE	Canada	Chemistry
Ing. Gén. G. R. LACLAVÈRE	France	Geophysics
Professor J. VAN MIEGHEM	Belgium	Geophysics
Academician E. K. FEDEROV	U. S. S. R.	Geography
Dr. D. W. BRONK	U. S. A.	Biology
Dr. H. W. THOMPSON	U. K.	Chemistry

The three remaining members shall be co-opted by the Committee with due regard to geographical and scientific distribution.

The Committee in its conclusions may recommend to the Bureau that it convene an Extraordinary General Assembly to be held not earlier than *one year* after the distribution of the Committee's report.

4. — REVISION OF STATUTES

The General Assembly resolved that the revised Statutes submitted to the Ninth General Assembly be adopted with the following two amendments specifically designed to eliminate changes of substance from the present Statutes :

- (a) *Statute n° 8* : Replace by present Statute n° 20 : « On the proposal of the Executive Board the General Assembly shall classify the Scientific Members ».
- (b) *Statute n° 34* : Replace the final paragraphs : « Funds received from donations... of the Council » by the present Statute n° 28 : « Funds derived from donations accepted by the Council shall be used in accordance with the wishes expressed by the donors ».

5. — THE INTERNATIONAL YEAR OF THE QUIET SUN (I.Q.S.Y.)

The General Assembly of I.C.S.U.

noting that the need for a geophysical programme during sunspot minimum was emphasised in 1958 by the International Scientific Radio Union - International Geophysical Year Committee and that the Comité International de Géophysique, at its meeting in January 1961 in Paris, discussed the project in some detail and agreed it should be planned for the period April 1, 1964, to December 31, 1965 ;

considering the International Geophysical Year was deliberately planned for a sunspot maximum period and that if the International Geophysical Year is to be brought to full fruition, a comparable and complementary set of measurements is needed at solar minimum activity ;

considering further the real advantage in making these measurements at the next solar minimum which is expected in 1964-1965 ;

realising that the Comité International de Géophysique is now in possession of invaluable experience from the International Geophy-

sical Year ; that most of the new stations established for the I.G.Y. are still operating and that it would be advisable on economic and scientific grounds to use these stations in 1964-1965 ;

desiring that the International Year of the Quiet Sun should not be a simple repetition of International Geophysical Year observations but that fullest possible use be made of all new and improved techniques developed during and since the International Geophysical Year ;

considering the universally acknowledged success of the International Geophysical Year and the world-wide fund of goodwill for international co-operation in geophysics which it established,

unanimously resolved that approval be given to the proposal by the Comité International de Géophysique for a further international geophysical programme in 1964-1965 to be known as the International Year of the Quiet Sun, and recommends the fullest participation in it by all Scientific and National Members.

6. — INTERNATIONAL BIOLOGICAL PROJECT

The General Assembly resolved

(a) that among the many biological problems which should be studied, two specific problems need immediate attention :

(1) The effect on living communities of changes in the natural environment. This shall include

- (i) the study of somatic and genetic variations induced by the environmental factors on man and other organisms, at the individual and population levels ;
- (ii) the study of the best means for the preservation of biotic communities that are in danger of destruction or transformation.

(2) The augmentation through basic research of natural resources and the reduction of losses and waste, to the ultimate benefit of mankind.

(b) that planning for an International Biological Programme (I.B.P.) shall begin at once by authorising the I.C.S.U. Bureau to appoint a Planning Committee which shall be guided by the following general principles

(1) The Planning Committee shall initially at least, restrict its activity, within the main fields mentioned above, to a small number of projects of limited scope ;

(2) The investigations shall be restricted to basic scientific work only. This does not preclude collaboration with other bodies who may be studying applied problems, provided that such collaboration does not affect the basic character of the work done for the I.B.P. ;

(3) The I.B.P. shall be restricted to work that can only be done by international co-operation.

(c) that the Planning Committee for I.B.P. be assisted by a paid scientific secretary, who will arrange for co-ordination of its activities with the interested Unions, with the I.C.S.U. National Members, with Unesco, W.H.O., F.A.O., I.A.E.A., the Council for International Organisations of Medical Sciences (C.I.O.M.S.), the International Brain Research Organisation (I.B.R.O.), the International Union for the Conservation of Nature (I.U.C.N.), and other organisations which may be interested in the programme or in parts of it.

7. — SCIENTIFIC DOCUMENTATION AND THE I.C.S.U. ABSTRACTING BOARD

The General Assembly, being conscious of the magnitude of the problems of scientific documentation,

and being aware of the necessity of association with government agencies concerned with this problem,

instructs the I.C.S.U. Abstracting Board to draw up for the use of I.C.S.U. an informative report in this field. This report should enable I.C.S.U. to determine precisely the part it may play in the future, and help I.C.S.U. to determine its own policies towards this end.

8. — PRODUCTION OF A NEW EDITION OF GENERAL BATHYMETRIC CHART OF THE OCEANS

The General Assembly

taking into account the Report of the GEBCO Tripartite Committee of the International Council of Scientific Unions, the Inter-

national Association of Physical Oceanography, the International Hydrographic Bureau,

recognising the importance of the General Bathymetric Chart of the Oceans for scientific and other purposes,

expresses its strong and continuing interest in the promotion of G.E.B.C.O., and invites the Secretary General of I.C.S.U. to approach the Unesco Intergovernmental Oceanographic Commission and the International Hydrographic Bureau for assistance in the production of a new edition of G.E.B.C.O., the International Association of Physical Oceanography and S.C.O.R. acting as advisory bodies.

9. — I.C.S.U. FINANCES

The General Assembly resolves

(1) that the Annual Dues from National Members, calculated according to the present scale will be doubled as from January 1, 1963. In order to effect this, the unit subscription per category shall be doubled so that the scale will be as follows :

Category	Unit Subscription (in U. S. dollars)
I	40
II	80
III	160
IV	300
V	600
VI	1200

(2) that for the year 1962, National Members be encouraged to make voluntary contributions to the funds of the Council in addition to their dues calculated on the present scale. It is hoped that these contributions will be generous — if possible up to the amount of the additional dues payable for 1963.

10. — SPACE EXPERIMENTS

WITH POTENTIALLY UNDESIRABLE EFFECTS

The General Assembly

considering that certain experiments conducted by means of space vehicles and contributing in an important way to the advancement of science, may also affect present or future scientific activities in other fields,

invites the Committee on Space Research to examine any proposed experiments or other space activities that may have potentially undesirable effects on scientific activities and observations, to arrange for careful, objective, quantitative studies and to make available to Scientific and National Members, adhering to the International Council of Scientific Unions, and to Governments, the facts and analyses needed by them for making wise and proper decisions concerning the proposed experiments; and,

appeals to all Governments planning to launch space experiments which could possibly affect other scientific research adversely to make available to I.C.S.U. in timely fashion the information and data about the proposed experiments necessary to make the desired studies.

C.I.G.

THE INTERNATIONAL YEAR OF THE QUIET SUN (I.Q.S.Y.)

Abstracts from I.U.G.G. Chronicle n° 40, Dec. 1961, p. 315

A formal proposal for a programme of geophysical research at the time of the next sunspot minimum epoch was made at a meeting of the Comité International de Géophysique (C.I.G.) in August 1960.

The case for a renewed geophysical effort in certain disciplines at a period of minimum solar activity is abundantly clear. In the disciplines of geomagnetism, aurora and airglow, ionosphere, aeronomy, solar activity, and cosmic rays the results obtained during the maximum solar activity period of the I.G.Y. can only be brought to full fruition by a complementary if smaller programme at the forthcoming period of minimum activity. It is emphasized that the sunspot minimum programme is not to be regarded as a small scale repetition of the I.G.Y., but it is intended that full advantage shall be taken of the new knowledge of solar-terrestrial relationship gained during the I.G.Y. and also of the new and improved techniques for geophysical research developed recently.

The Comité International de Géophysique discussed the proposal in detail at its meeting in Paris in 1961 and agreed that the project, to be called the International Year of the Quiet Sun (I.Q.S.Y.), should be planned for the period 1 April 1964 to 31 December 1965, and that the following disciplines should be included ; World Days, Meteorology, Geomagnetism, Aurora and Airglow, Ionosphere, Solar Activity, Cosmic Rays, and Aeronomy.

