Bulletin nº 140 Septembre-Octobre 1963

U. R. S. I.

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ORBITUARY

Prof. J. L. H. Jonker

Professor J. L. H. Jonker, former Vice-President of U.R.S.I. Commission VII on Radio Electronics, died on July 12th, 1963, at the age of 62.

Professor Jonker graduated in 1925 from the Technological University at Delft as « elektronisch ingenieur ». In 1942 he obtained a doctor's degree with a thesis on the subject of the current distribution in electron tubes. From 1930 till 1956 he was associated with the N. V. Philips' Gloeilampenfabrieken at Eindhoven, from 1936 as director of research on electron tubes in the Natuurkundig Laboratorium.

From 1949 on Dr. Jonker taught electronics at the Technological University at Delft. In 1956 he accepted the responsability for organising the Department of Electrical Engineering at the new Technological University at Eindhoven. Until his death he acted as head of this department.

Among his many contributions to the development of electron tubes his work in two fields may be mentioned in particular : the role of secondary emission in the performance of electron tubes and the detailed study of the electron trajectories in electron tubes of various electrode configurations.

XIII[e] ASSEMBLÉE GÉNÉRALE

Elections

L'Assemblée Générale de l'U.R.S.I. a élu ou confirmé dans leurs fonctions les personnalités suivantes :

Président : Prof. I. KOGA.

Président sortant : Dr. R. L. SMITH-ROSE.

Vice-Présidents : M. B. DECAUX (ré-élu),
Prof. W. DIEMINGER,
Prof. A. PROKHOROV (ré-élu),
Prof. S. SILVER.

Trésorier : Prof. Ch. MANNEBACK (ré-élu).

Secrétaire Général : Ing. E. HERBAYS (ré-élu).

Présidents d'Honneur : Sir Edward E. APPLETON,
Dr. L. V. BERKNER,
Dr. R. BUREAU,
Dr. W. ECCLES.

Présidents des Commissions :

Commission I : Dr. L. ESSEN.

Commission II : M. J. VOGE (ré-élu).

Commission III : Mr. J. A. RATCLIFFE (ré-élu).

Commission IV : Dr. H. G. BOOKER.

Sous-Commission du Bruit Radioélectrique d'Origine Terrestre : Prof. A. KIMPARA.

Commission V : Prof. W. N. CHRISTIANSEN.

Commission VI : Dr. F. L. STUMPERS.

Commission VII : Prof. P. GRIVET.

General Resolutions Submitted by the Executive Committee

and adopted by the XIVth General Assembly Tokyo, 1963

Resolution I

The XIVth General Assembly of U.R.S.I. meeting in Tokyo, September 1963 endorses the report on the future structure of I.C.S.U. (as summarized by Dr. L. V. Berkner) and further endorses the recommendation of the Executive Committee to appoint delegates to expose U.R.S.I.'s views on the new structure of I.C.S.U.

Those delegates are Dr. L. V. Berkner (Honorary President of U.R.S.I.), Dr. W. J. G. Beynon (Chairman U.R.S.I.-C.I.G. Committee), Prof. Ch. Manneback (Treasurer of U.R.S.I.), Dr. R. L. Smith-Rose (Past President of U.R.S.I. and U.R.S.I. Official delegate to I.C.S.U.).

Resolution II

Report of the ad hoc Committee appointed to consider the proposal of the U. S. Academy of Sciences to the International Council of Scientific Unions (I.C.S.U.) recommending the formation of a special Committee on Atmospheric Research to the Board of Officers of U.R.S.I.

The Committee has reviewed the documents pertaining to this matter :

(1) The Special Report of the National Academy of Sciences entitled « An Outline of International Programs in the Atmospheric Sciences ».

(2) I.C.S.U. Document EBXV/GA10/8.7.63 — Item 12 entitled « Atmospheric Sciences Research, Summary » outlining the I.C.S.U. action to date.

(3) I.C.S.U. Document EB15/25.7.63, Document 7 entitled

« The Secretary General's Report » as it relates to the subject at hand.

The Committee believes it appropriate and desirable that the Executive Committee and the General Assembly of U.R.S.I. adopt the following resolution :

Resolution of the XIV General Assembly of U.R.S.I. Meeting at Tokyo, Sept. 19, 1963.

The U.R.S.I. invites to the attention of I.C.S.U. the rapid progress of the sciences underlying our ultimate understanding, effective utilization, and perhaps eventual control of the behaviour of the Earth's atmosphere for man's greater benefit. From the I.G.Y., space research, and other recent scientific activity, the comprehension of atmospheric phenomena, and effective experimental approaches to this comprehension, now appear within reach.

The U.R.S.I. appreciates the special study of the National Academy of Sciences, U. S. A., outlining the broad measures of international scientific activity that are now possible through the advanced measures of scientific research at hand. This proposed study, in the long term, is intended « to bridge the gap between conventional meteorology and aeronomy, and involves the upper reaches of the stratosphere and the layers beyond, including the lower part of the ionosphere ». This upper part of the atmosphere has long been the direct concern of U.R.S.I. More recently, the Union has fostered radio meteorological studies of the troposphere as well as other pertinent matters.

The U.R.S.I. further endorses the recognition of these potentialities by the United Nations, which, in its resolution 1802 (XVII) taken on Dec. 19, 1962 :

«Invites the International Council of Scientific Unions through its member unions and national academies to develop an expanded programme of atmospheric science research which will complement the programme fostered by the World Meteorological Organization ».

The U.R.S.I. believes that the I.C.S.U. and its affiliated international scientific unions bear a deep responsibility to respond to these expressions of scientific need.

Therefore, the U.R.S.I. urges the formation by I.C.S.U. of a Special Committee on Atmospheric Sciences of limited duration, in the pattern of the Special Committee for the International Geophysical Year (C.S.A.G.I.), dealing with the different and explicit disciplines which the atmospheric sciences of the future necessarily embrace, to fulfil the scientific purposes and opportunities expressed in these documents. Such a Committee would direct its effort to solving the operational problem of international organization of world wide research programmes in several disciplines of the atmospheric sciences. It would not simply add one more to those international bodies who are considering the scientific aspects of the subject.

The U.R.S.I. further expresses the view that through the character of its scientific interests, it can play a major role in furthering the purposes and objectives of such a Special Committee and is prepared to co-operate fully to this end.

Resolution III

It is recommended that the names of Commissions III and IV be changed as follows :

Commission III on the Ionosphere,
Commission IV on the Magnetosphere.

The subject appropriate to Commissions III and IV together include a study of all the earth's upper and ionised atmosphere, the outer regions of which are coming to be called the Magnetosphere. Since the division between the subjects cannot be rigidly defined, the Chairmen of the two Commissions will arrange for the necessary division of subjects between the programmes of the two Commissions prior to each General Assembly or scientific symposium.

It is further decided to set up, within Commission IV, a permanent Sub-Commission on Radio Noise of Terrestrial Origin.

Resolution IV

At its XIVth General Assembly in Tokyo, Japan, September 1963, the U.R.S.I. reviewed the recent work of the Inter-Union Committee for Frequency Allocations for Radio Astronomy and

Space Science (I.U.C.A.F.) and endorses its efforts on behalf of these two branches of science in preparation for the Extraordinary Administrative Radio Conference of the I.T.U., Geneva, October 1963.

U.R.S.I. recommends to I.C.S.U. on behalf of the I.U.C.A.F. that the terms of reference of this committee be broadened to ensure international protection of scientific activities, not limiting itself to radio astronomy and space science but covering all areas of science in which radio frequency allocations are involved.

