Bulletin nº 151 Juillet-Août 1965

U. R. S. I.

TABLE DES MATIÈRES — CONTENTS

XIV[e] ASSEMBLÉE GÉNÉRALE

Progress in Radio Science 1960-1963

Volume IV

Radio Noise of Terrestrial Origin

Le Volume IV de la série « Progress in Radio Science 1960-1963 », édité par F. Horner, passe en revue les divers aspects des travaux consacrés au bruit radioélectrique d'origine terrestre, travaux que les experts avaient été priés de présenter à la XIV[e] Assemblée Générale de l'U.R.S.I., à Tokyo en septembre 1963.

Après un rapport du Président donnant un résumé de l'activité de la Commission IV ainsi que les résultats, les progrès, les nouveaux problèmes à étudier et des considérations sur les travaux futurs, l'ouvrage présente les communications qui ont été faites lors des séances de la Commission IV et des séances communes avec les Commissions II et III, ainsi qu'un compte rendu des discussions qui en ont résulté.

Les sujets traités comprenaient l'étude des propriétés de la source d'éclairs (spectres de fréquence, propagation des ondes de très basse fréquence et des émissions d'atmosphériques dans la gamme des fréquences très basses et extrêmement basses, dans des conditions de propagation normales et anormales, y compris celles résultant des éruptions solaires, des tempêtes géomagnétiques et des explosions nucléaires), des résultats de l'A.G.I. et du programme de l'A.I.S.C. (possibilité d'utiliser des fusées et des satellites pour l'avancement de la recherche sur les bruits atmosphériques), des sifflements (développements nouveaux dans la recherche au cours de la période 1960-1963, notamment les méthodes utilisant des signaux émis par satellites ou d'origine humaine), des phénomènes de très basse fréquence (bruit de très basse fréquence de la magnétosphère, micropulsations du champ électromagnétique terrestre), des ondes guidées dans la troposphère et l'ionosphère (ondes guidées dans la cavité terre-ionosphère, guidage et rayon-

nement dans la magnétosphère aux fréquences hydromagnétiques, audio et radio fréquences).

L'ouvrage est publié par Elsevier Publishing Company (Amsterdam, London, New York).

XIVth GENERAL ASSEMBLY

Progress in Radio Science 1960-1963

Volume IV

Radio Noise of Terrestrial Origin

Volume IV of the *Progress in Radio Science* 1960-1963 series edited by F. Horner contains the review of various aspects of the works on radio noise which experts were invited to present at the XIVth General Assembly of U.R.S.I., Tokyo, September 1963.

After a report of the Chairman giving a summary of the activities of Commission IV, results and progress, new problems to be studied and considerations for future work, papers presented during the sessions and joint sessions with Commissions II and III and accounts of the subsequent discussions are given.

The subjects discussed included the properties of the lighting flash source (frequency spectra, propagation of VLF waves and atmospherics, intensity and phase characteristics of VLF waves and atmospherics in normal and abnormal propagation conditions, including solar flares, geomagnetic storms and nuclear explosions), I.G.Y. results and I.Q.S.Y. programme on atmospheric noise (consideration of the possible use of rockets and satellites in furtherence of research on atmospheric noise), whistlers (new developments in research during 1960-1963, notably those using satellites and man-made signals), VLF and noise phenomena (VLF noise from the terrestrial magnetosphere, micropulsations of the earth's electromagnetic field), guided waves in the troposphere and the ionosphere (guided waves in the earth-ionosphere cavity, guidance and beaming in the magnetosphere at hydromagnetic, audio and radio frequencies).

The book is published by Elsevier Publishing Company (Amsterdam, London, New York).

XVth GENERAL ASSEMBLY

Arrangements for Commission III

The attached programme of scientific sessions is being arranged for Commission III. At the start of each session the speaker named will read a review paper lasting not more than 45 minutes. *Others who have contributions to make should send a* 500 *word abstract to the reader of the review paper with a copy to Mr. Ratcliffe, the Chairman, before May* 15*th* 1966. The reader of the review will incorporate a mention of these abstracts in his paper. The remainder of each session will be devoted to free discussion during which the reading of set papers or the presentation of long series of slides will be discouraged. Those who have sent in summaries will be expected to contribute to the discussion.

In view of the fact that the Inter-Union Symposium on Solar-Terrestrial Physics in Belgrade will not end until Friday, September 2nd, the first scientific session of U.R.S.I. Commission III will be on Thursday, September, 8th.

Scientific Programme

THURSDAY, SEPTEMBER 8th

a.m. *D-region.* Structure and formation (Dr. LANDMARK).

p.m. *D-region.* Absorption, collision frequencies, relation to stratosphere (Mr. PIGGOTT).

FRIDAY, SEPTEMBER 9th.

a.m. *The ionospheric F-region (above the peak) and magnetosphere* (Dr. Willmore and a speaker from Commission IV to deal with incoherent scatter).
(Joint with Commission IV. Organised by Commission III).

p.m. *Special Session of U.R,S.I.* at which all Commissions will report in general terms on their activities. Commission III, IV and V will present reports on « Highlights of the Belgrade Symposium » (Mr. RATCLIFFE).

MONDAY, SEPTEMBER 12TH.

a.m. *Dynamics of the ionosphere.* Overall picture and E-region in particular (Dr. HINES).

p.m. *VLF radio waves and micropulsations* (Dr. BELROSE together with a speaker from Commission IV on micropulsations)
(Joint with Commission III. Organised by Commission IV).

TUESDAY, SEPTEMBER 13th.

a.m. *Dynamics of the ionosphere.*
F-region phenomena, interaction between movements of neutral atmosphere and ionosphere (Dr. KOHL).

p.m. *The Ionospheric F-region* with special reference to subpeak morphology (Dr. KING).

WEDNESDAY, SEPTEMBER 14th.

a.m. *No meeting of Commission III.* Commission VI will discuss radiation and scattering in ionised regions.

p.m. *Reserved for new topics.*

The addresses of the people concerned are as follows :

Dr. J. S. BELROSE, Defence Research Telecommunications Establishment, Shirley Bay, Ottawa, 4, Ontario, Canada.

Dr. C. O. HINES, Department of Geophysical Sciences, University of Chicago, Chicago, Illinois, U. S. A.

Dr. J. W. KING, Ph. D., M. Sc., B. Sc., A. Inst. P., S. R. C., Radio and Space Research Station, Ditton Park, Slough, Bucks England.

Dr. H. KOHL, Max Planck Institut für Aeronomie, Lindau über Northeim/Hann, Germany.

Dr. B. LANDMARK, Norwegian Defence Research Establishment, Division for Telecommunication, Kjeller pr Lillestrom, Norway.

Dr. W. R. PIGGOTT, O. B. E., B. Sc., S. R. C. Radio and Space Research Station, Ditton Park, Slough, Bucks, England.

Mr. J. A. RATCLIFFE, C. B. E., M. A., M. I. E. E., F. R. S., Director, S.R.C. Radio and Space Research Station, Ditton Park, Slough, Bucks.

Dr. A. P. WILLMORE, Department of Physics, University College London, Gower Street, W.C. 1., England.

J. A. RATCLIFFE,

NATIONAL COMMITTEES

Canada

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Denmark

OFFICIAL DANISH MEMBERS OF U.R.S.I. COMMISSIONS

The Danish National Committee of U.R.S.I. on its meeting June 14, 1965, has appointed the following Official Members of Scientific Commissions. Their task will be to prepare the scien-

tific programme of the XVth General Assembly in Munich in September, 1966.

Commission I *on Radio Standards and Measurements* : Professor Georg BRUUN, Laboratory of Electronics, Technical University of Denmark, Lyngby, Denmark.

Commission II *on Radio and Troposphere* : Mr. M. GRØNLUND, Microwave Laboratory, Technical University of Denmark Lyngby, Denmark.

Commission III *on the Ionosphere*, Mr. J. K. OLESEN, Ionosphere Laboratory, Technical University of Denmark, Lynbgy, Denmark.

Commission IV *on the Magnetosphere* : Dr. E. UNGSTRUP, Ionosphere Laboratory, Technical University of Denmark, Lyngby, Denmark.

Commission IV*a on Radio Noise of Terrestrial Origin* : Dr. E. UNGSTRUP, Ionosphere Laboratory, Technical University of Denmark, Lyngby, Denmark.

Commission V *on Radio Astronomy* : Professor Dr. A. REIZ, Astronomical Observatory of the University of Copenhagen, Øster Voldgade 3, Copenhagen K, Denmark.

Commission VI *on Theoretical Radioelectricity and Information Transmission* : Mr. P. E. GUDMANDSEN, Laboratory of Electromagnetic Field Theory, Technical University of Denmark, Lyngby, Denmark.

Commission VII *on Electrophysics* : Professor Dr. H. L. KNUDSEN, Ionosphere Laboratory, Technical University of Denmark, Lyngby, Denmark.

Japan

CHANGE OF ADDRESS

We inform our readers that Prof. A. Kimpara, Chairman of U.R.S.I. Sub-Commission on Radio Noise of Terrestrial Origin, Director of the Research Institute of Atmospherics, Nagoya University for more than 15 years since the establishment of the

Institute, retired for his age limit on March 31, 1965. He will continue his research on atmospherics, whistlers and VLF phenomena as Professor of « Chûbu Institute of Technology » Matsumotocho, Kasugai, Aichi, Japan, in collaboration with the Research Institute of Atmospherics.

Those who want to have contact with Honorary Professor A. Kimpara are requested to write or send documents to his new office in Chûbu Institute of Technology.

U. S. A.

1965 FALL U.R.S.I. MEETING

Announcement and Call for Papers

October 4-6, Hanover, New Hampshire at
DARTMOUTH COLLEGE

Commission 1. — *Radio Measurement Methods and Standards.*
Commission 2. — *Radio Propagation in Non-Ionized Media.*
Commission 3. — *Ionospheric Radio.*
Commission 4. — *Magnetospheric Radio.*
Commission 5. — *Radio and Radar Astronomy.*
Commission 6. — *Radio Waves and Transmission of Information.*

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Geoscience Electronics	Microwave Theory and Techniques

ABSTRACTS

Up to approximately 200 words by July 9, 1965 in duplicate to : Prof. T. LAASPERE, Radiophysics Laboratory, Dartmouth College, Hanover, New Hampshire.

Authors should indicate to which commissions papers are tendered but they should not be sent to commission chairmen. The attention of authors is called to the « Guide for the Preparation and

Publication of Synopses », which has been adopted by the International Council of Scientific Unions.

1966 SPRING U.R.S.I. MEETING

Information

The meeting will be held April 18-21 (Mon-Thur; Easter is Apr. 10) in Washington, D. C., at the National Academy of Sciences. The U.S.N.C. will meet on the evenings of April 17 and 20 (Sun and Wed). The A.G.U. will meet in Washington April. 19-22 (Tue-Fri) at the Sheraton Park Hotel.

Announcement of a Special Interdisciplinary Issue of Radio Science on the Mode Theory of Wave Propagation

It is planned in 1966 to have a special issue of *Radio Science* (*N.B.S. Journal of Research*, Section D), devoted to the subject of the *Mode Theory of Wave Propagation*. Although emphasis on electromagnetic waveguides is expected, papers dealing with guided wave concepts in acoustics, seismology, and hydromagnetics will be welcomed.

It is felt that workers in these seemingly diverse fields do not always appreciate that some of the analytical and experimental methods developed may be carried over into another discipline. By collecting together a number of definitive papers on mode theory in these various fields, it is possible that a service will be rendered, particularly to radio scientists (who often are unaware of developments outside their speciality).

Keeping in mind the interdisciplinary nature of this special issue, theoreticians and experimentalists are hereby invited to submit manuscripts for consideration to the Editor (Dr. James R. Wait, National Bureau of Standards, Boulder, Colorado 80301), before December 31, 1965. These should be prepared in accordance with the Instructions-to-Authors inside the back cover of any current issue of *Radio Science*. In order to facilitate editorial planning it would be appreciated if prospective authors would submit a short abstract or summary of their paper to the editor at the earliest convenience.

COMMISSIONS ET COMITÉS

Commission II. — Radioélectricité et Troposhère

COLLOQUE SUR LES ATMOSPHÈRE ET SURFACE PLANÉTAIRES OBSERVÉES PAR RADIO

(Dorado, Porto-Rico, 24-27 mai 1965)

A la suite d'une proposition formulée par la Commission II de l'U.R.S.I. à la XIVe Assemblée Générale de Tokyo, un Colloque sur les atmosphère et surface planétaires observées par radio a été organisé en collaboration par l'U.R.S.I. (Commission II et V) et l'U.A.I. (Commission 16 et 17). Présidé par le Professeur W. Gordon, il s'est tenu à Dorado, Porto Rico, les 24-27 mai 1965.

Le nombre de participants, sur invitation, a été d'une quarantaine provenant d'Australie, de la République Fédérale Allemande, de la France, de la Grande-Bretagne, de Norvège, des Etats-Unis et d'U. R. S. S. Les disciplines représentées étaient l'astronomie et la radioastronomie en majorité, et la troposphère.

Les séances organisées ont été les suivantes :

1. — Jupiter, observé en ondes longues ; avec un rapport introductif de G. Ellis.
2. — Jupiter, observé en ondes courtes ; avec un rapport introductif de J. Roberts.
3. — Observations passives de Vénus, Saturne, Mercure, Mars et Uranus ; avec un rapport introductif de A. Barrett.
4. — Observations passives de la Lune ; avec un rapport introductif de V. Troitski présenté par A. E. Salomonovich.
5. — Observations radar des planètes ; avec un rapport introductif de G. Pettengill.
6. — Observations radar de la Lune ; avec un rapport introductif de J. Evans présenté par T. Hagfors.

Les rapports introductifs et les contributions à la discussion seront publiés dans *Radio Science*.

OVERSEA PROPAGATION OF SHORT WAVES

The Hellenic Telecommunication Organisation has issued in the series of scientific reports of the Radio Research Laboratory : « Signal statistics on a long line-of-sight (212 km) UHF (1760 Mc/s) oversea radio path », by J. S. Nicolis.

Summary.

This work gives a survey on the statistical behavior of radio received signal both in time and space in the case of a very long-line-of-sight radio path with great clearance above sea at east Mediterranean and for the period 3 July 1964-23 April 1965.

The study refers in particular to the long and short term distributions of instantaneous values through the year, the diurnal effect on fading depth, duration and rate for various fixed signal levels during the summer period (July-October), the influence of scattered components during the winter (February) and the instantaneous correlation envelop between signals received on vertically as well as on horizontally spaced antennae as a function of signal strength for different time intervals and various corresponding propagation modes.

Commission III on the Ionosphere

NOMENCLATURE AND SYMBOLS FOR TOPSIDE SOUNDER IONOGRAMS

The Canadian National Committee of U.R.S.I. endorse the recommendations for standard nomenclature for the topside ionosphere, as represented hereunder.

1. — Recommended nomenclature.

f_N — frequency of the plasma spike that occurs at X = 1 (i. e., plasma frequency at the satellite)

f_oS — frequency of the ordinary wave reflection trace (X = 1) at the satellite (i. e., plasma frequency at the satellite) f_N and f_oS are equivalent, but describe different phenomena

f_XS — frequency of the extraordinary wave reflection trace (X = 1 — Y) at the satellite.

f_ZS — frequency of the Z-wave reflection trace (X = 1 + Y) at the satellite

$f_Z\infty$ — frequency at which the Z-wave reflection trace approaches infinite retardation

$$\left(X = \frac{1 - Y^2}{1 - Y_L^2}\right)$$

f_T — frequency of the spike observed at the limit of transverse propagation ($X = 1 - Y^2$)

nfH — frequency of the « *n* »*th* harmonic of the gyrofrequency

h_S — height of satellite

fE_s — maximum frequency of observation of Sporadic E

J — preceding any of the symbols, indicates that the parameter is calculated from other observables, e.g., Jf_oS is the frequency of the ordinary wave reflection trace at the satellite (or the plasma frequency at the satellite), calculated from the observed extraordinary wave frequency.

2. — It is recommended that ionograms be published with zero range (from the satellite) appearing at the top of the figure, and with apparent range increasing from top to bottom.

It is requested that U.R.S.I. consider these recommendations with a view to accepting them as an U.R.S.I. standard, as has been done for bottomside ionosphere nomenclature.

Comments on the recommendation of the Canadian National Committee should be sent to :

Mr. J. A. Ratcliffe, Chairman of Commission III, Radio and Space Research Station, Ditton Park, Slough, Bucks, United Kingdom,

or to the

Secretary General of U.R.S.I., 7, place Emile Danco, Brussels 18, Belgium.

BIBLIOGRAPHIE

Nous attirons l'attention des lecteurs sur un article paru dans le *Bulletin de Géophysique* de l'Observatoire de Géophysique de Montréal (nº 17, mai 1965) et intitulé : « Ionospheric Cavity Resonances », par H. R. Radoski.

Sommaire. — Grâce à une décomposition des champs solénoïdaux qui interviennent dans la théorie de la dynamo, les équations vec-

torielles des ondes électro-magnétiques sont transformées en équations scalaires pour les modes poloïdaux et toroïdaux. Pour les parois parfaitement conductrices d'une cavité, les conditions aux limites sont particulièrement simples. Une seule approximation basée sur le fait que l'épaisseur de la cavité est petite comparée au rayon de la terre est introduite dans le but de simplifier la dérivation des deux modes de basse et de haute fréquences. On trouve que les modes magnétiques toroïdaux possèdent des solutions à la fois de haute fréquence (dans la région des sifflements) et de basse fréquence (résonance de Schumann) ; tandis que, pour les modes magnétiques poloïdaux, seules les solutions de haute fréquence sont possibles.

BIBLIOGRAPHY

We call the reader attention to a paper published in *Bulletin de Géophysique*, Observatoire de Géophysique, Montréal : « Ionospheric Cavity Resonances », by H. R. Radoski.

Abstract. — Employing a decomposition of solenoidal fields useful in dynamo theory, the electromagnetic vector wave equations are transformed into scalar wave equations for the poloidal and toroidal modes. For perfectly conducting cavity walls the boundary conditions are particularly simple. A single approximation based on the fact that the cavity tickness is small compared to the radius of the earth is made to simplify the derivation of both the low and high frequency modes. It is found that the magnetic toroidal modes have both high frequency (in the whistler range) and low frequency (Schumann resonance) solutions ; while for magnetic poloidal modes only high frequency solutions are possible.

LA PROPAGATION DES ONDES RADIOÉLECTRIQUES

Sous ce titre le *Journal des Télécommunications* (Vol. 32, n° 6, 15 juin 1965), publie un article de P. J. Brice du General Post Office du Royaume Uni.

Cette étude résulte de la fusion de deux conférences données par l'auteur à l'occasion des cycles d'études sur la gestion des fréquences organisés par le Comité international d'enregistrement des fré-

quences (I.F.R.B.) en février 1963 et en mai 1964. Elle attire essentiellement l'attention sur les données relatives à la propagation utilisables pour résoudre les problèmes de gestion et d'utilisation des fréquences, et donne des renseignements facilitant l'évaluation de la qualité des circuits radioélectriques.

RADIO-WAVE PROPAGATION

Under that title the *Telecommunication Journal* (Vol. 32, nº 6, June 15, 1965) has published a paper by P. J. Brice, General Post Office, U. K.

This paper is an integrated version of two lectures given by the author at the I.F.R.B. Seminars on Frequency Management held in Geneva in February 1963 and May 1964. In it attention is focussed upon the propagation data available for dealing with problems in frequency planning and utilization although some information also is given which will assist in estimating the performance of radio circuits.

INDICES D'ACTIVITÉ SOLAIRE POUR LA PROPAGATION IONOSPHÉRIQUE

(Extrait du *Journal des Télécommunications*)

Les tableaux ci-après, contenant les valeurs des indices fondamentaux de la propagation ionosphérique, ont été établis par le secrétariat spécialisé du Comité consultatif international des radiocommunications (C.C.I.R.), conformément à la Résolution 4, l'Avis 371 et le Rapport 246 du C.C.I.R.

Remarque : De nombreux détails sur les indices ionosphériques sont contenus dans une publication récente : *Advances in radio research*, volume 2, éditée par J. A. Saxton (Academic Press, Londres et New York, 1964). Il s'agit de la contribution de C. M. Minnis, intitulée *Ionospheric indices*, pages 1-36, de l'ouvrage en question.

VALEURS OBSERVÉES :

● R_{12} (moyenne glissante sur douze mois du nombre de taches solaires).

Année \ Mois	1	2	3	4	5	6	7	8	9	10	11	12
1963	29	30	30	29	29	28	28	27	27	26	23	21
1964	19	18	15	13	11	10	10	10	10	10	9	

● I_{F_2} (indice ionosphérique) :

Mois (année 1964)

1	2	3	4	5	6	7	8	9	10	11	12
0(2)*	6(2)*	20(2)*	14(2)*	1(2)*	—3(1)*	1(1)*	—3(1)*	4(1)*	3(1)*	—3(1)*	—4(1)*

Mois (année 1965)

1	2	3
7(1)*	5(1)*	20(1)*

(*) Les chiffres entre parenthèses indiquent le nombre de valeurs de foF_2 qui ne sont pas encore parvenues au secrétariat du C.C.I.R. et dont on n'a donc pas tenu compte dans le calcul de l'indice I_{F_2}. Pour plus de détails, voir *Journal des télécommunications* (avril 1964, page 119).

Par rapport aux données contenues dans le Rapport 246 du C.C.I.R., une station de sondages ionosphériques a cessé de fonctionner — celle de Porto Rico (en juin 1963). Les valeurs de I_{F_2} contenant entre parenthèses le chiffre (1) sont donc depuis le mois de juin 1963 les valeurs définitives de l'indice I_{F_2}. En outre, la station de Fairbanks n'a pas fonctionné pendant la période août-octobre 1963. Pour cette période les valeurs définitives de l'indice I_{F_2}, sont celles contenant le chiffre (2) entre parenthèses.

● Φ (flux du bruit solaire moyen mensuel) ** :

	1	2	3	4	5	6	7	8	9	10	11	12
1964	74	76	75	73	69	69	67	69	70	73	73	78
1965	78	75	74									

(**) Renseignements obligeamment fournis par le « National Research Council », Ottawa.

PRÉVISIONS POUR LES MOIS A VENIR (1er mai 1965) *** :

● R_{12}

Année \ Mois	5	6	7	8	9	10
1965	14	15	16	17	18	20

(***) Renseignements obligeamment fournis par le professeur Waldmeier, Observatoire fédéral de Zurich.

Estimation de l'erreur sur les prévisions de R_{12} : ± 10.

● I_{F2} ****

Année \ Mois	3	4	5	6	7	8	9
1965	4	5	7	9	11	13	(16)

(****) Renseignements obligeamment fournis par le « Department of Scientific and Industrial Research, Radio Research Station », » Slough.

La valeur prévue six mois à l'avance est donnée entre parenthèses.

Estimation de l'erreur sur les prévisions de I_{F2} :

Mois (1965)	3	4	5
maximum	+5,5	+3,5	+3,5
minimum	—8	—11	—11,5

Mois (1965)	6	7	8	9
maximum	+3	+3	+4.5	+2
minimum	—12.5	—12.5	—12.5	—13

SOLAR INDICES FOR IONOSPHERIC PROPAGATION

(Abstract from *Telecommunication Journal*)

The following tables, giving values of the basic indices for ionospheric propagation have been prepared by the Specialized Secretariat of the International Radio Consultative Committee (C.C.I.R.) in accordance with C.C.I.R. Resolution 4, Recommendation 371, and Report 246.

Note : A considerable amount of information on ionospheric indices will be found in an article by C. M. Minnis, entitled *Ionospheric indices* on pages I-36 of the recent publication *Advances in radio research*, volume 2, edited by J. A. Saxton (Academic Press, London and New York, 1964).

PARAMETERS :

● R_{12} (smoothed mean, over twelve months, of the number of sunspots observed) :

Year \ Month	1	2	3	4	5	6	7	8	9	10	11	12
1963	29	30	30	29	29	28	28	27	27	26	23	21
1964	19	18	15	23	11	10	10	10	10	9		

● I_{F_2} (ionospheric index) :

Month (year 1964).

1	2	3	4	5	6	7	8	9	10	11	12
0(2)*	6(2)*	20(2)*	14(2)*	1(2)*	—3(1)*	1(1)*	—3(1)*	4(1)*	3(1)*	3(1)*	—4(1)*

Month (year 1965).

1	2	3
7(1)*	5(1)*	20(1)*

(*) The figures in brackets represent the number of values of foF_2 which have not yet reached the C.C.I.R. Secretariat, and which have not therefore been taken into account in the calculation of I_{F_2}. For further details, see the *Telecommunication Journal*, April 1964, page 119.

With regard to the data contained in C.C.I.R. Report 246, one ionospheric sounding station has ceased to operate — Puerto Rico (in June 1963). The values of I_{F_2}, that include the figure (1) in brackets are therefore, as from the month of June 1963, definitive values for I_{F_2}. Furthermore the sounding station Fairbanks did not operate during the period August-October 1963. For this period the definitive values of I_{F_2} are those including the figure (2) in brackets.

● Φ (monthly mean value of solar noise flux) ** :

Month	1	2	3	4	5	6	7	8	9	10	11	12
Year												
1964	74	76	75	73	69	69	67	69	70	73	73	78
1965	78	75	74									

(**) Data kindly supplied by the National Research Council, Ottawa.

FORECASTS FOR THE NEXT FEW MONTHS (1 May, 1965) *** :

● R_{12}

Month	5	6	7	8	9	10
Year						
1965	14	15	16	17	18	20

(***) Data kindly supplied by Professor Waldmeier, Federal Observatory, Zurich.

Estimated error in forecasts of R_{12} : ± 10.

● I_{F_2} ****

Month	3	4	6	7	8	8	9
Year							
1965	4	5	7	9	11	13	(13)

(****) Data kindly supplied by the Department of Scientific and Industrial Research, Radio Research Station, Slough.
The figure in brackets is the value forecast six months in advance.

Estimate of the error in I_{F_2} predictions :

Month (1965	3	4	5
maximum	+5,5	+3,5	+3,5
minimum	—8	—11	—11,5

Month (1965)	6	7	8	9
maximum	+3	+3	+4.5	+2
minimum	—12.5	—12.5	—12.5	—13

Sous-Commission IVa.
Bruit Radioélectrique d'Origine Terrestre

ÉTUDE DE LA MAGNÉTOSPHÈRE

Nous signalons à l'attention des membres de la Commission IV et de la Sous-Commission IV*a* la publication par le Centre National de la Recherche Scientifique de France (C.N.R.S.) d'un ouvrage intitulé : « Etude de la magnétosphère au moyen des sifflements radioélectriques (1957-1963) » par Yvonne Corcuff.

Sommaire.

Cet ouvrage présente l'étude des sifflements radioélectriques enregistrés à Poitiers dans la bande de 1 à 10 kHz, pendant et depuis l'Année Géophysique Internationale.

Après un bref rappel de la loi générale de dispersion, le principe de la mesure du paramètre D_o, choisi pour caractériser un sifflement, est exposé. Sa valeur dépendant non seulement de la densité électronique du milieu traversé mais aussi de la longueur du chemin suivi par l'énergie, un chapitre est consacré aux sources et trajectoires réelles de propagation. Les résultats obtenus s'accordent avec l'hypothèse d'un confinement de l'énergie par des irrégularités d'ionisation réparties suivant certaines lignes de force du champ magnétique terrestre dont le paramètre de MacIlwain est de l'ordre de 2,2 à Poitiers.

Les variations diurnes, saisonnières et annuelles de l'occurrence moyenne des sifflements sont ensuite étudiées, ce qui permet de préciser quelques-unes des conditions les plus favorables à une propagation magnétosphérique d'ondes de basse fréquence.

Les variations de la dispersion au cours du maximum d'activité solaire sont traitées dans le dernier chapitre. La plupart d'entre elles peuvent être interprétées en fonction de la densité électronique N de l'ionosphère et de la magnétosphère dont les contributions sont calculées séparément en périodes magnétiquement calmes. Il est alors possible de montrer que, dans ces conditions, la variation relative de N dans la magnétosphère, entre 17 et 02 heures TML, est trois fois plus faible que dans l'ionosphère ; c'est là l'indice d'un faible couplage électronique de ces deux milieux. En outre, N présente des variations annuelles et surtout semi-annuelles qui se superposent et dont les minimums de juin sont en phase : elles

sont attribuées à une anisotropie du vent solaire le long de l'orbite terrestre. Enfin, les effets des orages magnétiques tant sur la dispersion des sifflements que sur les fréquences critiques de F2 à Poitiers et Cape Town, stations magnétiquement conjuguées, sont décrits et discutés. Ils peuvent s'interpréter par l'existence, dans la magnétosphère, de deux régions distinctes, l'une interne calme, l'autre externe perturbée, séparées par une zone de transition de fort gradient d'ionisation qui serait située à des altitudes d'autant plus basses que l'orage est plus intense.

Sub-Commission IVa
on Radio Noise of Terrestrial Origin

STUDY OF THE MAGNETOSPHERE

We call the attention of the members of Commission IV and Sub-Commission IV*a* to the work issued by the Centre National de la Recherche Scientifique de France (C.N.R.S.) : « Etude de la magnétosphère au moyen des sifflements radioélectriques (1957-1963) » by Yvonne Corcuff.

Summary.

Experimental whistler results, obtained at Poitiers in the 1-10 kHz band during and since the International Geophysical Year, are described and used to study the magnetosphere and its variations of ionization.

First of all, the dispersion law is recalled and the method to obtain D_o, specific of a given whistler, is emphasized. As D_o is a function of both the length of the path followed by the electromagnetic energy of the flash and the ionization density along it, a chapter is devoted to the sources of whistlers and to the effective paths of propagation. The results agree with the hypothesis of a guidance of the waves by irregularities of ionization distributed along certain lines of force of the earth's magnetic field ; the MacIlwain parameter of which being about 2,2 at Poitiers.

Diurnal, seasonal and annual variations of the mean occurrence of whistlers are then reviewed, leading to the specification of the most favourable conditions for a magnetospheric propagation of low frequency waves.