A Working Group, including the C.I.G. discipline members for the above subjects, prepared recommendations for the minimum programme, to be undertaken during the I.Q.S.Y. The recommendations are given in section V « Preliminary Programmes for I.Q.S.Y.-65 » on pages 13 to 20 of the I.U.G.G. Chronicle n° 34, or pages 119 to 126 of C.I.G. Bulletin n° 4, March 1961. Other reports of I.Q.S.Y. Working Group meetings are given on pages 213 to 216 of the I.U.G.G. Chronicle n° 38.

The Comité International de Géophysique in its report of the meeting submitted the proposals for the International Year of the Quiet Sun to the participating committees and invited their comments and co-operation. The committees were invited to formulate provisional programmes before 1 December 1961.

The fourth meeting of C.I.G. will be held in Paris from 22 to 30 March, 1962. It has been suggested that this meeting should be attended by representatives of all the countries intending to participate in the I.Q.S.Y., and that an Advisory Committee, consisting of each principal delegate from the countries represented, should meet to discuss problems of mutual help, the establishment and/or continuation of World Data Centres, the development of joint expeditions, etc. The period 26-29 March will be devoted to I.Q.S.Y.

All countries interested in participating in I.Q.S.Y. have been invited to send delegates or observers.

C.O.S.P.A.R.

Fourth C.O.S.P.A.R. Meeting, Florence 7-18 April 1961

The International Year of the Quiet Sun (I.Q.S.Y.)

Sub-Group on Ionosphere and Airglow

Report by Prof. W. J. G. BEYNON

The group considered the document on I.Q.S.Y. which had been prepared for C.O.S.P.A.R. by Professor Beynon and this report represents the revision of those sections referring to the ionosphere and airglow together with certain additional proposals which were adopted by C.O.S.P.A.R. It will be noted that throughout this report emphasis is based on the need for co-ordinating rocket and satellite studies of the ionosphere and exosphere with ground based observations.

(i) *The top-side of the ionosphere.*

It is agreed that a detailed study of the electron profile of the upper side of region F and its time and geographic variations by a co-ordinated programme of ground based, rocket and satellite experiments should form a major objective of I.Q.S.Y. studies.

(ii) *Radio noise in the exosphere.*

I.G.Y. and I.G.C. measurements on whistlers and VLF emissions have established that the exosphere is the main medium of origin propagation, and amplification of the phenomena. It is now proposed that rockets and satellites should be used to study directly the reception of radio noise in the exosphere. It is appreciated that there may be considerable technical difficulties in making such measurements but the following objectives should be aimed at :

- (i) measurements of the level of intensity of the radiation and its spatial and temporal variation ;
- (ii) studies of the energy spectrum ;
- (iii) studies of the direction of propagation of the radiation ;
- (iv) measurements of its polarisation.

The frequency range suggested is from 50 kc/s downwards although studies at much higher frequencies will also be invaluable.

The scientific value of such rocket and satellite observations will be greatly enhanced if they are closely tied-in with ground based observations of the phenomena and with studies of the van Allen radiation belts.

(iii) *The lower ionosphere.*

During I.Q.S.Y. it is recommended that a special effort be made to study the comparatively less known part of the ionosphere between 50 and 100 km. This is a region of the upper atmosphere in which data from frequent small rockets flights supplemented by simultaneous ground based studies should prove very profitable.

(iv) *Study of the E-layer at night.*

Routine ground based radio soundings of the ionosphere provides little or no data on the electron (and/or ion) density of the E-layer at night. Rocket measurements of these parameters at night would fill an important gap in our present knowledge of the E-layer.

(v) *Studies of the dynamics of the ionosphere and exosphere.*

The dynamic processes in the ionosphere are of considerable interest and importance and it is clear that a complete picture of these processes can only be obtained from a full knowledge of the three-dimensional movements of both the neutral and ionized components and from studies which distinguish between large scale circulation, irregular motions and the propagation of disturbance waves. Ground based routine radio studies of drift measurements by the various known methods and systematic determinations of the temporal variation of the electron density profile must be considered as a basis framework for these studies. The new rocket and satellite techniques should be widely used during I.Q.S.Y. to check and complete these observations.

It is therefore recommended that during I.Q.S.Y.

- (i) at places where many rocket experiments will be made, these complementary ground based radio measurements should be made on a routine basis.
- (ii) that the rocket and the ground-based experiments should be concentrated during certain periods, for example during World Meteorological Intervals.

(vi) *Production and loss processes in the ionosphere.*

Studies of the physics and chemistry of ion production and loss processes in the ionosphere remains an important problem and should be vigorously pursued during the relatively undisturbed conditions of I.Q.S.Y. Ion mass spectrometer measurements in rockets will be particularly helpful in studying the chemistry of recombination processes. Here again the rocket and satellite studies should be co-ordinated with those of the ground based vertical sounding network.

(vii) *The ionosphere at polar and equatorial latitudes.*

I.G.Y. and I.G.C. ionospheric studies have again focussed attention on the many problems associated with the ionosphere at both high and low latitudes. The Polar Cap Absorption (P.C.A.) phenomenon and the Equatorial Anomaly in region F2 are two such examples. During I.Q.S.Y. it is strongly recommended that studies of the ionosphere at polar and equatorial latitudes using rocket, satellites and ground-based techniques should be given high priority.

(viii) *Measurement of the electric field in the ionosphere and exosphere.*

Although the electron density is clearly of prime importance for ionospheric and exospheric studies a knowledge of the energy spectra of electrons and ions would also be invaluable in analyses of the dynamics of the medium. In such studies of the dynamics of the ionosphere (and exosphere) the electron and magnetic fields play very important roles. Special efforts should now be made to develop rocket and satellite instruments for the measurement of these fields.

(ix) *Quiet Sun Reference Atmosphere.*

It is recommended that research agencies in various countries intensify and carry out research using rockets and satellites to obtain information to describe the Quiet Sun Reference Atmosphere.

This recommendation requires a series of organized rocket flights during the Quiet Sun Interval to measure the atmospheric parameters of density, temperature, (pressure) and composition profiles as a function of time of day, season, and latitude. Such flights should be co-ordinated with appropriate satellite experiments.

The whole information including related measurements of solar radiation and cosmic radiations may be used to specify a Quiet Sun Reference Atmosphere.

(x) *Airglow studies with rockets.*

The group fully endorses the proposal that the study of airglow emission heights by rocket methods should continue during I.Q.S.Y. at wavelengths in the ultra-violet, visible and infra-red spectrum and that such experiments be conducted at several latitudes.

(xi) *Pre-I.Q.S.Y. Rocket Studies.*

The Group recommends that several programmes of co-ordinated rocket atmospheric experiments should be conducted prior to I.Q.S.Y. in preparation for similar experiments during I.Q.S.Y. and it is recommended that a Working Group be established immediately to plan, organize and participate in these sounding rocket programmes.

S.C.A.R.

**REPORT OF THE WORKING GROUP
ON UPPER ATMOSPHERE PHYSICS
TO THE PLENARY SESSION AT THE FIFTH MEETING
OF S.C.A.R.**

Wellington, New Zealand, 9-14 October 1961

Abstracts

REVIEW OF PROGRESS

RADIO STUDIES OF THE UPPER ATMOSPHERE.

1. *Routine Ionospheric Observations.* — Ionosonde observations in the Antarctic should be continued without curtailment up to and through the I.Q.S.Y. period, and in any event until it is certain that the period of minimum solar activity is past. (Certain ionosondes may require to be relocated, or even new ones added,

if work is initiated in new projects, such as oblique incidence forwarded scatter studies).

2. *Absorption* :

(a) Absorption based on studies of f -plots and f -min, while desirable, should not be made at the expense of better techniques described below.

(b) Maximum possible use should be made of riometers for the study of absorption with special emphasis on the use of instruments recording at more than one frequency, with a view to increasing their sensitivity and obtaining absorption height information.

Riometers should be regarded essentially as instruments for the observation of special events. Riometer installations should therefore be contemplated not only at every ionosonde installation but more importantly at every neutron monitor installation.

(c) Riometers are inherently incapable of measuring absolute ionospheric absorption, when sources of noise other than the galactic background are present. Furthermore, they can only measure the total absorption for the entire ionosphere.

Low power low cost oblique incidence VHF ionospheric forward scatter experiments should be contemplated, in addition to riometers. These enable the absorption resulting from soft solar cosmic rays (polar cap absorption events or solar proton events) to be measured uncontaminated by auroral absorption phenomena. In addition, the scattering region may with advantage be arranged to lie in otherwise inaccessible geographic locations (ice-cap or ocean).

These observations — like those of the riometer — should be made continuously. Scatter experiments, in particular, if operated in this way will give useful propagation information.