Resolution V

The ad hoc Committee appointed to advise the Executive Committee on the future organization of U.R.S.I. reports as follows :

1. Both in U.R.S.I. and I.U.G.G. there have grown up groups of active young workers concerned with the closely related subjects such as aeronomy, the ionosphere, upper atmospheric physics, geomagnetism, solar physics and the like, which now form a unified and rapidly growing field of science which is here called solar-terrestrial physics. Separate parts of these subjects tend, at present, to be dealt with not only by U.R.S.I. and I.U.G.G. but also by I.A.U., I.U.C.I. (the Inter-Union Committee on the Ionosphere), I.U.S.T.R. (the Inter-Union Committee on Solar and Terrestrial Relations), I.U.P.A.P. (the International Union on Pure and Applied Physics, through its Cosmic Ray Commission), and COSPAR. All of these bodies come under I.C.S.U.

Solutions to problems of radio wave propagation depend on the whole of this branch of science.

2. The workers in solar and terrestrial physics feel themselves to constitute a coherent group, and if this rapidly developing field of science is to develop properly they feel the need for a more unified home in the I.C.S.U. organization. Evidence of this need is contained in a resolution of I.U.C.I. and a letter from the Chairman of I.U.C.S.T.R. The Committee is informed that one or more Commissions of U.R.S.I. will pass similar resolutions at the General Assembly. Likewise the General Assembly of I.A.G.A. (International Association of Geomagnetism and Aeronomy, an Association of I.U.G.G.) drafted the following Resolution which has similar implications :

« The Association of Geomagnetism and Aeronomy requests its Executive Committee to appoint a committee to study and discuss with other bodies within the framework of the I.C.S.U. the most appropriate and suitable organization of the broad and rapidly developing field of Solar and Terrestrial Physics ».

3. If U.R.S.I. acts promptly it can play some part in determining how the necessary re-organization is made.

A solution of the problem is so urgent that if U.R.S.I. takes no action now the necessary re-organization will almost certainly take place, without reference to U.R.S.I.

4. The necessary re-organization could come about through the transfer of the appropriate subjects of study to

(*a*) an organization closely allied to U.R.S.I., or

(*b*) a new Union.

5. The Executive Committee recommends that the General Assembly of U.R.S.I. be asked to pass the following Resolutions :

(i) The General Assembly of U.R.S.I.

recognising the need to provide, within the structure of I.C.S.U. an organization which will bring together the closely allied subjects of ionospheric physics and aeronomy, geomagnetism, solar physics and the like (solar-terrestrial physics for short),

authorizes the Board of Officers to establish a Committee charged with the following terms of reference :

(*a*) to investigate how to establish within the structure of I.C.S.U. an Organization which will bring together the closely allied subjects of ionospheric physics and aeronomy, geomagnetism, solar physics and the like, and will provide the most efficient means for development, discussion and exchange of information, data and research,

(*b*) to consider the achievement of this objective through the possibility of a continuing organization closely linked with U.R.S.I.,

(*c*) to report within one year.

(ii) The General Assembly of U.R.S.I.

authorizes the President, when he has received the report of the Committee mentioned in Resolution (i), to call an extraordinary

meeting of the Executive Committee and of the General Assembly as may be necessary.

(iii) The General Assembly of U.R.S.I.

recognising the need to unify the international discussions of solar-terrestrial physics, even before any organizational changes can take place in the structure of the Unions involved,

resolves that it will approach other I.C.S.U. organizations to establish the principle that scientific discussions on solar-terrestrial physics will be held only in collaboration and at joint meetings.

(iv) The General Assembly of U.R.S.I.

recognising in the spirit of resolution (iii), that the next General Assembly of U.R.S.I. should be associated with a Scientific Symposium on topics in solar-terrestrial physics, and that this Symposium should be conducted by U.R.S.I. jointly with one or more other international bodies,

intends that the next General Assembly should be associated with a scientific symposium on some aspect of solar-terrestrial physics run in conjunction with some other international body.

Resolution VI

The XIVth General Assembly salutes Mrs. van der Pol and wishes to express its gratitude to her for her generosity and thoughtfulness in providing the van der Pol Medal in memory of her illustrious husband.

Resolution VII

The XIVth General Assembly expresses its gratitude to the Science Council of Japan for making it possible for U.R.S.I. to meet in the hospitable climate of Japan.

The Assembly further expresses its appreciation to the Science Council for its generous financial support which aided greatly in making this Assembly a success.

Resolution VIII

The XIVth General Assembly commends the Japanese National Committee for the excellent arrangements it has made for the conduct of this assembly and for the very adequate facilitaties that have been provided.

The Assembly would be remiss were it not to acknowledge its deep appreciation for the very successful programme of the Ladies Committee. Their graciousness and thoughtfulness has made the visit to Japan a happy experience that will never be forgotten.

Resolution IX

The XVth General Assembly expresses its gratitude to UNESCO for its generous financial support which enabled young scientists to attend the Assembly.

Resolutions and Recommendations emanating from Commissions and Committees

Recommendation I.1

The International Scientific Radio Union considering that some physical measurements require an accuracy of time measurement which can be given only by an atomic standard recommends that the results of such measurements should be in terms of an atomic unit.

It is further recommended that an atomic unit of time interval should be adopted by the General Conference of Weights and Measures at the earliest possible opportunity. The unit adopted should be based on the atomic transition which in the opinion of the Consultative Committee for the Definition of the Second is at the present time most satisfactorily evaluated with the suggestion that the position should be re-examined as techniques develop with the objective of adopting transitions capable of being used with higher accuracy. The adoption of a new transition should not change the values of any previously adopted transitions within the accuracies with which they were evaluated.

Moreover whereas confusion has been caused by the deliberate offsetting of the frequency of standard frequency transmissions it is recommended that when an atomic unit has been formally adopted, standard frequency transmissions should be operated without offset.

A copy of this recommendation is to be sent by the Secretary General to B.I.P.M., C.C.I.R. and I.A.U. as soon as possible.

RECOMMENDATION I.2

Whereas

(*a*) Atomic standards of frequency have been used for establishing a unit of time to an accuracy of the order 1 part in 10^{11} with respect to an atomic transition, and

(*b*) The integration of the atomic frequencies to provide scales of atomic time is well demonstrated experimentally, and

(*c*) A unique origin of atomic time from which the occurrence of any event or instant of time may be reckoned has foreseeable scientific convenience and use, especially for experiments and observations of long duration,

(*d*) That for physical measurements it is necessary to measure intervals of time of any duration on a scale common to all observers,

Therefore, it is recommended that

1. Scales of atomic time be established in conjunction with national atomic frequency standards, and
2. The origins of these scales relative to each other be determined as well as the state of the art allows (now of the order of one microsecond), and
3. The subsequent time differences among these scales be regularly determined.

A copy of this recommendation is to be sent by the Secretary General to B.I.P.M., C.C.I.R. and I.A.U. as soon as possible.

RECOMMENDATION I.3

Recommendation to the International Committee of Weights and Measures Regarding Expansion of its Activities to All Radio Frequencies (as expressed in the minutes of the meeting of the Consultative Committee on Electricity and published in the « Comité International des Poids et Mesures, Procès-Verbaux des séances, 2e série, Tome 29, 50e Session, 1961, 9-12 Octobre and the minutes of the 10th Meeting of the Comité Consultatif d'Electricité (1), *2 and 3 May 1963).*

(1) Or Consulting Committee on Electricity.