The variations of dispersion during maximum solar activity are dealt with in the last chapter. Most of them can be interpreted as a function of the electron density N of the ionosphere and of the magnetosphere, the respective contributions of which are calculated during magnetically quiet periods. In such conditions, the relative variation of N in the magnetosphere is found three times smaller than in the ionosphere between 17 and 02 LMT, indicating a weak electronic link between these two media.

Furthermore, N sustains annual and especially semi-annual variations which become superimposed and the June minima of which are in phase. These variations are related to a possible anisotropy of the solar wind along the earth's orbit. Finally, the effects of magnetic storms both on whistler dispersion and on F2 critical frequencies at Poitiers and Cape Town, which are magnetically conjugate stations, are described and discussed. A possible explanation suggested is the existence of two distinct regions in the magnetosphere : an inner quiet one and an outer disturbed one, separated by a transition zone of steep ionization gradient, the altitude of which is thought to be all the lower as the storm is more intense.

Commission VI on Radio Waves and Circuits

FOURTH SYMPOSIUM ON ELECTROMAGNETIC THEORY AND ANTENNAS

The papers submitted at the fourth Symposium on Electromagnetic Theory and Antennas, held in Copenhagen from June 25 through June 30 have been published by Pergamon Press in two volumes of the « International Series of Monographs on Electromagnetic Waves ».

The two volumes have been edited by E. C. Jordan.

Besides an Introduction by J. Rybner, a Welcoming Address by J. Loeb and a paper on the Scientific Works of L. V. Lorenz, by Mogens Phil, the following papers have been published.

PART I.

SECTION A : *Scattering and Diffraction Theory.*

A survey of short wavelength diffraction theory, J. B. KELLER.

On the Transverse Diffusion of Short Waves Diffracted by a Convex Cylinder, V. FOCK and L. WAINSTEIN.

Scalar Diffraction by a Thin, Oblate Spheroid, R. F. Goodrich, N. D. Kazarinoff and V. H. Weston.

Diffraction of a Scalar Wave by a Plane Circular Disc (summary), E. B. Hansen.

Diffraction of Radio Waves by Several Smooth Surfaces, K. Furutsu.

The Scattering of a Plane Electromagnetic Wave by a Finite Cone, C. C. Rogers, J. K. Schindler and F. V. Schultz.

Scattering by Nonspherical Particles Whose Size is of the Order of the Wavelength, J. Mayo Greenberg, L. Libelo, A. Lind and R. T. Wang.

Scattering and Diffraction of Transient Plane Electromagnetic Waves (summary), E. M. Kennaugh.

Plane Wave Diffraction by a Strip, Ralph E. Kleinman.

Scattering by a Wide Grating (summary), R. F. Millar.

A Boundary Wave Theory of Diffraction at an Aperture (summary), E. Wolf, E. Marchand and K. Miyamoto.

Diffraction Wave in Case of an Arbitrary Incident Field in the Electromagnetic Kirchoff Theory (summary), A. Rubinowicz.

An Asymptotic Expansion of Electric Vector Fields with Complex Phase Function (summary), S. Pogorselzki.

Forward and Backward Scattering from a Penetrable Sphere at Short Wavelengths (summary), S. I. Rubinow.

Application of Boundary Layer Techniques to the Calculation of Shadow Region Diffraction Fields (summary), W. P. Brown, Jr.

The Radar Cross-Section of a Conducting Cylinder with Dielectric Sleeve at the Optical Limit, R. D. Kodis.

Scattering from a Cylinder Coated with a Dielectric Material, C. W. Helstrom.

Scattering by a Finite Cylinder, R. B. Kieburtz.

The Diffraction Fields of a Non-Uniform Circular Aperture, S. Cornbleet.

Diffraction on a Broad Aperture in Broad Waveguide, B. Z. Katsenelenbaum.

Some Recent Developments in Scattering and Diffraction Theory (summary) A. E. Heins.

Reflection at the Junction of an Inhomogeneously Loaded Waveguide — A Quasi-Static Approach, L. Lewin.

Systematic Improvement of Quasistatic Calculations (summary), S. N. Karp.

Reflection at Incidence of an H_{mn} — Wave at Junction of Circular Waveguide and Conical Horn, G. Piefke.

Scattering Diagrams in Electromagnetic Theory, G. A. Deschamps.

Generalized Variational Principles for Electromagnetic Vibrations; Application to the Theory of Waveguide Junctions, D. M. Kerns.

The Sommerfeld-Runge Law and Geometric Optics in Four Dimensions (summary), H. POEVERLEIN.

Angular Momentum of Electrodynamic Radiation (summary), G. TORALDO DI FRANCIA.

Predicted Lunar Temperature Variations during Future Eclipses (summary), K. M. SIEGEL.

A Representation of Electrodynamic Fields in Curvilinear Coordinates, N. A. KUZMIN.

SECTION B : *Anisotropic and Stratified Media.*

Wave Propagation in Anisotropic Plasmas (summary), W. P. ALLIS.

The Relation between Hydromagnetic Waves and the Magneto-Ionic Theory, C. O. HINES.

Notes on Waves in Plasma (summary), B. AGDUR.

Discontinuous Flow of Plasma (summary), K. BOCHENEK.

Unstable Transverse Modes of Drifting charged Particles in a Plasma in a Magnetic Field, F. SHIMABUKURO.

Propagation des ondes dans un guide rempli de plasma en présence d'un champ magnétique, M. CAMUS et J. LE MEZEC.

Self-Interaction of Longitudinal Plasma Oscillations with Generation of Electromagnetic Radiation. Application of the Narrow-Band Radio Burst of the Sun (summary), R. LARENZ.

Wave Propagation in Anisotropic Media (summary), P. MATTILA.

Vector Integral Equations for the Electric Field in an Inhomogeneous Magneto-Ionic Medium (summary), W. C. HOFFMAN.

Harmonic Excitation in and Reradiation from Non-Uniform Ionized Regions, L. WETZEL.

Impedances and Reflection Coefficients for Anisotropic Media, I.KAY.

Theory of Radiation from Sources in Anisotropic Media :

Part I : General Sources in Stratified Media ;
Part II : Point Source in Infinite, Homogeneous Medium, E. ARBELL and L. B. FELSEN.

On the Theory of Radiation from a Source in a Magneto-Ionic Medium, P. C. CLEMMOW.

Electromagnetic Radiation from Sources Embedded in an Infinite Anisotropic Medium and the Significance of the Poynting Vector, H. MOTZ and H. KOGELNIK.

Field Solution for a Dipole in an Anisotropic Medium, R. MITTRA and G. A. DESCHAMPS.

The Impedance of an Aerial Immersed in an Anisotropic Medium, K. G. BUDDEN.

Lateral Waves on Air Magnetoplasma Interfaces, G. TYRAS, A. ISHIMARU and H. M. SWARM.

Antenna Characteristics in the Presence of a Plasma Sheath, G. G. CLOUTIER and M. P. BACHYNSKI.

Coupling of Electromagnetic and Magnetostatic Waves in Ferrite Waveguides, B. A. AULD.

Gyromagnetic Resonances of Thick Ferrite Slabs Excited in a Transverse Electric Mode (summary), H. SEIDEL.

On the Possibility of Intrinsic Loss Occurring at the Edges of Ferrites (summary), R. A. HURD.

A Modal Solution for a Rectangular Guide Loaded with Longitudinally Magnetized Ferrite, G. BARZILAI and G. GEROSA.

Unidirectional Waves in Anisotropic Media, A. ISHIMARU.

Backward Waves in Longitudinally Magnetized Ferrite filled Guides, G. H. B. THOMPSON.

On the Penetration of a Static Homogeneous Field in an Anisotropic Medium into an Ellipsoidal Inclusion consisting of another Anisotropic Medium (summary), V. FRANK.

A Note on the Oblique Incidence of Electromagnetic Waves upon an Absorbing Slab, K. MORITA.

Propagation of Electromagnetic Waves in an Anisotropic Stratified Medium (summary), R. W. HOUGARDY and D. S. SAXON.

Diffraction at High Frequencies in a Stratified Medium (summary), D. S. JONES.

Nonuniform Transmission Lines or Stratified Layers, G. LATMIRAL, R. VINCIGUERRA and G. FRANCESCHETTI.

Effects of Mutual Coupling in a System of Magnetized Ferrite Samples, A. L. MICAELJAN and V. I. ANTONJANZ.

PART II.

SECTION C : *Random Media and Partial Coherence.*

Delination of Problems and Methodology in the Subject of Scattering by a Statistically Inhomogeneous Medium (summary), S. SILVER.

Scattering by a Perturbed Continuum, H. BREMMER.

Scattering by Random Media, V. TWERSKY.

The Depolarization of Electromagnetic Waves Scattered from Rough Surfaces, P. BECKMANN.

Propagation guidée le long d'un feuillet atmosphérique ou (plus particulièrement) exosphérique (summary), J. VOGE.

On the Propagation of Electromagnetic Waves at Optical Frequencies in the Troposphere, D. S. BUGNOLO.

Correlation Matrix for Radio Waves in the Troposphere (summary), E. C. BARROWS.

The Description of a Random Propagation Circuit by the Coherence between Adjacent Frequencies, T. HAGFORS.

Réflexion spéculaire et réflexion diffuse en milieu feuilleté(summary), F. DU CASTEL.

Etudes des réflexions par la mer au moyen d'un gonicmètre, L. BOITHIAS, A. SPIZZICHINO et C. TAIEB.

Microwave Properties of the Atmosphere and Cloud Layer of Venus (summary), C. SAGAN.

Introduction to Partially Coherent Electromagnetic Fields, F. J. ZUCKER.

Some Fundamental Questions of Coherence Theory (summary), G. B. PARRENT, Jr.

Partially Coherent Diffraction by a Circular Aperture, R. A. SHORE.

Polarization Properties of the Electromagnetic Field Diffracted from an Aperture (summary), B. KARCZEWSKI and E. WOLF.

Phase Determination of Coherence Functions by the Intensity Interferometer, H. GAMO.

The Determination of Spectral Distributions from Measurements of Radiation Fluctuations, L. MANDEL.

Diffraction of Fluctuating Fields, N. G. DENISOV and L. S. DOLIN.

SECTION D : *Surface Waves, Leaky Waves and Mode Propagation.*

Leaky Waves in Electromagnetic Phenomena, A. A. OLINER.

Solution of the Exact Excitation Problem on Tubular Waveguides, A. E. Karbowiak.

Modulated Surface Wave Antennas, O. BILLSTRÖM.

Wood's Anomalies and Leaky Waves (summary), A. HESSEL and A. A. OLINER.

A Surface Wave Antenna as a Boundary Value Problem (summary), J. KANE,

The Radiation Emitted by a Charged Particle in Uniform Straight Motion through a Particular Stratified Medium (summary), R. PRATESI, L. RONCHI, A. M. SCHEGGI and G. TORALDO DI FRANCIA.

Optical Dielectric Waveguides (summary), E. SNITZER.

Optical Relations for Coherent Wave Beams, G. GOUBAU.

Waveguides with Anisotropic Impedance Walls, H. G. UNGER.

Hybrid Modes of a Circular Cylindrical Cavity Containing a Coaxial Sheet with Anisotropic Properties, J. FALNES.

Mode Classification for Various Waveguiding Structures of Elliptical Cross-Section (summary), J. C. WILTSE and M. J. KING.

Backward-Wave Propagation in Non-Periodic Waveguide Structures, P. J. B. CLARRICOATS and D. E. CHAMBERS.

Propagation of Electromagnetic Waves Along Unidirectionally Conducting Screens, F. C. KARAL, Jr. and S. N. KARP.

A Soluble Problem in Duct Propagation, E. T. KORNHAUSER and G. S. HELLER.

The Poynting's Vector and the Velocity of the Energy Propagation (summary), V. KOZELJ.

On the Definition of Some Electromagnetic Quantities (summary), G. B. Rego.

SECTION E : *Antenna Theory and Radiating Elements.*

On the Theory of Frequency Independent Antennas, V. H. RUMSEY.

Log-Periodic Antennas and Circuits, R. H. DUHAMEL.

Fresnel Region Power Transfer (summary), E. JACOBS.

Reactive Energy in Aperture Fields and Aperture Q (summary), R. E. COLLIN and S. ROTSCHILD.

The Theory of an Antenna Over an Inhomogeneous Ground Plane, J. R. WAIT.

The Radiation Field from a Vertical Dipole on an Inhomogeneous Ground, J. B. ANDERSEN.

A Survey on the Use of Conformal Mapping for Solving Wave-Field Problems, H. H. MEINKE.

On the Unity Gain Antenna (summary), W. K. SAUNDERS.

Exact Solution of the Antenna Equation (summary), E. HALLEN.

Interpretation of Antenna Impedance (summary), R. H. DUNCAN.

A Class of a New Type of Broad-Band Antennas, E. SPITZ.

Les Radiateurs Electromagnétiques Sphérique et Sphéroïdal (summary), L. ROBIN et P. POINCELOT.

Application of Selective Mode Coupling in the Solution to Biconical Antennas, M. A. PLONUS.

A Low Noise Feed System for Large Parabolic Reflector Antennas (summary), H. JASIK and A. D. BRESLER.

Radiation and Reception with Buried and Submerged Antennas (summary), R. C. HANSEN.

The Insulated Dipole Antenna Immersed in a Conducting Medium (summary), K. IIZUKA.

An Analysis of a Natural VLF Slot Antenna, H. STARAS.

A One-Eight-Wave Broadband Folded Unipole Antenna (summary), T. KITSUREGAWA, Y. TAKEICHI and M. MIZUSAWA.

A Plasma Antenna and Wave Filter, I. KAUFMAN and W. H. STEIER.

SECTION F : *Antenna Arrays and Data Processing.*

A Variational Method of Synthesizing Antenna Power Patterns (summary), E. K. PROCTOR and C. M. ABLOW.

On Large Non-Uniformly Spaced Arrays (summary), J. L. YEN and J. L. CHOW.

The Selection and Evaluation of Antennas for the Survey of Incoherent Source Distributions, A. C. SCHELL.

Spatial Frequency Characteristics of Finite Aperture Antennas, A. KSIENSKI.

Pattern Limitations in Multiple Beam Antennas (summary), W. D. WHITE.

Multiplicative Receiving Arrays, V. G. WELSBY.

Transfer Functions and the Resolving Power of Radio Telescopes (summary), R. M. CHISHOLM.

Angular Location, Monopulse and Resolution (summary), W. HAUSZ.

Current Development in an Electronically Scanned Antenna, H. V. COTTONY.

Active Electronic Antennas (summary), R. N. GHOSE.

Near-Field Characteristics of a Linear Array (summary), L. J. RICARDI.

Linear Arrays : Currents, Impedances and Fields, II, R. KING and S. S. SANDLER.

Comité des Recherches Radioélectriques dans l'Espace

BIBLIOGRAPHIE

Nous attirons l'attention des membres de ce comité sur un article publié dans le *Journal des Télécommunications*, Vol. 32, n° 5, 15 mai 1965 et intitulé : « L'avenir des télécommunications par satellites », par L. Jaffe.

Space Radio Research Committee

BIBLIOGRAPHY

Attention of the members of the Committee is called to a paper published in *Telecommunication Journal*, Vol. 32, n° 5, 15 May 1965 : « Satellite communications in the future », by L. Jaffe.

U.R.S.I.-C.I.G. Committee

BRIEF REPORT ON 5th MEETING HELD AT MADRID ON 28 MARCH 1965

Present :

Professor W. J. G. Beynon (*Chairman*),
Dr. W. Dieminger,
Mr. W. R. Piggott,
Dr. K. Rawer
Professor A. J. Lyon attended as an observer.

1. — I.Q.S.Y. Manuals.

Dr. Dieminger reported that Dr. Schwentek of his laboratory will produce a short supplementary manual on calibration of the A. 3 method of measuring ionospheric absorption. It was proposed to insert this as a supplement in the existing ionospheric manual and the Chairman stated that he would arrange for this to be done.

Dr. Rawer stated that the calibration of the A.2 method was also open to criticism and that there was evidence for attenuation being produced by non-ionospheric causes.

Members commented on the fact that in *I.Q.S.Y. Notes* there are many matters of interest to workers in the ionospheric field and that the attention of National Committees should be drawn to this fact.

2. — I.Q.S.Y. Station List.

Drs. Dieminger and Rawer agreed to prepare an I.Q.S.Y. Station List at the end of the I.Q.S.Y. This List would include data on ionosondes and information on the ionospheric measurements which had been made during the I.Q.S.Y. It was agreed that scales should be sent with ionograms to the World Data Centres.

3. — I.G.Y. Annals.

There was some discussion on the delay in publishing the I.G.Y. drift and absorption data. Dr. Rawer reported that the drift data had now been printed but that the volume concerned had not

been published because of the possibility of including some absorption data. Mr. Piggott reported that he had about 70 tables of absorption data (daily values at noon for 2.2 Mc/s and monthly medians of about 21 stations) and that these were in a form suitable for rapid publication. It was agreed that Mr. Piggott should despatch these immediately to the Chairman, who then undertook to see whether they could be included in the volume on drift data.

4. — Atlas of Ionograms.

The members re-affirmed their views on the need for a revised atlas of ionograms and it was resolved to urge Mr. J. W. Wright to get this published before the end of the I.Q.S.Y. if at all possible.

5. — N(h) Monograph.

It was resolved that the revised Report of the London N(h) Meeting prepared by Mr. J. W. Wright should be reprinted in the *U.R.S.I. Information Bulletin* and should include a reference to the fact that the monograph itself will appear in the C.R.P.L. « Radio Science » series. It was also agreed that a note should be included in *I.Q.S.Y. Notes* concerning the London N(h) Meeting and the C.R.P.L. monograph.

There was discussion on the Titheridge N(h) method and it was agreed that further tests were desirable in which a given realistic N(h) profile is converted to an ionogram and back again. It was agreed that no manual N(h) method should be published as a Supplementary *I.Q.S.Y. Manual.* Dr. Dieminger undertook to inform Dr. Titheridge.

6. — Ionosonde Sub-Committee.

Dr. Rawer reported that there had been no meeting of this Sub-Committee since the last meeting of the U.R.S.I./C.I.G. Committee. He commented on the existing situation in relation to ionosondes. Stoffregen's was probably the last of the old style ionosondes and Munro's the first of the new style with no moving parts. Solid state devices were now being used more extensively and although the limitation at present was one of power, it could be expected that there would be rapid developments in the near future. Digitising of the output of ionosondes is underway and there is considerable interest in this problem in various countries. Data reduc-

tion is a topic also under consideration and Mr. Piggott, as vertical incidence reporter, agreed to compile a list of the groups interested and to initiate discussion by correspondence between them. After discussion it was agreed to dissolve the Sub-Committee on Ionosondes. Dr. Rawer agreed to complete his earlier task of publishing in the *U.R.S.I. Bulletin* details of I.Q.S.Y. ionosondes. It was expected that this would be done between June 1965 and June 1966.

7. — Other Matters.

The Committee agreed to defer consideration of the reports of discipline consultants (vertical soundings, drifts, etc.) and the question of post-I.Q.S.Y. ionospheric activity to the I.Q.S.Y. Ionosphere Working Group Meeting to be held during the current Assembly in Madrid. The report of this meeting, prepared by Dr. Dieminger, follows.

W. J. G. Beynon.

Revised Report of Working Group for Ionosphere

IIIrd I.Q.S.Y. Assembly : *Madrid* 1965

The Working Group for Ionosphere considered reports from the sub-committees on ionosondes and on the determination of electron-density profiles, and from the working group on identification letters for ionosphere stations. It also reviewed the reports and recommendations of the Working Group for Ionosphere at the IInd I.Q.S.Y. Assembly and the progress on the acquisition of ionospheric data during the I.Q.S.Y. Other matters discussed in detail were I.Q.S.Y. publications, the future of international cooperation in ionosphere, and future international interchange of ionospheric data.

The following problems were delegated to the Reporter for Ionosphere and his Consultants, or their successors :

(*a*) preparation of proposals for changes in the Guide to International Data Interchange ;

(*b*) the possibility of the central analysis of D1 drift data by computers ;

(*c*) to examine whether the processing of data on punched cards could be made easier for individual research workers by inviting the cooperation of organizations already using such methods ;

(*d*) the development of N(*h*) analysis using data obtained from sources other than ionograms and, when necessary, the organization of the production of catalogues of such data.

The following resolutions were adopted :

1. — *Post-I.Q.S.Y. Organization of International Cooperation for Ionosphere.*

The Working Group

(*a*) *recommends* the maintenance of international geophysical cooperation, particularly in connection with synoptic observations of the ionosphere ;

(*b*) *believes* that the future development of international research in the upper atmosphere sciences will eventually require a small organization to provide a permanent service. This organization should be within the framework of I.C.S.U. and its arrangements for international cooperation in other geophysical disciplines ;

(*c*) *recommends* setting up a small permanent Ionospheric Bureau with one full-time officer advised and assisted as necessary by recognized experts. The collection of data should remain the responsibility of the W.D.Cs, assisted and advised by the Ionospheric Bureau.

2. — *World Data Centres.*

The Working Group *recommends*

(*a*) that the W.D.Cs A, B and C for Ionosphere should be maintained with the current rules of operation until at least the end of 1967.

(*b*) that their future should be reconsidered at the IVth I.Q.S.Y. Assembly in 1967 in the light of possible developments of data handling and exchange.

3. — *Special World Geophysical Centre for Whistler Studies.*

The Working Group feels that a Specia World Geophysical Centre for Whistler studies is desirable and *recommends* that the possibility of setting up such a Centre under Dr. M. G. Morgan (U. S. A.) be investigated.

4. — *Sub-Committee on Data Processing.*

The Working Group *recommends* that U.R.S.I. be invited to consider setting up a sub-committee of the U.R.S.I.-C.I.G. Committee to deal with data processing under the interim chairmanship of Professor K. Rawer for the following purposes,

(*a*) to expedite collaboration and discussion between workers in different organizations on problems of automatic methods of obtaining and processing the data obtained by pulse methods ;

(*b*) to encourage the development of such methods for the handling of ionospheric data.

5. — *International Geophysical Calendar for* 1966.

The Working Group adopted the I.U.W.D.S. International Calendar for 1966 with certain alterations which have been passed to I.U.W.D.S. for consideration.

6. — *Retrospective World Intervals.*

The Working Group *notes* that, in practice, the effective application of the procedure for the selection of Retrospective World Intervals, as specified in *I.Q.S.Y. Instruction Manual*, No. 1, pp. 16-17, has proved too difficult, *recommends* that in future the initiative for action and the final decision on the selection of R.W.Is. should rest with the Reporter for World Days, and that the experts and groups mentioned in Manual No. 1 should serve as principal advisors to the Reporter, *requests* the Reporter to seek advice, especially from Dr. S. Pushkov, Michard and Piggott, and to meet one or more of them personally, if convenient.

7. — *Station Names and Identification Symbole.*

The Working Group *recommends* :

7.1 The adoption of the list of station names and two-letter symbols published in *I.Q.S.Y.Notes*, No. 11, pp. 34-41 for the

identification of station data used in computer systems of data handling and for other purposes.

7.2. That the Consultant for Vertical Soundings be notified of the establishment of new VI stations and be responsible for issuing two-letter identifications for such stations.

7.3. That the Consultant for Vertical Soundings be authorized to issue a similar list for absorption and drift stations where these differ from VI stations using, where necessary, a letter and figure combination.

7.4. That the I.Q.S.Y. Secretariat, in collaboration with the Consultants for vertical incidence, absorption and drift measurements, be responsible for the preparation of I.Q.S.Y. station lists and for the verification of these lists with the sponsoring organizations.

8. — *Catalogue of Topside* N(*h*) *Profiles.*

The Working Group *noles* that topside ionograms are being reduced at a number of laboratories to give electron density as a function of height (N(*h*) profiles) and *recommends* :

(*a*) that a catalogue of all N(*h*) profiles be maintained at the W.D.Cs. :

(*b*) that all laboratories making such analyses be asked to send catalogues of their analyses at six-monthly intervals to the W.D.C. with which they normally maintain contact, together with an indication, with references, if necessary, of the method of analysis used.

9. — *Catalogue of Digitalised Data.*

The Working Group *recommends* that the W.D.Cs. prepare, and keep up to date, a catalogue showing data which are available in digital form (on punched cards, punched tape or magnetic tape) together with the names and addresses of organizations holding these data.

10. — *Frequency Scales for Ionograms.*

The Working Group *recommends* that stations which have sent or are sending ionograms to W.D.Cs. be requested to send also

copies of the frequency scales in use ; the scales should preferably bear dates showing the period during which they were used. Key fiduciary marks should be indicated clearly so that correct interpolations may be made when the ionograms do not match the scales accurately.

11. — *Supplementary Ionospheric Manual.*

The Working Group *recommends* that no action be taken to publish the Titheridge method of manual N(h) analysis as an *I.Q.S.Y. Instruction Manual.*

12. — *Publication of* Annals of the I.Q.S.Y.

The Working Group *recommends* that the data to be published, if any, in *Annals of the I.Q.S.Y.* should be similar to those published in *Annals of the I.G.Y.*, and that every effort be made to minimize cost of the volumes.

13. — *Absorption Measurements.*

The Working Group.

1. after reviewing the present status of ionospheric absorption measurements, notes with concern the almost complete absence of A1 (pulse amplitude) stations in North and South America and *recommends* the use of the A1 method at all primary ionosphere stations ;

2. considers that the determination of ionospheric absorption by means of measurements of the field strength of continuous wave transmitters (A3 method), when carried out at suitable frequencies and over appropriate distances, is an economical method particularly for synoptic observations and *recommends*

(a) the widespread use of the A3 method, particularly at secondary stations ;

(b) the establishment and publication of a simple method of calibration ;

3. *notes* that the cosmic noise (A2 riometer) method requires further investigation to be carried out on the calibration and interpretation of the observations and recommends that, pending

the publication of the conclusions of these investigations, the A2 method should not be regarded as a substitute for the A1 and A3 methods for the measurement of ionospheric absorption.

21 April 1965.

REPORT OF THE SUBCOMMITTEE ON N(h) PROFILES

by J. W. WRIGHT

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BACKGROUND

During its final meeting in Nice, December 1960, the U.R.S.I. Special Committee on World-Wide Ionospheric Soundings recommended the formation of a « Subcommittee on N(h) Profiles ». This was implemented, and following the dissolution of the parent body, the subcommittee has continued under the Committee on International Geophysics.

The N(h) subcommittee exists to bring together workers actively engaged in N(h) analysis of sweep frequency ionospheric radio vertical soundings, recognizing that although this work is of considerable importance to modern geophysics, it is still beset with difficulties and subtile sources of error. Since N(h) analysis represents a highly specialized aspect of the otherwise widely known vertical soundings technique, it is important that specialists in this field resolve their disagreements, identify outstanding problems, and keep their other colleagues aware of what can and cannot be expected of current N(h) data.

With these objectives in mind, the N(h) subcommittee began planning for a meeting early in 1964, at the suggestion of the C.I.G. chairman. This preparation included a world-wide survey of I.Q.S.Y. N(h) plans (here reported in an appendix), and the solicitation of papers for a Monograph on N(h). In preparation for the meeting, the members conducted tests of their available methods using ionograms and model virtual height data prepared for the subcommittee by Dr. W. Becker.

Representation

The subcommittee membership includes workers actively engaged in N(h) analyses and particularly those developing and testing methods for N(h) analysis. The current membership list is as follows :

Dr. W. Becker, Institut für Ionosphären-Physik, Lindau.
Dr. H. Hojo, Radio Research Laboratories, Tokyo.
Dr. A. K. Paul, Nationai Bureau of Standards, Boulder.
Mr. W. R. Piggott, Radio Research Station, Slough.
Dr. E. R. Schmerling, Pennsylvania State University.
Dr. C. Taieb, Group de Recherches Ionosphériques, Paris.
Dr. J. O. Thomas, Cavendish Laboratory, Cambridge.
Dr. J. E. Titheridge, University of Auckland, New Zealand.
Mr. J. W. Wright, *Chairman*, National Bureau of Standards, Boulder.
Dr. G. M. Brown (Info), University College of Wales, Aberystwyth.

Those attending the London meeting were :

Prof. W. J. G. Beynon (*Chairman*, C.I.G. Committee).
Mr. G. M. Brown (*Secretary*, C. I. G. Committee).
Mr. J. W. Wright (*Chairman*, Subcommittee on N(h) Profiles.
Dr. W. Becker.
Dr. H. H. Howe (N.B.S.).
Dr. A. K. Paul.
Dr. J. O. Thomas.
Mr. D. Eccles (D.S.I.R.).
Dr. C. Taieb.
Dr. J. E. Titheridge.

Organization and Agenda of Meeting

The subcommittee gratefully accepted the invitation of the I.Q.S.Y. Secretary, Mr. C. M. Minnis, to hold the meeting at the

offices of the I.Q.S.Y. Secretariat. As finally accomplished, teh agenda was as follows :

Thursday afternoon, 21 *May* 1964 : Review of a vailable N(h) Methods.

Introduction — Budden's Method ...	H. H. Howe
Direct use of Phase Index (H. Hojo) .	J. W. Wright
The 2nd Order Method (A. K. Paul) .	H. H. Howe
Use of Virtual Height Slopes	A. K. Paul
The Polynomial Method	J. E. Titheridge
Graphical and Correction Methods ...	W. Becker
Profile Parameters from M(3000), etc.	C. Taieb.

Friday morning, 22 *May* 1964 :

Discussion and Review of N(h) tests using Dr. Becker's models and Maui Ionograms ; comparison of Lindau, Tokyo, New Zealand, U. S. A. (N.B.S. and Penn State), and French calculations.

Friday afternoon, 22 *May* 1964 :

Continued discussion. Review of I.Q.S.Y. N(h) plans. Formulation of recommendations and Subcommittee report.

Results of the Meeting

By bringing together for the first time in recent years the individuals developing N(h) analyses as a research tool, the subcommittee meeting was of considerable benefit to its members. The meeting stimulated discussion and thought concerning principle problems and difficulties which are otherwise not sufficiently appreciated. An important result should be renewed attention to the « valley » and « starting » problems. Furthermore, some progress was made to classify methods of analysis on the basis of the types of error they may permit, so that a choice of method may now be based upon the intended application for the data.