3. *Studies of the Outermost Ionized Regions of the Exosphere.* — Under this heading are grouped the phenomena of radio whistlers, VLF noise emission, geomagnetic micropulsations, and HF ducting.

Many of these studies involve propagation which is guided by the lines of force of the terrestrial magnetic field. The field lines which reach furthest into space are those which terminate in high latitudes. For this reason experiments require sites in the

Antarctic, and in some cases simultaneously at the conjugate point in the Arctic.

4. *Drifts involving Mass Transport.* — Radio echoes from the lowest heights observable occur in the Arctic and Antarctic regions. Studies of movements by means of these echoes are more likely to involve mass transport than drift studies in lower latitudes. They consequently can contribute most fruitfully in polar regions to studies of total atmospheric circulation.

5. *Measurements by Rockets, Deep Space Probes, and Satellites.* — Small rockets are already in fairly wide usage, up to altitudes of one or two hundred kilometers, for meteorological and other studies in Polar regions. Such work now obviously provides an essential extension to ground-based.

In addition, many branches of science are beginning to make increasing use of satellites and deep space probes fitted with instrumentation suitable for recording phenomena peculiar to high latitudes. Every effort should be made to expend these observations.

6. *Radio Auroral Studies.* — The study of radio auroral echoes must be continued, in conjunction with other studies.

RECOMMENDATIONS

RADIO INTERFERENCE.

The Working Group recommends :

1. that the design and operation of power supplies and radio communications equipment be such as to reduce interference to a tolerable level,
2. that provision be made for a period as quiet as feasible (i.e., with minimum radio communications) of at least five minutes, from one minute before each hour and half-hour to four minutes past it. In particular, it is requested that communication schedules not be commenced within this quiet period.

COMMUNICATION NEEDS.

The amount of scientific information to be sent from the Antarctic in this discipline varies widely from station to station. It depends on the amount of routine data that has to be sent, and at what

intervals. Some stations send no routine data during the working season, and have no traffic at regular intervals. In other cases the maximum traffic to be expected is :

from stations sending	Ionosonde	300 groups per day
data daily :	Cosmic Rays	60 groups per day
from stations sending	Ionosonde	300 groups per month
data monthly :	Cosmic Rays	500 groups per month
	Geomagnetism	75 groups per month

(On World Days these stations may have the same traffic as the daily stations.)

At all stations occasional consultation is essential. There will be about two messages per month of about 100 words each way per project.

RELATIONS OF THE WORKING GROUP WITH INTERNATIONAL UNIONS.

The Working Group considers :

7. that the activities of I.A.G.A. in auroral physics is not adequate to meet fully the present requirements in this field and that this situation should be improved as soon as possible ; the Chairman of this Working Group is instructed to convey these views to I.A.G.A. and C.I.G. and to maintain close contacts with these bodies,

8. that delegates bring this matter to the notice of their appropriate national committees.

PERMANENCE OF THE WORKING GROUP.

The Working Group recommends :

10. that a permanent Working Group on Upper Atmosphere Physics be established ;

11. that this Working Group maintains close liaison with the relevant committees of U.G.G.I., U.R.S.I., C.O.S.P.A.R. and C.I.G. ;

12. that Dr. F. Jacka be appointed Chairman.

DISTRIBUTION OF ALERTS, etc.

The Working Group does not consider necessary any scheme of general distribution of Alerts or Warnings to or within the Antarctic. Any requirements for Warnings should be arranged bilaterally.

The Working Group has been informed that the observing programmes at some Antarctic stations will be aided by the receipt of immediate warning of disturbance from other observers (to the east of the station).

The Working Group recommends :

13. that stations requiring such warnings make appropriate arrangements with a selected station ;

14. that the selected station be strongly urged to cooperate with such arrangements.

OTHER BUSINESS.

The Working Group recommends :

15. that greater attention be given to the study of upper atmosphere phenomena from Antarctic expedition ships.

The Working Group draws attention to the potential value of VHF (30-40 Mc/s) forward scatter continuous wave signal intensity recordings for the study of solar cosmic rays.

The Working Group recommends :

16. that interested parties in Australia, New Zealand, France and U. S. A. take steps to construct a series of forward scatter links for this purpose. Such links should not be shorter than about 1000 km, nor longer than about 2000 km : McMurdo, Dumont d'Urville, Macquarie Island and Australia or New Zealand are appropriate stations.

From the scientific viewpoint these links need operate only in one direction. However, the immunity of such VHF forward scatter signals make such a system of links attractive for communications. In this case two way operation will be necessary.

The Working Group notes that it is proposed to cease magnetic recordings at Macquarie Island at the end of 1962. In view of the great importance of these records in studies of the upper atmosphere, the Working Group views this proposal with great concern.

It would be pointed out that the data are of supreme importance for conjugate point studies between Alaska and the Southern Hemisphere. Radar auroral zone studies based at Invercargill, Tasmania and Scott Base rely on detailed knowledge of disturbance of the magnetic field in this area. Optical auroral studies in this area demand continuity in the magnetic records.

The Working Group draws attention to the great importance of chains of auroral stations that were situated approximately meridionally. Such chains, if on a geomagnetic meridian, could distinguish variations of auroral form and intensity at right angles to the auroral zone. If two chains of stations were placed, one within about 30° of the Greenwich meridian and one between about 150° and 210° longitude, the possible effect of eccentricity of the geomagnetically trapped radiation may be established.

The Working Group is in favour of the inclusion of upper atmosphere physics in any general symposium on Antarctic research held prior to the last meeting of S.C.A.R. before the start of I.Q.S.Y.

F. JACKA,
Chairman, Working Group
on Upper Atmosphere Physics

Note. — All the recommendations adopted by the Working Group were later endorsed as S.C.A.R. Recommendations.

UNION ASTRONOMIQUE INTERNATIONALE

Rapport sur les activités de l'U.A.I. intéressant l'U.R.S.I. au cours de la XI^e Assemblée Générale de l'U.A.I. à Berkeley (1961)

par J. F. DENISSE, *représentant de l'U.R.S.I.*

1. — *Allocations de fréquences pour la Radioastronomie.*

La nécessité d'obtenir des allocations de fréquences adaptées aux besoins de la Radioastronomie a été considérée avec beaucoup d'attention au cours de cette assemblée. En particulier la commission 40 (Radioastronomie) a adopté à l'unanimité une résolution proposée par le Dr J. P. Hagen et formulée comme suit :

Recommendation on frequency allocations for Radio Astronomy :

considering that the exclusive allocation of channels for Radio Astronomy is essential for the successful pursuance of this branch of Astronomy,

that in order to be effective one such channel, having a width of at least 1 %, should be available in every octave consistent with earlier discussion relating to specific frequencies ;

that at present only one world-wide allocation of a channel has been agreed upon ;

proposes that all possible steps be taken to include radio astronomy in the agenda of the proposed extraordinary administrative radio conference in 1963 ; and that steps be taken to make allocations for radio astronomy approximately in each octave of the spectrum on a world-wide basis.

2. — *Protection des observations radioastronomiques contre certaines expériences spatiales en particulier le projet West Ford.*

Le projet West Ford a suscité parmi les astronomes réunis à Berkeley une indiscutable émotion qui s'est exprimée par deux résolutions votées par le Comité Exécutif :

I. — *Viewing* with great concern the grave danger that some future space projects might seriously interfere with astronomical observations in the optical as well as in the radio domain,

and *believing* that a degree of contamination of space which at the present time would be hardly detectable, might, if long-lived, well be disastrous to future observations with improved techniques,

and *maintaining* that no group has the right to change the Earth's environment in any significant way without full international study and agreement ;

the International Astronomical Union *gives* clear warning of the grave moral and material consequences which could stem from a disregard of the future of astronomical progress,

and *appeals* to all Governments concerned with launching space experiments which could possibly affect astronomical research to consult with the International Astronomical Union before undertaking such experiments and to refrain from launching until it is established beyond doubt that no damage will be done to astronomical research.

II. — The International Astronomical Union expresses its appreciation that the plans for project West Ford have been publicly announced well ahead of proposed launching and of the United States Government's official policy that further launchings will be guided by the principle that such projects shall not be undertaken unless sufficient safeguards have been obtained against harmful interference with astronomical observations.

Nevertheless the International Astronomical Union views with the utmost concern the possibility that the bands of dipoles proposed in project West Ford might be long-lived, and it is completely opposed to the experiment until the question of permanence is clearly settled in published scientific papers with adequate time being allowed for their study. The International Astronomical

Union is opposed to any experiment which might hamper future developments in astronomy.