The XIVth General Assembly of U.R.S.I. hereby expresses full support of a study by the International Committee of Weights and Measures of ways to enhance the availability of standards of electromagnetic quantities at all frequencies.

A copy of this recommendation is to be sent by the Secretary General to B.I.P.M.

Recommendation I.4

Recommendation Regarding Previous Commission I Resolution on Accuracy of Measurement of Electronic Quantities.

In order to implement Resolution nº V, and Nº IV, of Commission I, U.R.S.I., XIIth and XIIIth General Assemblies respectively (1), the National Committees are asked by the Chairman of Commission I to submit in writing a list of radio electric quantities, magnitudes, and frequency ranges of interest and need at present, and which are likely to be needed during the next five years. An indication of measurement accuracy and precision for the national standards is to be included, if possible.

The list is to be mailed to the International Chairman of Commission I prior to July 1, 1965, for distribution to national chairmen prior to the 1966 General Assembly.

Recommendation I.5

In view of the benefits which have resulted from the international intercomparisons of power standards, it is recommended that this activity be continued among the member countries at their highest national technical level and that these intercomparisons be extended to include other radio electric quantities and other frequency ranges. These intercomparisons should be encouraged and if possible, coordinated by the National Commission I chairmen of the countries involved, who will also advise the International Chairman of the results achieved.

Finally, in order to avoid duplication of scientific effort, it is recommended that the measurement capability of any one country be made available upon request to other member countries.

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(1) Resolution No. V, XIIth General Assembly of U.R.S.I., Proceedings of the XII th General Assembly, Volume XI, Part I, p. 87 ; and Resolution No. IV, XIIIth General Assembly of U.R.S.I., Proceedings of the XIIIth Gzneral Assembly, Volume XII, Part I, p. 105.

RECOMMENDATION I.6

Commission I views with concern the fact that the development of precision radio-frequency measuring equipment employing coaxial lines, now proceeding in different countries, is based upon incompatible connectors.

It recommends to the International Electrotechnical Commission that a study be made of the problem of interconnecting such equipment with a view to obtaining, first, international agreement on a standard value of characteristic impedance and a standard inner diameter of the outer conductor in the range 12 mm to 24 mm and, secondly, agreement on a standard means for interconnection of equipment without the need for adaptors.

A copy of this recommendation is to be sent to the International Electrotechnical Commission by the Secretary General as soon as possible.

These Resolutions and Recommendations were approved by the Executive Committee.

Recommendations I.3 and I.6 were endorsed by the General Assembly.

Commission II

RESOLUTION II.1

The terms of reference of Commission II be extended to include radio propagation phenomena associated with the solid and/or liquid material, as well as non-ionized gases, of which the earth, the other planets and the moon, together with their atmospheres, are made.

RESOLUTION II.2

That in future space studies attention be given to measuring characteristics of planetary atmospheres and surfaces, including those of the earth as viewed from space ; controlled laboratory and model experiments may be of assistance in this endeavour.

RESOLUTION II.3

That more data be taken on terrestrial and atmospheric radiative energy as regards (*a*) the effect on atmospheric structure, and (*b*) the effect on sensitive receiving systems.

RESOLUTION II.4

That attention be given to coherent submillimetre (including optical) waves as regards (*a*) their propagation through the atmosphere, and (*b*) their use in providing additional information on atmospheric structure.

RESOLUTION II.5

That continued attention be given to gathering further data on surface and subsurface propagation as regards (*a*) determining characteristics of the medium, and (*b*) measuring the effects on signal level, angle of arrival, etc.

RESOLUTION II.6

That methods of studying the structure of refractive index irregularities be exploited, specifically : fluid mechanical theory, higher resolution systems, simultaneous vertical and oblique radio measurements (including Doppler techniques), simultaneous radio and meteorological measurements (encouraging interdisciplinary cooperation) ; and also that stress be placed on finding the upper limit of accuracy imposed by the atmosphere on measurements of range, angle and Doppler effects.

RESOLUTION II.7

That continued effort be devoted to improved theories and models of the atmosphere providing adequate explanation of propagation phenomena, — in particular the question of antebna performance as a function of distance, frequency, etc.

Resolution II.1 has been approved by the Executive Committee and endorsed by the General Assembly.

Commission III

RESOLUTION III.1. — *Reorganization of U.R.S.I.*

Commission III, recognizing the need to provide within the structure of I.C.S.U. a single coherent organization where closely allied subjects such as aeronomy, ionospheric physics, geomagnetism, solar physics and the like, can be discussed internationally, requests the Executive Committee to set up a small committee empowered

to discuss with the I.C.S.U. bodies concerned, the best way to accomplish this in an organization strongly linked to U.R.S.I. (1).

RESOLUTION III.2

Continued need for a Commission on ionospheric propagation

Commission III recognizes the continuing need inside U.R.S.I. for a Commission to deal with the propagation of radio waves in the ionosphere.

RESOLUTION III.3. — *Symposia*

The General Assembly of U.R.S.I. recommends that, within the next three years, symposia be held on the subject of solar-terrestrial physics only in conjunction with other international scientific bodies. It recommends that the first symposium be held in May 1964 in Florence jointly with COSPAR, on the subject of interaction of energetic particles with the atmosphere ; it recommends a further symposium in 1965, the subject to be determined by negotiation with other international scientific organizations.

RESOLUTION III.4. — *Rocket measurements of the Sq current system during the I.Q.S.Y.*

The General Assembly of U.R.S.I., considering the importance of electrodynamic forces in the ionosphere and the present lack of knowledge of the levels in the ionosphere at which the quiet day currents flow, taking note of the proposals contained in section 2.2.2 of the Preliminary Joint Report of COSPAR Working Group II for I.Q.S.Y. Working Group XV on Aeronomy (I.Q.S.Y. Notes » n° 3, 1963, pp. 60-61) « Ionospheric Electric Current Measurements », views with concern the comparatively small number of rocket measurements of ionospheric electric currents planned at medium latitudes for the I.Q.S.Y., and strongly recommends that steps be taken to increase the number of such measurements at temperate latitudes in order to delineate the d,urnal and seasonal behavior of quiet day current systems.

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(1) *See Resolution V submitted by the Executive Committee.*

The General Assembly further urges that each rocket measurement of ionospheric currents be supported by at least the following measurements :

— Ground-based sweep-frequency vertical incidence ionospheric soundings ;

— Adequate ground-based recording of magnetic elements so as to establish the quiet day magnetic variation ;

— Rocket-borne measurements of the electron density of the relevant height range of the ionosphere (where feasible).

RESOLUTION III.5

VLF and LF measurements during I.Q.S.Y.

The General Assembly of U.R.S.I., considering the importance of long term synoptic observations of the D-region, and aware of recent developments that hold the promise of significantly increasing the usefulness of the VLF and LF measurements for D-region profile studies, recommends the continuation of an active worldwide programme of continuous recording of VLF and LF transmissions by as many organizations as possible during the I.Q.S.Y. period.

These Resolutions have been approved by the Executive Committee. Resolutions III.3, III.4 and III.5 were endorsed by the General Assembly.

Commission IV

RESOLUTION IV.1

Commission IV, recognizing that discussions are about to take place within I.C.S.U. concerning the international organization of the field of atmospheric sciences and solar-terrestrial relationships, and recognizing its own interests in these discusions, requests U.R.S.I. to participate in them and to include representation from Commission IV therein.