The first agenda item was to review the essentials of the more important modern methods for convenient reference in the ensuing discussion. It is useful to do the same here, as an introduction to the aims of various methods and their typical sources of error.

Nature of the N(h) Problem :

The basic N(h) analysis problem has been attacked in many ways. Although it is impracticable to outline them all here, it is useful to state the basic integral equation as

$$h'(f) = \int_{0}^{h(\mathrm{N}(f))} \mu'(f,\ f_{\mathrm{N}},\ f_{\mathrm{H}},\ \theta,\ \nu)dh, \qquad (1)$$

where the symbols have their usual meanings. The functional relationships should be emphasized. From the standpoint of *observations*, the virtual height (h') is the dependent variable, and is a two-valued function (ordinary and extraordinary) of observing frequency, the independent variable f. The real height (h) of reflection (to be found) must be considered to be a function of electron density (N), which in the reflection point is also a function of f. The group refractive index (μ', also double-valued) ranges between 1 and ∞ at the two integral limits, respectively. Thus, great individual weight is given to heights near the reflection point A. It is easy to anticipate a difficulty if h is not a unique function of N — i. e., if the profile is « non-monotonic ». More generally, it is apparent that difficulties will arise if the frequencies used have not explored the *entire* function h(N). Thus at low-frequencies, the lower part of the h(N) function is likely to remain unexplored, either because of ray-theory failure, overpowering absorption, or equipment design.

The above remarks emphasize the *first mathematical difficulty* of N(h) analysis — that the experimental data are usually *incomplete*, either at the « start » (lower edge) of the analysis, or in valley regions. A *second mathematical difficulty* is evident from the complexity of the μ' function, which prohibits explicit inversion of the integral to obtain h(N).

The development of Budden's method (1954) may be considered the first practical solution of this latter problem, without which progress elsewhere in this subject could not have been achieved. It is significant that *most of the modern methods differ principally in their method of attack on this matter of inversion of the integral equation* ; the subcommittee is in agreement that *most of the methods accomplish this in a satisfactory way*. Although differences (some-

times important differences, discussed below) exist even for treatment of this problem, it is undeniable that all of the valid available methods *may* be used in such a way that, for all practical purposes, they give equivalently accurate results.

These points will be emphasized again, but it is now useful to illustrate the differences among methods.

Principle Features of Several Methods :

Some confusion has arisen around the ways in which methods have been classified, with such adjectives in use as « model », « integralequation », « lamination », « polynomial », « manual », « machine », etc. Although no simple classification will satisfy everyone, we note here that most methods may first of all be classified according to whether they seek to give the entire profile, or simply a few specific parameters of it. Although it is the former which principally concerned the sub-committee, it must be mentioned that new methods, and several older methods, have been devised to give layer peak parameters more or less directly from ionograms (Titheridge's new polynomial method ; Ratcliffe's comparison method ; Shinn's development to include magnetic field ; Becker's comparison method), or from published data of foF2, M(3000), etc. (C. Taieb's new method).

Complete Profile Methods :

Methods which seek to obtain the complete profile must deal in one way or another with the inversion of the integral equation (1). These methods may again be classified according to *the* N(h) *profile assumption made to permit inversion of* (1). Budden's method (1955), for example, assumes that $dh/df_N = \text{const.}$ over uniform intervals Δf_N. It is obvious from Budden's formulation that other assumptions $dh/d\varphi = \text{const.}$, where φ is any single-valued differentiable function of electron density, may also be made with equivalent ease, assuming that the work is to be done by an electronic computer. Thus a choice is offered at this point concerning the function $\varphi(N)$. Is there a physical basis for making this choice ? It may be argued, with justification, that if the intervals Δf_N (or $\Delta\varphi$) are made small enough, a good convergence to the integral will be obtained with any choice. On the other hand, each interval requires a virtual height datum, and labor may be saved, with equivalent accuracy, if the choice of φ locally

fits the profile. Clearly, with complicated profiles, no simple choice of φ can be best everywhere, although the unique importance of the region near the layer peak would argue for a function having positive curvature such as $\varphi(N) = N^2$. Another example is the choice $\varphi = \log f_N^2$ (King, 1960; Fitzenrieter and Blumle, 1964) which fits large parts of topside sounder profiles, and gives some other mathematical advantages. Probably the best compromise for general purposes is the choice $\varphi = f_N^2$, as this corresponds to $h(N)$ laminae of constant slope. Finally, with regard to Budden's method it may be noted that the restriction to uniform intervals Δf_N (implying uniform scaling intervals Δf) may be dropped, to permit selection of significant individual points on the ionograms. Then however, it is necessary to calculate special coefficients (integrals over μ') appropriate to these intervals. With a fast computer, it is entirely practical to obtain the coefficients as needed, so that complete freedom may be permitted in scaling. This is another choice which the individual worker must make, based upon his needs and facilities.

Budden's method may be termed a « first-order » method, corresponding to the assumption $dh/d\varphi = \text{const.}$ in laminae. The resulting $h(N)$ function is continuous, but its slope (or gradient) is discontinuous at each interval limit.

A. K. Paul, 1960; Paul and Wright, 1963; observed that in fact any order of continuity could be assumed for the profile; he suggested that a second order assumption is optimum for the analysis. A method developed along these lines is in use by the National Bureau of Standards. This formulation observes that the infinite value of μ' in the reflection point gives heavy weight to the slope $dh/d\varphi$ there, so that if the latter quantity varies along the interval, a first order method will give a value more appropriate to the *end* of the interval rather than to the middle (as usually assumed). With the assumption $d^2h/d\varphi^2 = \text{const.}$ in laminae, however, an independent value of $dh/d\varphi$ is obtained in the reflection point. This method does not depend so strongly on the choice of $\varphi(N)$ — for example, N.B.S. uses the choice $\varphi = \log f_N^2$ to permit uniform division of the logarithmic frequency scale of their ionograms. More important, the second order assumption gives a much closer « fit » to the true shape of the profile, whether the local curvature be positive, negative, or zero. This may be significant if virtual height calculations, or other ray tracings, are to be per-

formed on the profile. On the other hand, the method requires two sets of coefficients rather than one, and to be fully useful demands free choice in locating interval limits; this effectively restricts the method to larger computers where the coefficients can be calculated as needed.

The other significantly different approach to the general problem is thermed the polynomial solution. With the assumption of a polynomial representation for $h(N)$ — over the entire range of N, or any segment — Titheridge (1961, 1965 *a*, *b*) and others have shown how the integral equation may be inverted and the coefficients of the polynomial determined from virtual height data. In the simplest case, the polynomial is taken to represent the entire profile, and virtual height measurements equal in number to the number of unknown coefficients (typically 5-10) are required. The method is seldom used in this form, however, since it is difficult — and often impossible — to determine a single polynomial of sufficiently high order to approximate the profile without incurring un-physical oscillations. Titheridge (1965*a*) has proposed a refinement of the basic polynomial approach which deals with the oscillation difficulty by formulating the analysis in a sequence of overlapping polynomials such that the curvature of the profile *above and below* each selected reflection point, is permitted to influence the calculation. This condition is sufficiently powerful that inflections may be represented in the profile *between* selected reflection points, so that a fixed grid of scaled data may be used.

The principle differences among the methods described so far have concerned the assumption of the function $\varphi(N)$. First emphasis has been given this point both for historical and technical reasons, since some assumption is essential before the analysis method may be developed. These methods have been alike though, in seeking an inversion of (1) given scaled virtual height data. Two methods were outlined before the subcommittee in which other measurable input parameters were suggested as offering special advantages for complete profile calculations.

Hojo (1965), among other authors, has shown how an integration of (1) with respect to frequency can lead to an equation similar to (1) in which the much simpler *phase refractive index* appears under the integral. The input datum then is the *area* of the $h'(f)$ curve below f. This is essentially an analysis of the phase height to obtain the profile, and has certain advantages of mathe-

matical simplicity. The same necessity for a choice of $\varphi(N)$ arises, and the same criteria for choice apply. One unique feature of this formulation is that $\int h'df$ remains finite as f approaches a layer critical frequency, so that in principle the method leads to a direct, convergent process for obtaining the height of the layer peak. Of course the virtual height data are incomplete near the critical frequency, so that an extrapolation remains unavoidable. Another potential advantage of the formulation is that the effect of electron collisions might be introduced in a fairly simple way Although the formulation deals with the quantity $\int h'df$, it is of course expected that this will be obtained by a numerical integration using chosen ordinate $h'(f)$.

In complete contrast to this and the conventional use of h' data, Paul (1965) has outlined a formulation in which the *slope of the virtual height* curve is taken as the input data. By differentiation of (1) with respect to f, Paul obtains an expression which depends mainly on the *second height derivative* of the profile in the reflection point. Although the method has yet to be put to practical test, it is suggested that the quantity $dh'df$ may hold some advantages over h' if determined by a sensitive optical reflection process, since some local smoothing of the $h'(f)$ curve would be accomplished. From a theoretical standpoint, in any case, the formulation is of interest since it demonstrates one highly advantageous aspect of the general $N(h)$ problem : *differences* of h' are the conventional observed quantity, and they are seen by this formulation to depend mainly on the *second height derivative* near the reflection point. It is rare that an experimental process can lead directly to a derivative ; in this case, the virtual height conveniently represents a magnification of the profile, so that many details of the profile shape can be determined with great sensitivity by a well designed $N(h)$ process.

Manual Methods for Specific Parameters :

We now come to methods which do not require the participation of a computer in the analysis. As a rule, these methods aim at determination of special parameters of the profile (total content, peak parameters, etc.), although most of them can be used to get height at chosen electron densities. No method exists to obtain directly the converse — the electron density at a chosen height ; this must always be obtained by interpolation.

Historically, « manual » methods were the first available. The Ratcliffe (1951) — Shinn (1953) comparison method, although no longer used, offers a quick way to judge hmax and layer thickness by comparing the observed $h'(f)$ curve with a set of standard $h'(f)$ curves.

Somewhat more directly related to other modern manual methods are the « 5-point » or « 10-point » averaging techniques which originated as an easy approach to the no-field case. Here, with $\mu' = (1 - f_N^2/f^2)^{-\frac{1}{2}}$, it is possible to invert (1) explicitly, and to obtain

$$h(f_N) = \frac{2}{\pi} \int_0^{fv} \frac{h'(f)}{\sqrt{1 - fv^2/f^2}} \, fd \qquad (2)$$

Since $h'(f)$ is an experimental function, the integration required in (2) must be done by a weighted averaging over ordinates of $h'(f)$ selected at fractions of fv dictated by the integration method used. In its modern form (Schmerling and Ventrice, 1959), 5 or 10 ordinates are necessary for each fv desired, spaced so that their equally-weighted average h' gives $h(f_N = fv)$. For logarithmic ionograms, the ordinate relative positions are nearly constant, so that transparent overlays (Wright and Norton, 1959) permit fairly rapid selection of the 5 or 10 h′ values needed for each h. Nevertheless, considering that even the more elaborate machine analyses require only 20-40 ordinates for a complete profile, the 10-point methods cannot be considered economical unless no computer is available, or unless the number of analyses needed is quite limited.

In any case, it appears that the 10-point approach may be replaced entirely by modern manual polynomial methods, devised by Titheridge (1965), which give more information, more accurately and directly, and with less work than by the 10-point method. The manual polynomial method may easily be implemented by any worker using the coefficients provided by Titheridge. 84 sets of coefficients are given for analyzing $h'(f)$ records taken anywhere in the world, with critical frequencies between 1.5 and 20 Mc/s. These coefficients give the values of hmax, characteristic thickness, total electron content, and the real heights of reflection *directly*

in terms of the virtual heights at 5 or 6 frequencies. Coefficients including an extraordinary-ray correction for underlying ionization are also given, to enable accurate calculations on the nighttime F-layer.

Because of the great volume of non-N(h) data collected routinely over many years, it is important to ask if this contains sufficient information to permit the inference of any N(h) data. C. Taieb (1965) has taken up this question, and has devised a method to convert the conventional parameters (such as M(3000), foF2, h'minF2, foE, foF1) into layer peak parameters. Unfortunately, one parameter not routinely obtained, is also needed : the frequency at which h'min is obtained. The method might be valuable for an organization having a long history of conventionally-analyzed ionograms who wished to obtain an equivalent broad survey of hmax F2, with a minimum of additional work.

One other technique was discussed at the meeting which, while not a « method » in the usual sense, permits a large N(h) survey very economically. This is the method of averaging of $h'(f)$ data over long sequences (say, all days of a month, at noon) *prior* to N(h) analysis, to obtain one representative profile for the sequence (King, 1960 ; Wright, 1960). Obviously, any of the above N(h) methods may be applied to the average $h'(f)$ curve.

Profile Accuracy :

At the outset, the more difficult problems lacked clear definition. Obviously, a principle question concerns the accuracy of N(h) profiles, but how is this accuracy to be specified, and what standards are sensible ? It became clear in the subcommittee's discussion that the general accuracy question, to be answerable, must be specific in terms of

(a) The ionospheric profile parameters needed and

(b) The application intended.

For example, nighttime « low density » profile corrections (a principle topic for the subcommittee) often give 30-80 km of downward *heigh* correction for the « lower edge » of the F-region, and only about 5-10 km of downward correction at the F2 peak ; in electron density, however, the lower-edge correction may increase the electron density below 200 km from zero to 10^4 cm^3 10^5 cm^3, with the value of electron density at the layer peak,

of course remaining unchanged. Profile users concerned with diffusion — loss processes at the F2 peak may be relatively unconcerned whether or not « low density » corrections have been performed, while their colleagues studying airglow phenomena will be very much concerned with the position of the lower edge of the profile.

Keeping in mind this manner of subdividing the profile accuracy problem, the consensus of the subcommittee is as follows :

1) *Accuracy of Profile Peak Parameters* : For two reasons, profile peak parameters are usually obtained with fairly satisfactory accuracy by *all* of the modern N(h) methods, carefully applied.

(a) The *relative variation* of peak parameters (hmax E, hmax F2; characteristic layer thickness parameters, total sub-peak electron content) is often usable without reference to absolute values, so that certain systematic sources of error are of secondary importance.

(b) Usually, N(h) calculations near a layer peak will contain *relatively* less error due to « underlying ionization » causes.

Thus the subcommittee feels that *for general survey purposes* any of the available methods may be employed for layer peak parameters. We accept as a criterion that the diurnal, seasonal, solar-cycle, geographic, and storm variations of such parameters are larger than the uncertainties imposed by any of the available (N)h methods. In view of the limited peak data yet available, such surveys are strongly to be encouraged.

On the other hand, for purposes requiring *great absolute precision* in individual profiles, much care is necessary in the selection of a method and in the selection of the ionogram for analysis. Typical examples of such applications are in matching bottom and topside sounder profiles, or in comparing rocket and ionogram results. Because of reason (b) above, peak parameters may still be among the more accurate results of profile calculations, but ultimately the precision of these results depends critically upon the ionogram, the analysis method, and the care employed in the analysis. The subcommittee clearly feels that none of the manual calculations, nor several of the simpler machine methods, can be depended upon for precision profiles.

Some discussion arose concerning the best way to obtain peak parameters with high accuracy. Obviously, accurate work pre-

supposes a highly detailed ionogram : the peak is obtained by an extrapolation at best, and it is hopeless to seek an accurate value if the extrapolation must be done over an interval (in frequency) greatly exceeding the frequency *resolution* of the ionogram. Even in these conditions, the peak extrapolation depends rather too delicately on the critical frequency asymptote, for which no definite measurement rules can be given. The N.B.S. group advocate an extrapolation to zero of the layer gradients near the peak, determined directly in their method ; at hmax the gradient is zero. This method does not use the critical frequency asymptote, and in fact determines it by a parabolic extrapolation of the profile.

2) *Accuracy of Heighls al Fixed Electron Densilies* : Except for mapping and other graphical purposes, this sort of parameter is not often of diret interest. It merits discussion, however, because heights are obtained in N(h) processes, and in these terms the profile accuracy is somewhat easier to describe than in the inverse (and more useful) sense.

Lower E-region : In the daytime, sensitive observations are handicapped by scattered echoes from irregularities. The observed virtual heights at frequencies well below foE may be 5-20 km higher than the corresponding real heights, and methods which take the bottom of the profile to equal the lowest virtual height, will be in error by this amount. This error slowly diminishes at greater heights, but still may remain relatively serious at the E-peak, since the error is comparable with the local scale height. Methods of correction are in development by the N.B.S. group, but are not yet fully satisfactory unless the ionogram provides both ordinary and extraordinary-ray data from the lower E layer.

At night, definitive E region information pre-supposes low frequency observations, at least down to 0.4 Mc/s. Such observations disclose that there is always an E layer of critical frequency 0.5 — 0.7 Mc/s, often also a somewhat higher « intermediate » layer, as well as highly variable layers of Sporadic E. Since most ionosondes do not reveal these features, and since many N(h) methods take no account of these low electron densities, there was little discussion on these matters at the meeting, although the effects of these low densities on nighttime F region calculations was much discussed.

A number of N.B.S. ionosondes now function at the lower frequencies and their N(h) methods are being applied to the night E observations. Profile accuracies are about the same as in daytime, or perhaps a little better, when the complete E-echoes are seen. However, the prevalence of Sporadic E, and broadcast interference seriously limit the occasions on which N(h) may be done.

Upper E — Lower F Regions : Except for the frequent appearance of stratifications, determination of the E-peak (night or day) presents about the same problems as does the F-peak, already discussed. Little work on this has been reported. However, just above the E-peak, grave errors arise in virtually all cases, irrespective of the N(h) analysis method applied. This is because the ionograms typically suggest more or less of a height-step (valley) at foE. It is important to note that it is principally the magnitude of this height step (valley width), rather than the minimum density in the valley (valley depth) which causes errors in the remainder of the profile. Most methods are incapable of representing accurately even a « full » valley, if it has appreciable width. Monotonic methods in such cases are too low by an amount equal to the valley width just above foE,and usually obtain gradients over this range which are also too low. The height error and the gradient error propagate each other much higher in the profile than would be expected from the effect of the neglected retardation of the valley alone. Thus a valley width error of, say, 30 km at foE = 3 Mc/s may diminish only to 5 km near the F peak at 6 Mc/s.

Some work on this problem was reported by the N.B.S. group. They attempt to correct for valley effects by « restarting » the calculation at foE. It is then necessary to allow for *all* of the underlying ionization ; their approach is to describe this by models with two to six unknowns, and to determine these unknowns in a least-squares process using four to twenty virtual heights from the ordinary and extraordinary echo traces. Good success is reported when foE is low (i. e., near f_4), for then the ordinary and extraordinary echoes are very differently affected by these low densities. At certain magnetic latitudes, and when foE is high (as at midday) their approach is less successful.

From this discussion, it is easy to see that the midday « valley » problem and the nighttime « starting » problems are really the same, with differences imposed by the amount of information given

by the ionogram by which to resolve the ambiguities of unobserved ionization.

Generally, it may be said that the lower edge of the F region may be seriously in error if « monotonic » methods are used. The errors are larger (20-100 km) by night than by day (5-30 km ?), and are easier to correct at night (because foE is then nearer f_H).

F2 peak : The special problems of determining layer peaks have been discussed above ; here we are concerned with the errors imposed on the peak by height errors elsewhere in the calculation.

Use of a monotonic method without valley corrections leaves the F-region peak too low by 20-100 km (night) and 5-20 km (day).

Conversely, *neglect* of the underlying E layer (usually at night) causes errors in the opposite sense and of about the same magnitude as those above, viz. 20-200 km too high. These errors must be expressed as ranges, since the height of the F2 peak is itself so highly variable : careful analyses show that extremes of 170-450 km are not uncommon.

(3) *Accuracy of Electron Densities at Fixed Heights* : Since « N(h) » processes really give h(N), the inverse function must be obtained by interpolation. It is obvious that if the electron density gradient is large over the interpolation range, small errors in the gradient or in the height can lead to very large errors in the quantity N(h). Furthermore, these errors will vary with the shape of the profile, i. e., as the gradient changes. This is why it is difficult to specify the accuracy of an N(h) profile determined from an ionogram in terms of the errors of N at fixed h. Still, it is possible to review the several types of error noted in (2) above and note their specific effects in the present sense.

Lower E-region : Errors of an order of magnitude in N(h) are possible due to the 5-20 km uncertainties in h(N) at the lower edge of the E layer, vanishing near the E peak.

Upper E- Lower F-regions : Even with valley corrections, the profile shape in the valley cannot be obtained from ionograms. The errors of calculation may still be referred to a mean valley depth, and experience suggests that the mean density in the valley may be 1 %-25 % below foE (daytime) and 25 %-90 % or greater at night. Uncertainties of this magnitude in N(h) for heights in the valley are inescapable even if « non-monotonic » corrections

are used ; if they are not, even larger errors (perhaps doubled) will be incurred, since the electron densities obtained for these heights will be larger than foE.

F2 peak : Here, because the gradient dN/dh is small, the errors in N(h) are minimized unless the height of the peak is itself greatly in error.

N(h) *Programs Planned for the I.Q.S.Y.* :

In preparation for the London meeting, the subcommittee decided to undertake a survey of plans for systematic N(h) analyses of I.Q.S.Y. vertical soundings. This was combined, at the suggestion of U.R.S.I.-C.I.G., with a broader survey of I.Q.S.Y. ionogram data reduction plans. The results of the subcommittee's N(h) survey were given in its Memorandum No. 12 ; they provided helpful guidelines concerning the choices of method, selection of significant N(h) parameters, and volume of data planned by various organizations. The principle results of the survey are given here in the form of a table showing the groups definitely expressing a plan to conduct some N(h) analysis during the I.Q.S.Y.

Recommendations Concerning Ionosondes :

The foregoing remarks concerning profile accuracy have identified several respects in which ionograms suitable for conventional critical frequency work are inadequate for N(h) analysis. It is the intent of this section to discuss and summarize this matter, recognizing that there exists a sister subcommittee of U.R.S.I.-C.I.G. specifically interested in ionosonde design.

It is not widely enough appreciated that the vertical soundings technique is capable of significantly more than has traditionally been asked of it. It is, after all, quite an achievement to measure directly the maximum charge densities at three or more levels in the ionosphere, to detect Sporadic E, and to provide in directly usable form, the equivalent oblique propagation conditions. These are the traditional aims of vertical soundings, and they have been suitably satisfied by most of the ionograms obtained over the past 25 years. It has been recognized all along that the N(h) profile is available from the complete $h'(f)$ observation, but until recently, this has seldom motivated the design of ionosondes, or even their method of operation.

As it becomes easier, more economical, and more useful to obtain N(h) profile from ionograms, it becomes wasteful *not* to do so

Country	Organization, Stations	Program	Method	Application	Publi-cation
Argentina	L.I.A.R.A. Univ. Tucuman	Systematic Hourly Median	Integral Eq'n. Paul's	 Equatorial Anom.	Yes ?
Austria	Univ. Graz	World Days	Becker's		No
Australia	Brisbane, Canberra, Cocos, Hobart, Mawson, Mundaring Norfold, Pr. Moresby, Townesville, Wilkes	Not Systematic	Undecided		?
Belgium	Dourbes	Hourly	Paul's		Yes
Canada	D.R.T.E. : Churchill, Ottawa, Resolute,St. Johns,Winnipeg	Not Systematic	Lamination, then Polynomial	Topside Sounder	No(?)
China	R.W.R.L. : Taipei	Hourly Medians	Budden's		Yes
Czechoslovakia	Pruhonice	Not Systematic	Budden's	Satellite Tracking	No
France	C.N.E.T. : Bangui, Kerguelen Garchy, Tamanrasset, Terre Adelie	Hourly	Taieb's		Yes

Country	Organization, Stations	Program	Method	Application	Publication
E. Germany	Juhliusruh (Rügen)	Not Systematic	Budden's		No
W. Germany	Breisach	Hourly	Taieb's	Satellite-Faraday	Yes
	Lindau	Not Systematic	Becker's	Valley ; dynamics	No
	Tsumeb	Not Systematic	Becker's	Valley ; dynamics	No
Great Britain	D.S.I.R. : Halley Bay, Argentine Isl., Pt Stanley, Singapore, Slough	Not Systematic	Budden's or Titheridge's	Iono. Phys. Valley, Topside Sounder	No
Japan	R.R.L. : Akita, Kokubunji, Yamagawa, Wakkani	World Days (?)	Hojo's	Low freq. 135° E meridian	Yes
New Zealand	D.S.I.R. : Christchurch, Campbell Is., Hallet, Scotts Raratonga	Not Systematic	King's ; 10 pt.	General Iono. Research	No
Portugal	S.M.N. : Macao	Systematic	Bibl. et al., 1955		Yes
S. Africa	N.I.T.R. : Capetown, Johannesburg	Not Systematic	*hc, qc*		No

Country	Organization, Stations	Program	Method	Application	Publication
Switzerland	P.T.T. : Sottens	Hourly	10-point		?
U. S. A.	C.R.P.L. and (Coop) : Adak ; Anchorage ; Barrow ; Bogota (Colomb.) ; Boulder ; Cape Kennedy ; Conception (Chile) ; Ft. Belvoir ; Ft. Monmouth ; Godhavn, Narssarssuaq Greenland (Denmark) ; Grand Bahama ; Huancayo, Talara (Peru) ; Kingston (Jamaica) ; La Paz (Bolivia) ; Manila (Phikippines) ; Mayi ; Mexico City (Mexico) ; Okinawa ; Pt. Arguello ; San Salvador ; South Pole ; Thule ; Wallops Island ; White Sands	Hourly Medians	Paul's	Physics-Continuity Equation, Meridional Morphology, Topside, Propagation	?
Yugoslavia	I.A.T. : Beograd	Systematic	10-point	Ionos. Morphology Storms	Yes

— or, at least, it becomes wasteful to obtain ionograms which cannot be analyzed. What are the principle requirements on ionograms for N(h) analyses ?

(1) The frequency range should encompass the variation of the main thick layers of the ionosphere — the E and F layers — with a generous margin to obtain Sporadic E information as well. The range 0.25-20 (or at most, to 25 mc for stations near 30° Dip) is satisfactory. Accurate F-region work can, however, be done if the low frequency limit extends only to the gyrofrequency.

(2) Relative virtual height accuracy should be at least 1 km. Absolute h' measurements of this accuracy are seldom necessary, and require special calibration ; relative accuracy of this order is simply a matter of recording quality. For convenience, it would be ideal to accept certain format standards : (a) Logarithmic frequency variation ; (b) Linear virtual height variation ; (c) 35 mm film recording ; (d) 0.25-20 mc in 100 mm.

(3) The use of improved antenna systems is desirable, particularly at lower frequencies where broadcast interference handicaps observations near the gyrofrequency. Such antenna systems are not expensive in comparison with instrumentation costs. N.B.S. uses a half-wave folded dipole, tuned by switches over the 0.25-3 Mc/s range, and a log-periodic antenna between 3-20 Mc/s.

(4) A sensible balance must be maintained regarding time resolution and integration on the ionigrams. If the sweep time is too short, sensitivity may be sacrificed and, in any case, a « snapshot » is obtained which may fail to represent the average conditions desired in, say, systematic hourly profiles. It is rather easier to average over « random » variations when making the ionograms, than by making and averaging over many profiles. On the other hand it is clearly undesirable to go to the other extreme. It is perhaps sufficient to observe that many ionograms now being obtained at 30 sec. sweep time could show more echo continuity were they obtained with a sweep time of 2-3 minutes.

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ABSORPTION IONOSPHÉRIQUE

Le Comité National Français des Recherches Antarctiques (C. N. F. R. A.) vient de publier : « Mesure de l'Absorption Ionosphérique à Kerguelen à l'Aide d'un Riomètre à 30 MHz » (Mars à Décembre 1962), par Melle G. Pillet et M. J. Moureton, du Groupe de Recherches Ionosphériques.

L'introduction de cet ouvrage, que nous reproduisons ci-après donne des renseignements complets sur son contenu.

Introduction

La mesure de l'absorption ionosphérique à l'aide d'un riomètre fonctionnant à la fréquence de 30 MHz, a été entreprise en 1962 à Port-aux-Français, District de Kerguelen (Territoire des Terres Australes et Antarctiques Françaises) sous la responsabilité du Groupe de Recherches Ionosphériques.

La station de Port-aux-Français a les coordonnées suivantes :

— Coordonnées géographiques : 49°21′ S.
70°16′ E.

— Coordonnées géomagnétiques : 57°3′ S.
128°.

— Inclinaison magnétique : 68°.

Le riomètre utilisé fait partie du réseau de « l'Air Force Cambridge Research Laboratories ». Installé à Kerguelen au cours de la campagne d'été 1961-1962, il a fonctionné régulièrement à partir du mois de mars 1962. L'installation et la maintenance du riomètre, ainsi que l'antenne de type Yagi vertical à 2 éléments pointée au zénith, ont été effectuées sous la responsabilité de M. Albert Ben Aben.

Dans cette publication sont présentés successivement :

— La courbe de jour calme ayant servi à calculer l'absorption ;

— La reproduction des enregistrements originaux ;

— Les tableaux mensuels des valeurs horaires de l'absorption ionosphérique.

La réduction des données a été effectuée conformément aux recommandations publiées par les Années Internationales du Soleil Calme. Le temps utilisé est le temps universel.

Partant des enregistrements analogiques originaux, les valeurs numériques de l'amplitude ont été obtenues sur un appareil « Boscar », par lecture directe à chaque heure ronde avec une précision de 5/1 000, et perforés directement sur cartes.

Chaque enregistement journalier peut être comparé point par point au précédent, à condition de le décaler de 4 minutes en retard ; le point servant d'origine dans notre cas est le 1er mars 1962 à 0 heure. On a pu ainsi établir pour chaque mois une « courbe de jour calme provisoire » en comparant tous les points relevés correspondant à un même point de cette courbe de jour calme provisoire et en ne conservant que le plus élevé, c'est-à-dire celui qui correspond à l'absorption la plus faible. Cette courbe est formée de 360 points espacés dans le temps de 4 minutes et couvrant ainsi toute une journée.