If a short lifetime for the dipoles and the harmless nature of the experiment can be assured, and if Project West Ford is carried out, the International Astronomical Union regards it as essential that the fullest observations of, and experiments on, the properties and behaviour of the band of dipoles be carried out by all possible means. The observations and experiments should be performed and analysed according to the highest scientific standards and with the best equipment available, bearing in mind that signals which are barely, or not, detectable today will probably cause serious interference with future scientific research because of the development of more sensitive equipment.

The observations and experiments to be made on West Ford are likely to be difficult to perform, and will, in many ways, be similar to those carried out by the authorities responsible for operating West Ford. Moreover, much specific information such as precise and up-to-date ephemerides will be required. The International Astronomical Union will attempt to arrange for rapid and full cooperation among astronomers making observations and calculations, and to provide for world-wide dissemination of their results conforming to accepted standards of scientific research.

The International Astronomical Union welcomes the position taken by the Government of the United States that any decision on later experiments of the West Ford type will be taken in the light of the results obtained from the presently proposed experiments. To enable the International Astronomical Union to obtain the necessary data, it requests the Government of the United States to grant full privileges to a group of astronomers, acceptable both to the Government and to the Union, to co-operate with the West Ford authorities in performing quantitative experiments to determine the properties of the proposed belt of dipoles, its changes with time and location, and its impact upon present and future astronomical research.

Concernant les lancements de même nature qui pourraient suivre le Projet West Ford, le Gouvernement Américain a publié la déclaration suivante :

« The United States Government, in conducting the West Ford Project, will be guided as follows :

1. No further launches of orbiting dipoles will be planned until after the results of the West Ford experiment have been analyzed and evaluated.

The findings and conclusions of foreign and domestic scientists (including the liaison committee of astronomers established by the Space Science Board of the National Academy of Sciences) should be carefully considered in such analysis and evaluation.

2. Any decision to place additional quantities of dipoles on orbit, subsequent to the West Ford experiments, will be contingent upon the results of the analysis and evaluation and the development of necessary safeguards against harmful interference with space activities or with any branch of science.

3. Optical and radio-astronomers throughout the world should be invited to cooperate in the West Ford experiment to ascertain the effects of the experimental belt in both the optical and radio parts of the spectrum. To assist in such cooperation, they should be given appropriate information on a timely basis. Scientific data derived from the experiment should be made available to the public as promptly as feasible after the launching ».

3. — *Commission inter-Union pour les relations solaires-terrestres.*

La commission mixte des relations solaires-terrestres a été remplacée par une commission inter-Union sous les auspices de l'U.A.I.

La première réunion de cette nouvelle commission s'est tenue le 14 août 1961 à Berkeley sous la présidence du Professeur C. W. Allen.

Les nouveaux statuts et le rôle de cette commission ont été discutés.

Les douze membres proposés pour faire partie de la commission sont :

pour l'U.A.I. : C. W. ALLEN (U. K.), J. F. DENISSE (France),
R. GIOVANELLI (Australie), E. R. MUSTEL (U. R. S. S.);

pour l'U.R.S.I. : G. M. ALLCOCK (Nelle Zélande), D. K. BAILEY
(U. S. A.), R. COUTREZ (Belgique), A. H. SHAPLEY (U. S. A.);

pour l'I.U.G.G. : J. BARTELS (Allemagne), B. HAURWITZ (U. S. A.),
F. LINK (Tchécoslovaquie), M. NICOLET (Belgique).

Diverses communications scientifiques ont été présentées au cours de cette séance.

4. — A l'issue de l'Assemblée de l'U.A.I. les membres présents à Berkeley du Comité d'organisation de la commission 40 composé de MM. Hanbury Brown (Vice-Président), Bracewell, Mayer, Vitkevitch, Westerhout et Wild (tous membres de l'U.R.S.I.) ont jugé très désirable d'organiser à l'occasion de la prochaine assemblée de l'U.R.S.I. à Tokio en 1963 deux symposia de Radioastronomie, l'un sur la Radioastronomie Solaire, l'autre sur les Instruments Radioastronomiques à Haute Résolution. Ces deux sujets sont en pleine évolution et sont susceptibles d'intéresser les membres de plusieurs commissions de l'U.R.S.I. et évidemment des astronomes. Il serait souhaitable que ces réunions (de deux à trois jours chacune) soient organisées comme des joint-symposia de l'U.R.S.I. et de l'U.A.I.

5. — Il est intéressant de signaler aux membres de l'U.R.S.I. deux réunions qui ont eu lieu à Berkeley où ont été présentées des communications portant sur les sujets suivants :

Large instruments in Radioastronomy (Philco Symposium) ;
Problems requiring radio astronomical observations of high sensitivity and resolution (Joint session of commissions 28 and 40).

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

Radiation Commission of International Association of Meteorology and Atmospheric Physics

Records of the meetings in Vienna 15th and 19th August, 1961

APPENDIX OF RESOLUTIONS AND RECOMMENDATIONS

RESOLUTION 1.

The comparison of methods of measuring radiation in the free atmosphere. — The Radiation Commission of the International Association of Meteorology and Atmospheric Physics notes that physically different methods of measuring the radiation flux in the free atmosphere, from sounding balloons, are in use. It strongly recommends that comparison should be made between the various instruments. These comparisons should be carried out under various weather and climatic conditions; in clear and cloudy skies during precipitation, and in different parts of the world.

RESOLUTION 2.

The publication of radiation data. — The Radiation Commission of the International Association of Meteorology and Atmospheric Physics notes with satisfaction the resolution of the Executive Committee of W.M.O. concerning the collection and publication of data in physical meteorology. It is in full agreement with the proposal to divide radiation data into two classes, the one for central collection and publication, the other for local publication, and trusts that arrangements for central publication will be completed without delay. The Commission urges the authorities responsible for the measurement of radiation to supply promptly to the W.M.O. or the nominated publishing agency the data required for central publication, and to arrange for local publication of the more detailed data if this is not already done.

RESOLUTION 3.

Radiation measurements during the International Quiet Sun Year.

— The Radiation Commission of the International Association of Meteorology and Atmospheric Physics draws the attention of the authorities responsible for the programmes of scientific work using rockets and artificial earth satellites to the importance of monitoring the solar radiation reaching the earth in all spectral regions, and hopes that all possible efforts will be made to carry this out, particularly during the International Quiet Sun Year. The Commission has also noted the paucity of results obtained during I.G.Y. and I.G.C. on the project to determine the radiation fluxes at all levels in and above the atmosphere. It considers that the period of I.Q.S.Y. offers an opportunity to profit from lessons learnt during I.G.Y. and I.G.C. and hopes that all efforts will be made to measure the incoming and outgoing radiations fluxes, or the net flux, from artificial earth satellites, by means of sounding balloons, and at the earth's surface. Surface measurements are particularly necessary over the tropical and sub-tropical oceans.

RECOMMENDATION 1.

Radiation measurements for use in engineering, agriculture, and architecture, with particular reference to arid and semi-arid zones. —

The Radiation Commission of I.A.M.A.P. has at its meeting in Vienna in August, 1961 considered reports by experts on radiation climatology, instrumentation for radiation measurement, and needs of engineers and agricultural scientists, particularly in the arid zones, for radiation data. Its discussions can be summarized in four recommendations :

RECOMMENDATION 1a.

The «ideal programme» outlined by the Unesco Group of Experts on Radiation Data for the Arid Zones is a modest and feasible proposal, and should be put into effect by the responsible authorities. It calls for the measurement at each radiation measuring station of the global and diffuse short-wave radiation on a horizontal surface and the tabulation of the measurements in a manner similar to the W.M.O. I.G.Y. form R3 ; and for the operation of sunshine recorders and the tabulation of sunshine statistics on an hourly basis.

RECOMMENDATION *1b.*

In view of the needs of bioclimatologists and agricultural scientists, increased attention should be given to the measurement of the separate components of the radiation balance near the earth's surface. Where complete measurement is not possible, computation from partial data is possible and useful, and should be carried out.

RECOMMENDATION *1c.*

The Commission has been impressed by the needs of biologists and agricultural scientists for knowledge of the spectral distribution of the global radiation, and its variations. It draws the attention of suitably qualified Services and Institutes to the importance of this field of investigation.

RECOMMENDATION *1d.*

The Commission considers that it is now possible to prepare technical guidance on the use of radiation data for practical purposes in the arid zones and urges compilation of such a guide.

UNION INTERNATIONALE
DE MÉCANIQUE THÉORIQUE
ET APPLIQUÉE (I. U. T. A. M.)