RESOLUTION IV.2

Commission IV recommends that COSPAR consider adding the topic « Generation of radio noise by energetic particle streams »

to its forthcoming symposium on « Interaction of energetic particles with the atmosphere » to be held in Florence, Italy.

If this proposal is accepted, Commission IV offers to organize the session and to provide the chairman. Commission IV further recommends that a brief account of the relevant discussions in Commission IV be presented as a paper at the COSPAR symposium.

RESOLUTION IV.3

Commission IV recommends the adoption of the Draft Programme for whistlers and VLF Ionospheric Noise during the I.Q.S.Y. as given in Appendix A.

Appendix A. — Whistlers and VLF Ionospheric Noise (W)

1. — *Introduction.*

During the I.G.Y. tape recordings of whistlers and VLF ionospheric noise were collected from many stations in the northern and southern hemispheres. Aural data summaries were sent to the world data centres. In addition to providing useful statistical data on occurrence of various phenomena, these summaries have served as a catalog of activity on the tapes. Spectral studies of whistlers selected from this catalog have led to important new results on the distribution and variation of electron density in the magnetosphere, including diurnal, annual, solar cycle and magnetic storm effects. The connections between VLF ionospheric noise and whistlers have been better defined. New relations have been discovered between VLF ionospheric noise and other phenomena such as auroral and magnetic variations.

During I.Q.S.Y. synoptic observations similar to those taken during I.G.Y. are needed to define the effect of solar activity on the properties of whistlers and VLF ionospheric noise. In addition, new special programmes on continuous VLF noise observations, conjugate-point noise observations, fixed-frequency whistler-mode observations and satellite observations of whistlers and VLF ionospheric noise are recommended. Attention is also drawn to the usefulness of obtaining accurate amplitude spectra of whistlers.

2. — *Synoptic observations.*

A programme of synoptic observations is recommended for stations at all latitudes. Special emphasis should be given to pairs of magnetically conjugate stations. It is recommended that the frequency range 15-20 kc/s be included so that VLF code transmissions will be available for accurate relative timing. It is further recommended that, if practicable, the frequency range be extended above 20 kc/s at middle and low latitudes, to give information on path latitude from the noise properties of whistlers.

The following minimum programme is recommended for as many stations as is practicable :

(*a*) Recordings on magnetic tape should be made between 50 and 52 minutes past each hour UT.

(*b*) Normally every third recording schedule should be aurally monitored, namely those schedules commencing at 0050, 0350, 0650..... 1850, 2150 UT.

(*c*) In addition, every recording schedule should be aurally monitored on days designated retrospectively by the International Ursigrams and World Days Service to be included in Retrospective World Intervals (R.W.I.).

(*d*) Monthly aural data summaries should be compiled in the form used for reporting to World Data Centres during the I.G.Y.

3. — *Data.*

(*a*) *Aural data.* — It is recommended that World Data Centres be informed regularly of the existence of aural data summaries, so that researchers may obtain copies of the data summaries by writing directly to the station concerned.

(*b*) *Whistler dispersion data.* — It is recommended that the following stations obtain the numerical value of whistler dispersion for one typical whistler for each day, if possible obtained between the hours of 0150 and 0350 local time. When whistlers are not available from these hours, another hour should be selected anp identified.

Argentine Islands	Poitiers
Moscow	Stanford
Moshiri	Wellington

It is further recommended that World Data Centres be informed regularly of the existence of these data, and that complete information on the method of data reduction be supplied to researchers requesting data.

(*c*) The World Data Centres will report the existence of the above data in their Catalogs of I.Q.S.Y. Data.

4. — *Continuous VLF noise recording.*

To obtain a full picture of the time variation of VLF ionospheric noise it is recommended that continuous recordings be made in the range of the synoptic whistler observations (usually 300 to 30 000 cps). Of principal interest are stations at medium and high latitudes. Accurate amplitude information should be provided.

5. — *Conjugate-point noise observations.*

Special efforts should be made to determine the relation between noise observed at geomagnetically conjugate points. Of particular importance are locations in the vicinity of the auroral zones and on the polar caps.

6. — *Fixed-frequency whistler-mode propagation.*

Attention is drawn to the usefulness of observing man-made VLF transmissions for the study of attenuation and fading of signals propagated in the whistler mode. Nevertheless, at the present stage of art, such observations must be considered as supplementing rather than replacing observations of natural whistlers.

7. — *Rocket and satellite observations.*

It is recommended that whistler-mode propagation and the origin of VLF ionospheric noise be studied by means of rockets and satellites. In such experiments coordinated ground measurements should be undertaken over the range of geomagnetic latietuds covered by the rocket or satellite.

8. — *Related disciplines.*

It is recommended that wherever possible whistlers and VLF ionospheric noise be recorded at locations where other ionospheric

and magnetic measurements are made. Phenomena which are thought to be connected with whistlers and VLF ionospheric noise incluse auroral fluctuations, both visual and optical, geomagnetic micro-pulsations, magnetic storms, F region electron density and ionospheric absorption. Measurement of all these phenomena will therefore be of interest at whistler stations.

These Resolutions have been approved by the Executive Committee. Resolution IV.2 has been referred to the U.R.S.I. Committee on Space Radio Research.

Commission V

Resolution V.1

Commission V commends the past action of I.U.C.A.F. in attempting to obtain protected frequency bands for Radio Astronomy and supports the recommendation made in Doc. nº 50 of I.U.C.A.F. submitted to the Extraordinary Administrative Conference of I.T.U. to be held in Geneva, Oct. 1963.

Resolution V.2

Commission V requests that it be specifically represented on the permanent committee of U.R.S.I. that will discuss reorganization with the Unions.

Resolution V.3

Commission V will support only forms of reorganization in which the unity of the Commission is preserved.

Resolution V.4

Recognizing the great value to solar-terrestrial research of radio measurements of solar emission, Commission V endorses the resolution of the Inter-Union Commission on the Ionosphere concerning continuous recording of solar radio emissions in the range of wavelengths from 1 to 25 cm and concerning the continued recording of spectroheliograms in this same wavelength range.

Recommendation V.1

That Sub-Commission Vc on the Basic Solar Index be continued with the following membership : Waldmeier (Chairman), Bartels, Covington, Nicolet, Denisse, Mme Pick, Dodson-Prince, Bracewell, Maxwell, Smerd, Kawabata.

Recommendation V.2

That Sub-Commission Ve on Frequency Allocations for Radio Astronomy be continued with the following membership : Findlay (Chairman), Blum, Vitkevitch, Christiansen, Coutrez, Mitra, Seeger (Secretary).

Recommendation V.3

That the following titles be considered for symposia to be held during the next triennium :

(*a*) Radio Astronomy Techniques — preferably an U.R.S.I. Symposium to hold with the next U.R.S.I. General Assembly.

(*b*) as an alternative, preferably joint with I.A.U. :

(*b*1) Planetary Radio Astronomy,
(*b*2) Radio Galaxies,
(*b*3) Galatic Radio Astronomy.

These Resolutions and Recommendations were approved by the Executive Commitee. The three Recommendations were endorsed by the General Assembly.

Commission VI

Résolution VI.1

L'Assemblée Générale recommande la réunion d'un symposium sur la Théorie Electromagnétique en 1965. Le Comité National Hollandais ayant proposé de le réunir à Delft, la proposition est acceptée avec reconnaissance.