Les dix courbes de jour calme mensuelles ont alors été comparées entre elles avec la même origine de façon à obtenir la courbe de jour calme définitive, en ne retenant que les points les plus élevés de chaque courbe de jour calme provisoire correspondant à un même point de courbe de jour calme définitive.

Les valeurs horaires de l'absorption sont obtenues par comparaison entre la valeur mesurée à une heure déterminée (Im) et la valeur du point correspondant de la courbe de jour calme définitive (Ic). Ic et Im sont exprimés en milliampères variant dans un intervalle de 0 à 5 milliampères.

La formule $$\frac{1}{100} \operatorname{Log}_{10} \left(\frac{Ic}{Im} \right)$$

donne la valeur de l'absorption horaire en dixièmes de décibel (centibels).

Compte tenu des précisions de l'appareillage et de la lecture, la précision obtenue sur l'absorption est estimée à 0,5 dixième de décibel. Le chiffre correspondant au centième de décibel n'est donc pas significatif.

Dans certains cas, conformément aux conventions internationales, certaines valeurs numériques ont été remplacées ou pondérées par des symboles littéraux ayant les significations suivantes :

C : panne de l'appareillage ;

S : brouillage ;

E : absorption inférieure à la valeur minimale mesurable (soit 0,05 dB) ;

U : valeur douteuse.

L'établissement des différentes courbes de jour calme ainsi que le calcul des valeurs horaires de l'absorption, ont été effectués sur l'ordinateur IBM 704 de l'Institut Blaise Pascal, centre de calcul du Centre National de la Recherche Scientifique, par les soins de M. Moureton.

Au cours de l'année 1965 paraîtra une publication faisant suite à celle-ci contenant pour l'année 1962 les absorptions anormales avec l'amplitude maximale, l'heure de début et de fin de chacune d'elles.

Au cours de cette même année seront publiés les tableaux d'absorption horaire pour Kerguelen mesurés avec ce même riomètre à 30 MHz d'après les enregistrements de 1963.

De plus, le G.R.I. a installé pendant la campagne d'été 1963-1964 4 nouveaux riomètres à Kerguelen, fonctionnant sur les fréquences 6,5 MHz — 10,1 MHz — 15,5 MHz — 25 MHz, dont les observations pourront être publiées au début de 1966.

I.U.W.D.S.

Regional Warning Centers

The following circular letter (R.W.C. 87) has been circulated to the Regional Warning Centers, Associate R.W.C. and National Warning Contacts.

This circular will cover a variety of topics arising from the I.U.W.D.S. Steering Committee Meeting in Madrid March 28 through April 3, 1965, and from discussions with staff members of the different Regional Warning Centers. The minutes of the meeting and the R.W.C.-A.R.W.C reports prepared for the meeting will be distributed with a later circular. Each different topic is numbered below. Please note requests for R.W.C. action in items 3, 5, 6(*c*), 6(*d*), 6(*e*), 7 and 9, especially.

1. *GEOALERT NUMBERING.* — When two or more types of Geoalerts are issued on a given day, each type will be given a number. This will assist in the translation of these messages by those whose native language is not English. For example, if on the fourth of the month, both a SOLACTIVITY EXISTS and MAGSTORM EXISTS alert were to be issued the message would read :

GEOALERT 04161 SOLACTIVITY EXISTS 04162 MAGSTORM EXISTS.

2. *GEOALERT AND ADALERT DISTRIBUTION IN ANTARCTICA.* — The Geoalerts and Adalerts addressed to McMurdo, Antarctica from AGIWARN now carry an additional heading : « PASS TO ALL ANTARCTIC STATIONS ». We believe that this heading will insure that the messages will promptly reach the stations of all nations. In turn, it is hoped that Antarctic stations upon identification of event-type activity (and especially of polar cap absorption events) will forward their observations of these events in an ADALERT message (or in appropriate synoptic code) to AGIWARN via McMurdo. Include in the message : « PASS TO AGIWARN ».

3. *ADALERTS.* — For the SOFLARE type of ADALERT, now that solar activity is increasing it is requested that the message always include the *importance* of the flare. Otherwise the significance of the ADALERT cannot be readily evaluated. Observatories and R.W.C. are reminded that solar ADALERTS for prompt international interchange among R.W.C. must be *timely.* We have heard many comments on the value of such timely ADALERTS. However, if the messages are not originated within minutes of the identification of the event, then the data need be sent only on the next normal interchange message and encoded in synoptic code form rather than as an ADALERT.

4. « *REAL-TIME* » *REPORTING.* — Requests are being made to some Regional Warning Centers for reporting outstanding events while they are in progress, for very prompt forwarding to a few specialized users. This means hat *observatories should telephone information in plain language to the center* on specified types of events *as soon as the event is identified.* The R.W.C. will notify the « real-time » users and then prepare the ADALERT message or encode the data for regular interchange.

5. *KEY STATIONS.* — The demands for « real-time » reporting require visual solar flare patrols and constant monitoring of solar noise records, visual magnetographs and the like. *Each R.W.C. or A.R.W.C. is requested to supply the Deputy Secretary of I.U.W.D.S. with a list of the stations capable of providing such reporting in their region together with types of data.* R.W.C. are reminded to inform the stations in their region of the use and value of their reports from time to time.

6. *Codes* : (*a*) A revised synoptic code booklet is to be prepared for issue at the end of 1965 or early in 1966. Any suggested revisions, not already furnished to the I.U.W.D.S. Secretaries since March 1965, should reach Dr. Leen D. de Feiter, Sterrewacht der R. U., 13, Servaas Bolwerk, Utrecht, the Netherlands, by *July* 1, 1965.

(*b*) *UPLAG* (p. 42 of Synoptic Codes for Solar and Geophysical Data 1963). — McMath-Hulbert Observatory, indicator 08, gives plage area « *iii* » as millionths of the solar *hemisphere*, not disk as specified in the code. This fact does not affect the evaluation of one calcium region as compared to another, but it should

be taken into account if comparing areas as reported by McMath-Hulbert to those of another observatory.

(*c*) *UPATA* (p. 40 of Code Booklet). — Stations whose observing periods cover two (Universal Time) dates frequently encode their patrol hours so that there is ambiguity in decoding. Though more code groups are required it is requested in such cases that the « UPATA JJUII » groups be repeated whenever the time group would cover two dates. For example, if the observing hours were 1530UT on the 25th of the month to 0130UT on the 26th encode asfollows :

UPATA 25278 15540 UPATA 26278 00015.

Always be sure the date in the « JJUII » group is that of the UT time in « *aaabb* ».

If there have been no observations possible, use the plain language statement « NO DATA » following the « JJUII » group rather than « 00000 ». If « 00000 » is given, there can always be a question as to whether there has been a garble in transmission of the digits.

The UPATA messages should be sent telegraphically, only if transmitted as soon as the flare observations have been reduced. The necessity of knowing flare patrol times is so that the R.W.C. and other users will know that no important flares occurred during those hours except the ones reported by the accompanying UFLAR reports. Such negative information can be of great value in evaluating other reports, such as S.I.D.'s and solar radio noise. UPATA sent before the photographic flare data are reduced are misleading. If for some reason the flare reductions are made more than 48 hours after observation, the data (UFLAR and UPATA) should be forwarded by airmail rather than telegraphically.

(*d*) *UPATE.* — This is a new code word which is being introduced now .The code is identical to UPATA (see p. 40 of Code Booklet and the remarks in (*c*) immediately above) except that it will signify visual flare patrol times. *Hereafter UPATA will be restricted to photographic flare patrol times and UPATE to visual flare patrol times.*

(*e*) *ADV—.* — Because of a change in mission at the C.R.P.L. station at Anchorage, Alaska, they will no longer serve as an Associate Regional Warning Center. AGIWARN at the C.R.P.L. Forecast Center, Ft. Belvoir, Virginia, U. S. A. has been able

to assume all of the former A.R.W.C. activities of Anchorage.

Upon the request of several R.W.C. another category of advice is now added to the code on p. 102 of the Code Booklet. For « *bbbbb* » the code word « NOLOX » will signify insufficient information available for making any advice on Alerts.

(*f*) *UXRAY.* — R.W.C. are encouraged to contact observatories known or thought to be monitoring the telemetry from the N.R.L. Solar Radiation Satellite (1965-16D). Each R.W.C. is being supplied, as an attachment to this circular, with a list of observatories in their region which have contacted Mr. Robert W. Kreplin at the U. S. Naval Research Laboratory for information on how to record and interpret the solar x-ray telemetry. The following code is suggested for data interchange use to report such events :

Code UXRAY.

1. *Content* :

— report on solar x-ray event detected by a solar radiation monitoring satellite.

2. — *General form.*

UXRAY JJaII bHHmm cHHmm deeef

deeef: band of flux measurement; flux in tenths of ergs cm^{-2} sec^{-1} $X10^{-f}$, exponent of power 10

cHHmm: number of groups to follow, UT end of satellite pass

bHHmm: subjective importance of level of daily average flux, UT begin of satellite pass

JJaII: UT date of observation, satellite, observatory indicator

UXRAY: key word

3. — *Definition of symbols.*

UXRAY = key word, *XRAY* for solar x-ray events

JJ = Greenwich date of observation

a = satellite
1 = 1965-16D Solar Radiation
II = observatory indicator (see lists in part C of Code Booklet)
Note : particular stations monitoring the satellite will be detailed at a later date
b = subjective importance of level of daily average flux
1 = low, 2 = normal, 3 = high
HH*mm* = UT hours and minutes of beginning of satellite pass
c = number of groups to follow
HH*mm* = UT hours and minutes of end of satellite pass
d = band of flux measurement
1 = 2- 8 Angstroms
2 = 8-14 Angstroms
3 = 8-16 Angstroms
4 = 44-55 Angstroms
5 = 44-60 Angstroms
eee = flux in ergs cm^{-2} sec^{-1} $X10^{-f}$
f = exponent of 10 in group « *eee* »
1 = 1
2 = 2
etc.

7. *OBSERVATORY INDICATORS.* — Please *add* the following indicators appropriately to the lists on pages 140-152 of the Code Booklet :

Indicator	Observatory	Country	Codes
02	New Delhi	India	USIDA
20	Tucaman	Argentina	USIDA, UFOFA

In order to simplify arrangements, *in the future all new observatory indicators will be assigned by the I.U.W.D.S. Deputy Secretary*, Miss J. Virginia Lincoln. If there are additions or deletions to be made please notify her.

8. *EVENT REPORTING.* — R.W.C. or A.R.W.C. which do not operate every day of the week are requested to transmit event data of Priority I on their next interchange message even if the data are more than 24 hours old. Such information permits a solar region's activity to be assessed, and may explain a not-well-understood geophysical event in a period when observations included in the daily interchange were incomplete.

9. 1966 *GEOPHYSICAL CALENDAR.* — The 1966 Planning Edition of the 1966 International Geophysical Calendar was presented to the scientific working groups at the IIIrd I.Q.S.Y. Assembly in Madrid and the C.O.S.P.A.R. Meeting in Buenos Aires, in order to obtain further material for the suggested scientific programs. *The Operational Edition of the* 1966 *Calendar will be issued in August* 1965. *Please notify the Deputy Secretary of I.U.W.D.S. (by July* 15) *as to how many copies you would like for redistribution in your region.*

J. Virginia LINCOLN,
Deputy Secretary

INTER-UNION COMMISSIONS

Inter-Union Commission on Radiometeorology

1964 WORLD CONFERENCE ON RADIO METEOROLOGY

BOULDER, COLORADO, SEPTEMBER 14-18, 1964

Radio-Science (Vol. 69D, n° 6, June, 1965) has published a selection of papers presented at the World Conference on Radio Meteorology.

We are publishing hereunder abstracts of those papers.

Angels in Focus

by D. ATLAS

— Recent independent observations of « dot » angel echoes are drawn together to provide a coherent picture of their physical structure. The angels act as point targets with durations proportional to beam width (for vertically pointing radars). The echoes are strongly coherent, indicating a smooth specular-like surface. Dual frequency measurements in the band I to 3 cm indicate that their radar cross sections are proportional to between the first and second power of wavelength. A range square dependence is also indicated. When tracked, the cross sections show strong enhancement at the zenith, decreasing roughly symmetrically on either side. Doppler measurements indicate that they almost always ascend with speeds of about 1 m sec^{-1}.

The observations are shown to be consistent with specular reflections from the hemispherical, concave-downward cap of a rising thermal or convective bubble. The specular point of the cap appears only briefly in a vertically pointing beam and so the echo appears to be from a point source. The concave-downward surface provides at least partial focusing, thus accounting for both the magnitude of the cross sections and their range-square dependence as the bubble expands with altitude. Furthermore, only rising bubbles have such favorably disposed upper surfaces.

The dual frequency data indicate that the transition zone across the bubble cap is extremely sharp, of the order of 0.5 cm. The sharp transition, the smoothness of the cap, and the slow ascent rates suggest that the flow is laminar.

An Investigation of Clear Air Stratification With Radar and Elevated Instruments

by D. R. Hay and K. Naito

A study of radar reflections within the clear air of the lower troposphere has been carried out over two prolonged intervals. A specially designed radar operating at 7000 MHz has been used for this purpose, with its stationary antennas directed vertically into the layer of frictional influence. An interpretation of these radar observations has been made with the aid of synoptic weather information, to indicate that the incidence of reflections varies with the type of air mass and with the degree of dampness of the underlying ground. The distribution of reflecting centers generally has a maximum at a height of 300 m, but this distribution is altered by the intrusion of a weather front. These reflecting centers appear to be small departures in air refractivity within horizontal layers that are only a few centimeters in vertical depth and that are either flat or weakly concave downwards, extending over horizontal distances of at least a few meters. The need for further information on the air structure to support these radar observations has led to a program of special instrument development. Included are a balloon-borne refractometer and temperature sonde which have a rapid response and a high degree of spatial resolution, and a smoke-generating nose cone for low level rockets. Preliminary observations have been carried out with these instruments to assess their capabilities, and some details on the smoke trail analysis are given in this paper. Inspection of the smoke trails indicates localized layers of turbulence and rapid diffusion within deeper layers of laminar translation. It appears that averaging times in excess of 20 min. are required to obtain some mean wind-speed profiles. The vertical extent of velocity inhomogeneities is not small as compared with their horizontal extent, and the law of diffusion generally is different at levels above and below 300 m.

On Inferring the Refractive-Index Structure of the Troposphere from Electromagnetic Scattering Experiments

by P. L. Smith, Jr.

Determining the refractive-index structure associated with the scattering of electromagnetic waves by the troposphere is a problem of considerable interest. This paper emphasizes the fact that the refractive-index profile cannot be inferred from scattering measurements at only one wavelength and one scattering angle. Such measurements determine only the spatial Fourier spectrum of the refractive index, at a particular wave number determined by the wavelength and the scattering angle. This point is illustrated by a set of hypothetical refractive-index profiles that cannot be distinguished by measurements at one wavelength and one scattering-angle. Methods of obtaining further information about the atmospheric refractive-index structure are reviewed briefly. The suggestion is made that measuring the cross sections of radar angels as a function of the pulse length would provide useful information.

The Biexponential Nature of Tropospheric Gaseous Absorption of Radio Waves

by E. J. Dutton and B. R. Bean

This paper discusses the characteristics, and some of the statistics of the general climatological aspects of considering atmospheric oxygen and water vapor absorption (the two principal contributors to atmospheric gaseous absorption in the 6 to 45 Gc/s frequency range) to be decreasing exponential functions of height from their surface value. The paper is intended primarily as an examination of these climatological aspects and the maps included are not primarily intended for application. The dry (oxygen) term of this biexponential model is extremely well behaved, but the wet (water vapor) term depends on time of year, geographic location, air mass, and general climatology of the areas for which application is intended.

Gaseous absorption of radio energy in the 6 to 45 Gc/s frequency range arises principally from water vapor and oxygen. The combined absorption may be represented by a biexponential decrease from the surface values. The oxygen absorption is well described by the model, as is water vapor absorption except in regions of very low water vapor content.

Complete Scatering Parametersof Polydispersed Hydrometeors in the 0.1 to 10 cm Range

by D. Deirmendjian

The extinction, the albedo of single scattering, the differential scattering cross section, and the complete polarization properties, per unit volume of cloud and rain elements, irradiated by microwave radiation at various frequencies have been determined. Continuous drop-size distribution functions are introduced to represent real clouds and precipitation, and the absorption and scattering parameters are integrated with high accuracy. A Rayleigh approximation is found adequate for the cloud model, but the complete Mie expressions had to be used for precipitation-sized particles. Older estimates have been corroborated, but some new features have been brought out for the first time, such as the scattering intensity and polarization (including its ellipticity) as a function of scattering angle.

The quantitative results, presented graphically and in extensive tables included in the original study (available as RAND publication 4-422-PR, 1963), will be useful in advancing cloud physics research by means of active and passive microwave techniques. The same results can be used in the theoretical interpretation of the observed continuous and discrete microwave emissions from certain planets.

I.U.C.A.F.

RADIOASTRONOMY AND THE C.C.I.R.

Interim meeting of C.C.I.R. Study Group IV at Monte Carlo, February 1965

This document listed Doc. I.U.C.A.F./77 has been circulated on July 12, 1965 by Dr. R. L. Smith-Rose, Secretary General of I.U.C.A.F.

C.O.S.P.A.R. EIGHT PLENARY MEETING

ARGENTINA — MAY 1965
(Doc. I.U.C.A.F./78)

INTRODUCTION.

It had originally been intended to hold the 1965 C.O.S.P.A.R. Plenary Meeting and Space Science Symposium at the University of Buenos Aires but, in view of certain local conditions there, the meeting place was transferred at short notice to a large hotel at Mar del Plata, some 250 miles away from the capital of Argentina.

At the Plenary Meeting a paper on « Radio Frequencies for Space Research » was presented by the writer (see Doc. I.U.C.A.F./75). This paper outlines the present position of the frequencies allocated to space research, and emphasises the need of those engaged in this field to notify the International Frequency Registration Board in Geneva of the frequencies in use, and of any cases of harmful interference associated therewith.

RESOLUTIONS RELATING TO FREQUENCY ALLOCATIONS.

At a meeting of the C.O.S.P.A.R. sub-group on Radio Tracking and Telemetry, the following two Resolutions were drawn up and were among those adopted at the closing meeting in Argentina.

RESOLUTION 2 : *Frequency Allocations for Space Research.*
C.O.S.P.A.R.

notes with satisfaction the improvements in frequency allocations to space research effected by the Final Acts of the Extraordinary Administrative Radio Conference in Geneva, 1963, but

considering :

(i) the expected extension of tracking and telemetry facilities in the near future, especially for deep space probes in all regions and for earth satellites in Regions 1 and 3,

(ii) the importance of recovering a high proportion of the telemetered data at all times, and of all data at certain critical times,

and

(iii) the limitation in the steps which can be, and are being, taken by system designers to reduce the effects of interference,

recommends that I.U.C.A.F. takes all possible steps to ensure that the protection now accorded in the bands 2290-2300 Mc/s and 1700-1710 Mc/s in Region 2, be extended to Regions 1 and 3, the case for the former band being considered the more urgent.

RESOLUTION 3 : *Notification of Cases of Interference.*
C.O.S.P.A.R.

realizing the importance of achieving effective protection against harmful interference for those using the allocated radio frequency bands for space research purposes, and

noting the advice given by the Secretary General of I.U.C.A.F.,

urges all national space science committees to ensure, through their national administration (see Resolution 6, Florence 1964), that :

(i) All space research earth stations and space stations are registered with the International Frequency Registration Board of the I.T.U.

(ii) Reports of harmful interference be brought to the notice of the appropriate National administration so that it may take action towards securing elimination of this interference.

ACTION BY I.U.C.A.F.

As in the case of corresponding matters relating to Radioastronomy and the C.C.I.R., attention will be drawn to these Resolutions in the agenda of the next meeting of our Commission.

R. L. SMITH-ROSE,
Secretary-General

I.G.Y. AND I.G.C.

Bibliography

The Research Department, All India Radio, New Delhi, has issued : « Ionospheric Observations during the International Geophysical Year 1957-1958 and the International Geophysical Co-operation 1959 », Vol. 2, n° 3.

The volume contains the ionospheric characteristics over Tiruchirapalli from January to March 1958.

Catalogue of Data

The World Data Center A has issued the Catalogue of Data received by W.D.C. — A for the period 1 January 1960 to 31 December 1964.

The Catalogue contains data on : airglow, ionosphere, aurora, cosmic rays, geomagnetism and solar activity.

I.Q.S.Y.

Scientific Programme

In May 1964, the I.Q.S.Y. Committee decided that, in view of the progress made, the Provisional Programme of November 1962 should be replaced by a fuller and more up to date version in which the scientific objectives of the I.Q.S.Y. could be more adequately described. It was agreed that the discipline Reporters and several other members of the I.Q.S.Y. Committee should each be responsible for the preparation of the material describing a particular part of the programme. Almost all these individual contributions were written during the closing months of 1964. They have since been edited at the I.Q.S.Y. Secretariat and are now published in *I.Q.S.Y. Notes* (No. 12, June 1965) following a recommendation of the I.Q.S.Y. Publications Sub-Committee.

The chapters, which describe the work in hand in each of the I.Q.S.Y. disciplines are :

I. Solar Terrestrial Relations, by Dr. C. M. MINNIS.
II. Solar Activity, by Dr. R. MICHARD.
III. Meteorology, by Dr. W. L. GODSON.
IV. Geomagnetism and Earth Currents, by Father J. O. CARDUS, S. J.
VI. Aurora and Noctilucent Clouds, by Mr. J. PATON.
VI. Airglow, by Prof. D. BARBIER†.
VII. Ionosphere, by Prof. Dr. W. DIEMINGER.
VIII. Cosmic Radiation and Geomagnetically Trapped Particles, by Prof. S. N. VERNOV and Dr. L. I. DORMAN.
IX. Space Research, by Dr. H. FRIEDMAN.
X. World Days by Mr. A. H. SHAPLEY.
XI. International Data Exchange and the World Data Centres, by Dr. H. ODISHAW.
XII. Publication, by Dr. D. C. MARTIN.

Taking into account their particular interest to U.R.S.I., we are publishing hereunder Chapter I and Chapter VII.

Chapter I. — Solar Terrestrial Relations

C. M. Minnis
I.Q.S.Y. Secretary, London

1. — Introduction.

At the present time, scientists in more than 70 countries are voluntarily making a wide range of special scientific observations and measurements which are related to the enterprise known as the International Years of the Quiet Sun (I.Q.S.Y.). These observations are being made at about 2000 stations of numerous kinds scattered throughout the world from the far north, near latitude 82°, southwards across the equator to the South Pole.

The picturesque title of the enterprise, and the success achieved in the close coordination of the work of the participating scientists in so many different parts of the world, have attracted the attention and interest of many people who have no direct contact with the I.Q.S.Y. programme. Some of these people have a general interest in scientific affairs, but are not specialists in any one branch of science ; on the other hand, many are active scientists but their interests lie in fields far removed from the I.Q.S.Y. disciplines. These are, broadly speaking, the branches of physics and geophysics that are concerned with the earth's atmosphere and its environment in space. Since this environment is strongly influenced by the sun's radiation, it is often convenient to say that the I.Q.S.Y. programme is concerned with the acquisition of new knowledge concerning solar-terrestrial relations and the closely related branches of physics.

This introductory section is intended for the general reader who has no detailed knowledge of these relations, or of the complex ways in which all the I.Q.S.Y. disciplines are interconnected with each other, often in spite of the lack of any obvious connecting links. In order to appreciate the significance of the term « solar-terrestrial relations », it is necessary to consider, in a little more detail, first the particular features of the sun and the earth which enable these relations to be established, and second, the physical interactions that are responsible for the particular phenomena than can appropriately be included in studies of solar-terrestrial relations.

2. — The Sun and the Earth.

One of the most important characteristics of the sun is that it emits a copious flood of electromagnetic wave radiation over a wide range of the spectrum : radio waves, heat and infra-red radiation, visible light, ultra-violet and X-radiation. It emits also a large variety of charged atomic and sub-atomic particles ; these have a wide range of velocities and many of them travel at such high velocities that they escape completely from the sun's atmosphere and travel outwards into space. Both the wave and the particle radiations are emitted in all directions ; after traversing the 150 million kilometres between the sun and the earth, a small fraction of the radiation passes close to the earth and may be intercepted by it. It is obviously necessary to enquire what effects are caused by the arrival of this radiation but, before doing so, it is important to consider two important facts about the earth and its immediate environment in space. First, the earth is enveloped by its atmosphere which contains a mixture of different gases. This atmosphere is retained only because of the existence of the earth's gravitational field which controls many of the fundamental characteristics of the atmosphere. It is worth noting, in passing, that the gravitational field of the moon also has a role to play : in addition to the familiar tides in the oceans, the moon is responsible also for tidal movements in the atmosphere. The second important characteristic of the earth is that it has a strong magnetic field which extends far out into space, although with ever-decreasing intensity.

3. — The I.Q.S.Y. Disciplines.

In the following paragraphs it will be convenient to refer to the wave and particle radiations which reach the earth from the sun by the letters W and P respectively ; in the same way, the earth's atmosphere and magnetic field will be denoted by A and M respectively. A simple extension of the use of these letter symbols can be used to denote interactions between the solar radiations and the earth's surroundings ; for example, if solar ultra-violet radiation (W) enters the atmosphere (A), it may detach electrons from one of the atmospheric gases and this interaction can be denoted by WA. The free electrons thus produced are mainly responsible for the ionosphere, and studies of a wide variety of

ionospheric phenomena represent the main activity of Discipline V of the I.Q.S.Y. programme.

The scientific disciplines into which the I.Q.S.Y. programme has been divided are as follows :

II. Meteorology
III. Geomagnetism
IV*a*. Aurora
IV*b*. Airglow
V. Ionosphere
VI. Solar Activity
VII. Cosmic Radiation and Geomagnetically Trapped Particles
XV. Aeronomy

In all of these disciplines, as a result of the spectacular developments of the last decade, it is now possible to make many types of measurement by instruments in rockets, satellites and space probes, and it is convenient to regard all such measurements as an additional composite discipline which is known as :

XI. Space Research.

The Roman numerals that are used above to identify the I.Q.S.Y. disciplines were adopted during the International Geophysical Year ; the missing numbers refer to « solid-earth » disciplines which are not included in the I.Q.S.Y. programme because they are concerned with phenomena in which the influence of solar radiation in unimportant : glaciology, volcanology, etc.

4. — Solar/Terrestrial Interactions.

4.1. — *Basic Ideas.*

Table 1 shows diagrammatically how investigations of the principal physical phenomena which result from the various possible interactions are distributed among the different I.Q.S.Y. disciplines. For example, the interaction (PM) between solar particles (P) and the earth's field (M) gives rise to phenomena which are investigated mainly in Disciplines III (Geomagnetism), IV*a* (Aurora) and VII (Cosmic Radiation and Geomagnetically Trapped Particles). In addition to investigations of the various interactions referred to above, it is essential also to investigate the four basic solar and terrestrial entities represented by W. P, A and M ; work relating to all of these is included in one or more of the I.Q.S.Y. disciplines and is indicated in the appropriate cells in Table 1.

The later chapters describe, in more detail, the scientific programmes in each of the I.Q.S.Y. disciplines. Here it will be sufficient to summarize only the most elementary facts about the different interactions that are represented in diagrammatic form in Table 1.

4.2. — *Wave/Atmosphere Interactions* (*WA*).

Meteorology. — Much of the energy contained in the incoming wave radiation is absorbed by the atmosphere and converted into heat ; the heat generated has many very important consequences in meteorological studies.

Airglow, — The ionization and even the excitation of the atmospheric gases by incoming wave radiation often results in the emission of light from which important information about the state of the atmosphere can be obtained.

Ionosphere. — Ultra-violet and X-radiation causes electrons to be detached from atmospheric gases : this is the process of photo-ionization. The different layers of the ionosphere are formed mainly by electrons produced in this way.

Aeronomy. — Solar radiation causes chemical changes in the atmospheric gases.

4.3. — *Particle/Atmosphere Interactions* (*PA*).

Aurora. — The light emitted during auroral displays results from collisions between particles and atmospheric gases.

Ionosphere. — Some of the free electrons in the ionosphere are produced by the charged particles which bombard the atmosphere.

Cosmic Radiation. — When the fast primary cosmic ray particles enter the earth's atmosphere, secondary particles are often generated as a result of collisions with the atmospheric gas atoms.

4.4. — *Particle/Magnetic Field Interactions* (*PM*).

Geomagnetism. — Incoming streams of charged particles can be regarded as electric currents which have associated magnetic fields. The magnitudes of these fields are partly determined by the trajectories of the particles which, in turn, are modified by the earth's magnetic field. It is possible for geomagnetic observatories to detect and measure the fields associated with these streams.

Aurora. — The striking geometrical forms, which can easily be seen in many auroral displays, are controlled partly by the

TABLE 1.

		SOLAR RADIATION	
		W *Electromagnetic Waves* (I.A.U. and U.R.S.I.) VI Solar Activity	*P* *Atomic Particles* (I.A.U. and I.U.P.A.P. VI Solar Activity VII Cosmic Radiation (primary particles)
EARTH	*A* *Atmosphere* (basic characteristics) (I.U.G.G.) II Meteorology XV Aeronomy	WA II Meteorology (energy balance etc.) IV*b* Airglow V Ionosphere (Layer structure) XV Aeronomy (photochemistry etc.)	*PA* IV*a* Aurora (spectra) V Ionosphere (disturbances) VII Cosmic Radiation (secondary particles)
	M *Magnetic Field* (permanent field) (I.U.G.G.) III Geomagnetism	*WM* V Ionosphere (wave propagation)	*PM* III Geomagnetism (variations) IV*a* Aurora (structure) VII Cosmic Radiation (trapped partieles)

Investigations of solar wave and particle radiation, the earth's atmosphere and its magnetic field are relevant to the I.Q.S.Y. disciplines indicated in the cells marked *W*, *P*, *A* and *M*. The disciplines mainly concerned with interactions are shown in the cells marked *WA*, *PA*, *WM* and *PM*.