Symposium sur la « Dynamique des Satellites »

Ce colloque aura lieu à Paris du 28 au 31 mai 1962. Le Comité Scientifique comprend les personnalités suivantes :

Président : Prof. Maurice ROY (France).

Membres : D^r H. L. DRYDEN (E. U. A.),
D^r D. G. KING-HELE (Royaume Uni),
Prof. G. C. McVITTIE (E. U. A.),
Prof. L. I. SEDOV (U. R. S. S.).

Remarque : La participation aux colloques de l'I.U.T.A.M. n'a lieu que sur invitations adressées par le Comité responsable de l'organisation. Les demandes en ce sens doivent donc être adressées normalement au Président ou au Secrétaire dudit Comité.

ABRÉVIATIONS — ABBREVIATIONS

Nous donnons ci-après une liste des abréviations qui nous paraissent les plus utiles pour nos lecteurs :

We are publishing hereunder a list of abbreviations which we think to be useful for our readers :

A.G.I.	Année Géophysique Internationale.
A.I.G.	Association Internationale de Géodésie.
A.I.G.A.	Association Internationale de Géomagnétisme et d'Aéronomie.
A.I.M.P.A.	Association Internationale de Météorologie et de Physique de l'Atmosphère.
A.I.S.P.I.T.	Association Internationale de Séismologie et de Physique de l'Intérieur de la Terre.
A.P.T.U.	African Postal and Telecommunications Union.
A.S.I.C.A.	Association Internationale pour le Calcul Analogique.
C.C.I.R.	Comité Consultatif International des Radiocommunications — International Radio Consultative Committee.
C.C.I.T.T.	Comité Consultatif International Télégraphique et Téléphonique.
C.C.U.	Central Committee on Ursigrams — Comité Central des Ursigrammes.
C.E.T.E.X.	Committee on Extra Terrestrial Exploration.
C.E.E.A.	Communauté Européenne de l'Energie Atomique.
C.E.I.	Commission Electrotechnique Internationale.
C.E.P.T.	Conférence Européenne des Administrations des Postes et des Télécommunications.
C.I.G.	Comité International de Géophysique.
C.I.O.M.S.	Council for International Organizations of Medical Sciences.
C.I.O.S.	Comité International de l'Organisation Scientifique.
C.I.S.P.R.	Comité International des Perturbations Radioélectriques.
C.I.U.S.	Conseil International des Unions Scientifiques.
C.M.T.T.	Joint Committee on Television Transmission.
C.O.P.E.R.S.	Commission Préparatoire Européenne de Recherche Spatiales.
C.O.S.P.A.R.	Committee on Space Research.

- C.S.A.G.I. Comité Spécial pour l'Année Géophysique Internationale.
C.S.E.E.R.I. Comité Scientifique pour l'Etude des Effets des Radiations Ionisantes.
E.B.U. European Broadcasting Union.
F.A.G.S. Federation of Astronomical and Geophysical Services.
F.A.I. Fédération Aéronautique Internationale.
F.I.D. Fédération Internationale de Documentation.
I.A.A.B. Inter-American Association of Broadcasters.
I.A.B. I.C.S.U. Abstracting Board.
I.A.C. International Advisory Committee on Research in the Natural Sciences Programme of U.N.E.S.C.O.
I.A.C.O.M.S. International Advisory Committee on Marine Sciences.
I.A.E.A. International Atomic Energy Agency.
I.A.F. International Astronautical Federation.
I.A.G. International Association of Geodesy.
I.A.G.A. International Association of Geomagnetism and Aeronomy.
I.A.M.A.P. International Association of Meteorology and Atmospheric Physics.
I.A.P.O. International Association of Physical Oceanography.
I.A.R.U. International Amateur Radio Union.
I.A.S.H. International Association of Scientific Hydrology.
I.A.S.P.E.I. International Association of Seismology and Physics of the Earth's Interior.
I.A.U. International Astronomical Union.
I.A.V. International Association of Vulcanology.
I.B.P. International Biological Programme.
I.C.A.S. International Council of Aeronautical Sciences.
I.C.E.S. International Council for the Exploration of the Sea.
I.C.O. International Commission for Optics.
I.C.O.. Intergovernmental Conference on Oceanic Research.
I.C.P.H.S. International Council for Philosophy and Humanistic Studies.
I.C.S.U. International Council of Scientific Unions.
I.F.E.M.S. International Federation of Electron Microscope Societies.
I.F.I.P.S. International Federation of Information Processing Societies.
I.F.O.R.S. International Federation of Operational Research Societies.
I.G.O. Intergovernmental Organization.
I.G.U. International Geographical Union.
I.G.Y. International Geophysical Year.
I.H.B. International Hydrographic Bureau.

I.M.U.	International Mathematical Union.
I.O.C.	Intergovernmental Oceanographic Commission.
I.O.E.	Indian Ocean Expedition.
I.O.V.S.T.	International Organization for Vacuum Science and Technology.
I.P.M.S.	International Polar Motion Service.
I.Q.S.Y.	International Year of the Quiet Sun.
I.R.A.S.A.	International Radio Air Safety Association.
I.S.O.	International Organization for Standardization.
I.T.U.	International Telecommunication Union.
I.U.B.	International Union of Biochemistry.
I.U.B.S.	International Union of Biological Sciences.
I.U.C.A.F.	Inter-Union Committee on Frequency Allocations for Radio Astronomy and Space Science.
I.U.C.N.	International Union for Conservation of Nature and Natural Resources.
I.U.Cr.	International Union of Crystallography.
I.U.G.G.	International Union of Geodesy and Geophysics.
I.U.G.S.	International Union of Geological Sciences.
I.U.H.P.S.	International Union of the History and Philosophy of Sciences.
I.U.P.A.C.	International Union of Pure and Applied Chemistry.
I.U.P.A.P.	International Union of Pure and Applied Physics.
I.U.P.S.	International Union of Physiological Sciences.
I.U.T.A.M.	International Union of Theoretical and Applied Mechanics.
I.W.D.S.	International World Days Service.
J.C.A.M.	Joint Commission on Atomic Masses.
J.C.A.R.	Joint Commission of Applied Radioactivity.
N.G.O.	Non-governmental Organization.
O.I.G.	Organisation intergouvernementale.
O.I.R.	Inter-American Radio Office.
O.I.R.	Organisation Internationale de Radiodiffusion.
O.I.R.T.	Organisation Internationale de Radiodiffusion et Télévision.
O.M.M.	Organisation Météorologique Mondiale.
O.M.S.	Organisation Mondiale de la Santé.
O.N.U.	Organisation des Nations Unies.
O.N.G.	Organisation Non-Gouvernementale.
P.I.O.S.A.	Pan Indian Ocean Science Association.
P.S.C.	Pacific Science Council.
S.C.A.R.	Special Committee on Antarctic Research.

S.C.O.R.	Special Committee on Oceanic Research.
S.I.L.	Service International des Latitudes.
U.A.I.	Union Académique Internationale.
U.A.I.	Union Astronomique Internationale.
U.A.I.	Union des Associations Internationales.
U.A.T.I.	Union des Associations Techniques Internationales.
U.E.R.	Union Européenne de Radiodiffusion.
U.G.G.I.	Union Géodésique et Géophysique Internationale.
U.G.I.	Union Géographique Internationale.
U.I.C.P.A.	Union Internationale de Chimie Pure et Appliquée.
U.I.S.B.	Union Internationale des Sciences Biologiques.
U.I.T.	Union Internationale des Télécommunications.
U.N.	United Nations.
U.N.E.S.C.O.	United Nations Educational, Scientific and Cultural Organization.
U.R.S.I.	Union Radio Scientifique Internationale.
W.D.C.	World Data Centre.
W.H.O.	World Health Organization.
W.M.O.	World Meteorological Organization.
W.W.S.C.	World Wide Soundings Committee.

BIBLIOGRAPHIE

(See English text p. 68)

Commission Electrotechnique Internationale

Publication 95-1. Deuxième édition. — Batteries d'accumulateurs de démarrage au plomb. Première partie : Prescriptions générales et méthodes d'essai.

Publication 96-2. Première édition. — Câbles pour fréquences radioélectriques. Deuxième partie : Spécifications particulières de câbles.

Publication 129. Première édition. — Sectionneurs à courant alternatif et sectionneurs de terre.

Modification n° 1 à la Publication 34-1. — Recommandations pour les machines électriques tournantes (à l'exclusion des machines pour véhicules de traction).