Résolution VI.2

La Commission VI fait connaître le grand intérêt qu'elle a pris pour le symposium qui doit se tenir à Tokyo en 1964 sur les thèmes suivants :

Ondes millimétriques
Circuits
Théorie de l'Information

Elle exprime sa satisfaction de voir figurer l'U.R.S.I. parmi les organisations qui ont accordé leur patronage à ce symposium.

RÉSOLUTION VI.3

La Commission VI émet l'avis que les mathématiques ne devraient pas, en elles-mêmes, constituer l'objet de ses études. L'emploi de méthodes mathématiques particulières pour résoudre les problèmes de radioélectricité scientifique est cependant un sujet d'étude désirable et légitime pour cette Commission.

L'attention des autres Unions Internationales intéressées pourrait être attirée sur cette résolution.

Ces résolutions ont été approuvées par le Comité Exécutif. La Résolution VI.1 a été confirmée par l'Assemblée Générale.

Note

La traduction des textes anglais paraîtra dans un des prochains numéros du Bulletin.

The translation of the French texts will be published in one of the next issues of the Bulletin.

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

See page 28.

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

MINUTES OF FOURTH MEETING

The fourth meeting of the U.R.S.I.-C.I.G. Committee was held in Tokyo on September 13, 1963, during the XIV General Assembly of U.R.S.I.

The following members were present :

Prof. W. J. G. Beynon (*Chairman*),
Mr. G. M. Brown (*Secretary*),
Dr. G. M. Allcock,
Mr. Y. Aono,
Prof. W. Dieminger,
Mr. F. Horner,
Prof. E. A. Lauter,
Dr. C. G. Little,
Dr. P. M. Millman,
Dr. M. G. Morgan,
Mr. A. H. Shapley ;

and the following attended by invitation :

Dr. S. A. Bowhill,
Mr. F. du Castel,
Mr. R. W. Knecht,
Mr. A. Lebeau,
Dr. G. M. Pillet,
Dr. E. R. Schmerling, representing Dr. H. E. Newell,
Mr. N. Wakai,
Mr. J. W. Wright.

1. — Publications

(*a*) The Chairman stated that the Ionosphere Supplementary Manual for the I.Q.S.Y. had recently been published by the I.Q.S.Y. Secretariat as I.Q.S.Y. Instruction Manual No. 4. This contains information to supplement that given in the I.G.Y. Manual for the guidance of operators concerned with vertical incidence soundings, absorption measurements by methods A1, A2, A3, and drift measurements. Additional material for other subdisciplines, e.g. for whistlers, oblique incidence observations, etc., will be published through the medium of « *I.Q.S.Y. Notes* ».

(*b*) Mr. J. W. Wright reported that all the material for the revised Atlas of Ionograms was now assembled and it was hoped that it would be ready for publication by the end of 1963. This Atlas would contain sample ionograms illustrating noon and midnight conditions for the three seasons for various ionospheric stations,

together with illustrations of special events, explanatory text, and details of ionosonde characteristics.

Dr. C. G. Little stated that the C.R.P.L., Boulder, was able to publish the Atlas as a N.B.S. Technical Note ; and it was agreed that an announcement concerning its distribution should be inserted in « *I.Q.S.Y. Notes* » when it is published. The Chairman expressed the thanks of the Committee to Dr. Little for agreeing to undertake the publication.

(*c*) The Chairman reported that Dr. Rawer had completed the manuscript for the I.G.Y.-I.G.C. drifts data volume to be published in the « Annals of the I.G.Y. ». In order that the drifts and absorption data be published in the same volume, the Chairman had agreed with Mr. Piggott that the absorption data should be completed by 30 November 1963.

(*d*) Mr. G. M. Brown stated that the preparation of the manuscript for the Supplement to the U.R.S.I. Manual of Ionospheric Stations was almost complete and that it only remained to discuss details of its publication with the Secretary General. This supplement would cover station details for the I.G.Y. and immediately post-I.G.Y. periods, but would not include the I.Q.S.Y. since this period would be covered by the station details to be published by the I.Q.S.Y. Secretariat.

(*e*) The Chairman reported that some difficulty had been encountered in the publication of the proceedings of the Symposium on Ionospheric Soundings in the I.G.Y./I.G.C. held in Nice in December 1961. As a result it has not been possible to publish the proceedings as an U.R.S.I. Monograph and, instead, papers which have not already been published have been submitted to the *Journal of Atmospheric and Terrestrial Physics.*

2. — Plans for the I.Q.S.Y.

(*a*) Prof. W. Dieminger, C.I.G. Reporter for Ionosphere, drew the attention of the Committee to the Report of the C.I.G.-I.Q.S.Y. Working Group V on Ionosphere which met in Rome in March 1963. This Report has been published in « I.Q.S.Y. Notes » No. 3, pp. 24-25, and in « *U.R.S.I. Information Bulletin* » No. 137, pp. 36-70 (English text) and No. 138, pp. 31-69 (French text). It contains full details of most of the ionospheric programmes of

observation, reduction, and data flow to W.D.Cs for the I.Q.S.Y.

The present status of the geographical distribution of vertical incidence stations was reviewed, and the question of an extension of the low frequency limit of ionosondes was discussed.

The Secretary reported that Mr. Wright had circulated an enquiry to all ionospheric stations requesting information on their proposed ionogram reduction programmes, and that the information received would be communicated to Prof. Dieminger.

The Reporter stated that the coverage for absorption and drifts for the I.Q.S.Y. was, as yet, insufficient.

Prof. Dieminger stated that the report of a conference held in Lindau on oblique incidence and backscatter observations would be published in « *I.Q.S.Y. Notes* »

(*b*) Mr. F. Horner indicated that the I.Q.S.Y. recommendations for radio noise studies mainly represented a continuation of the I.G.Y. programme with an extension to lower frequencies. He undertook to submit details of any changes in programmes or transmission of data to W.D.Cs for publication in « *I.Q.S.Y. Notes* ».

(*c*) Dr. G. M. Allcock reported that the I.Q.S.Y. programme for whistlers and VLF emissions had been agreed by the Sub-committee of Commission IV on Synoptic Whistler Observations, and this would be published in « *I.Q.S.Y. Notes* ».

Dr. M. G. Morgan suggested that a supplementary manual should be prepared and it was agreed that this should be published in « *I.Q.S.Y. Notes* ».

(*d*) Dr. P. M. Millman undertook to obtain information on stations proposing work on measurements of meteor flux by the radar technique, and of ionospheric drifts by the meteor method during the I.Q.S.Y. The latter information would be transmitted to the Consultant for drifts, Prof. R. W. H. Wright.

3. — World Data Centres

(*a*) Mr. A. H. Shapley reported that the new Guide to W.D.Cs had been completed and would be published by the I.Q.S.Y. Secretariat this autumn.

(*b*) The Secretary reported that, following the dissolution of the World Wide Soundings Committee, WDC-A for Ionosphere had

indicated its willingness to cooperate with the consultant for Vertical Soundings, Mr. Piggott, in the manner indicated in the Minutes of the previous meeting (*U.R.S.I. Information Bulletin* N°. 137, p. 34).

(*c*) Mr. J. W. Wright stated that WDC-A for Ionosphere has issued code numbers for all ionospheric stations for use on punched cards, and these will be published in « *I.Q.S.Y. Notes* ». The need for standardization of code numbers to facilitate interchange of punched card data was stressed, and it was agreed that the issuing of new code numbers should be undertaken in collaboration with the W.D.Cs.

(*d*) Dr. E. R. Schmerling reported that the number of ionograms obtained from the top-side sounder « Alouette » was already so large that it was impracticable to duplicate all of them. However they will all be deposited in WDC-A, and a catalogue will be circulated.