The entry in the *WM* cell refers to a special type of radio-wave propagation, but the waves do not come from the sun (see 4.5.).

velocity and other characteristics of the particles, and partly by the structure of the geomagnetic field.

Cosmic Radiation and Geomagnetically Trapped Particles. — Under certain conditions, some of the incoming particles can not continue their progress from the Sun to the Earth because they are trapped by the geomagnetic field. When this occurs, the trapped particles circulate backwards and forwards along closed paths in the so-called radiation belts.

4.5. — *Wave/Magnetic Field Interactions (WM).*

Ionosphere. — The propagation of radio waves along the lines of force of the earth's field and especially between the Northern and Southern Hemispheres, is an important method for studying the highest levels of the ionosphere. The radio waves used do not, however, come from the sun, but are generated on the earth by lightning flashes or radio transmitters.

4.6. — *More detailed interactions.*

The foregoing description of the I.Q.S.Y. disciplines omits a great deal of detail and is intended to be only a very much simplified outline. In each of the disciplines, there are many subsidiary phenomena which are, nevertheless, important subjects for investigation. Some of these are shown in Table 2 which can be regarded as a further development of Table 1. The cells marked A represent the W and P cells in Table 1, and those marked B the A and M cells. Some of the cells marked C represent interactions between A and B cells as in Table 1 ; others arise from more complex interactions in which C cells may also be involved. The Roman numerals indicate the I.Q.S.Y. disciplines that are mainly concerned with the various phenomena represented, but it will be noticed that in many cases these phenomena are subjects for inter-disciplinary study.

5. — Organization of the I.Q.S.Y. Programme.

In concluding this chapter, it is appropriate to refer briefly to the International Council of Scientific Unions (I.C.S.U.) and those of the member Unions that are closely interested in the I.Q.S.Y. programme :

International Astronomical Union (I.A.U.),
International Union of Geodesy and Geophysics (I.U.G.G.),

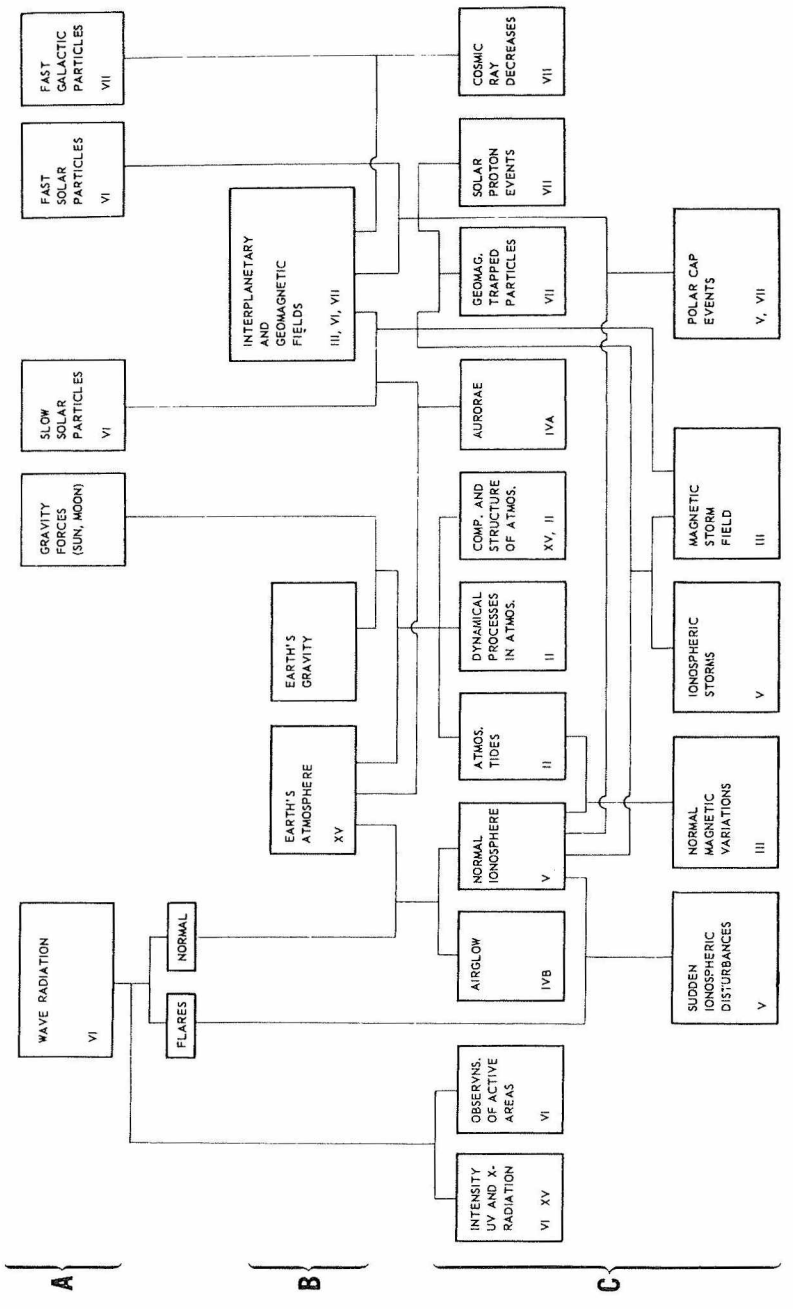
A
B
C
WAVE RADIATION VI
NORMAL
FLARES
OBSERVNS. OF ACTIVE AREAS VI
INTENSITY UV AND X-RADIATION VI XV
EARTH'S ATMOSPHERE XV
EARTH'S GRAVITY
GRAVITY FORCES (SUN, MOON)
AIRGLOW IVB
NORMAL IONOSPHERE V
ATMOS. TIDES II
DYNAMICAL PROCESSES IN ATMOS. II
COMP. AND STRUCTURE OF ATMOS. XV, II
AURORAE IVA
SLOW SOLAR PARTICLES VI
FAST SOLAR PARTICLES VI
FAST GALACTIC PARTICLES VII
INTERPLANETARY AND GEOMAGNETIC FIELDS III, VI, VII
SUDDEN IONOSPHERIC DISTURBANCES V
NORMAL MAGNETIC VARIATIONS III
IONOSPHERIC STORMS V
MAGNETIC STORM FIELD III
GEOMAG. TRAPPED PARTICLES VII
SOLAR PROTON EVENTS VII
COSMIC RAY DECREASES VII
POLAR CAP EVENTS V, VII

TABLE 2.

International Union of Pure and Applied Physics (I.U.P.A.P.), International Scientific Radio Union (U.R.S.I.).

In Table 1, the cells marked W. P. A. and M include the initials of the Unions that are mainly concerned with the four basic entities. As explained earlier, the phenomena indicated in the cells WA, PA, WM and PM are the result of interactions between the basic entities and, in consequence, if frequently occurs that several Unions are interested in each of the I.Q.S.Y. disciplines that are concerned with these interaction phenomena. It is for this reason that the central coordination of the I.Q.S.Y. is not the responsibility of any one Union, but of the Special Committee for the I.Q.S.Y. which was established by I.C.S.U. The I.Q.S.Y. Committee includes in its membership representatives of the four Unions mentioned above, and of other I.C.S.U. Committees that have close connections with particular aspects of the I.Q.S.Y. programme : the Committees for Space Research, for Antarctic Research and for Geophysics. Since the I.Q.S.Y. Committee has such a broadly-based membership, it is well suited to act as the central organizing body for the I.Q.S.Y. and also as a focus for discussions of the many interdisciplinary questions which constitute one of the most important parts of the I.Q.S.Y. scientific programme.

Chapter. VII — Ionosphere

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Introduction

The I.Q.S.Y. programme is generally aimed at completing studies, initiated during the I.G.Y., of the solar-cycle dependence of ionospheric properties, but special emphasis has been given to investigations made possible by the present quiet sun conditions. A continuation of conventional techniques is imperative in order to obtain results which can be directly compared with those obtained previously during the I.G.Y.

In addition, the start of new investigations has been made possible by recent progress in knowledge and technology. For example, the expanded work on electron-density profiles provides the basis

for a better understanding of dynamical processes in the ionosphere ; and the use of topside sounders and high-power radar, combined with the observations of beacon satellites, provides new types of information about the upper ionosphere which were available only in fragmentary form during the I.G.Y. The observation of VLF and ELF phenomena should give at least partial information about the events occurring in the outer fringe region of the ionosphere. The closer coordination between ground observations and measurements made « in situ » on board rockets and satellites will greatly increase the value of the individual experiments.

A list of some of the problems which are especially appropriate for study during the I.Q.S.Y. is given below.

(*a*) The upper side of the F region is now accessible to measurements in several ways, both indirectly from the ground and directly by rockets and satellites. A study of the total F-region electron content and its time and geographic varitions is an important I.Q.S.Y. project since it involves close cooperation between scientists responsible for measurements made using ground-based and space techniques.

(*b*) Geomagnetic control of the ionosphere has acquired a new significance with the improved understanding of the role of the magnetic field in aligning and guiding electrons. Coordinated observations at magnetically conjugate stations takes on increased importance in the ionospheric discipline as well as in studies of the aurora.

(*c*) The lower ionosphere, 50 to 100 km, is still not well understood. A special effort is required to improve the understanding of ionospheric absorption processes, and work carried out during the relatively simple conditions of minimum solar activity will be helpful. The opportunity now exists to bring together the potentialities of various improved ground-based techniques and those of the newer rocket methods.

(*d*) One of the major conclusions of I.G.Y. and I.G.C. was that the ionosphere cannot at all times be regarded as a medium in quasi-equilibrium, especially during disturbed conditions. The dynamic processes in the ionosphere are thus of paramount interest. Obviously, a satisfactory picture of these processes can be obtained only from a knwoledge of true motions in the ionosphere. These, in turn, may be derived from the temporal variations of

N(h) profiles and from simultaneous ionospheric drift observations, but it is also important to calibrate the data obtained in this way against drift measurements made by meteor and rocket techniques.

(e) The physics and chemistry of the formation and maintenance of the regular ionospheric layers remains an important problem, even though great progress resulted from the vertical soundings and the rocket programmes of the I.G.Y. A complementary programme during the I.Q.S.Y. is most important, especially since conditions are relatively undisturbed and the F1 layer is more prominent. The broad geographic coverage of the vertical-incidence sounding network is contributing significantly to this work.

(f) The characteristics and the development of the ionosphere over the polar caps may hold the key to an understanding of many ionospheric processes. Here the comparison of solar maximum and minimum data will help. Readjustment of station networks in view of I.G.Y. results and the introduction of additional experiments at high-latitude stations would be valuable.

(g) Irregularities in the electron distribution in the very high ionosphere or exosphere have become better recognized as a result of the I.G.Y. and subsequent efforts. It seems certain that very significant solar-cycle effects will be found in this part of the ionosphere, although the details of such changes can hardly be predicted.

Programme of Observations

For practical reasons, the very broad programme covered by the ionospheric discipline has been divided into sub-disciplines. In most of these, the work may be divided into two parts : synoptic observations and special experiments. Both types of work are essential for the attainment of the I.Q.S.Y. objectives.

1. — Synoptic Observations.

1.1. — *Vertical Incidence Soundings.*

An adequate coverage of the entire globe by routine vertical incidence sounding stations is the prime requisite for a world-wide study of the diurnal, seasonal and geographic variations of the principal ionospheric parameters. Only the restoration of the

complete network as it existed during the I.G.Y. would ensure full comparability of the results obtained during the I.G.Y. and I.Q.S.Y. periods. An improvement of this network in polar regions and near the dip equator is aimed at a better understanding of the anomalies discovered in these areas during the I.G.Y. The use of shipborne and airborne ionosondes, even if it is only temporary, will help to fill the gaps still existing in ocean areas.

A substantial improvement of most existing ground-based ionosondes is, however, a prerequisite for a sufficiently accurate reduction of bottomside ionograms. Although no uniform procedure for the reduction of ionograms to electron-density profiles has been designated, the profile work has increased considerably during the I. Q. S.Y. and will lead to a better understanding of the dynamical processes in the ionosphere. The extension of the low-frequency limit of the ionosondes to 0.25 Mc/s gives an opportunity to study, on a routine basis, the lower part of the ionosphere at locations where interference from radio stations is small on these frequencies. Comparison of the data with those obtained using other methods such as ionospheric cross-modulation, partial reflections and rocket sounding will be indispensible for calibration purposes.

The combined use of satellites, and particularly of the successful topside sounders, with high-power radar provides ionospheric data at heights above the maximum of the F2 layer which were not yet accessible during the I.G.Y. Because of the very great amount of data obtained continuously by the topside sounders, substantial improvements and modifications in the methods of reduction and a drastic expansion of the facilities for analysing the ionograms are required to ensure the full exploitation of the data now being obtained.

1.2. — *Absorption Observations.*

The main objectives of the I.Q.S.Y. absorption programme are :

(*a*) to study diurnal, seasonal, and solar-cycle variations of absorption, and their connection with local and world-wide magnetic activity ;

(*b*) to compare the absorption at different latitudes and longitudes and to determine the areas over which the absorption has the same characteristics ;

(*c*) to correlate the observed changes in absorption, as a function of frequency and time, with the variations of the distribution of ionization.

The methods of measurement fall into three main groups :

A1 — measurement of the amplitudes of radio pulses reflected from the ionosphere.

A2 — measurement of the absorption in the ionosphere of extra-terrestrial radio noise (Riometers).

A3 — measurement of the field strength of sky-wave radio signals propagated over short distances at oblique incidence on frequencies suitable for obtaining data on ionospheric absorption.

In addition, relative changes in absorption can be measured semi-quantitatively using ionogram parameters such as the minimum frequency at which echoes can be detected.

Since the full analysis of absorption measurements is very complicated, and involves a number of different techniques, it is scarcely practicable to adopt it on a scale suitable for synoptic studies. Thus, it is necessary not only to use the full analysis when and where possible, but also to supplement it by simpler procedures which can be used on a world-wide scale.

The data obtained using methods A1, A2 and A3 do not refer to the same region of the ionosphere. The riometer (A2) measurements, which are made on frequencies well above 10 Mc/s, are mostly influenced by the absorption below 70 km. Thus, a combination of A2 with A1 or with A3 is highly desirable.

To ensure unambiguous results in the pulse amplitude method, the measuring frequency must never approach the critical frequency of the reflecting layer. Since this is not possible if a single frequency is used at all times of the day throughout the entire year, a minimum of two frequencies has been adopted for both the I.G.Y. and I.Q.S.Y. observations.

Absorption studies at conjugate points have been strongly recommended during the I.Q.S.Y. Experiments are desirable to study the geomagnetic cut-off for the cosmic radiation which presumably generates the normal ionization at low heights in the ionosphere.

Since the ultimate objective of absorption measurements is to obtain information about the physical properties of the upper

atmosphere, particularly the electron density and collision frequency at heights below 100 km, a combination of absorption measurements with some other types of observations is recommended. For example : the partial reflection and cross modulation techniques, VLF observations, and direct rocket measurements.

1.3. — *Drift Observations.*

The main objectives of the I.Q.S.Y. drift programme are :

(*a*) to study diurnal, seasonal, and solar-cycle variations of drift and their connection with local and world-wide magnetic activity ;

(*b*) to interpret drift data obtained by different methods in order to gain a clearer picture of the relevant atmospheric phenomena.

The following methods are used for drift observations :

D1 — intercomparison of the fading patterns of radio reflections from the ionosphere received on three or more antennae spaced a few wavelengths apart.

D2 — radar observations of drifting meteor trails.

D3 — radio-star scintillations with three or more antennae spaced several wavelengths apart.

D4 — observation of characteristic reflection features of the ionosphere at widely spaced sites.

It is not yet clear which features of the fading pattern actually drift with the ionospheric plasma, but the observation of drifting meteor trails (D2) presumably gives directly the motion of the gas. Thus, it is essential to make intercomparisons of the different methods at the same location, and to compare the results with those obtained by more direct methods ; for example, by optical observation of visible meteor trails, or of artificial clouds released from rockets.

Experience gained during the I.G.Y. has shown that, in order to obtain satisfactory statistical results, it is necessary to have a large number of observations well spread out in time. It is preferable, therefore, to have many observations on a few days, rather than a few observations on many days. Accordingly, it has been recommended that observations should be carried out on every Wednesday and Thursday, on all Regular World Days and on all Geophysical Intervals at least once every hour for a recording period of 5-15 min.

Since the drift parameters change rapidly with height, it is important to obtain an accurate determination of the height to which the data refer.

1.4. — *Almospheric Radio Noise.*

The world-wide synoptic programme started during the I.G.Y. is being continued diring I.Q.S.Y. with the following objectives :

(*a*) to explain the generation of radio noise and to evaluate the energy radiated from lightning discharges at all frequencies ;

(*b*) to describe quantitatively the world distribution of occurrences of lightning discharges ;

(*c*) to compare the present radio noise intensities at a number of receiving locations with those observed during the maximum of the solar cycle.

The programme includes automatic monitoring on a series of frequencies chosen to be relatively free of interference from normal radio transmissions, as well as specific observations of energy spectrum, noise level, and waveform of atmospherics. An extension of the observations into the ELF range is recommended. Measurements in topside sounders are expected to give valuable information about extra-terrestrial radio noise.

1.5. — *Whistlers and VLF Ionospheric Noise.*

Synoptic observations, similar to those taken during the I.G.Y., are being continued during the I.Q.S.Y. at all latitudes in order to determine the effect of solar activity on the properties of whistlers and VLF ionospheric noise. An extension of the frequency range to 20 kc/s is recommended so that VLF code transmissions will be available for accurate relative timing. Special emphasis on observations at pairs of magnetically conjugate stations is also recommended.

To obtain a full picture of the time variation of VLF ionospheric noise, continuous recordings are needed in the range of synoptic whistler observations, usually between 300 and 30.000 kc/s, and especially at medium and high latitudes. The provision of accurate information about the amplitude of whistlers would be of value.

1.6. — *Forward Scatter.*

The scattering of metric radio waves by auroral structures has proved to be an important addition to visual observations of aurorae, especially during daylight and in overcast sky conditions at night. In middle latitudes, this technique also provides information about the ionized trails produced by meteors, the occurrence of sporadic-E ionization, and movements in the lower ionosphere. The scientific use of operational radio links, the establishment of a VHF network in the Antarctic and the investigation of forward-scatter phenomena at conjugate points have been recommended during I.Q.S.Y.

2. — Special Projects.

Some types of investigation are too expensive to be carried out on a synoptic basis and must be restricted in their use ; others are confined to the study of peculiar regions or of particular conditions. Such investigations are referred to as special experiments.

The structure of the lower ionosphere could not be observed on a routine basis during the I.G.Y. It is desirable during the I.Q.S.Y. that some of the different methods for investigating the D and the lower E region be compared and that the simpler ones be calibrated by comparisons with the more sophisticated ones. By combining the results from vertical soundings on low frequencies, absorption measurements on many frequencies, cross-modulation experiments, partial reflection techniques, propagation, and direct-probe experiments on board rockets, new or more reliable information may be obtained about the lowest part of the ionosphere. As a result of the experience gained during the I.G.Y., closer-spaced networks of observing stations are to be operated in areas where the structure of the ionosphere changes rapidly with geographic position.

Drift observations will be planned to coincide with direct observations of atmospheric motion through the use of artificial clouds ejected from rockets and tracked either optically or by radar.

2.1. — *Extra-Terrestrial Radio Noise measured in Topside Sounders.*

Extra-terrestrial radio noise in the frequency range between the lower limit of the topside sounder and the critical frequency of the F layer, will be recorded during periods when the transmitter of the topside sounder is off.

2.2. — *Whistler and VLF.*

Whistler and VLF noise will be recorded in rockets and satellites thus providing information on VLF propagation through and, within the ionosphere.

2.3. — *Incoherent Scatter.*

The amplitude of signals sent out by high-power radar on frequencies greater than the critical frequency of the F2 layer, and scattered back by the unevenly distributed electrons in the upper ionosphere, will give information about the electron density at altitudes up to approximately 1000 km. A comparison with the results obtained by rockets and satellites will remove the uncertainties inherent in the scatter technique.

2.4. — *ELF Radio Noise.*

Observations of radio noise on frequencies between 10 and 300 c/s will be compared with geomagnetic phenomena and the flux of solar corpuscles in order to reveal the origin of the noise.

2.5. — *Backscatter.*

Improvements in technique will enable backscatter and oblique incidence observations on paths of widely different length to be carried out more frequently than in the I.G.Y. Modes of propagation and time delays will be studied during special experiments.

2.6. — *Conjugate Point Experiments.*

In the disciplines of aurora, geomagnetism and ionospheric physics, conjugate point observations will play an especially important part in the programme. Several pairs of stations have already been in operation on a trial basis, and the first results show the need for the establishment of as many pairs of such stations as possible during the I.Q.S.Y. In general, the conjugate-point network should provide at least one pair of stations well inside, one station well outside the auroral zones, and two stations near its maximum. Plans are already under way for some of these locations, and investigations of additional possibilities are being made. Observations to be undertaken at such locations include : vertical incidence soundings, magnetic field variations including micropulsations, ionospheric absorption with riometers,

cosmic-ray intensity by means of neutron monitors, frequency of occurrence and details of auroras using all-sky cameras and photometers, and the incidence of fast particles and X-radiation utilizing instruments carried aloft in balloons.

C.C.I.R.

Interim Meeting of C.C.I.R. Study Group IV

(Space systems and radioastronomy)

Attention of the members of Commissions V and VI, S.R.R.C., I.U.C.A.F. and U.R.S.I./C.C.I.R. is called to the following report reprinted from the *European Broadcasting Union E.B.U. Review*, n° 90-A, Technical, April 1965.

In preparation for the XIth Plenary Assembly of the C.C.I.R., Study Group IV (Space systems and radioastronomy) held an interim meeting at Monte-Carlo from 10th February to 2nd March, 1965, under its Chairman, Professor I. Ranzi (Italy). We give below a summary of the conclusions of that meeting, insofar as they relate to matters associated with broadcasting. The reports deal individually with the work of the several subgroups set up at Monte-Carlo, the numbers in square brackets referring to their more important documents.

SUB-GROUP IV-A : *Technical characteristics of communication satellite systems.*

(*Chairman*, Mr. W. KLEIN, Switzerland)

This Sub-group divided up into six working parties, one of which dealt with direct broadcasting from satellites.

Most of the discussion on the technical characteristics for communication satellite systems dealt with the use of wide-band FM links for both up-going and down-coming signals. Links of this type, which are already widely used for terrestrial radio-relay purposes, can provide up to 1200 telephone channels and are suitable also for transmitting television signals. The problem of interference in the bands shared with terrestrial services was given particular attention, and there was some discussion of methods of dispersing the energy over the band occupied by the carrier, in order to avoid too great a concentration of energy in the neigh-

bourhood of the carrier centre-frequency during periods of low telephone traffic density (IV/134). A new study programme stresses the importance of further research on « carrier energy dispersal », for telephony as well as for television (IV/135). Alternative methods of transmission also were discussed, notably single-sideband and pulse-code modulation.

The characteristics of the modulation system are evidently of fundamental importance in solving the problem of « multiple access » by more than one pair of Earth-stations to a single satellite, that is to say, of providing more than one circuit through the satellite at the same time. A draft report giving many data on this problem was prepared (IV.141), and one of the study programmes (IV/121) was amended to take account of the probability of increasing utilisation of pulse-code modulation in the terrestrial radio-relay links that share frequencies with satellite communication systems.

A new draft report (IV/131) describes the characteristics of large existing or projected aerial systems for Earth-stations. In general, these aerials have gains of from 58 to 59 decibels at 4000 Mc/s, relative to an isotropic aerial, and noise-temperatures of from 35° to 45° K at working angles of elevation.

During the discussions on direct broadcasting from satellites, it was mentioned that Report 215 (Geneva, 1965) gives reasonably correct figures for the power necessary for a transmitter in a « stationary » satellite, for broadcasting television or FM sound. Consequently, only slight modifications were made to that Report; the same was true of the corresponding Question (IV/107 and IV/108). The new contributions submitted dealt principally with the difficult problem of mutual protection between a broadcasting service direct from a satellite and a terrestrial service using the same channel. Even if the most favourable estimates are used, it would seem that channel-sharing in this manner must be excluded, and the problem of protection was referred to Study Groups X and XI.

It is interesting to report that circular polarisation rather than linear polarisation seems indicated for broadcasting direct from satellites, in order to avoid fading caused by varying « Faraday rotation » in the ionosphere. From the technological point of view, the achievement of broadcasting direct from satellites is likely to be delayed only by the difficulty of obtaining the necessary

transmitter power, especially in the case of television ; the nuclear generator is almost certainly the only possible solution.

SUB-GROUP IV-B : *Frequency-sharing problems.*
(*Chairman* : Mr. H. FINE, U. S. A.)

The proposed sharing of frequencies in the 4000 and 6000 Mc/s bands, between satellite telecommunication systems and terrestrial radio-relay links, poses numerous technical problems, including that already mentioned, the dispersion of the carrier energy. The discussions dealt notably with the calculation of the « coordination distance » suggested in Recommendation 1A of the Extraordinary Administrative Radio Conference (Geneva, 1963) (IV/117) ; it will be recalled that the coordination distance is defined as that range within which interference problems have to be investigated in detail. In addition, the Administrations were invited to re-examine, before the next C.C.I.R. Plenary Assembly Assembly, Recommendation 358, which fixes the maximum acceptable values of the spectral power density at the Earth's surface due to radiation from telecommunication satellites (IV/127).

SUB-GROUP IV-C : *Space-research systems and space-to-space links.*
(*Chairman* : Mr. W. A. C. SCHULTZ, Canada).

Two new draft Reports (IV/101 and IV/116) were prepared, dealing with radio-navigation satellites, as well as with the problems of the remote measurement and remote control of satellites using frequency bands shared with other services. An important conclusion of these draft Reports was that it would seem out of the question to envisage sharing frequencies with sound or television broadcasting, because of the disturbance that those services would cause to the satellite links. Other draft Reports gave new information on meteorological satellites and their frequency requirements (IV/43, IV/44, IV/102 and IV/103).

SUB-GROUP IV-D : *Propagation and noise problems.*
(*Chairman* : Mr. J. VOGE, France)

The problem of the calculation of the coordination distance between the Earth-stations of space systems and terrestrial radio-

relay stations has already been mentioned, with reference to Sub-group IV-B. The calculation of that distance poses some particular propagational problems, notably in the case of an Earth-station located on the floor of a hemmed-in valley. These problems have still to be studied in collaboration with Study Group V, but, in order to stress their importance, three new draft Questions on this subject were adopted (IV/122, IV/125 and IV/142).

Another draft Question (IV/123) relates to the use in the more distance future of a « space station » for radio-astronomical observations ; it might perhaps be located on the invisible face of the moon.

SUB-GROUP IV-E : *Radio-astronomy and radar-astronomy.*

(*Chairman* : Dr. R. L. SMITH-ROSE, United Kingdom).

An interesting contribution (IV/139) dealt with the recent discovery in the Galaxy of the spectral lines of the hydroxyl ion on frequencies of 1612, 1665.4, 1667.4 and 1720 Mc/s.

A draft Report replacing earlier reports on radio-astronomy comprises a revised table of the levels of interference susceptible to disturb the most sensitive observations (IV/137). It was mentioned that interference at a level of about 40 or 50 decibels below 1 V/m could affect certain measurements in the neighbourhood of 237, 610, 1420 and 1665 Mc/s. Thus it appears that the local oscillator of a television receiver is theoretically capable of disturbing radio-astronomical observations up to a range of some five or ten kilometers. Similarly, radio-astronomical observations can be disturbed at very long ranges by television transmitters. These problems are evidently very complex and require further study.

TERMINOLOGY WORKING PARTY.

A special working party was set up a few days before the end of the interim meeting of Study Group IV, in order to undertake a revision of Report 204 « Terms and definitions relating to space radiocommunication » (IV/155).

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

1965 Plenary Meeting

MAR DEL PLATA, ARGENTINA
May 11, 1965

1. REPORT BY PROF. S. SILVER, U.R.S.I. REPRESENTATIVE
Report of U.R.S.I. to the C.O.S.P.A.R. Assembly.

Mr. President, Ladies and Gentlemen :

It is my pleasure and privilege to bring greetings from the Board of Officers of the International Scientific Radio Union to the 8th Assembly of C.O.S.P.A.R. and the Symposium on Space Research. The U.R.S.I. maintains an active interest in space research and engages actively in space research programs through participation in various inter-union efforts such as the I.Q.S.Y. as well as in the projects of its own Commissions. Commission III and IV of our Union are specially interested in the sounding of the ionosphere from satellites such as the Alouette and in the investigations of the magnetosphere and the interplanetary medium by various space probes. Commission V which is devoted to Radio- and Radar-Astronomy is very much interested in space programs directed to the exploration of the planets.

The subject of solar-terrestrial physics has been of special concern to the U.R.S.I. over the past few years. Since the XVth General Assembly held in Tokyo in September, 1963, the Union has made special efforts to develop in concert with the I.U.G.G., the I.A.U., and C.O.S.P.A.R. a coherent program in the field of solar-terrestrial physics. These efforts are bearing fruit and the plans for a first major joint union symposium in this field to be held in Belgrade in August, 1966, are moving ahead quite rapidly.

The U.R.S.I. has a special interest in all aspects of communications. In the case of space experiments the processes of data acquisition and transmission constitute an integral part of the experiment itself and the special communications problems posed by the design of experiments are of paramount importance.

We are extremely pleased to be participants in the C.O.S.P.A.R. Space Science Symposium as cosponsors and co-organizers of the Symposium on Optimization of the Design of Instrumentation for Space Experiments from the Standpoint of Data Processing. This topic has been chosen for special study by the U.R.S.I. Committee on Space Radio Research and we expect that the symposium held here will do much to clarify the problems and the road we must follow.

Immediately following the close of the C.O.S.P.A.R. Assembly there will be held in Arecibo, Puerto Rico, an U.R.S.I. symposium on the study of the Moon and the planets in the radio part of the spectrum. Although the emphasis will be placed on observations made by earth-based instruments the scope of the symposium and its content are significant aspects of space science. The discussions will point the way to the radio-exploration of the planets by means of space vehicles.