Ces publications sont en vente au Bureau Central de la C.E.I., au prix de Fr. S. 7,50 l'exemplaire, plus frais de port, pour la Publication 95-1 ; Fr. S. 12.— l'exemplaire, plus frais de port pour la Publication 96-2 ; Fr. S. 20.— l'exemplaire, plus frais de port, pour la Publication 129, et Fr. S. 1,50 l'exemplaire, plus frais de port, pour la Modification n° 1 à la Publication 34-1.

Union Internationale des Télécommunications

L'U.I.T. vient de publier la *Nomenclature officielle des bureaux télégraphiques ouverts au service international*, 21^e édition 1961 (2 volumes, totalisant environ 1800 pages).

Ce document, qui est réédité tous les cinq ans, contient les indications reçues jusqu'au 30 décembre 1960. Il sera complété par des annexes qui contiendront les additions et les modifications à l'ouvrage.

Le prix de l'exemplaire a été fixé à :

Exemplaire broché : 42,50 francs suisses.

Exemplaire cartonné : 45,20 francs suisses.

Exemplaire relié : 47,70 francs suisses.

Ces prix comprennent l'abonnement aux annexes qui paraîtront jusqu'à la prochaine édition, ainsi que les frais de port et d'emballage pour envoi, par la poste ordinaire, dans le monde entier.

Cette nomenclature est munie d'une préface disponible, au choix du client, en français, anglais, espagnol, russe, italien, allemand, néerlandais, polonais, roumain et en trois langues (allemand-français-italien). Des préfaces supplémentaires sont en vente au prix de —.50 francs suisses l'exemplaire.

L'U.I.T. a également publié :

1) *Actes finals de la Conférence européenne de radiodiffusion sur ondes métriques et décimétriques, Stockholm, 1961.*

Cette publication comprend :

a) L'accord régional pour la Zone européenne de radiodiffusion relatif à l'utilisation par le service de radiodiffusion de fréquences des bandes des ondes métriques et décimétriques. Cet Accord abroge et remplace l'Accord européen de radiodiffusion (Stockholm, 1952) et les Plans y annexés ;

b) L'annexe 1. — Tableaux des distances à utiliser pour l'application de l'article 4 de l'Accord (modifications des caractéristiques des stations visées au présent Accord) ;

c) L'annexe 2. — Plans d'assignation des fréquences des bandes d'ondes métriques et décimétriques aux stations de radiodiffusion de la Zone européenne de radiodiffusion. Le chapitre II de cette annexe comprend les Plans suivants :

- Plan pour les stations de télévision dans la bande de fréquences 41-68 MHz,
- Plan pour les stations de radiodiffusion sonore dans la bande de fréquences 41-68 MHz,
- Plan pour les stations de radiodiffusion sonore dans la bande de fréquences 87,5-100 MHz,
- Plan pour les stations de télévision dans la bande de fréquences 87,5-100 MHz,
- Plan pour les stations de télévision dans la bande de fréquences 162-230 MHz,
- Plan pour les stations de télévision dans la bande de fréquences 470-960 MHz.

d) Le protocole final ;

e) Les Résolutions et Recommandations.

Ce document, d'environ 300 pages, a été édité séparément en trois langues (française, anglaise et espagnole). Les prix de vente ont été fixés à 10,60 *francs suisses* l'exemplaire pour le texte français ou anglais et à 20,15 *francs suisses* l'exemplaire pour le texte espagnol.

* * *

En application de la Résolution n° 2 de la Conférence européenne de radiodiffusion (Stockholm, 1961) ont été également publiées, à titre d'information, les :

- 2) *Données techniques prises en considération par la Conférence européenne de radiodiffusion sur ondes métriques et décimétriques (Stockholm, 1961) pour l'établissement des plans.*

Ce document, qui a été publié au même format que les Actes finals susmentionnés, a fait l'objet de trois éditions séparées (française, anglaise et espagnole).

Le prix de vente a été fixé à 4,10 *francs suisses* l'exemplaire.

* * *

Tous les prix comprennent l'emballage et les frais de port pour l'envoi par la poste ordinaire dans le monde entier.

La liste complète des publications de l'U.I.T., avec indication du prix de vente de chacune d'elles, sera envoyée gratuitement sur demande adressée au Secrétariat général de l'U.I.T., Palais Wilson, Genève, Suisse.

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International Electrotechnical Commission

Publication 95-1. Second edition. — Lead-acid starter batteries. Part 1 : General requirements and methods of test.

Publication 96-2. First edition. — Radio-frequency cables. Part 2 : Relevant cable specifications.

Publication 129. First edition. — Alternating current isolators (disconnectors) and earthing switches.

Amendment n° 1 to Publication 34-1. — Recommendation for rotating electrical machinery (excluding machines for traction purposes).

These publications are on sale at the Central Office of the I.E.C., at the price of Sw. Fr. 7,50 per copy, plus postage, for Publication 95-1, ; Sw. Fr. 12.— per copy, plus postage, for Publication 96-2 ; Sw. Fr. 20.— per copy, plus postage, for Publication 129, and Sw. Fr. 1,50 per copy, plus postage, for Amendment n° 1 to Publication 34-1.

International Telecommunication Union

The I.T.U. has just published the Official List of Telegraph Offices open for International Traffic, 21st edition, 1961 (2 volumes containing in all approximately 1800 pages).

This document, a new edition of which is published every five years, sets out the information received up to 30 December, 1960. It will be supplemented by annexes incorporating additions and amendments to the List.

The price per copy is :

Paperback : 42.50 Swiss francs.

Cardboard : 45.20 Swiss francs.

Clothboards : 47.70 Swiss francs.

These prices included a subscription to the annexes to be issued before the next edition is published, as well as delivery by ordinary post throughout the world.

The List contains a preface available in French, English, Spanish, Russian, Italian, German, Dutch, Polish, Roumanian and in three languages (German-French-Italian). Additional copies of the preface are on sale at —.50 Swiss francs per copy.

The I.T.U. has published :

1. *The Final Acts of the European V.H.F./U.H.F. Broadcasting Conference (Stockholm, 1961).*

This comprises :

(a) The Regional Agreement for the European Broadcasting Area, relative to the use of the VHF and UHF bands for broadcasting. This cancels and replaced the European Broadcasting Agreement (Stockholm, 1952) and the Plans annexed thereto.

(b) Annex 1. — Tables showing the distances to be used in applying Article 4 of the Agreement (changes in the characteristics of stations).

(c) Annex 2. — Plans for the assignment of frequencies from the VHF and UHF bands to broadcasting stations in the European Broadcasting Area. Chapter II of this Annex comprises the following plans :

- plan for television stations in the band 41-68 Mc/s ;
- plan for sound broadcasting stations in the band 41-68 Mc/s ;
- plan for sound broadcasting stations in the band 87.5-100 Mc/s ;
- plan for television stations in the band 87.5-100 Mc/s ;
- plan for television stations in the band 162-230 Mc/s ;
- plan for television stations in the band 470-960 Mc/s.

(d) The Final Protocol.

(e) The Resolutions and Recommendations.

This volume runs to some three hundred pages, and is published separately in three languages (English, Spanish and French). A copy of the English or French edition costs 10.60 *Swiss francs*, and a copy in Spanish 20.15 *Swiss francs*.

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Pursuant to Resolution n° 2 of the Stockholm Conference (1961), the I. T. U. has also published :

2. *The Technical Data taken into consideration by the Conference in drawing up its Plans.*

These data are published in a volume of the same dimensions as the volume of Final Acts. There are three editions, one in English, one in Spanish, and one in French. The cost per copy will be 4.10 *Swiss francs*.

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All the prices include carriage by ordinary mail to any address.

A full list of I.T.U. publications, with prices, will be sent free of charge on application to the I.T.U. General Secretariat, Palais Wilson, Geneva, Switzerland.

The sunspot-activity in the years 1610-1960. Edited by M. Waldmeier, Director of the Swiss Federal Observatory Zürich.

CONTENTS :

Epochs of Minima and Maxima of the Sunspot-Activity 1610-1960.

Yearly Means of Sunspot-Relative-Numbers 1700-1960.

Monthly Means of Sunspot-Relative-Numbers 1749-1960.

Smoothed Monthly Means of Sunspot-Relative-Numbers 1749-1960.

Daily Sunspot-Relative-Numbers 1818-1960.

Diagrams of the Yearly Means of Sunspot-Relative-Numbers 1700-1960.

Diagrams of the Observed and Smoothed Monthly Means 1755-1960.

Diagrams of the Daily Sunspot-Relative-Numbers 1825-1960.

The text is given in English and German.