4. — Reports of Sub-committees

Mr. J. W. Wright reported on the recent activities of the sub-committees on N(*h*) profiles and on Ionosondes. Considerable information on the characteristics of ionosondes had been collected, and will be published in the revised Atlas of Ionograms (see para. 1*b*). As far as N(*h*) analysis is concerned, improvements in ionosondes are highly desirable.

It was felt that some encouragement should be given to stations to undertake the « mainly profile programme » (programme D) during the I.Q.S.Y. if possible, and that, where impracticable, a less extensive N(*h*) analysis programme would make a valuable contribution.

On a proposal of the Chairman it was agreed to hold a meeting of workers concerned with N(*h*) analysis to explore the features of the various methods at present available, to rank them according to their suitability for particular purposes, and to make recommendations concerning their application and improvement. It is hoped that this meeting can be held in the spring of 1964, following an interchange between workers by correspondence. Mr. J. W. Wright was appointed convener of the meeting.

5. — Membership of Committee

The Chairman reported that all the additions to the membership of the Committee, listed in the Minutes of the previous meeting (*U.R.S.I. Information Bulletin*, No. 137, p. 35, para. 5), had been agreed by the Executive Committee of U.R.S.I. The list of sub-discipline consultants should, accordingly, include the following additions :

Auroral radar : Dr. T. R. Kaiser.

Meteoric radar : Dr. P. M. Millman.

On a proposal of Prof. Dieminger it was also agreed to invite Dr. K. Davies to act as consultant for oblique incidence and back-scatter observations.

6. — Future Meetings

It was agreed that the Committee should meet at least once before the next General Assembly of U.R.S.I., probably in 1965.

G. M. Brown,
Secretary.

16 September 1963.

Resolutions of the U.R.S.I.-C.I.G. Committee

1. The U.R.S.I.-C.I.G. Committee reaffirms its earlier recommendation that greater emphasis be placed on the use of shipborne and airborne ionosondes.

1.1. The U.R.S.I.-C.I.G. Committee expresses its interest in the German project to make shipborne ionosonde measurements at the Atlantic crossing of the magnetic and geographic equators and along the meridian through the crossing point. It endorses the French project to make simultaneous airborne ionosonde measurements at the magnetic equator in Africa. It expresses the hope that similar shipborne and/or airborne experiments will be carried out simultaneously at the Pacific crossing of the equators.

1.2. The U.R.S.I.-C.I.G. Committee expresses its interest in the French project to make an airborne ionosonde survey on the magnetic equator in Africa. It expresses the hope that the

flight will take place at the same time as the German experiment with a shipborne ionosonde at the Atlantic crossing of the magnetic and geographic equators.

1.3. The U.R.S.I.-C.I.G. Committee recommends that efforts be made to fly airborne ionosondes at times when topside soundings are available, to study the latitude variations of any effects in the F1, E or D layers accompanying the localised phenomena detected in the F layer by topside sounding .

2. The U.R.S.I.-C.I.G. Committee recommends that shipborne measurements of atmospheric radio noise should be made during the I.Q.S.Y. to cover the areas between high and low latitudes, since a study of the contribution of the main thunderstorm areas of the world to the effective noise level at a given place, and the influence on radio propagation, can best be made by the use of mobile stations.

3. The U.R.S.I.-C.I.G. Committee, realizing that an important feature of the I.Q.S.Y. vertical soundings observations will be an increased emphasis on the determination of electron density profiles on a regional and worldwide basis, wishes to encourage broad participation in the « mainly profile programme » (programme D of « *U.R.S.I. Information Bulletin* » No. 137, p. 40, and « *I.Q.S.Y. Notes* » No. 3, p. 27), particularly among representative stations near the 0°, 75° W, and 150° E meridians. At stations where full participation in programme D is impracticable, the Committee stresses that valuable contributions to a world morphology may be made through a less extensive programme of analysis including hourly monthly mean profiles for summer, winter, and equinox months.

4. The U.R.S.I.-C.I.G. Committee notes the suggestion that some special attention be placed on analysis of ionospheric observations during an extended series of 27-day recurrent disturbances during the I.Q.S.Y., and recommends to the World Days organization that it make one or more such selections and distribute the information through « *I.Q.S.Y. Notes* » and otherwise. The Committee suggests to those stations and organizations with special interest or facilities that these periods be treated on the same basis as the IONOMAGSTORM Retrospective World Intervals.

5. The U.R.S.I.-C.I.G. Committee draws attention to, and strongly supports, the following resolutions adopted by Commission III of U.R.S.I. (Tokyo, September 1963) :

5.1. Commission III, considering the importance of electrodynamic forces in the ionosphere and the present lack of knowledge of the levels in the ionosphere at which the quiet day currents flow ; taking note on the proposals contained in section 2.2.2 of the Preliminary Joint Report of COSPAR Working Group II for I.Q.S.Y. and I.Q.S.Y. Working Group XV on Aeronomy (« I.Q.S.Y. Notes » No. 3, 1963, pp. 60-61) « Ionospheric Electric Current Measurements », views with concern the comparatively small number of rocket measurements of ionospheric electric currents planned at medium latitudes for the I.Q.S.Y., and strongly recommends that steps be taken to increase the number of such measurements at temperate latitudes in order to delineate the diurnal and seasonal behaviour of the quiet day current systems.

Commission III further urges that each rocket measurement of ionospheric currents be supported by at least the following measurements :

— Ground-based sweep-frequency vertical incidence ionospheric soundings.

— Adequate ground-based recording of magnetic elements so as to establish the quiet day magnetic variation.

— Rocket-borne measurements of the electron density over the relevant he,ght range of the ionosphere (where feasible).

5.2. Commission III, considering the importance of long term synoptic observations of the D-region, and aware of recent developments that hold the promise of significantly increasing the usefulness of the VLF and LF measurements for D-region profile studies, recommends the continuation of an active world-wide programme of continuous recording of VLF and LF transmissions by as many organizations as possible during the I.Q.S.Y. period.

6. The U.R.S.I.-C.I.G. Committee supports the proposals to establish a vertical incidence sounder at Sierre Leone, and expresses the hope that this station will be able to operate during the I.Q.S.Y.

7. The U.R.S.I.-C.I.G. Committee recommends to the Executive Committee of U.R.S.I. that it forward promptly to I.C.S.U. an opinion on the future of the C.I.G., noting that in addition to (*a*) the completion of I.G.Y. publications and (*b*) the continued co-ordination of the World Data Centres there still seems to be a real need for an inter-union body in the I.C.S.U. structure for the discussion of or generation of possible new major cooperative observational enterprises in areas of geophysics of joint concern to the participating Unions. The U.R.S.I.-C.I.G. Committee believes that any substantial change in the structure and aims of the C.I.G. at the present time is premature.

PROF. BALTH. VAN DER POL GOLD MEDAL

For the first time the van der Pol Gold Medal was awarded to a scientist whose works brought outstanding progress in one of the fields covered by U.R.S.I.'s activites.

In 1963 the Medal was awarded to Professor M. Ryle, F.R.S.

Prof. Ryle obtained a degree in Physics from Oxford University in 1939 and immediately joined the Telecommunications Research Establishment where he worked for the duration of the war on problems of « radio counter measures » directed towards defeating the operation of radar equipment. When the war ended in 1945 he went to Cambridge University to become the leader of a group working on Radio Astronomy. At first he held a research fellowship from the I.C.I. Company ; in 1958 he was made a Reader and in 1959 a Professor. He was elected a Fellow of the Royal Society in 1952 and to their Hughes Medal in 1954.