The International Scientific Radio Union has been pleased and gratified by the cooperative spirit that prevails its relations with C.O.S.P.A.R. My colleagues of the Board of Officers have asked me to express our deep sense of appreciation to Prof. Roy and the C.O.S.P.A.R. Bureau for this development. We hope to join with C.O.S.P.A.R. in many more projects of mutual interest and we are certain that our continuing cooperation and collaboration will do much to further the development of space research.

2. — Resolutions.

The resolutions approved by the Assembly in its final plenary session are reproduced hereafter. The following resolutions are of special interest to U.R.S.I. : 2 (I.U.C.A.F.), 3 (I.U.C.A.F.), 6 (Commission V), 8 (I.U.W.D.S.) and 12 (Commissions II, III and IV, and Sub-Commission IV*a*, and U.R.S.I./C.I.G. Committee).

Working Group 1 on Tracking, Telemetry and Dynamics.

Resolution 1. — *New I.A.U. System of Astronomical Constants.*

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

stressing the importance of rapid publication of observational data obtained by Space Research techniques which are of interest to positional astronomy and celestrial mechanics,

considering that such data should be consistent and directly comparable for many consecutive years, and

recognizing the importance of the I.A.U. system of astronomical constants as a reference system,

recommends that such observational data should be published with the shortest possible delay,

and *urges* that, if these data are to be published in a reduced form, the reduction be made using the new conventional values of these constants, and that this fact be explicitly stated in the publication.

RESOLUTION 2. — *Frequency Allocations for Space Research.*

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

noting with satisfaction the improvements in frequency allocations to space research effected by the final acts of the Extraordinary Administrative Radio Conference in Geneva, 1963, but

considering

(i) the expected extension of tracking and telemetry facilities in the near future, especially for deep space probes in all regions and for Earth satellites in Region 1 and 3,

(ii) the importance of recovering a high proportion of the telemetered data at all times, and of all data at certain critical times, and

(iii) the limitation in the steps which can be, and are being taken by system designers to reduce the effects of interference,

recommends that I.U.C.A.F. take all possible steps to ensure that the protection now accorded in the bands 2290-2300 Mc/s and 1700-1710 Mc/s in Region 2, be extended to Regions 1 and 3, the case for the former band being considered the more urgent.

RESOLUTION 3. — *Notification of Cases of Interference.*

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

recognizing the importance of achieving effective protection against harmful interference for those using the allocated radio frequency bands for space research purposes, and

noting the advice given by the Secretary General of I.U.C.A.F. (1),

(1) Radio Frequency for Space Research by R. L. Smith-Rose. Report of I.U.C.A.F. Representative to C.O.S.P.A.R., Buenos Aires, 1965.

urges all national space science committees to ensure, through their national administration (see Resolution 6, Florence 1964), that :

(i) All space research earth stations and space stations be registered with the International Frequency Registration Board of the I.T.U. ;

(ii) Reports of harmful interference be brought to the notice of the appropriate national administration so that it may take action towards securing elimination of this interference.

RESOLUTION 4. — *Simultaneous Observations for Scientific Purposes.*

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

recognizing the importance for geodetic and geophysical purposes of simultaneous observations from visual and photographic tracking stations, and

noting with satisfaction that several cooperative programs between several countries have produced fruitful results,

encourages the continuation and extension of such programs.

RESOLUTION 5. — *Visual Observations of Low-Perigee Satellites.*

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

noting that visual observations are most valuable for satellites of low perigee, and that more visual observations of such satellites as are not observed by more precise methods are needed,

encourages existing visual tracking stations to give the highest priority in observing such satellites ;

recommends that an effort be made by existing centers, or others yet to be created, to use all such observations in an attempt to derive variations in air density ; and

urges the prediction centers to provide predictions of such satellite and also to circulate to visual tracking stations lists of satellites already observed by more precise methods in order to avoid unnecessary efforts.

Working Group II for the I.Q.S.Y.

RESOLUTION 6. — *Solar Flare Observation and Prediction.*

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

recommends that every effort should be made to maintain the solar flare observation and prediction service established for the I.Q.S.Y.

Working Group III on Data and Publications.

RESOLUTION 7. — *Launch Information.*

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

calling attention to the provision of the *Guide* relating to pre-launch information, rockets flight summaries, and description of spacecraft experiments, and to C.O.S.P.A.R. Resolution Nos. 18 and 20 of 1964.

urges that all adhering bodies comply with the relevant sections of the *Guide.*

RESOLUTION 8. — *Spacecraft categorization for SPACEWARN.*

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

Concurring in the recommendation of the International Ursigram and World Days service that the effectiveness of international distributions of satellite and space probe information via the SPACEWARN System may be improved if for these purposes spacecraft are identified in categories according to the urgency and details of information needed by the scientific community,

suggests the following categories

I. — Spacecraft particularly suited for broad international participation;

II. — Spacecraft of unusual interest; and

III. all others,

recommends that launching authorities include these categories in their launching announcements and

requests I.U.W.D.S. to develop on behalf of C.O.S.P.A.R. suitable methods of handling information of the different categories.

RESOLUTION 9. — *SPACEWARN Telegrams.*

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

notes with appreciation the response of the International Ursigram and World Days Service to earlier C.O.S.P.A.R. resolution providing for distribution by mail of a confirmed list of satellite designations and of satellites with continuous radio transmissions, and

suggests that I.U.W.D.S. uses the same method for widespread distribution of other non-urgent information now carried in SPACEWARN telegrams.

RESOLUTION 10.

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

noting with satisfaction the assistance of the United Nations in the publication of two special manuals, and

considering such support extremely valuable,

encourages further cooperation between C.O.S.P.A.R. and the United Nations in the publication and exchange of information

RESOLUTION 11. — *Distribution of Reports of National Scientific Institutions adhering to C.O.S.P.A.R.*

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

expressing the desirability of providing additional wide circulation and publicity for reports to C.O.S.P.A.R.,

requests that this be accomplished through the UN Committee on the Peaceful Uses of Outer Space.

General.

RESOLUTION 12. — *New Working Group VI.*

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

noting the resolution passed by the I.C.S.U. Executive Committee at its June, 1964 meeting to the effect that the programs of

atmospheric research recommended by the I.U.C.A.S. should be developed and executed under the general aegis of the I.U.G.G. in cooperation with C.O.S.P.A.R. and

noting the subsequent establishment by the I.U.G.G. of a Committee on the Atmospheric Sciences,

withdraws Resolution 25 of its Seventh Meeting and dissolves the Working Group VI established thereby,

expresses interest in the future work of the I.U.G.G. Committee on the Atmospheric Sciences and a desire to participate in this work to the fullest extent consistent with the Charter of C.O.S.P.A.R. and the terms of reference of the I.U.G.G. Committee,

authorizes the President of C.O.S.P.A.R. *to designate* two representatives to the I.U.G.G. Committee,

establishes a new *Working Group VI for Scientific Space Experiments Concerned with Properties and Dynamics of the Troposphere and Stratosphere*, with the following terms of reference :

(i) To further international understanding of, and cooperation in, the use of rocket and satellite systems and techniques for meteorological research, and

(ii) To promote international discussions involving meteorologists with scientists of other disciplines in order to provide a good climate for the development of imaginative new approaches to the use of rockets and satellites for meteorological research.

In order to ensure useful and proper collaboration between C.O.S.P.A.R. and W.M.O., and between C.O.S.P.A.R. and the I.U.G.G. Committee on the Atmospheric Sciences, C.O.S.P.A.R. *invites* each of these organizations to designate a person to serve as liaison representative with the new Working Group VI.

RESOLUTION 13. — *Place and date of the Ninth Plenary Meeting of C.O.S.P.A.R. and the Seventh International Space Science Symposium.*

The Plenary Meeting of C.O.S.P.A.R. gratefully acknowledges the invitation received from the National Academy of Sciences of Austria to hold the 1966 C.O.S.P.A.R. Meeting and Symposium in Vienna and decides that this Meeting and Symposium should be held during the period 10-19 May.

3. — Recommendations.

Special attention is called to Recommendations 5 and 6.

Recommendation 1. — *Revision of the World List of Satellite Tracking Stations.*

C.O.S.P.A.R. Working Group I,

noting the large number of corrections and additions which have been made to the World List of Satellite Tracking Stations since its first publication,

recommends that a completely revised List edited by Dr. B. G. Pressey with both optical and radio stations in the same volume, be issued early in 1966.

The Group also recommends that the attention of the national correspondents be specially drawn to the need for furnishing the Secretariat with all amendments by January 1966 at the latest, in accordance with the Resolution No. 1 of Florence, so that the revised list may be as complete and accurate as possible.

Recommendation 2. — *Manual on Optical Tracking Stations.*

C.O.S.P.A.R. Working Group I,

having approved the proposed « Manual for the Establishment of Optical Tracking Stations », prepared by C. de Jager and W. de Graaff,

expresses its thanks to Drs. De Jager and de Graaff for their work, and

recommends prompt publication of this Manual.

Recommendation 3. — *Guide to Plate Reduction Techniques.*

C.O.S.P.A.R. Working Group I,

noting that several methods for satellite photographic plate reduction are used by different groups, and that often the results of those reductions are not in a common reference system,

recommends that a detailed document on the different methods of reduction be prepared under the direction of Dr. G. Veis, to facilitate the precise utilization of published data, and to provide a reference text for new reduction centers.

RECOMMENDATION 4. — *Space Science Glossary of W. G.* III.

C.O.S.P.A.R. Working Group III,

noting that the International Academy of Astronautics has compiled a multilingual dictionary in *Astronautics* and that the UN terminology Unit has collected 3,500 space science terms in the 5 UN languages and Japanese,

and that both organizations have expressed interest in C.O.S.P.A.R. collaboration,

considers it undesirable to compile a third space science glossary and

recommends that the Panel on an International Multilingual Glossary collaborate with the UN and assist the IAA in the collection and definition of terms.

Working Group IV

RECOMMENDATION 5. — *Upper Atmosphere Studies.*

C.O.S.P.A.R. Working Group IV,

having considered recent results in the physics of the upper atmosphere,

draws attention to the following :

1. The systematic discrepancies between direct density measurements and those derived from satellite drag
2. The deviation from thermal equilibrium between the electrons, ions and neutral particles in the thermosphere and exosphere
3. The importance of minor constituents in the production and loss of ionization

and *recommends* increased emphasis on :

1. Studies of the basic principles involved in the different methods of atmospheric density measurements
2. Studies of the height distributions of the major and minor constituents and additional measurements of the minor neutral and ionized constituents with emphasis on the mesosphere and lower thermosphere.

RECOMMENDATION 6. — *New Name of Working Group IV.*

C.O.S.P.A.R. Working Group IV,

recommends that the name of the Working Group be changed from « International Reference Atmosphere » to « Properties of the Upper Atmosphere ».

The upper atmosphere being defined as the range of altitudes where Observational results are mostly obtained from rockets and satellites, i. e. from 30 km upwards.

The *purpose* of W. G. IV is to remain as defined in 1962.

RECOMMENDATION 7. — *CIRA* 1965.

C.O.S.P.A.R. Working Group IV,

appreciating the large effort exercized by the members of Working Group IV in constructing the CIRA 1965 models

recommends that C.O.S.P.A.R. Secretariat arranges for supplying a courtesy copy of CIRA 1965 to each member of the Working Group.

4. — NEXT MEETING OF C.O.S.P.A.R.

The 1966 meeting of C.O.S.P.A.R. will take place in Vienna. The dates will be established in the near future. Two symposium topics are under consideration :

The Moon and the Planets
Circumterrestrial Dust.

There will be as usual a section devoted to latest results in all fields.

5. — SYMPOSIUM ON OPTIMIZATION OF THE DESIGN OF INSTRUMENTATION FOR SPACE EXPERIMENTS.

The U.R.S.I. sponsored symposium on Optimization of the Design of Instrumentation for Space Experiments form the Standpoint of Data Processing seemed to have been received with great interest. The program comprised seven invited papers and discussion as follows :

1. General Introduction, S. SILVER (U. S. A.)

2. Processing of Telemetry Data Generated by Sensors Moving in a Varying Field, D. J. SAKRISON (U. S. A.).
3. On-Board Data Processing in Spacecraft as an Aid to Optimizing the Design of Experiments, A. P. WILLMORE (U. K.)
4. Parallel Decoding and Optimization of Data Processing, B. S. FLEYSHMAN (U. S. S. R.)
5. Modulation and Sampling of Gydromagnetic Radiation, C. P. SONETT (U. S. A.).
6. Statistical Treatment for Cosmic Ray Intensity Observed by Detectors Moving Above the Earth's Surface, H. MINE (Japan)
7. Design Considerations Involved in Preparation of Experiments for Small and Large Satellites, R. W. KREPLIN (U. S. A.)
8. Relative Advantages of Small and Observatory-Type Satellites, G. H. LUDWIG (U. S. A.).

The papers will be published in the volume of the proceedings of the symposium entitled Space Research, vol VI. The discussions were quite lively and made it apparent that we had served a useful purpose in opening up the subject. Much remains to be done, however, and the Space Radio Committee may find it profitable to continue a study of the subject.

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

Ninth Plenary Meeting and Seventh International Space Science Symposium

1. — C.O.S.P.A.R. is pleased to announce that its Ninth Plenary Meeting and Seventh Symposium will be held : in Vienna (Austria), from 10 to 19 May 1966.

The registration will start on May 9 at 10.00.

The symposium itself will start on Wednesday 11 May at 15.00 and will end on Wednesday 18 May at 18.30.

2. — The Symposium will comprise the following sections :

2.1. — Two specialized Physical Parts on the topics :

(*a*) Moon and Planets (R1)

(*b*) Interactions between the neutral part and the ionized part of the Atmosphere (R2).

These specialized Parts will comprise only invited review papers and invited contributed papers. The sessions are foreseen to be held on May 16, 17 and 18.

2.2. — Latest Significant Results (S).

Papers presented must deal with really latest results which are really significant,a nd obtained by means ofSatellites, Space probes, Sounding rockets and High altitude balloons.

2.3. — Life Sciences in relation with Space Research (L).

This part will be devoted to the four following topics :

— L1 Space Probe Sterilisation
— L2 Flight Observations on Primates
— L3 Bioregenerative Systems
— L4 Miscellaneous.

3. — The S sessions (paragraph 2.2 above) will be held within the framework of open sessions of C.O.S.P.A.R. Working Groups Nos. I, II, IV, VI.

The L sessions (paragraph 2.3 above) will be held within the framework of open sessions of C.O.S.P.A.R. Working Group V.

These S and L sessions are foreseen to be held from May 11 afternoon to May 14 morning.

4. — C.O.S.P.A.R. recalls that a Symposium sponsored by U.R.S.I.-I.A.U.-I.A.G.A. (I.U.G.G.) with the participation of C.O.S.P.A.R. will be held in Belgrade from August 29 to September 2, 1966.

The scope and the topics of this Symposium are given in annex. Scientists who have new data dealing directly with these topics are encouraged to present them in Belgrade rather than in Vienna.

Paris, July 30, 1965.

ANNEX TO C.O.S.P.A.R. ANNOUNCEMENT DATED JULY 30, 1965

Belgrade Symposium.

The Belgrade Symposium is a general Symposium on Solar Terrestrial Physics, cosponsored by U.R.S.I., I.A.U., I.A.G.A. (I.U.G.G.), C.O.S.P.A.R. agreeing to participate.

The Programme Committee of this Symposium is located at the Radio Space Research Station, Ditton Park, Slough, Bucks, England.

The main topics selected by the Programme Committee are :

Topic 1 : Solar Particle Emissions and Interplanetary Magnetic Fields.

Topic 2 : The Interaction of Solar Plasma with the Geomagnetic Field :
I : Quiet Conditions.

Topic 3 : The Interaction of Solar Plasma with the Geomagnetic Field :
II : Disturbed Conditions.

Topic 4 : Energetic Charged Particles in the Magnetosphere.

Topic 5 : The temperature of Neutral and Charged Particles in the Ionosphere and the Magnetosphere.

CONSEIL INTERNATIONAL DES UNIONS SCIENTIFIQUES (I.C.S.U.)

Comité Exécutif
IIIe Réunion

MUNICH, 5-7 AVRIL 1965

(See English text p. 115).

Nous publions ci-après des extraits du « Summary Record » rédigé par le Secrétariat de l'I.C.S.U.

RÉSOLUTIONS, DÉCISIONS ET RECOMMANDATIONS DU IIIe COMITÉ EXÉCUTIF

1. — ARTICLE 5.2.— RAPPORT DU TRÉSORIER.

Le Comité exécutif *décide* que les cotisations à l'I.C.S.U. doivent être versées en devises convertibles (Résolution nº 1).

Le Comité exécutif *approuve* le transfert au Fonds de Roulement de 25 000 dollars provenant de dons récents des Membres nationaux.

6. — ARTICLE 9.1. — RÉORGANISATION DU C.I.G.

Le Comité exécutif *accepte* le rapport du C.I.G. et *décide*

(1) que le C.I.G. reste en fonctions jusqu'à la fin de 1967 ;

(2) que le règlement limitant le mandat du président et des vice-présidents soit suspendu ;

(3) que le président et les vice-présidents en charge soient priés de rester en fonctions jusqu'à la fin de 1967, afin de leur permettre d'aider et de conseiller l'I.C.S.U. dans la préparation d'une nouvelle Constitution du C.I.G. (Résolution nº 4).

7. — Article 9.2 — Commission Inter-Unions des Relations Terre-Soleil (I.U.C.S.T.R.).

Le Comité exécutif décide que la Commission Inter-Unions sur les Relations Soleil-Terre soit instamment priée de faire les additions appropriées à sa composition actuelle, et d'apporter des modifications à son règlement, de façon à assurer la représentation de toutes les Unions, et de tous les Comités intéressés de l'I.C.S.U. ; que les Unions et Commissions concernées soient, de même, instamment priées de coordonner l'organisation de ces symposiums par l'intermédiaire de cette commission (Résolution 5).

8. — Article 9.6 — Commission Inter-Unions de l'Ionosphère (I.U.C.I.).

Le Comité exécutif *estime* que la Commission Inter-Unions des Relations Terre-Soleil pourrait fort bien inclure dans ses attributions le domaine d'activités de la Commission Inter-Unions de l'Ionosphère, et que l'éventualité de la dissolution de cette dernière commission devrait être considérée par les Unions intéressées, après consultation de Mr. Ratcliffe.

9. — Article 9.8 — Commission Inter-Unions de l'Enseignement des Sciences (C.I.E.S.).

Le Comité exécutif *décide* de demander au Président de désigner un comité chargé :

(1) de considérer les objectifs tant immédiats qu'à long terme de la Commission Inter-Unions de l'Enseignement des Sciences ;

(2) de s'enquérir des opinions de la Commission elle-même et des autres organismes intéressés ;

(3) de proposer une définition des attributions de la commission et d'envisager d'éventuelles modifications de sa constitution ;

(4) de soumettre ses conclusions au Comité exécutif à sa prochaine réunion (Résolution n° 6).

10. — Article 10.1 — Fédération des Services Astronomiques et Géophysiques (F.A.G.S.).

Le Comité exécutif *décide* de considérer attentivement la demande de F.A.G.S. concernant une allocation supplémentaire de 3800 dollars pour 1965.

15. — Article 11.6 — Groupe de Travail sur la Liberté de circulation des hommes de science.

1) Le Comité exécutif *décide* que ce Groupe de Travail devra tenir une réunion avant la prochaine Assemblée Générale.

2) Le Comité exécutif *décide* en outre qu'en ce qui concerne la République populaire de Chine, il convient d'encourager les contacts individuels entre hommes de science, et de recommander aux Académies au cours de leur correspondance avec l'Academia Sinica de Pékin, d'attirer l'attention de cette dernière sur l'importance de la liberté de circulation des hommes de science.

17. — Article 11.8 — Groupe de Travail de la Structure future.

Le Comité *décide* que :

1) les buts fondamentaux de l'I.C.S.U. doivent rester inchangés ;
2) de nouvelles Unions scientifiques ne devraient être admises à l'I.C.S.U. que lorsqu'aucune Union membre de l'I.C.S.U. n'a la possibilité d'étendre ses attributions à la nouvelle discipline par modification de sa structure propre ;
3) un Membre national ne saurait normalement être habilité à postuler son admission à l'I.C.S.U. que s'il est en mesure de faire face aux obligations de Membre, et possède un organisme national représentant adéquatement les activités scientifiques de la nation et existant au moins depuis six années ;
4) chaque Union devrait avoir un représentant au Comité exécutif, qu'il devrait être procédé à l'élection d'un représentant national supplémentaire pour chaque groupe de deux nouveaux représentants supplémentaires des Unions scientifiques ;
5) la périodicité des Assemblées Générales devrait être maintenue à deux années ;
6) le Président devrait être rééligible pour un second mandat de deux années, et le Secrétaire Général et le Trésorier devraient être rééligibles pour un maximum de trois mandats consécutifs ;
7) il devrait être créé un Comité permanent chargé d'examiner les demandes d'admission, comprenant le Président et huit autres membres, n'appartenant pas nécessairement au Comité exécutif ;

8) l'I.C.S.U. ne devrait normalement assumer la charge financière des réunions de ses Comités scientifiques et spéciaux que pendant leur période de formation ;

9) une plus large publicité devrait être assurée dans les publications de l'I.C.S.U. aux mesures prises dans l'intérêt général de la communauté mondiale, et il conviendrait d'examiner la possibilité d'établir une carte d'identité pour hommes de science de bonne foi participant aux activités de l'I.C.S.U. ou de ses organismes.

19. — Article 13.1 — Candidatures — Unions Scientifiques.

Le Comité exécutif

1) *recommande* à l'Assemblée Générale d'admettre comme Membre l'Organisation internationale de Biophysique pure et appliquée (I.O.P.A.B.) ;

2) *décide* de communiquer à l'Assemblée Générale le résultat du vote concernant l'admission éventuelle de l'Union internationale des Sciences de la Nutrition ;

3) *ne recommande pas* à l'Assemblée Générale d'admettre comme Membre la Section de Pharmacologie de l'Union internationale des Sciences Physiologiques.

20. — Article 13.2 — Candidatures — Membres nationaux.

Le Comité exécutif *recommande* à l'Assemblée Générale d'admettre comme Membre le Centre Scientifique de la Principauté de Monaco.

21. — Article 14.1 — Comité U.G.G.I. des Sciences atmosphériques

Le Comité exécutif *approuve* formellement le programme proposé par le Comité U.G.G.I. des Sciences atmosphériques, et *exprime* l'espoir que des mesures ultérieures seront prises, avec l'appui de l'I.C.S.U., de l'O.M.M., et peut-être plus tard de l'U.N.E.S.C.O.

25. — Article 21 — Déclaration concernant les provenances de fonds.

Le Comité exécutif *donne son approbation morale* à la recommandation proposée selon les termes suivants : « que l'I.C.S.U. et ses

organismes ne doivent pas accepter, ou transmettre, pour quelque objet que ce soit, de fonds provenant d'un groupe international quelconque à caractère militaire. »

Réunions du Comité Exécutif

Des extraits du procès-verbal établi en langue anglaise sont donnés pp. 118 à 139.

Rapports présentés au Comité Exécutif

Nous publions aux pages indiquées ci-après, les textes originaux des rapports présentés par les Unions, Commissions et Comités.

I.C.S.U.

Executive Committee
IIIrd Meeting

MUNICH, 5-7 APRIL, 1965

We quote the following parts from the Summary Record issued by I.C.S.U. Secretariat.

RESOLUTIONS, DECISIONS AND RECOMMENDATIONS OF THE IIIRD EXECUTIVE COMMITTEE

1. — ITEM 5.2 — TREASURER'S REPORT.

(1) The Executive Committee *resolved* that membership dues to I.C.S.U. shall be paid in internationally convertible currencies (Resolution 1).

6. — ITEM 9.1. — C.I.G. REORGANIZATION.

The Executive Committee *accepted* the report on C.I.G. and *resolved*

(1) that C.I.G. continue until the end of 1967;

(2) that the rules limiting the terms of office of the President and Vice-Presidents be waived; and

(3) that the incumbent President and Vice-Presidents be asked to continue in office until 1967 in order to assist and advise I.C.S.U. on the preparation of a new constitution for the C.I.G. (Resolution 4).

7. — ITEM 9.2 — INTER-UNION COMMISSION ON SOLAR AND TERRESTRIAL RELATIONSHIPS (I.U.C.S.T.R.).

The Executive Committee *resolved* that the Inter-Union Commission on Solar and Terrestrial Relationships be urged to make appropriate additions to its membership and modifications of its

rules so as to provide representation for all interested Unions, Commissions and Committees of I.C.S.U., and that the Unions, Commissions and Committees concerned be likewise urged to coordinate the arranging of symposia through this Commission (Resolution 5).

8. — Item 9.6 — Inter-Union Commission on the Ionosphere (I.U.C.I.).

The Executive Committee felt that the I.U.C.S.T.R. could satisfactorily cover the work of the I.U.C.I. and *agreed* that after consultation with Mr. Ratcliffe, the possibility of the dissolution of the I.U.C.I. should be considered by the interested Unions.

9. — Item 9.8 — Inter-Union Commission on Science Teaching (I.U.C.S.T.).

The Executive Committee *resolved* to request the President of I.C.S.U. to appoint a Committee :

(1) to consider the objectives both immediate and long-term of the Inter-Union Commission on Science Teaching ;

(2) to ascertain the views of the Commission itself and of other interested bodies ;

(3) to draft the terms of reference of the Commission and to consider possible changes in its constitution ;

(4) to submit its conclusions to the Executive Committee at its next meeting (Resolution 6).

10. — Item 10.1 — Federation of Astronomical and Geophysical Services (F.A.G.S.).

The Executive Committee *agreed* to give serious consideration to the application of F.A.G.S. for a further $ 3800 in 1965.

15. — Item 11.6 — Working Group on Free Circulation of Scientists.

(1) The Executive Committee *agreed* that the Working Group should hold a meeting before the next General Assembly.

(2) The Executive Committee further *agreed* that with regard to the People's Republic of China, contacts between individual

scientists should be encouraged, and the academies asked to stress in their correspondence with the Academica Sinica in Peking the importance of the free circulation of scientists.

17. — ITEM 11.8 — WORKING GROUP ON FUTURE STRUCTURE.

The Executive Committee *decided* that :

(1) there should be no changes in the main objectives of I.C.S.U.

(2) new scientific Unions should be admitted to membership of I.C.S.U. only where there is no possibility for an I.C.S.U. Member Union to accommodate the new discipline by modification of its own structure ;

(3) a National Member should not normally be considered as ready for full membership, unless it can fulfil the obligations imposed by full membership and has a national body representing the country's scientific activities which has been in existence for six years.

(4) each Union should have a Representative on the Executive Committee, and one additional National Representative should be elected to the Executive Committee for every two additional Union Representatives ;

(5) an interval of two years should be maintained between General Assemblies ;

(6) the President should be eligible for re-election for a second term of two years, and the Secretary-General and Treasurer should be eligible for not more than three successive terms of office ;

(7) a Standing Committee for the consideration of admissions should be set up, consisting of the President and eight other members not necessarily Members of the Executive Committee ;

(8) I.C.S.U. should normally bear the expenses of meetings of Special and Scientific Committees only during the formative stages of such Committees ;

(9) greater publicity should be given in I.C.S.U. publications to actions taken in the general interests of the world community, and the feasibility of an identity card for *bona fide* scientists engaged on I.C.S.U. business should be explored.

19. — Item 13.1 — Applications for Admission — Scientific Unions

The Executive Committee

(1) *recommend* to the General Assembly the admission of the International Organization of Pure and Applied Biophysics to I.C.S.U. ;

(2) *decided* to communicate to the General Assembly the result of the vote concerning the admission of the International Union of Nutritional Sciences ; and

(3) *decided* not to recommend to the General Assembly the admission of the Section of Pharmacology of the International Union of Physiological Sciences.

20. — Item 13.2 — Applications for Admission — National Members.

The Executive Committee *recommended* to the General Assembly the admission of the Monaco Scientific Center as National Member.

21. — Item 14.1 — I.U.G.G. Committee on Atmospheric Sciences.

The Executive Committee formally *approved* the plan put forward by the I.U.G.G. Committee on Atmospheric Sciences, and *expressed* the hope that further steps would be taken with help from I.C.S.U., W.M.O. and perhaps later from U.N.E.S.C.O.

25. — Item 21 — Statement Concerning Sources of Funds.

The Executive Committee *gave its moral approval* to the following proposed recommendation : « that I.C.S.U. and its components must not accept or channel funds for any purpose from any military group of countries. »

Meeting of the Executive Committee

(Abstracts from the minutes)

The Meeting took place at the Bavarian Academy of Sciences at the kind invitation of the Academy and of the Deutsche Forschungsgemeinschaft.

6. — Reports of the Unions.

6.4. — *Scientific Radio (U.R.S.I.).*

U.R.S.I. was represented by Dr. R. L. Smith-Rose, who presented the report of the Union (see p. 127), and said that the U.R.S.I. Executive Board had met at the end of March 1965 and had discussed the arrangements for the XV General Assembly, which would be held in Munich from 5th to 15th September, 1966. He reminded the Members of the Executive Committee that the XIV General Assembly in 1963 had coincided with the Golden Jubilee of the Union, and that a memorial volume had been published surveying the activities of U.R.S.I. over the fifty-year period.

Dr. Smith-Rose added that U.R.S.I. would like to record its gratitude for the subvention from U.N.E.S.C.O. received through I.C.S.U., which was being used for the publication of a series of eight manuals on radio measurements and standards and space research.

Preliminary arrangements were being made for a symposium on solar-terrestrial physics, which would be held in Belgrade in August-September 1966, prior to the next U.R.S.I. General Assembly.

7. — Reports of Scientific Committees.

7.3. — *Committee on Space Research (C.O.S.P.A.R.).*

The President of C.O.S.P.A.R., Professor M. Roy, presented the report of the Committee (p. 128). He was pleased to announce that the United Nations Organization had made a grant of several thousand dollars towards the expenses of the publication of a manual.

8. — Reports of Special Committees.