Price : Swiss francs 20.— (\$4.70), postage and packing included.

Orders are to be sent to Eidgenössische Sternwarte, Zürich, Switzerland, Schmelzbergstrasse, 25.

Project West Ford

Memorandum for Members of the West Fort Committee of the International Astronomical Union

Dear Colleague,

The Space Science Board of the National Academy of Sciences has received from the United States Government a status report on Project West Ford prepared by the Lincoln Laboratory of the Massachusetts Institute of Technology, a copy of which I am forwarding to you for your analysis and comments. The Space Science Board is also advised that preparations are under way for a second attempt at launching a West Ford dipole package later this year. As the enclosed report indicates, the proposed launching will include a very important safeguard, namely, a triggering device that can be activated to release the package only on command from the ground, which will ensure that it will be ejected only if a suitable orbit is achieved, that is, one in which the lifetime of the dipoles in orbit is of limited duration.

As you know, astronomers and other scientists appointed by the Space Science Board (S.S.B.) have long had Project West Ford under study. A short historical review of this study is in order. In the fall of 1959, the S.S.B. was informed of a proposal by the Lincoln Laboratory to place one or more belts of thin microwave dipoles in orbit around the Earth at an altitude of a few thousand kilometers as a means of exploring a possibly reliable, new system of long-range radio communication. The Board was asked by the Lincoln Laboratory and by the government to consider the effects of this experimental belt from the standpoint of science as a whole, and particularly to ascertain whether the first experimental test proposed by the Lincoln Laboratory would destroy or put any important limitation on activity in any field of basic scientific research.

In response to this request, the Board appointed an ad hoc committee of scientists under the chairmanship of Dr. O. G. Villard, Jr., to examine the consequences of the proposed experiment. Astronomers on this committee included G. M. Clemence, U. S. Naval Observatory; C. H. Mayer, Naval Research Laboratory, and F. L. Whipple, Smithsonian Astrophysical Observatory. The committee held several meetings, the last of which took place at the Lincoln Laboratory in April 1960 and was attended also by about a dozen optical and radio astronomers and by representatives of the Lincoln Laboratory and of several government agencies.

After receiving the report of its ad hoc Committee in June 1960, the S.S.B. arrived at a number of conclusions and recommendations : (1) The first exploratory test proposed by the Lincoln Laboratory would probably not have an adverse effect on any branch of science. (2) The Board was seriously concerned with the harm which an operational system or systems might entail for optical and radio astronomical observations and strongly recommended that any planning for such a system or for large-scale future tests protect the interests of basic astronomical research and of science in general. (3) Full information of the scientific and operational aspects of the initial experiment should be published as soon as possible. (4) In view of the possible seriousness of the interference to radio astronomy, which is likely to result not only from dipole belts but also from active communication satellites, protected frequency bands for radio astronomy should be established on a world-wide basis. Finally, the Board established a committee of astronomers to work closely with the developers of Project West Ford and to serve in an advisory capacity in connection with the question of interference to astronomy.

The present composition of the S.S.B. committee is as follows : John W. Findlay (National Radio Astronomy Observatory) chairman, Frederick T. Haddock (University of Michigan), William A. Hiltner (Yerkes Observatory), William Liller (Harvard University), A. E. Lilley (Harvard University), and Allan Sandage (Mount Wilson and Palomar Observatories). Edward R. Dyer, Jr., of the Space Science Board Secretariat, serves as secretary to this group.

The S.S.B. committee has studied the subject matter of the enclosed report and has, in the course of this study, engaged in direct consultations with Lincoln Laboratory staff scientists and engineers. The committee has reported to the Executive Committee of the Space Science Board that :

(1) The reasons discovered by the Lincoln Laboratory for the failure of the dipoles to disperse into a cloud or belt appear to be by far the most likely in the light of all available evidence. It also seems, based on the same evidence, extremely unlikely that the several fairly large fragments (into which the dipole package placed in orbit on 21 October 1961 has broken) will ever disperse to form a dipole cloud or belt.

(2) The modifications to the experiment proposed for the next launch provide a significant measure of control and surveillance over the behavior of the package — in particular, the inclusion of a device for commanding the release of the dipoles from the ground after determining that a suitable orbit has been achieved.

The conduct of the West Ford experiment has been governed by the White House statement made available on 11 August 1961, and will continue to be so governed. That statement specifically recognizes the Space Science Board and its special committee on this subject as a vehicle by which continuing studies are to be undertaken. We shall continue to make available the outcome of these studies to scientists throughout the world, in particular to the members of the West Ford Committee appointed by the International Astronomical Union.

That statement says, in part, that any decision to place additional quantities of dipoles in orbit, subsequent to the West Ford experiment, will be contingent upon the results of the analysis and evaluation (by scientists) and upon the development of necessary safeguards against harmful interference with space activities or with any branch of science. That statement was intended to refer to a fully successful experiment — that is, one in which the dipoles dispersed to form a belt which astronomers all over the world were asked to observe, if possible, in order to assess its effect on their observations and hence estimate the degree of interference to be expected from any such belt. Nevertheless the S.S.B. committee has taken the view that the data available

on the abortive launch of 21 October 1961 should be analyzed and evaluated just as carefully as if the launch had been successful, in view of the concern which might arise about the possibility that the fragments now in orbit could some day form a belt. As stated above, the S.S.B. liaison committee is satisfied that the probability is negligibly small that this will happen.

Although a careful evaluation of the 21 October launching and its aftermath has been made, it is still incumbent on the S.S.B. and scientists generally to measure and evaluate the effects of an orbiting belt of dipoles, if and when such a belt has been successfully formed in any future attempt.

March 8, 1962.

Yours truly,
John W. FINDLAY,
Chairman, S.S.B. West Ford Committee,
and Secretary, I.A.U. West Ford Committee

Status Report on Project WEST FORD

1 March 1962

M. I. T. Lincoln Laboratory
Lexington 73, Massachusetts

ABSTRACT

1. *Background.*

On 21 October 1961, an Air Force Atlas-Agena B carried into orbit a dispenser package containing 75 pounds of fine copper dipole fibers embedded in naphthalene. The package was expected to release the fibers in such a way that they would gradually disperse to form a thin, narrow, circular orbital ring or belt about 40 thousands miles long at an altitude of about 2 thousands miles, intended to reflect radio waves of a particular wavelength. This operation was part of an experiment in long-distance radio communication being conducted by the M. I. T. Lincoln Laboratory with the support of the U. S. Air Force.

The cylindrical dispenser package was to be ejected from its container, which was attached to the Agena B parent vehicle, in such a way that it would spin about its axis (like the projectile; from a rifle barrel) at a rate of about seven revolutions per second the dispersal of the individual dipole fibers depends on the way in which they are spun off the outer surface of the cylindrical package as the solid naphthalene binder gradually evaporates.

2. *Recent Results.*

Since the date of launch, there has been no sign that any dipole fibers have dispersed from the package, and there is now a convincing body of evidence as to why this is the case. A mechanical malfunction at the time of ejection caused the package to be ejected without the spin needed to release and disperse the fibers, and the fibers have remained clustered together in five or six small clumps that have been tracked for several months by the Millstone Hill UHF radar. The cause of the mechanical malfunction

has now been determined and verified in a laboratory experiment, under simulated space conditions of low pressure, low temperature and free fall. The experimental results and calculations are consistent with the radar measurements on the fragments of the package.

3. *Technical Plans.*

The design of the experiment has now been modified (1) to prevent a recurrence of the spin malfunction; (2) to incorporate telemetry that will indicate the package position, temperature, spin rate, tumble rate, and extent of dipole dispensing; and (3) to permit the package to be ejected only if the parent vehicle is ascertained to be in a suitable orbit, in which the lifetimes of the dipole belt will be of limited duration. The telemetry equipment on the package will displace about one-third of the dipole fibers, reducing the weight of material from 75 pounds to 50 pounds, and reducing the number of individual dipoles from about 350 million to less than 250 million. In all other respects, the description of the Project WEST FORD experiment presented in the fact sheet released after the initial launch (21 October 1961) remains unchanged.

4. *Some Related Activities.*

Pending the establishment of a test belt of dipoles, considerable progress has been made in the development and testing of equipment and techniques that are necessary for the experiment but will be very useful in many other areas of science and technology. Transcontinental digital data transmission by lunar relay at a rate of 50 000 bits per second has been demonstrated, and detailed, quantitative measurements have been made on the radar reflectivity of the lunar surface at X-band (wavelength 3.6 centimetres).