Ryle has been responsible for building up and running the Radio Astronomy group at the Mullard Observatory of the Cavendish Laboratory Cambridge. This group has made outstanding contributions to Astronomy, particularly to problems of Cosmology, and to radio science, particularly in the development of new types of aerials especially suited for radio astronomical researches. In particular his techniques of « phase-switching » and of « aperture synthesis » represent a major advance.

Professor Ryle has made outstanding contributions to Radio Science

(*a*) in the devising of new types of aerials, particularly for use in radio astronomy, and

(*b*) in the field of Radio Astronomy.

In his work on aerials he has exploited to the full the ideas of information theory and techniques of phase switching, in such a

way as to make optimum use of the collecting power and resolving power of aerial structures. He has shown that it is possible to use comparatively small aerials combined together in a series of successive positions to synthesise the effect of a much larger aerial. The complications of the problem are then in the calculation of the results, which can be done with a digital computer, and not in the construction of the aerial.

Ryle's work on Radio Astronomy has been varied, the most important has concerned the structure of the Solar Corona, a study of the radio emissions from the Galaxy, and the measurement of the positions and intensities of the weakest radio sources. The past 3 years have seen the complete success of a large interferometer radio telescope which uses the new technique of aperture synthesis, a success which is demonstrated by an outstanding series of papers from Professor Ryle's observatory. This work has led to some of the first experimental evidence with which cosmological theory may be tested.

* * *

Exceptionally, and due to the generosity of Mrs van der Pol and with the unanimous agreement of the Board of Officers, the van der Pol Gold Medal was also awarded to our Secretary General, Ing. E. Herbays for « his excellent and devoted service » from 1928 to 1963.

Details on this ceremony will be published in the « van der Pol Memorial Lecture ».

GOLDEN JUBILEE MEMORIAL

Le volume publié à l'occasion du Cinquantième Anniversaire de la fondation de l'U.R.S.I. vient de sortir de presse.

Pour définir cet ouvrage, nous ne pouvons faire mieux que de citer les premières phrases de la préface due à Sir Edward V. Appleton, Président d'Honneur de l'U.R.S.I. :

« Ce volume de l'U.R.S.I., le Golden Jubilee Memorial, est à la fois une narration qui concerne des personnes aussi bien que des choses. Il n'est pas simplement une relation des progrès dans le domaine de la radio scientifique ; c'est aussi une histoire des exploits coopératifs d'êtres humains pour aboutir à ces progrès ».

L'ouvrage, de 163 pages, a le format des autres publications de l'U.R.S.I. et est divisé comme suit :

Annexes : I. Liste des Assemblées Générales.
II. Bureaux des Commissions et principaux Comités.
III. Publications.

Des exemplaires de cet ouvrage peuvent être obtenus au Secrétariat Général de l'U.R.S.I. au prix de £ 4, *F. B.* 200, *F. F.* 20 *ou* £ 1.9.0 *(port compris).*

GOLDEN JUBILEE MEMORIAL

The volume published for the Golden Jubilee of U.R.S.I. has just been issued.

To define this work, we cannot do better than to quote the first sentences of the preface written by Sir Edward V. Appleton, Honorary President of U.R.S.I.

« This Golden Jubilee Memorial Volume of U.R.S.I., is, at once, a story about people as well as about things. For it is not merely a record of progress in the field of scientific radio : it is also a history of the co-operative exploits of human beings in bringing that progress about ».

The volume of 163 pages is published in the same formate as the other U.R.S.I. publications and is divided as follows :

Preface, Sir Edward V. Appleton, Honorary President of U.R.S.I.

Foreword, R. L. Smith-Rose, President of U.R.S.I.

History of U.R.S.I., J. H. Dellinger, Honorary President of U.R.S.I.

Chap. I. — Radio measurements and standards, L. Essen.

Chap. II. — Tropospheric Radio, J. A. Saxton.

Chap. III. — Ionospheric Radio, J. A. Ratcliffe.

Chap. IV. — Radio Noise, F. Horner.

Chap. V. — La Radioastronomie et l'U.R.S.I., R. Coutrez et R. Gonze.

Copies of the volume are available at the General Secretariat of U.R.S.I. at the price of $ 4, *B. F.* 200, *F. F.* 20 *or* £ 1.9.0 (*postage included*).

NATIONAL COMMITTEES

Australia

MEMBERSHIP

The National Committee for Scientific Radio consists of the following members appointed for a term of three years :

Prof. W. N. CHRISTIANSEN, FAA (Convener),
Associate Professor R. E. AITCHESON,
Mr. R. W. BOSWELL,
Mr. F. E. COOK,
Dr. W. G. ELFORD,
Prof. G. R. ELLIS,
Mr. L. M. HARRIS,
Associate Professor R. M. HUEY,
Dr. D. F. MARTYN FAA,
Dr. G. H. MUNRO,
Mr. L. S. PRIOR,
Professor H. C. WEBSTER.

U. S. A.

SYMPOSIUM ON SIGNAL STATISTICS
jointly sponsored by
U. S. A. Natioanl Committee of U.R.S.I.
Boeing Scientific Research Laboratories
University of Washington

To be held December 6 and 7, 1963 in conjunction with the Fall 1963 U.R.S.I. meeting in Seattle, Washington

Preliminary Programme :

A. V. BALAKRISHNAN, « Effects of signal processing, linear and non-linear, on signal statistics ».

P. BECKMANN, « The Rayleigh distribution and its generalizations ».

H. BREMMER, « Random volume scattering ».

J. P. GORDON, « Laser signal statistics ».

Y. T. Lo, « A probabilistic approach to the design of large antenna arrays ».

E. PARZEN, « Statistical methods for stochastic processes ».

G. H. PETTENGILL, « Doppler measurement techniques in planetary radar ».

M. ROSENBLATT, « New mathematical techniques ».

M. M. SIDDIQUI, « Statistical inference for Rayleigh distributions ».

J. B. SMYTH, « Phase fluctuation statistics ».

P. SWERLING and I. KAY, « Random surfaces ».

A. D. WHEELON, « Amplitude distribution for atmospheric noise ».

F. J. ZUCKER, « Current topics in partial coherence ».

A panel discussion on important open problems will also be held.

Meeting Place : Boeing Scientific Research Laboratories (An alternative location at the University of Washington will be used if larger facilities are required.)

Hotel Accommodations : A block of rooms has been reserved at the Olympic Hotel for symposium participants.

Transportation : Bus service will be provided for symposium participants between the Olympic Hotel and the meeting place.

Registration : Preregistration forms will be mailed with the final programme. In addition to registration at the meeting place, there will be early registration and a social hour at the Olympic Hotel the evening of December 5th.

Registration Fee : $ 3.50 for the symposium, $ 5.00 for the following U.R.S.I. meeting, $ 7.50 for both.

General Correspondence : Address to : Prof. I. C. Peden, Dept. of Electrical Engineering, University of Washington, Seattle, 5 Washington.

The final programme for the symposium will be included with the printed programmes for the Fall U.R.S.I. meeting, December 9-11 1963.

Conference on Non Linear Processes in the Ionosphere

Dates : December 16-17, 1963.

Place : Radio Building, National Bureau of Standards, Boulder Laboratories, Boulder, Colorado, U. S. A.

Sponsor : Central Radio Propagation Laboratory, Boulder Laboratories, National Bureau of Standards.