8.1. — *I.Q.S.Y. Committee.*

Professor W. J. G. Beynon supplemented his report (p. 130) with a few remarks about the recent III General Assembly held in Madrid, at which representatives from various I.C.S.U. bodies and from 38 nations had been present.

I.Q.S.Y. too was suffering from difficulties over payments in non-convertible currencies. However, of the loan of $ 5000 received from I.C.S.U., $ 3000 had already been repaid and the remaining $ 2000 would be repaid this year.

He recommended that Dr. Minnis, Secretary of I.Q.S.Y., should be appointed the new Secretary of C.I.G., following the resignation of the present Secretary, as the I.Q.S.Y./C.I.G. background would be particularly useful.

9. — Reports of Union and Inter-Union Commissions.

9.1. — *C.I.G. Reorganization.*

Professor Beynon, the President of C.I.G., presented a report on the history and future plans for C.I.G. (p. 131).

Professor Kaplan said that I.C.S.U., through the rules of C.I.G., had assigned authority for its administration to the I.U.G.G., which, under its present rules, intended to continue to carry out this authority to the best of its ability.

The Executive Committee *accepted* the report on C.I.G., and *resolved* :

(1) that C.I.G. continue until the end of 1967 ;

(2) that the rules limiting the term of office of the President and Vice-Presidents be waived ; and

(3) that the incumbent President and Vice-Presidents be asked to continue in office until 1967 in order to assist and advise I.C.S.U. on the preparation of a new constitution for the C.I.G. (Resolution 4).

9.2 and 11.5. — *Inter-Union Commission on Solar and Terrestrial Relationships, and Working Group on Solar and Terrestrial Physics.*

Professor Kaplan stated that the increasing importance of solar terrestrial physics had led to many proposals, including one for the formation of a new Union for physics of the solar system, which had caused considerable concern amongst the other interested Unions. He then presented Professor Allen's reports (p. 134).

Dr. Smith-Rose, on behalf of U.R.S.I., recommended that I.U.C.S.T.R. should continue, but that its terms of reference should be revised and extended in agreement with I.A.U., I.U.G.G. and U.R.S.I.

Professor Pecker said that I.A.U., as parent Union of I.U.C.S.T.R., had given a great deal of thought to the matter. I.U.C.S.T.R. had, on the one hand, done much useful work in

the form of reports, which had been much appreciated, but on the other hand its work had in some ways not been so satisfactory. I.A.U. was in favour of studying possible changes in the existing terms of reference of I.U.C.S.T.R., rather than in replacing it by another organization. It was necessary to avoid duplication in the organization of symposia, and in order to do this, the different bodies arranging symposia in this field should do so in consultation with I.U.C.S.T.R. Its existence had in fact often been forgotten in this respect.

Professor Garland suggested that the Executive Committee, taking into account the recommendations of the Working Group on Solar-Terrestrial Physics, should recommend :

(1) That the Inter-Union Commission on Solar and Terrestrial Relationships re-examine its membership and statutes so that it may become the responsible body for the coordination of symposia in the solar-terrestrial field.

In particular, the Commission be requested to ensure that it has representation, in addition to that now provided, from all interested I.C.S.U. groups, such as C.O.S.P.A.R. and I.Q.S.Y.

(2) That in fulfilling the function of a coordinating body for symposia, the Commission does not of itself organize symposia.

(3) That the interested Unions and Committees, namely U.R.S.I., I.U.G.G., I.A.U., I.U.P.A.P., C.O.S.P.A.R. and I.Q.S.Y. organize symposia in the solar-terrestrial field only with the concordance of the Commission.

(4) That the Unions U.R.S.I., I.A.U. and I.U.G.G. re-examine the need for the continued existence of the Inter-Union Commission for the Ionosphere in view of the other I.C.S.U. bodies active in this field.

(5) That definite recommendations for action on the part of I.C.S.U. on the above matters be submitted before the General Assembly of Bombay.

Professor Pecker's and Professor Garland's views were supported by Professor Beynon, Professor Agoshkov and Professor Kaplan, and the Executive Committee *resolved* that the Inter-Union Commission on Solar and Terrestrial Relationships (I.U.C.S.T.R.) be urged to make appropriate additions to its membership and modifications to its terms of reference so as to provide representation for all interested Unions, Commissions and Committees

of I.C.S.U., and that the Unions and Commissions concerned be likewise urged to coordinate the arranging of symposia through this Commission (Resolution 5).

9.3. — *Inter-Union Commission on the Allocation of Frequencies.*

Dr. Smith-Rose presented the report on I.U.C.A.F. (p. 135).

I.U.C.A.F. had considered a recommendation from I.A.U. that membership from that Union on the Committee should be increased from four to six, but had decided that this would make the Committee too large and expensive to operate.

In pursuance of its aim to obtain appropriate recognition for radioastronomy and better protection of frequencies, I.U.C.A.F. had issued a document encouraging radio-astronomers to indicate their needs for new frequencies to their own national bodies, and giving the relevant facts on the present position.

In reply to a question from the President, Dr. Smith-Rose explained why I.U.C.A.F. had reduced its dues two years ago to $ 200. I.U.C.A.F. had originally been set up for a period of three years, and having, towards the end of its third year of existence, a balance in hand, had decided that this balance should be reduced. Now that the Commission had been given a new lease of life, it had been decided to raise the dues again to $ 500 for the current year, with a probable increase to $ 1000 in 1966.

Professor Pecker, on behalf of the I.A.U. Executive Committee, explained that they had requested increased representation on the Committee of I.U.C.A.F. because they wanted to try and improve the field coverage. They were, however satisfied with the present position in I.U.C.A.F.

The Treasurer stated that I.U.C.A.F. expected to be able to carry forward the sum of $ 7000 from 1965 to 1966. The Standing Finance Committee had felt that under these circumstances and in view of the fact that there were so many I.C.S.U. bodies needing support, they were unable to grant the requested increase of $ 3500 to the present subvention to I.U.C.A.F. of $ 2500.

The President stressed that this decision should not be interpreted as any lack of confidence in the work of the Commission, which must be continued and supported, but was due entirely to lack of funds.

The report of I.U.C.A.F. was *accepted.*

9.5. — *Inter-Unions Commission on Radiometeorology.*

Dr. Smith-Rose presented the report of I.U.C.R.M. which was *accepted.*

10. — Reports of Services.

10.1. — *F.A.G.S.*

Professor Garland presented the report on F.A.G.S. (p. 137) F.A.G.S. required a further allocation of $ 3800 from I.C.S.U., in order to cover the expenses of a new service called Sparmo, which deals with the launching of balloons to study the atmosphere.

Dr. Tha Hla stated that U.N.E.S.C.O. was very interested in seismology and would continue to support F.A.G.S.

He suggested that for the purpose of the services on seismology, F.A.G.S. should make a tentative proposal to U.N.E.S.C.O. now, so that the extra money could be included in the budget. They should make the approach through I.C.S.U.

Ing. Gén. Laclavère stated that the cost of F.A.G.S., which was considerable, was borne by the countries which housed the various services. However, some services must be on an international basis. F.A.G.S. received from U.N.E.S.C.O. the sum of $ 22 000, which sum had remained the same since the inception of F.A.G.S., although their activities had increased. The instruments now being used had increased in sensitivity and therefore more detailed data were being received. Financial support from I.C.S.U. had decreased owing to I.C.S.U.'s other commitments, and F.A.G.S' income in 1965 was only $ 39 000. He recommended that the Executive Committee seriously consider the application of F.A.G.S. for a further $ 3800 in 1965.

This was *agreed.*

10.3. — *World Data Centres.*

Professor Kaplan stated that there were two groups within C.I.G. making a serious study of this problem in consultation with other interested bodies, e.g. S.C.O.R., C.O.S.P.A.R., I.O.C., U.M.P., I.H.D. and I.B.P. C.I.G. has proposed that the group to handle W.D.C. matters should consist of the President, three Vice-Presidents, and Secretary and the representatives of the World Data Centres A and B. The Executive Committee *agreed* that the C.I.G. should continue to look into the matter of the W.D.C.'s during the next two years.

II. — Reports of Working Groups.

11.6. — *Working Group on the Free Circulation of Scientists.*

Professor Harrison Brown introduced this item.

The main effort of the Working Group since its foundation consisted in securing the attendance at international meetings of scientists form the German Democratic Republic. However, a more favourable N.A.T.O. ruling had been made, which now improved the possibilities for the attendance of scientists from the German Democratic Republic to meetings in N.A.T.O. countries.

Some difficulties may also occur in regard to scientists from the People's Republic of China, and the Republic of China/Taiwan. There is almost complete lack of contact with scientists in the Peoples' Republic of China. Some Unions and I.Q.S.Y., however, have some correspondence and are exchanging data on an individual basis.

Professor Agoshkov proposed that the Group should meet again in the near future, as it had not met since the London Executive Committee, that it should discuss the question in detail and submit recommendations. It was agreed that the working group should meet before the next General Assembly if circumstances made it desirable.

Dr. Yanney Ewusie asked wheter the Group considered the problems of the travel of scientists apart from their attendance at I.C.S.U. meetings. This was considered too wide a problem for the Group to tackle, and it was felt that it should confine itself to the travel of scientists to I.C.S.U. meetings.

It was agreed that the best way of tackling the problem as regards the Peoples' Republic of China, at the present, was through individual contacts with scientists, and by asking the Academies to stress the point in their correspondence with the Academia Sinica in Peking.

11.7. — *Working Group on Relations with Developing Countries.*

Professor Florkin presented the report of the Working Group He stressed that several organisms were already active in this field and that I.C.S.U. should limit itself to an advisory role, and he emphasized the value of individual contact with scientists in the countries concerned, in order to be better able to evaluate their needs.

It was felt that the position of I.C.S.U. with regard to the developing countries should be strengthened. Scientists from the developed countries should be encouraged to undertake missions in the developing countries, and scientists from those countries should be assisted to attend as many meetings as possible in the developed countries.

The Executive Committee felt that the Working Group should be enlarged and should hold a meeting before the Bombay Assembly, to which it should submit its proposals.

It was *agreed* that the President should convene such a meeting.

14. — Reports of New Committees.

14.1. — *I.U.G.G. Committee on Atmospheric Sciences.*

Professor Kaplan stressed the contact maintained between I.C.S.U. and I.U.G.G. over the formation of this Committee, and also the point of contact which this new Committee provided between the Officers of I.U.G.G. and their National Committees. He thanked Professor Garland for his part in arranging the meeting which had recently been held in Geneva, and Dr. Malone, the Secretary General of the Committee, for dealing with the financial aspects and producing the report.

Professor Dolin, Chairman of the I.U.G.G. Committee on Atmospheric Sciences, then emphasized certain points contained in the Committee's report (p. 139). The programme of the Committee, developed in response to UN Resolution 1802, centered round the study of the circulation of the atmosphere up to about 30 km, and the building up of observational facilities on that basis. Long range weather forecasting and weather management were dependent on a perfect understanding of the behaviour of the atmosphere. The Atmospheric Sciences programme was closely related to other scientific programmes of I.C.S.U., particularly to the programme on Water Research, to S.C.O.R. and C.O.S.P.A.R. and also to the I.B.P. through world climatic effects, and cooperation and exchange of information should be built up between them.

The Committee explicitly proposed close collaboration between C.O.S.P.A.R., S.C.O.R. and I.C.S.U. It further proposed that it should continue its work and meet again next Spring in collaboration with W.M.O., and that small working groups should

meet once or twice during the year, leading up to a more general symposium on these problems to be held in Japan in 1966 in conjunction with the I.U.G.G./I.U.T.A.M. Conference on Turbulence.

Dr. Nyberg expressed his thanks for being invited to attend the Meeting. He said that the UN Resolution 1802 stressed cooperation between W.M.O. and I.C.S.U., and W.M.O. hoped that the cooperation thus established would continue.

Professor Garland said that he had represented I.C.S.U. at the recent meeting of the W.M.O. Advisory Committee. This Committee had recommended to the Executive Committee of W.M.O. a set amount to support this I.C.S.U. programme. U.N.E.S.C.O. should be informed about the programme and its relations to the U.N.E.S.C.O. Programmes in oceanography and hydrology. I.U.G.G. intended to give all possible help to the working groups to help them get under-way.

The Treasurer pointed out that S.C.A.R. too had an important programme on atmospheric sciences and should be added to the list of those whose collaboration with the new I.U.G.G. Committee would be advantageous.

Dr. Garcia pointed out the particular importance of this programme to meteorologists in the Southern Hemisphere. Due to their geographical position, the countries in that hemisphere could not hope to expand their conventional means of observations, so that the only hope of expansion for them was through such an international programme.

Professor Roy added that the Working Group 6 of C.O.S.P.A.R. would be reorganized by taking into account the activities of this Committee.

The President suggested that the Executive Committee formally give their approval to the plan put forward by the I.U.G.G. Committee on Atmospheric Sciences, and that they express their hope that further steps would be taken with help from I.C.S.U., W.M.O. and perhaps later from U.N.E.S.C.O.

This was *agreed.*

Reports Submitted to the Executive Committee

U. R. S. I.

Golden Jubilee of U.R.S.I.

The XIVth General Assembly of U.R.S.I. was held in Tokyo during September 9-20, 1963. It formed the occasion for celebrating the Golden Jubilee Anniversary of the U.R.S.I. in 1913 and it was accompanied by the publication of a Memorial Volume surveying the activities of U.R.S.I. over the fifty year period.

At the 1963 Assembly also, a special lecture was dedicated to Professor Dr. Balth. van der Pol, Honorary President of U.R.S.I., who devoted much of his activities to the growth of U.R.S.I. Wishing to leave a tangible testimony of her husband's devotion to the Union, Mrs van der Pol established a Gold Medal to be awarded at each General Assembly to a scientist whose research has increased one of the fields of U.R.S.I. activity. At Tokyo the medal was awarded to Professor M. Ryle who gave a lecture on « Giant Radio Telescopes ».

Preparations for the XVth General Assembly.

The Board of Officers of U.R.S.I. met in February 1964 to review in a preliminary manner the arrangements to be made for the next General Assembly. An invitation from the German National Committee to hold this in Munich was accepted, and the date now proposed is 5-15 September 1966.

Symposium on Solar-Terrestrial Physics.

The above General Assembly will be immediately preceded by a Symposium on Solar-Terrestrial Physics which, by the kind invitation of the Yugoslav National Committee, will be held in Belgrade, towards the end of August 1966. A special committee set up by I.C.S.U. in Vienna (1963) to consider the grouping of disciplines which are particularly concerned with solar-terrestrial physics, has recommended that I.A.U., I.U.P.A.P., and C.O.S.P.A.R. should co-operate with U.R.S.I. and I.U.G.G. in the symposium being planned for Belgrade (1966).

U.R.S.I. Board and Co-ordinating Committee.

Arrangements have been made for meetings of the Board of Officers of U.R.S.I. on March 23rd and 26th, and of the Co-ordina-

ting Committee, on March 24th and 25th, 1965. At these meetings the preliminary programmes of the scientific sessions for 1966 General Assembly will be prepared.

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

Report

(1) *Secretariat and administration of the Committee.*

(*a*) Mr. Maurice Gazin took over from Mr. P. J. Beaulieu as Executive Secretary on 29 June 1964.

(*b*) An agreement was reached between the President of C.O.S.P.A.R. and the Treasurer of I.C.S.U. enabling C.O.S.P.A.R. to administrate its budget direct, although national contributions will continue to be collected by the I.C.S.U. Accountant in Rome.

The C.O.S.P.A.R. Accountant is the Executive Secretary. The supervision and auditing of the accounts will be undertaken by Mr. L. Pioton, certified auditor to the Paris Law-Court.

(2) *Meeting of the Bureau.*

The C.O.S.P.A.R. Bureau met in Paris on November 12, 1964, with a view principally to finalizing the decisions, programmes, participation and preparatory measures for the 8th Plenary Meeting and 6th Symposium of C.O.S.P.A.R. at Buenos Aires from 10 to 21 May, 1965.

The high cost of travel, because of the geographical position of Buenos Aires, will restrict quite considerably the assistance which C.O.S.P.A.R. will be able to provide to participants from its own budget.

(3) *Publications for which the Secretariat is responsible.*

The draft of the Report of the C.O.S.P.A.R. Meeting in Florence was distributed on 22 July 1964. The final agreed report was distributed to all members of C.O.S.P.A.R. on 9 october 1964.

The following *Information Bulletins* have appeared :

No. 19. Reports of National Institutions, with the exception of the Report of the National Academy of Sciences of the U. S. S. R., October 1964

No. 20. Regular issue of the *Information Bulletin*, November 1964

No. 21. Sequel to Bulletin 19 — Report of the Academy of Science of the U. S. S. R. and report on satellite Ariel II, December 1964.

No. 22. Regular issue of the *Information Bulletin* (in course of printing), February 1965.

Several technical manuals are in course of preparation for publication during the first six months of 1965.

(4) *Work of the Committees and Working Groups.*

(*a*) The Editorial Committee, with the help of the Secretariat, directed the publication of Volume V in the series Space Research and managed to secure the publication of this volume of 1300 pages on 25 January 1965.

Volume III in the series Life Sciences and Space Research came out in March 1965.

The CIRA Tables 1964, compiled under the direction of Dr. W. Priester, President of Working Group 4, are in course of printing and will appear probably before May 1965.

(*b*) Working Group 2 has met under the Chairmanship of Dr. H. Friedman, on April 1, 1965 in Madrid, during the I.Q.S.Y. Assembly, dealing in particular with the next solar activity maximum and the distribution of rocket launching sites.

Working Group 3 held a small meeting in London on 6 October 1964, on the subject of C.O.S.P.A.R. publications and information exchange.

Working Group 6, although at present in abeyance until the Buenos Aires Meeting, held a private session in Geneva on 11 February, during the W.M.O. meeting.

The Consultative Group, under the Chairmanship of Dr. Sarabhai, met on 5 April in Moscow to consider notably the sterilisation of space vehicles.

(5) *Relations with the United Nations and with U.N.E.S.C.O.*

The Committee on the Peaceful Uses of Outer Space met in New York on 26.10 to 6-11-1964.

The report of the C.O.S.P.A.R. Consultative Group, already sent to I.C.S.U., was examined and very favourably received.

Several resolutions were passed at this session underlining the cooperation hoped for from C.O.S.P.A.R. in the :

— geographical distribution of launching sites,

— training of technicians concerned with the Thumba site,
— scientific bibliography in the space field.

U.N.E.S.C.O. is giving an appreciated assistance to C.O.S.P.A.R. for the participation of scientists at the Buenos Aires Symposium, although it is less in relation to that granted for the 1964 Symposium.

I.Q.S.Y. Report

Introduction.

The Special Committee for the I.Q.S.Y. was first formed, at the fourth meeting of C.I.G. in March 1962, as the C.I.G.-I.Q.S.Y. Committee. It ceased to be a committee of C.I.G. and became a Special Committee at the Xth General Assembly of I.C.S.U. in November 1963. The Rules for the Committee were approved at the I.C.S.U. Executive Committee Meeting in June 1964 and are reproduced in the « Year Book of the I.C.S.U., 1965 » (p. 79).

National Participation.

Since its formation, the Committee has proceeded with the detailed planning of the scientific programme of the I.Q.S.Y. and has actively encouraged the necessary international participation in the programme on as wide a scale as possible.

About 2000 stations are at present active and these are sponsored by the Participating Committees in 71 countries or territories.

I.Q.S.Y. Publications.

The I.Q.S.Y. Committee maintains contact with the Participating Committees by means of its information bulletin, *I.Q.S.Y. Notes*. This includes not only current information but news about decisions and recommendations made by the Committees and Unions of I.C.S.U. Ten issues of *I.Q.S.Y. Notes* were published between March 1963 and December 1964.

The series of I.Q.S.Y. Instruction Manuals contains more detailed scientific instructions and advices. Up to January, 1965, nine Manuals have been issued and two more are in process of preparation.

The booklet describing the I.Q.S.Y. scientific programme which was issued in November 1962 has been completely revised and will

be published jointly during 1965 by I.C.S.U. and the I.Q.S.Y. Committee.

During 1964, the I.Q.S.Y. Secretariat prepared a report on the I.Q.S.Y. for U.N.E.S.C.O. This has been published in four languages and has had a wide circulation through both U.N.E.S.C.O. and the I.Q.S.Y. Participating Committees.

Arrangements are being made for the publication of *Annals of the I.Q.S.Y.* which will describe the organization and achievements of the enterprise in 10 or 15 volumes which will probably be published between 1966 and 1969.

I.Q.S.Y. Finances.

The main sources of income for the I.Q.S.Y. Committee are the contributions received from the participating Committees, many of which have responded generously to appeals from the President. Valuable additional help has also been recived from I.C.S.U. and from I.A.U., I.U.P.A.P., I.U.G.G., and U.R.S.I. In addition, there is a contract between the I.Q.S.Y. Committee and U.N.E.S.C.O. A full account of the income and expenditure of the I.Q.S.Y. Committee is contained in the audited accounts for 1962 and 1963. The accounts for 1964 are at present being audited.

The expenditure during the years 1962, 1963 and 1964 has been very close to that estimated in the provisional budget which was prepared in July 1962. The decision to publish *Annals of the I.Q.S.Y.* will incur additional expenditure not previously envisaged, but it is hoped that funds received during 1964, 1965 and 1966 will be sufficient to cover the costs involved.

C.I.G. Report

The C.I.G. is an Inter-Union Committee, which was established in 1959 at the suggestion of the Special Committee for Inter-Union Cooperation in Geophysics (*I.G.Y. Annals* 10, p. 263, 1960). I.C.S.U., at its XI Executive Board meeting, delegated to the I.U.G.G. the authority to administer the Committee, on behalf of I.C.S.U., in consultation with, and with the participation of the I.U.G.G., I.A.U., U.R.S.I. and I.U.P.A.P.

The objects of the Committee as defined in the rules are :

« First, to ensure the fullest possible exploitation of the I.G.Y. and I.G.C. data, including : maintaining the efficient functioning of the W.D.Cs, encouraging the discussion and utilization of I.G.Y.

and I.G.C. 1959 results, and publishing the I.G.Y. and I.G.C. and bibliographies.

Second, to develop and coordinate international plans for the furtherance of cooperation in Geophysics and related sciences, especially those of an inter-disciplinary nature, including the assembly and inter-comparison of national programmes, the development of international data interchange arrangements and the continued utilization of W.D.Cs, and to encourage appropriate discussion and publication of the results of such programmes. »

However, the X General Assembly of I.C.S.U. resolved that the functions of C.I.G. in the future be :

(1) the completion of the *Annals of the I.G.Y.*, and
(2) the supervision of the W.D.Cs,

and requested that the Executive Committee make the arrangements necessary for the long-term supervision and coordination of the W.D.Cs, acting in close consultation with the discipline and the W.D.C. representatives on the C.I.G. and I.Q.S.Y. Committees.

I.G.Y. Annals.

The first of the series of volumes entitled « Annals of the International Geophysical Year » was published in 1957. Since then, 35 volumes, totalling more than 15.000 pages, have been published. The list of volumes proposed by the C.S.A.G.I. Discipline Working Groups is given in *I.G.Y. Annals*, 10, pp. 264-270, 1960. In general the volumes published or to be published correspond with those proposed.

Since the last meeting of the Executive Committee, six volumes have been published, and a further seven volumes have been edited and are in the process of publication. This leaves three outstanding volumes : a volume on aurora, the bibliography and the commentated index. Since the last two volumes are dependent to a greater or lesser extent, on the outstanding volumes being in page proof, it is not possible to complete them until proofs of all the earlier volumes are available.

World Data Centres.

The question of the establishment of I.G.Y. World Data Centres was first introduced at the third meeting of C.S.A.G.I. in Brussels in 1955. The C.S.A.G.I. passed the following resolution :

« The C.S.A.G.I. resolves that all observational data to be exchanged in accordance with the I.G.Y. programme shall be avai-

lable to scientists and scientific institutions in all countries. The C.S.A.G.I. will designate a number of World Archive at which the data relating to different subjects will be assembled and from which copies can be obtained, on payment of cost of reproduction if necessary. »

A Guide to the W.D.Cs was published in *I.G.Y. Annals*, 7, 1959. More recently, a Guide to International Data Exchange through the W.D.Cs (for the period 1960 onwards) has been issued by C.I.G. through the I.Q.S.Y. Secretariat. The I.Q.S.Y. Secretariat issued a Guide to International Data Exchange (I.Q.S.Y. Discipline in 1963). A supplement on Oceanography has been published and another on Solid earth sciences is in the press.

A catalogue of Data in the W.D.Cs for the period 1st July, 1957 to 31st December, 1959 was prepared at W.D.C. A, Washington, D. C., using material made available by a number of W.D.Cs, which had been assigned responsibility for the preparation of final catalogues of data by the V General Assembly of C.S.A.G.I. This Catalogue was published in *I.G.Y. Annals*, 36.

At present the membership of C.I.G. includes two representatives of the W.D.C.s one from W.D.C. A and one from W.D.C. B. The several branches of W.D.C. C appoint correspondents to the Committee. The sixth meeting of C.I.G. will consider whether there are sufficient members with adequate knowledge of collection, analysis, storage and retrieval of data, etc., in view of the C.I.G. functions being limited to the long-term supervision and coordination of the W.D.Cs.

Future of C.I.G.

At its Sixth Meeting (Madrid, 1st April, 1965), C.I.G. discussed its future functions and constitution. Consideration was given to the views received by correspondence from discipline reporters, from Presidents and Secretaries-General of the Unions concerned in C.I.G. and recommendations of the various scientific working groups at the III I.Q.S.Y. Assembly. Representatives of W.M.O. and I.O.C. also expressed the views of their organizations concerning the future role of C.I.G. It was clear from this discussion and from the views and recommendations mentioned above that there was fairly unanimous support for the continuation of C.I.G., as a body concerned with international cooperation and coordination of inter-disciplinary studies in the physics of the earth

and its atmosphere and related sciences, and also with the supervision of the World Data Centres.

Arising from these discussions, C.I.G. wishes to make the following proposals to I.C.S.U. :

(1) That for the present C.I.G. remain in being.

(2) That subject to the approval of the I.U.G.G. Executive Committee, Dr. Minnis (Secretary of I.Q.S.Y.) be appointed Secretary of C.I.G.

(3) That in the next year or so a plan be prepared for a revised long-term C.I.G., taking into account the recommendations outlined above. C.I.G. proposes that this plan be drafted by the present C.I.G. Bureau and W.D.C. Members, acting in consultation with I.C.S.U. and with all other interested bodies.

(4) C.I.G. has no funds and no income — this has been one of its great weaknesses — and at the suggestion of the Treasurer of I.C.S.U., it was agreed to seek a grant from I.C.S.U. to cover the expenses of a meeting of the above planning group in the next year or so. An agreed plan for the permanent international supervision and coordination of all the various aspects of geophysics from 1967 onwards can then be prepared.

I.U.C.S.T.R. Report

The discussions concerning the formation of a Special Symposium Committee on Solar-Terrestrial Physics (S.S.C.S.T.P.) have led many members of the Inter-Union Commission on Solar and Terrestrial Relationships (I.U.C.S.T.R.) to emphasize that this Commission should follow its objectives more vigorously and effectively. To do this a re-statement of the objectives is necessary and is given formally as follows :

The purpose of the I.U.C.S.T.R. is to promote the study of solar-terrestrial relations using the following methods when suitable,

1. by participation in symposia,
2. by coordination of such symposia (e. g. through the proposed S.S.C.S.T.P.),
3. by internal discussions which may take any of the forms
   a) invited addresses,

b) individual progress reports and recent results,

c) timely assessments on particular subjects,

d) working group activities,

e) project planning,

4. by the issue of review reports,
5. by accepting advisory responsibilities,
6. by coordination of programmes and data on a permanent basis,
7. by the collection and publishing of such data as might otherwise be lost or unnoticed.

Organization for these purposes.

The I.U.C.S.T.R. needs a considerable degree of continuity and permanence in order to cope with its long-term problems.

The I.U.C.S.T.R. should remain of inter-union character but may need direct representation from unions or bodies such as I.U.P.A.P., C.O.S.P.A.R. and I.Q.S.Y.

The I.U.C.S.T.R. would be willing to combine with the Inter-Union Commission on the Ionosphere (I.U.C.I.).

The I.U.C.S.T.R. is to maintain a roster of active workers (now about 160 names) on which it may expect to call for the participation of various activities enumerated above (where the word « internal » means internal to this roster).

The I.U.C.S.T.R. should meet at least within every three years for (*a*) business, and (*b*) internal discussion. Such meetings should be associated with Union Assemblies or General Symposia, but should not clash with the detailed programmes of such Assemblies or Symposia.

It is recommended that the next meeting be in Belgrade in 1966, associated with the Symposium on Solar Terrestrial Physics. The I.U.C.S.T.R. should participate in the special information session on the future organisation of solar terrestrial physics. There should be one invited address. There should also be an internal critical discussion on the suitability of solar data for terrestrial correlation.

I.U.C.A.F. Report

During 1964, the work of this Commission was continued by correspondence in pursuance of the frequency allocations drawn

up at the Extraordinary Administrative Radio Conference of the I.T.U. in November 1963 (See *I.C.S.U.Bulletin*, No. 1, May 1964 (p. 46). These allocations became effective on 1st January 1965.

Meeting.

The fifth Meeting of I.U.C.A.F. was held in Bonn on 12th and 13th January, 1965, at which various matters concerning Membership, Finance and the Terms of Reference of the Commission were discussed in addition to the more technical subject of frequencies for Radio Astronomy and Space Science.

Membership.

After a long discussion initiated by a recommendation from the General Assembly of I.A.U. in Hamburg, it was agreed that the constitution of I.U.C.A.F. should remain as determined by I.C.S.U. and published on p. 94 of the « Year Book of the International Council of Scientific Unions, 1964 ». Certain changes in the representation of the three constituent bodies — U.R.S.I., I.A.U. and C.O.S.P.A.R. — were proposed, and details of the revised membership were left for the chairman and secretary to determine after consultation with the secretaries-general of these bodies.

Finance.