* * *

Project WEST FORD is an experiment to determine the practical feasibility of a new method for reliable intercontinental radio communication by means of passive satellites. The satellites in this case are almost invisibly fine metallic fibers, distributed along a thin, narrow, circular orbital ring or belt several thousand miles above the earth. Radio messages could be relayed over very

long distances with great reliability by the use of such a belt, since the belt would be quite invulnerable to physical damage.

Initial plans for the Project WEST FORD experiment are described in detail in the fact sheet released on the initial launch date of 21 October 1961. At that time, the dipole dispenser package was successfully placed in orbit, but dipole fibers did not disperse from the package.

Dispenser Package.

The package consisted of a cylindrical stack of disks mounted on a hollow central shaft between two end plates. Each disk was made up of a large number of dipole fibers, closely packed parallel to each other and parallel to the central shaft. The dipoles were embedded in naphthalene, a hydrocarbon solid commonly used as the principal ingredient in moth balls, which sublimates (turns into gas) when exposed to the atmosphere; when exposed to very low pressures in space, naphthalene sublimates much more rapidly than it does at normal atmospheric pressure.

Dispensing and Dispersing Mechanisms.

After the launch vehicle achieved orbit, the package was ejected from its sealed canister by a coil spring. The main body of the package is normally clamped with a force of about 1000 pounds between the two end plates on the central shaft. The hollow interior of this shaft has grooves, like the rifling in a gun barrel, that mesh with spiral ridges on the central shaft of the canister. As the package is ejected, these spiral grooves cause the central shaft of the package to spin, and the spin is imparted to the dipole stack by way of the end plates.

The spin imparted to the dipole package at the time of ejection is vital to the dispersal of the dipole fibers: the spin supplies the force that impels individual fibers to fly off the stacks, as they are released by the gradual vaporization of the naphthalene. Each fiber then has a velocity that is very slightly but perceptibly different from all the others, and it is these very small differences in velocity that cause the fibers to diffuse slowly along the orbital path to form a thin, narrow circular ring.

Results of Initial Test.

Present evidence indicates that slippage occurred between the dipole package and the end plates momentarily at the time of ejection, under the combined influence of thermal distortions resulting from an unexpectedly long exposure to low temperature during the launch period and of the sharp ejection impulse. Under the circumstances, the spin imparted to the central shaft was not fully imparted to the dipole package. Most of the energy stored in the compressed coil spring went into pushing the package out of the container along its axis, and very little energy went into spinning it. The resulting spin was very much slower than the design value, and there was too little centrifugal force to spin off the individual dipoles. As the naphthalene sublimed, the package weakened to such an extent that even the small amount of existing centrifugal force caused the package to break into several pieces which separated very slowly along the orbital path. The residual rotation of the separate pieces was insufficient to cause any further break-up or dispersal of individual dipoles.

Evidence.

The evidence supporting this diagnosis is as follows :

(1) Telemetry data showed that the package container, as mounted on the launch vehicle, was consistently shaded from the sun and that it therefore was cooled down to 35° F. It has been demonstrated experimentally, as indicated below, that at this temperature the dipole package can slip with respect to the end plates during the initial ejection spin-up process.

(2) Telemetry data indicated linear ejection velocity somewhat greater than expected. This preliminary indication was later confirmed and emphasized by the Millstone Hill UHF radar measurements on the location of the package in orbit, from which it is calculated that the linear ejection velocity was 10.25 feet per second instead of the expected 7.5 feet per second. This suggests that, upon ejection, most of the energy from the coil spring was converted into the linear momentum of the package, and that only a very small amount of energy went into spinning the package. Calculations show that if all the spring energy had gone into linear momentum, an ejection velocity of 11.0 feet per second would have been achieved.

(3) When the Millstone Hill radar measurements had been continued long enough, the observed rate at which the pieces of the package were moving apart in orbit could be used to calculate the initial rate of spin which caused them to separate. This was found to be less than 1/10 the expected spin rate of 7 revolutions per second.

(4) No experimental or theoretical evidence has been found to indicate any reason that the naphthalene is likely to have failed to sublime or vaporize.

(5) The fragments observed by the UHF Millstone Hill radar are about 0.02 square meters in radar cross-section and have not changed in their apparent cross-section in the months since they were first detected. An exhaustive search by the special X-band Project WEST FORD radars has not yielded any returns, despite the fact that the orbit has been accurately determined and that a cloud of only a few hundred individual dispersed dipoles within the radar beam should produce detectable echoes.

Experimental Confirmation.

(1) The slippage of the end plates on the dipole package for a short interval during ejection, and the resulting low spin-rate of the package, have been successfully simulated in a laboratory experiment, with a test package in free fall in a large environmental test chamber at low pressure and low temperature. High speed photographs indicate that the package spin rate was less than one-tenth of the expected value, consistent with (3) above. This reduces the force pulling dipoles from the spinning package to less than 1/100 of the expected value.

(2) Further laboratory tests have shown that the dipoles are not pulled away and thrown off from the package by the weak forces that exist at the slow spinrate because of a slight tendency of the dipoles to stick together mechanically at their ends, a result of a machining process involved in fabrication.

In the absence of the forces necessary to throw off and disperse the individual dipoles, the dipoles have stayed tightly clustered together and have not dispersed, and there is no reason to expect that they will do so at any future time.

The evidence and experimental confirmation outlined above accounts for all observed results from the first attempt to establish a test belt of dipoles in orbit and shows that in fact no such belt was established.

Technical Plans.

Technical plans for a possible second attempt include the following changes :

(1) Mechanical redesign of the dipole package to prevent slippage and insure the desired spin.

(2) Incorporation into the package of a VHF beacon and telemetry to indicate package position, temperature, spin rate, tumble rate, and extent of dipole dispensing.

(3) Reduction of number of dipoles to make room for telemetry circuits : total weight of dipoles reduced from 75 pounds to 50 pounds, total number of dipoles reduced from about 350 million to less than 250 million.

(4) Addition of a radio circuit to cause the dispenser to be ejected only upon command from the ground (instead of as an automatic step in the launch sequence). This will insure that the package will be ejected only if a suitable orbit has been achieved, one in which the life-time of the dipoles will be of limited duration.

Some Related Activities.

The attempt to establish a test belt of dipoles in orbit is of course an essential part of the Project WEST FORD experiment, but a belt in itself would be useless without the special equipment and techniques that have had to be developed for the experiment. The ground terminal facilities and measurement techniques, and related theoretical and experimental studies in the laboratory, have required an expenditure of effort at least as great as the development and testing of the dipole dispensing technique. These other activities have yielded a number of results that are significant in their own right to various fields of science and engineering. High-power transmitters, very sensitive receivers, and large precision reflectors, as well as the antenna control and signal processing techniques that have been developed for this project,

will find applications in many other branches of electronics and communication technology, in addition to their essential roles in this experiment.

Pending the establishment of a test belt of dipoles, the two ground stations designed and built for Project WEST FORD (at Millstone Hill in Westford, Massachusetts and at Camp Parks in Pleasanton, California) have carried out extensive measurements on reflections from the moon. These measurements have been made at X-band (frequencies near 8000 megacycles per second, wavelength 3, 6 centimeters), the highest frequency range in which it has ever been possible to make such detailed, accurate measurements.

The surface of the moon resembles an orbital belt of dipoles as a reflector of radio waves in two important respects. First, it produces many multiple reflections from somewhat different distances, each reflected signal arriving at the receiving point at a slightly different time : thus a single transmitted pulse produces a smear of many overlapping pulses of various amplitudes at various arrival times, and the modulation-demodulation system must bring order out of this chaos without sacrificing precious power from the already feeble reflected signals. Second, because the reflecting elements are all moving at various different velocities with respect to the fixed transmitter and receiver, the received signals will no longer be at the same frequency as the transmitted signals : they will be smeared over a much wider range of frequencies, and the modulation-demodulation system must cope with this kind of distortion as well as with multipath.

Using advanced techniques of modulation developed for the Project WEST FORD experiment, the WEST FORD ground stations have achieved digital data transmission rates, over the transcontinental lunar-relay circuit, of 50 000 bits per second, a capacity that would accommodate one thousand simultaneous teletype channels, considerably greater than the capacity of lunar relay circuits currently in operational use. Good quality voice communication over this circuit has also been achieved. These successful tests on lunar reflections are encouraging omens of ground-station performance in testing the Project WEST FORD belt.

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 3. « Lifetime of Orbiting Dipoles », I. I. SHAPIRO and H. M. JONES. *Science*, 134, 3484, pp. 973-979, 6 October 1961.
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