A report from the Finance sub-commission was accepted at Bonn. This includes Budget estimates for the work of I.U.C.A.F. to be continued vigorously during the years 1965 and 1966. Should the inter-union commission be asked to extend its activities to cover matters requested by S.C.A.R., S.C.O.R. or I.U.G.G., it was assumed that these organisations would contribute equitably towards any increased expense involved.

Frequency Allocations.

It was agreed that I.U.C.A.F. should continue to work through the international bodies — C.C.I.R. and I.T.U. — on all occasions where matters concerning Radio Astronomy and Space Science were under discussion. It should also maintain close liaison with the appropriate national administrations with the object of securing improved protection from interference in all possible cases : and I.U.C.A.F. should circulate its activities widely among radio astronomers and scientists throughout the world.

The results of experience over the next year or two should be co-ordinated so that a good case for securing improved protection of the existing allocations to radio astronomy and space science can be prepared for the next Administrative Radio Conference of the I.T.U.

F.A.G.S. Report

Services federated at present.

Bureau International de l'Heure, established 1920, Paris.

International Polar Motion Service, established 1895, Mizusawa.

Service Permanent des Indices Geomagnétiques, established 1906, Tortosa, Utrecht, Gottingen.

Bureau Gravimétrique International, established 1951, Paris.

International Seismological Summary, established 1923, Kew, Edinburgh.

Bulletin Mensuel du Bureau Séismologique International, established 1903, Strasbourg.

Quarterly Bulletin of Solar Activity, established 1928, Zurich.

Permanent Service for Mean Sea Level, established 1957, Liverpool.

Service Permanent des Marées Terrestres, established 1959, Uccle.

International Ursigram and World Days Service, established 1931/1958, Utrecht.

Permanent Service for Crustal Tickness, established 1963, Toronto.

Statutes.

Revisions were necessary in the original statutes, because of changes in the method of financing of the Federation. Draft statutes were prepared at the Council meeting of 1964, and were circulated to the three Unions, I.A.U., U.R.S.I. and I.U.G.G., and approved in principle at the last meeting of the I.C.S.U. Executive Committee. With small modifications, all Unions have now approved these. The new statutes make no change in the aims or principles of operation of the Federation, but they specify more precisely how money received from I.C.S.U., and from U.N.E.S.C.O. through I.C.S.U. shall be used, and they provide for the part-time Scientific Secretary.

Contracts with U.N.E.S.C.O.

During 1964 the following contracts were arranged :

(*a*) With Permanent Service for Mean Sea Level, to prepare a report on the adequacy of the present world tide gauge network ($ 1000).

(*b*) With Bureau Gravimétrique International, to carry out a pilot programme for assembling world gravity data on punched cards ($ 3000).

(*c*) For a pilot study of glacial fluctuations ($ 3000).

For the years 1965 and 1966 it has been indicated that a total sum of $ 6000 is available for contracts.

Applications for membership from other organizations.

An application for membership of the Federation was received early in 1964 from the Solar Particles and Radiation Monitoring Organization (S.P.A.R.M.O.) This is an association of institutions which use balloons for upper atmosphere measurements, which provides a service by disseminating information on balloon launching, flight paths, etc., so that coordinated ground-air observations can be made. Although this function is somewhat different from that of other services, both I.A.U. and I.U.G.G. having examined the statutes and work of S.P.A.R.M.O. in detail, recommend that it be accepted as a federated service.

Future plans.

The format of the printed International Seismological Summary will have to be changed to meet the demands of modern seismology (i.e. to high-speed data interchange) but for a few years the present, publication will continue. The Committee responsible for the I.S.S. met, under the auspices of I.U.G.G., at the new International Seismological Centre in Edinburgh, in November 1964, to make further plans for the change.

The Permanent Service for Geomagnetic Indices suffered a serious loss in the death of Professor Bartels at Gottingen. Work is continuing there but it may eventually move to a different institute.

The Council of the Federation plans to meet in Paris, in September 1965.

Report of the I.U.G.G. Committee on Atmospheric Sciences

This Committee met in Geneva, February 8-11, 1965. It was agreed that it would act on behalf of I.C.S.U. as an answer to UN Resolution 1802, and that its functions would consist in the identification and formulation of specific atmospheric research problems, in cooperation with existing I.C.S.U. bodies, and in the development of this research on an international basis.

In separate sessions and in several joint sessions with the W.M.O. Advisory Committee, the I.U.G.G. Committee addressed its attention to the specific problem of the global circulation in the troposphere and lower stratosphere (below 30 km).

It was considered desirable to treat the entire atmosphere below 30 km as a single physical entity, and essential to increase substantially the existing global observations by the use of unconventional techniques such as :

(*a*) observations from instrumented satellites, ranging from the infrared to the microwaves regions of the spectrum.

(*b*) observations from manned satellites in which a trained meteorologist would combine visual observations with a selective use of instruments.

(*c*) observations from lunar meteorological laboratories.

Such a scientific programme obviously has an important bearing on the development of the World Weather Watch (W.W.W.), and may be considered as one of the many necessary preparatory studies required to organize the W.W.W. in as rational a way as possible.

Quite apart from its intrinsic scientific interest, the proposed research programme has many implications of a practical as well as of a scientific nature, such as, long range weather forecasting, daily operational forecasts, land utilization and water management, large scale climate modifications, etc.

Collaboration will be ensured with the International Association of Meteorology and Atmospheric Physics, with the International Association of Physical Oceanography, with I.U.T.A.M., I.U.P.A.P., U.R.S.I., C.O.S.P.A.R., S.C.O.R., I.Q.S.Y. and W.M.O.

A subvention of approximately $ 25 000 will be needed during the next year.

INTERNATIONAL ASTRONOMICAL UNION

General Information

We quote the following from the I.A.U. *Information Bulletin*, No. 14, June 1965.

13th General Assembly of the I.A.U.

The 13th General Assembly of the I.A.U. will be held in Prague, Czechoslovakia, from 22 to 31 August 1967.

Commission Activities.

Commission 40 *(Radio Astronomy)*.

Dr. F. Graham Smith, President of the Inter-Union Committee on Frequency Allocations for Radio Astronomy and Space Science (I.U.C.A.F.), has sent to all Members of I.A.U. Commission 40 a circular letter informing them of the present situation concerning the allocation of frequency bands. This letter contains an appeal to radio astronomers, asking them :

« — to send to your national Administration, for submission to the I.F.R.B. (International Frequency Registration Board) the complete particulars of the frequencies and the scope of the observations in your observatory, either in current use or expected to be in use in a foreseeable future ; and

« — to send copies of this submission to the Secretary-General of I.U.C.A.F. »

The attention of all Members of the Union is called to this important problem. Those who would like to have further particulars should write to Professor M. Ryle, President of Commission 40, or to Dr. R. L. Smith-Rose, Secretary-General of the I.U.C.A.F., 21 Tumblewood Road, Banstead, Surrey, England.

SYMPOSIA AND COLLOQUIA.

Future symposia.

Cosmical gas dynamics (5th Symposium). — Nice, France, 2-14 September 1965.

Instabilities phenomena in the Galaxy, Bjurakan, Armenian S.S.R., April-May 1966. The members of the Organizing Committee are : V. A. Ambarcumjan (President), M. Burbidge, J. Lequeux, A. Sandage, B. A. Voroncov-Vel'jaminov. The editor of the proceedings will be M. Arakeljan. The subject concerns the nuclei of galaxies and their activity, radiofrequency radiation of galaxies, and other non-thermal phenomena, quasi-stellar objects and compact galaxies, and physics and instability of bars and spirals. Further information can be had from Professor V. A. Ambarcumjan, President of the Academy of Sciences of the Armenian S.S.R., Erevan, Armenian S.S.R.

Radio Astronomy and the Galactic System. — The Netherlands, 25-31 August 1966. This Symposium is being organized in co-operation with U.R.S.I. The members of the Organizing Committee are : J. H. Oort (President), A. Blaauw, G. Burbidge, R. A. J. Coutrez (for the U.R.S.I.), M. Ryle, I. Sklovskij, L. Woltjer. The editor of the proceedings will be H. van Woerden. The subject concerns interstellar clouds, large-scale distribution and motion of interstellar gas, non-thermal radiation and magnetic fields. Further information may be obtained from Professor J. H. Oort, Sterrewacht, Leiden, the Netherlands.

Determination of Radial Velocity. — Toronto, Canada, probably June 1966

I.U.G.G.

Committee on Atmospheric Sciences

FIRST REPORT OF THE COMMITTEE

At the direction of Professor Bert Bolin, Chairman of the Committee, the Secretary General, Dr. T. F. Malone has transmitted to the President of I.U.G.G. a report of the I.U.G.G. Committee on Atmospheric Sciences (*I.U.G.G.Chronicle*, No. 59, May 1965). The report is in two parts : the first part is a summary of the principal actions of the Committee at its initial meeting in Geneva, February 8-11, 1965 and approved.

We quote the following from the first part of the report :

Summary Notes of Principal Actions of I.U.G.G. Committee on Atmospheric Sciences at its First Meeting in Geneva, Switzerland, February 8-11, 1965

I. — *Role of the Committee.*

Within the context of the charge given by I.U.G.G. President J. Kaplan, it was agreed that the Committee is to act on behalf of the International Council of Scientific Unions, and in concert with the other Unions, Commissions, Scientific and Special Committees, and National Committees of the I.C.S.U. family, in responding to United Nations Resolution 1802 which invited I.C.S.U. to develop an expanded program of research in the atmospheric sciences that would complement the programs fostered by the World Meteorological Organization (W.M.O.). As an initial responsibility, the Committee was charged with reviewing the preliminary I.C.S.U. response to the UN Resolution outlined by the Inter-Union Commission on Atmospheric Sciences (I.U.C.A.S.) and, as appropriate, develop it in more detail.

II. — *Function of the Committee.*

It was agreed that the functions of the Committee would include, but not be restricted to, the following :

1. To identify and to formulate atmospheric research problems which are particularly amenable to global treatment in view of developments in outer space.

2. To stimulate the interest of existing committees, commissions and working groups of I.U.G.G., the other Unions, and I.C.S.U. Scientific and Special Committees in these research problems and to arrange for their participation and cooperation in an international program addressed to these problems.

3. To seek such support as may be required to ensure the effectiveness of the participation of the above groups in these programs.

4. To invite national committees of I.U.G.G. to develop research programs directed toward the solution of these atmospheric problems of a global nature and to submit proposals for programs that would require cooperative effort among several countries. Similar invitations would be extended to the national committees of other Unions and Special Committees with an interest in the atmosphere. Coordination of responses with the national committees of I.U.G.G., if necessary, would be an internal matter within each country.

5. To serve as a focal point for bringing together these research activities and proposals into a coherent program which would be recommended to I.C.S.U. as appropriate for its continuing responsiveness to the United Nations Resolution 1802. The scientific requirements for observations from the World Weather Watch (W.W.W.) would be developed in co-operation with W.M.O. and close liaison with W.M.O. would be maintained on new and promising techniques for obtaining observations essential for research purposes.

6. To encourage scientists and engineers not presently concerned with atmospheric research to participate in the new research opportunities opened up by developments in the atmospheric sciences and in outer space.

7. To arrange symposia on these programs at regular meetings of relevant I.C.S.U. bodies and to arrange special symposia as may be necessary.

V. — *Relationship to Other International Programs.*

The program proposed will interact in a rather intimate way with other international programs in geophysics and should contribute to the fulfilment of their goals. For example :

The rapidly expanding international programs in aeronomy and the physics of the upper atmosphere are directed at an aspect of the atmospheric sciences which is distinct from, but related to, the scientific studies of the lower atmosphere. The precise nature of the linkage between the dynamics of the upper atmosphere and that of the lower atmosphere is not well understood, but it seems likely that the direction of the influence is from lower to higher levels. In one sense, an improved understanding of the general circulation of the atmosphere below thirty kilometers will provide useful insight into the physical nature of the boundary conditions at the base of the layer under study by aeronomists and upper atmospheric physicists. It is recognized that international programs concerned with the upper atmosphere will proceed on their own scientific merits, and under the auspices of existing I.C.S.U. and Union mechanisms, but here again the opportunities for collaborative effort during the next decade are attractive.

VII. — *Proposed Committee Activities.*

It is intended that this summary of the first meeting of the Committee and an expanded treatment of the program will be circulated rather extensively to interested international Unions, Committees and Working Groups and to National Committees, inviting their comments and participation.

The participation of other Unions within I.C.S.U. will also be solicited. In particular :

(i) The International Union of Theoretical and Applied Mechanics.
(ii) The International Scientific Radio Union.
(iii) The International Union of Pure and Applied Physics.
(iv) The International Union of Biological Sciences, the International Union of Physiological Sciences. and the International Union of Biochemistry.

In addition, it is intended to establish close working relationships with the following I.C.S.U. Committees :

(i) Committee on Space Research (C.O.S.P.A.R.).

(ii) Scientific Committee on Antarctic Research (S.C.A.R.).
(iii) Scientific Committee on Oceanic Research (S.C.O.R.).
(iv) Committee on the International Quiet Sun (I.Q.S.Y.).

VIII. — *Finances.*

In order that the activities of the Committee and the study groups may proceed with dispatch, a subvention of approximately $ 25 000 will be needed during the next year. This amount is deemed sufficient to assure the effectiveness of the Committee through its next meeting in early 1966.

Proceedings of the XIIIth General Assembly

The Proceedings of the XIIIth I.U.G.G. General Assembly held in Berkeley, 19-31 August 1963 have now been published. This 300 page volume was edited by the outgoing I.U.G.G. Secretary General, Mr. G. R. Laclavère and the new Secretary General, Prof. G. D. Garland. The first part of the volume prints the speeches made at the Opening Ceremony and Plenary Session and includes the message from the late J. F. Kennedy, the speech on Science and Man's View of Himself by Dr. J. B. Wiesner, and the Presidential Address by Prof. V. V. Beloussov. The report of the I.U.G.G. Secretary General for the period January 1960-December 1962 is followed by a summary of the actions taken on the resolutions adopted at the XIIth General Assembly in Helsinki in 1960. The Treasurer's report is followed by the report of the Finance Committee for the period 1960-1962, and the Audited Accounts for the same period.

The Minutes of the Executive Committee meetings and also those of the I.U.G.G. Council are printed in full. There are also short reports on 16 Symposia held during the course of the meeting.

The Statutes and By-Laws of I.U.G.G. in the French, English and Russian languages are reprinted. The Statutes and By-Laws of the seven I.U.G.G. Associations are reprinted in both the French and English languages. The Resolutions adopted

by the XIIIth General Assembly are printed in both the French and English languages. The Proceedings conclude with a list of the Officers of the Union, the Associations and Commissions for 1963-1966, a list by country of these 551 Officers, and lists of the organizations adhering to the I.U.G.G., the I.U.G.G. National Committees and the National Correspondents to the Associations. Finally, there is a list of the 1938 participants of the meeting who have each received a free copy of this volume. This has been made possible by the generous gift of $ 2000 received from the American Geophysical Union.

Copies of the Proceedings of the Berkeley General Assembly may be ordered from the I.U.G.G. Publications Office, 39*ter*, rue Gay-Lussac, Paris 5e, France, at a cost of $ 3.00 each with soft cover. A few bound copies are available at the cost of $ 4.00 each.

FÉDÉRATION ASTRONAUTIQUE INTERNATIONALE

Deuxième Symposium International concernant les facteurs d'ambiance rencontrés par l'Homme dans l'Espace

Adresse au nom de l'O.M.M. et de l'U.R.S.I.

C'est d'abord l'Organisation Mondiale de la Météorologie qui, sur l'initiative de son Secrétaire Général, m'a chargé en tant que membre de son Comité Consultatif de la représenter. Ensuite, c'est au titre de Président sortant du Comité National Français de Radio-Electricité Scientifique que l'Union Radio Scientifique Internationale m'a fait une demande analogue.

Personnellement cette double charge me ravit car depuis longtemps j'ai cru à l'homme dans l'espace. Je suis en effet le seul universitaire français encore vivant a avoir participé en octobre 1950 à la réunion qui eut lieu dans le grand amphithéâtre de la Sorbonne et où furent jetés les fondements de la Fédération Astronautique Internationale. Une telle prise de position me valut d'ailleurs à l'époque de nombreux sarcasmes.

Si la Météorologie intervient pour une faible part dans la balistique au moment du lancement des engins habités, son rôle est important à l'instant de l'atterrissage ou de l'amerissage de la cabine, opération délicate qui peut devenir dangereuse au milieu d'éléments déchaînés.

Dès le début de la Recherche Spatiale, l'O. M. M. a vu tout le parti à en tirer dans son domaine et cela dans deux directions :

— étendre en altitude la connaissance de l'atmosphère à l'aide des fusées,

— utiliser les satellites pour une exploration intensive des paramètres météorologiques autour du globe.

A cette intention se sont réunies depuis, à son siège, plusieurs assemblées d'experts qui ont établi des rapports détaillés en vue d'une transformation radicale des méthodes et méthodes et des moyens de la météorologie afin d'en accroître notablement l'efficacité.

Mais s'il s'agissait là de la mise en œuvre d'une automatisation très poussée, la possibilité récente que le pilote d'un satellite emmène un observateur scientifique ouvre de larges horizons.

Si déjà quelques embryons d'observations de physique atmosphérique ont été faits par les cosmonautes, rien ne s'oppose à ce qu'il en soit de même dans le domaine de la dynamique de l'atmosphère. De plus l'homme ne pouvant mettre dans la machine plus d'intelligence qu'il n'en a, on saisit tout l'intérêt qu'offre au spécialiste de la météorologie la possibilité d'aller étudier d'en haut les phénomènes à l'échelle planétaire. Nul doute, si toutefois nous ne sommes pas encore à l'époque des météorologistes satellisés, qu'on puisse rapporter de tels vols des idées fructueuses quant aux explorations automatiques à effectuer.

Je suis heureux d'exprimer au nom de l'O.M.M. tous les souhaits qu'elle forme en vue du succès de cette réunion et le gré qu'elle vous sait d'accomplir vos travaux, travaux qu'elle suit avec beaucoup d'intérêt.

Quant à l'U.R.S.I., on peut dire que ses sept Commissions s'intéressent plus ou moins directement à l'espace. Et même pour traiter de problèmes tout à fait particuliers elle a créé un Comité spécialisé, le « Committee on Space Radio Research » (Comité de la Recherche Radioélectrique Spatiale) dont le dernier colloque qui s'est tenu lors de la récente assemblée du C.O.S.P.A.R. avait pour sujet « Optimisation de l'instrumentation pour les expétiences spatiales du point de vue du traitement des données ».

Si l'aéronautique s'est développée parallèlement aux liaisons radio-électriques avec le sol, il en est de même de l'astronautique. Le cosmonaute a besoin d'une liaison constante et sûre avec l'infrastructure terrestre. Et cela ne va pas sans problèmes qu'il a fallu résoudre car l'ionosphère intervient pour perturber la propagation des ondes par des phénomènes de réfraction, de polarisation, d'absorption etc., éminemment variables avec les fréquences utilisées. Et si pour les atténuer on augmente trop celles-ci, c'est la troposphère qui perturbe à son tour.

En outre, au moment de la rentrée, le comportement des antennes dans un milieu qui est un véritable plasma pose encore de délicats problèmes.

Lors de sa dernière assemblée générale, à Tokyo en 1963, l'U.R.S.I. soucieuse des problèmes posés s'est encore plus nettement orientée vers l'espace à tel point qu'elle a proposé un changement de sa dénomination, correspondant mieux à ses travaux.

Ceci témoigne du grand intérêt qu'elle vous porte et c'est en son nom que je vous assure de son appui le plus compréhensif. Je souhaite aussi que votre Symposium soit le plus fructueux possible.

E. Vassy.

U.N.E.S.C.O.

Actes de la Conférence Générale

Troisième session, Paris, 1964

Résolutions

Nous avons extrait de ce volume les passages qui peuvent intéresser soit directement, soit indirectement les membres de l'U.R.S.I.

2. — Sciences exactes et naturelles

2. — Sous-Direction Générale.

2.1. — Développement de l'infrastructure scientifique des Etats membres.

2.11. — Aide aux états membres pour l'organisation et la planification du développement scientifique.

2.111. — Les Etats membres sont invités à formuler et à mettre en œuvre une politique scientifique nationale en vue d'accroître leur potentiel scientifique et technique et d'orienter la recherche scientifique vers le développement social et économique.

2.113. — Les Etats membres et Membres associés d'Afrique sont invités à prendre toutes les mesures nécessaires pour mettre en œuvre, aux échelons national et régional, les recommandations contenues dans le Plan pour la recherche scientifique et la formation en Afrique, adopté à la Conférence de Lagos en août 1964, et notamment :

(*a*) à créer un organisme national de recherche et un budget national de la recherche pour planifier, coordonner et diriger la recherche scientifique dans le pays ;

(*b*) à établir des registres nationaux du personnel de recherche ainsi qu'un cadre national de chercheurs de carrière ;

(*c*) à arrêter le projet et décider la création d'instituts nationaux ou sous-régionaux des ressources naturelles ;

(*d*) à assurer l'expansion de l'enseignement scientifique et la prise de conscience des valeurs scientifiques par la société.

2.2. — Coopération internationale pour le progrès de la recherche et de la documentation scientifiques.

2.21. — Sciences fondamentales.

2.211. — Coopération avec les organisations scientifiques non-gouvernementales.

2.2111. — Les Etats membres sont invités à encourager la création et le développement d'associations nationales spécialisées dans les diverses branches des sciences exactes et naturelles, et à aider ces associations à s'affilier aux organisations scientifiques internationales non gouvernementales ainsi qu'à coopérer activement avec elles.

2.2112. — Le Directeur général est autorisé à collaborer avec les organisations scientifiques internationales non gouvernementales, à faciliter la coordination de leurs activités respectives, et à leur fournir des subventions et des services appropriés en vue de développer l'action de l'U.N.E.S.C.O. dans le domaine des sciences exactes et naturelles.

2.2113. — Le Directeur général est autorisé à accorder en 1965-1966 des subventions jusqu'à concurrence de 444.000 dollars aux organisations internationales non gouvernementales du domaine des sciences exactes et naturelles.

2.212. — Amélioration de la documentation et de l'information scientifiques et techniques.

2.2121. — Les Etats membres sont invités :

(*a*) à créer des services nationaux et régionaux de documentation scientifique et technique, ou à faciliter la création et le développement de tels services ;

(*b*) à coordonner les activités de ces services et à développer les échanges de matériel, d'informations, etc. ;

(*c*) à encourager l'application à l'échelon national des mesures recommandées et des suggestions formulées dans le plan à long terme d'action concertée établi par l'U.N.E.S.C.O. en vue de l'amélioration de la documentation scientifique et technique

2.22. — Sciences de la terre.

2.221. — Astronomie et géophysique générale.

2.2211. — Le Directeur général est autorisé, en collaboration avec les organisations compétentes du système des Nations Unies et avec les organisations internationales non gouvernementales appropriées, notamment les unions scientifiques internationales et les comités scientifiques du Conseil international des unions scientifiques, à promouvoir et à faciliter la collaboration internationale pour l'étude scientifique de la terre, en fournissant une assistance destinée à favoriser :

(*a*) les programmes internationaux de recherche, notamment les Années internationales du soleil calme et le Levé magnétique mondial ;

(*b*) le perfectionnement de spécialistes des sciences et des techniques relevant de l'astronomie et de la géophysique ;

(*c*) l'échange de renseignements sur les progrès des recherches astronomiques et géophysiques ;

(*d*) le développement des activités des Etats membres en matière d'astronomie et de géophysique.

2.3. — Application de la science et de la technologie au développement.

2.33. — Aide au développement des Etats membres par l'application de la science et de la technologie.

2.334. — Prix U.N.E.S.C.O. pour une découverte scientifique ayant une importance particulière pour les pays en voie de développement.

Le Directeur général est autorisé, en collaboration avec les organisations scientifiques internationales intéressées, à créer un prix U.N.E.S.C.O., qui sera décerné au cours de chaque session de la Conférence générale, pour récompenser une grande découverte scientifique ou technique présentant une importance particulière pour les pays en voie de développement.

6. — Résolutions générales

6.6. — Relations avec les organisations internationales non gouvernementales.

6.61. — La Conférence générale,

Ayant examiné le document 13 C/PRG/31,

Notant l'importance du concours que les organisations internationales non gouvernementales apportent à la mise en œuvre des objectifs de l'U.N.E.S.C.O. et à l'exécution de son programme,

Considérant que les subventions accordées aux organisations internationales non gouvernementales doivent être utilisées pour promouvoir les fins de l'U.N.E.S.C.O.,

Considérant que ces subventions ont été utilisées conformément aux intentions de la Conférence générale et aux décisions du Conseil exécutif,

Considérant que la conclusion de contrats devrait de plus en plus souvent constituer l'un des moyens d'associer les organisations internationales non gouvernementales à la mise en œuvre des activités inscrites au programme de l'U.N.E.S.C.O.,

Invite les organisations internationales non gouvernementales à étendre géographiquement leurs activités, notamment avec la collaboration des Commissions nationales et dans le sens des besoins du Tiers Monde ;

Demande au Directeur général de continuer à associer à l'action de l'U.N.E.S.C.O. les organisations internationales non gouvernementales, en particulier celles qui sont largement représentatives et par ailleurs les mieux qualifiées, et à faciliter l'extension géographique des activités de ces organisations ;

Prend note du rapport sexennal présenté par le Conseil exécutif sur le concours apporté à l'action de l'U.N.E.S.C.O. par les organisations internationales non gouvernementales des catégories A et B et sur les résultats obtenus grâce aux subventions accordées à ces organisations.

Records of the General Conference

THIRTEENTH SESSION, PARIS 1964

Resolutions

We are quoting from that volume the following parts which may be of interest, directly or indirectly, to the members of U.R.S.I.

2. — NATURAL SCIENCES AND THEIR APPLICATION TO DEVELOPMENT

2. — Office of the Assistant Director-General.

2.1. — Development of basic structure of science in Member States.

2.11. — Aid to Member States in the organization and planning of scientific development.

2.111. — Member States are invited to formulate and implement a national science policy with a view to increasing their scientific and technological potential and to ensuring an adequate orientation of scientific research towards social and economic development.

2.112. — The Director-General is authorized, in collaboration with interested Member States and appropriate international, regional, and national organizations, both governmental and non-governmental, and particularly with institutions in developing countries :

(*a*) To collect, analyse and disseminate information on the scientific and technological potential of Member States and, in particular, on the institutional organization for research ;

(*b*) To undertake comparative and pilot studies on national science policy and research organization ;

(*c*) To promote regional co-operation for the development of national science policy, and

(*d*) To assist Member States, upon their request, in the establishment or improvement of science policy planning and research organization, through sending advisory missions, conducting scientific and technological potential surveys, with particular regard to human resources and budgets, or organizing training seminars, and, to this end, to participate in their activities in this field.

2.113. — Member States and Associate Members in Africa are invited to take all necessary steps to implement, at the national and regional levels, the recommendations set forth in the Plan for Scientific Research and Training in Africa, adopted by the Lagos Conference in August 1964, and in particular to :

(*a*) Establish a national research organ and national research budget to plan, coordinate and direct scientific research in the country ;

(*b*) Establish national research manpower registers and a national research service ;

(*c*) Plan and establish national or sub-regional institutes of natural resources ;

(*d*) Ensure the expansion of science education and of the science consciousness of society ; and

(*e*) Co-operate in the establishment of an African Committee on Natural Resources in revising the African convention on conservation and in the development of a network of African research institutes.

2.2. — International co-operation for the advancement of scientific research and documentation.

2.22. — Earth sciences.

2.221. — Astronomy and Geophysics : General.

2.2211. — The Director-General is authorized, in co-operation with the competent organizations of the United Nations system and appropriate international non-governmental organizations, especially the international scientific unions and the scientific committees of the international collaboration in the scientific study of the earth, by providing assistance for :

(*a*) International research programmes, including the International Years of the Quiet Sun and the World Magnetic Survey ;

(*b*) The advanced training of scientific and technical specialists in the fields of astronomy and geophysics ;

(*c*) The exchange of information on the progress of research in astronomy and geophysics ; and

(*d*) The development of astronomical and geophysical activities in Member States.

2.3. — Application of science and technology to development.

2.33. — Assistance to the development of Member States through the application of science and technology.

2.334. — U.N.E.S.C.O. prize for a scientific discovery having particular importance for developing countries.

The Director-General is authorized, in collaboration with the appropriate international scientific organizations, to establish a U.N.E.S.C.O. Prize for an outstanding scientific or technological discovery having particular importance for developing countries, to be awarded at each session of the General Conference.

6. — General Resolutions

6.6. — Relations with international non-governmental organizations.

6.61. — The General Conference,

Having examined document 13/C/PRG/31,

Noting the important contribution that international non-governmental organizations are making to the realization of U.N.E.S.C.O.'s objectives and the execution of this programme,

Considering that the subventions granted to international non-governmental organizations should be utilized to promote U.N.E.S.C.O's aims,

Considering that these subventions have been utilized in conformity with the intentions of the General Conference and with the decisions of the Executive Board,

Considering that formal contracts should more and more constitute one means by which international non-governmental organizations can be associated with the implementation of the activities included in U.N.E.S.C.O.'s programme,

Urges international non-governmental organizations to spread their activities over wider geographical areas, with particular reference to the collaboration of National Commissions and to the needs of developing countries ;

Requests the Director-General to continue to associate international non-governmental organizations with U.N.E.S.C.O's action, especially those that are largely representative and are other-

wise best qualified, and to assist in extending the geographical scope of their activities ;

Takes note of the sexennial report presented by the Executive Board on the contribution made to U.N.E.S.C.O. activities by international non-governmental organizations (Categories A and B) and on the results obtained through subventions granted to those organizations.

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Publication 55-2 : *Première édition.* — Essais des câbles isolés au papier imprégné sous gaine métallique. 2e partie : Câbles à imprégnation non migrante pour des tensions alternatives de 10 kV à 33 kV inclus (à l'exclusion des câbles à pression de gaz).

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Supplément au Bulletin d'information n° 151 (juillet-août 1965)
Supplement to Information Bulletin n° 151 (July-August 1965)

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