Organization :

Co-chairmen :

Dr. Donald H. MENZEL (Harvard),
Dr. Ernest K. SMITH, Jr. (C.R.P.L.).

Secretary/Treasurer :

Mr. Robert T. Frost (C.R.P.L.).

Advisory Committee :

Dr. C. Gordon LITTLE (C.R.P.L.), Chairman,
Dr. David LAYZER (Harvard),
Mr. George JACOBS (I.B.S./U.S.I.A.),
Mr. Roger M. GALLET (C.R.P.L.),
Dr. James R. WAIT (C.R.P.L.).

Programme Chairman :

Dr. Donald H. MENZEL (Harvard).

Papers are invited on both applied and scientific aspects of radio-wave interaction with the ionosphere. One- to two-hundred word abstracts should be sent as soon as possible, and in no event later than October 15, 1963 to : Dr. Donald H. Menzel, Director, Harvard College Observatory, Cambridge 38, Massachusetts.

Unfortunately, time will limit the number of papers than can be accommodated on the formal programme.

Final manuscripts are due at the time of the meeting. It is planned to publish the principal papers in the *N.B.S. Journal of Research*, Part D (Radio Propagation). A commitment of space has been obtained from the Journal for an issue approximately six months after the Conference. Drs. Menzel and Smith have agreed to serve as co-editors for this material.

Persons wishing to attend the Conference should advise the Conference Secretary, R. T. Frost (Radio Building, N.B.S. Boulder Laboratories, Boulder, Colorado) by November 15, 1963.

COMMISSIONS AND COMMITTEES

Commission III on Ionosphere

BIBLIOGRAPHY

Attention is drawn to the N.B.S. Technical Note No. 181 « *Computer Programme for Ionosphere Mapping by Numerical Methods* », by Martha E. Hinds and William B. Jones.

The mean items of this publication are :

1. Introduction.
2. Numerical map executive programme.
3. Data read subroutine 01.
4. Fourier analysis subroutine 02.
5. Geographic functions subroutine 04.
6. Synthesis subroutines 05-10.
7. Residual subroutine 11.
8. General data fitting subroutines 15, 17-20.
9. Intercomparison coefficients subroutines 16 and 21.
10. References.

Appendix A. — Sample printout of input to numerical map programme.

Appendix B. — Sample printout of output from numerical map programme.

* * *

The attention of our readers is called to the article « S66 Ionospheric Research Satellite » by G. Jacobs, published in the *Telecommunication Journal*, Vol. 30, No. 10, October 1963.

* * *

Oblique incidence soundings of the Ionosphere, see p. 45.

Commission V. — Radioastronomie

DOCUMENTATION

Nous attirons l'attention de nos lecteurs sur l'article « Les grands radiotélescopes modernes » par J. H. Oort, paru dans le *Journal des Télécommunications*, Vol. 30, nº 10, octobre 1963.

BIBLIOGRAPHY

We call the attention of our readers to the article « Recent large radio telescopes » by J. H. Oort, published in the *Telecommunication Journal*, Vol. 30, Nº 10, October 1963.

Space Radio Research Committee

DOCUMENTATION

The Royal Society, U. K., has issued the U. K. Report for 1962 to the I.C.S.U. Committee on Space Research (COSPAR).

We quote the following from this publication :

A. — Ground based activities

IONOSPHERIC INVESTIGATIONS.

At the University of Exeter's Norman Lockyer Observatory, Sidmouth a directional aerial is being constructed so that the apparent frequency and amplitude of radio signals from suitable satellites may be studied to provide information about the ionization above the F2 peak.

Equipment has been developed at the University College of Wales, Aberystwyth for studying the influence of the ionosphere on radio signals from satellites by automatically recording them on several frequencies. Particular attention is being given to the study of Faraday rotation phenomena, « scintillations » in signal intensity and regular variations in received field strength. The station has participated in the co-operative world-wide study of ionospheric scintillations as observed on signals from U. S. Discoverer satellites 32 and 36.

The Nuffield Radio Astronomy Laboratories, Jodrell Bank are co-operating with one U. S. and six European laboratories in a programme of simultaneous radio observations of beacon satellites. Mean latitude variations of ionospheric electron content and signal scintillation amplitude are being obtained as functions of time of day, magnetic activity, etc., and the morphology of discrete « patches » in the ionosphere producing enhanced scintillation, absorption or other unusual effects is being studied.

The Radio Research Station is making measurements of Faraday rotation of the waves emitted from satellites, both at Slough and at its overseas station in Singapore. The diurnal and seasonal variations of total electron content are being investigated.

The Radio Research Station, jointly with laboratories in Canada and the U. S. A., is a major participant in the topside sounder programme. Telemetry from Alouette is being received and analysed as described under « data acquisition and handling ».

The British Broadcasting Corporation continues to record telemetry signals and other features of the radio transmissions from a few chosen earth satellites.

B. — Rocket experiments

Solar-Terrestrial Relationships.

A substantial part of the British Space Research programme is directed towards the study of the electrical state of the atmosphere and its relation to the radiations which influence the ionosphere. Experiments have taken place and are being planned to make direct measurements of the electrons and ions in the upper atmosphere, to investigate the electrical properties by radio propagation means and to study solar and galactic radiations and their relationships to the electrical state of the atmosphere ; related phenomena being studied include geomagnetic fields and energetic particles, including the radiation belts.

(*a*) *Direct Ionosphere Measurements.*

University College London continues to fly various types of ion probes in Skylark and Black Knight rockets to explore the ionic constitution and electron temperature in the ionosphere, and to study irregularities and the relationship of these phenomena to solar behaviour and atmospheric motion.

Flights are also being undertaken using the Langmuir spherical probe which measures ion and electron concentration. A more precise version of the sporadic-E probe has been flown to determine the profile and especially the thickness of sporadic ionization layers. Data are still being analysed from these firings, but an excellent profile from one flight has been obtained, which shows the remarkable thinness (1 km) of the layer and underlines the necessity for associated wind measurements ; a co-operative experiment with French scientists is being planned in this connexion.

The electron temperature apparatus of the type included in the Ariel 1 satellite was flown successfully for test purposes in a Black Knight rocket, and further rocket flights are scheduled to measure the electron temperature profile in the E and F regions.

Apparatus for measuring positive ion temperature and constitution is included in the Ariel 1 payload, and further flights of it in Black Knight rockets are planned with the emphasis on measurements of ion temperature. The association of these measurements with results from electron temperature experiments is important for the study of thermodynamic equilibrium.

At the University of Birmingham R. F. electron probe of the type used in Ariel 1 was flown in a Skylark rocket prior to the launch of the satellite and gave a good electron density profile through the E and F regions as well as detecting a sporadic-E layer. Two further successful flights of this probe have been made and more flights are planned.

(*b*) *Radio Wave Experiments.*

Two methods of radio propagation from a Skylark rocket (one continuous wave and the other pulse) have been developed by the University of Wales in collaboration with the Royal Aircraft Establishment for the measurement of electron density and for the study of the true heights of reflexion of radio signals. Tests indicate that the equipment will be particularly valuable for ionospheric investigation.

The Radio Research Station has a programme of researches involving a series of rocket experiments. The first of these, conducted in collaboration with the University of Sheffield, has already been flown in two Skylark rockets, one by day and one by night. In it the waves radiated on a frequency of 200 kc/s from a ground-based

transmitter were received by three receivers using mutually perpendicular dipole aerials in the rocket. From the results the height-distribution of the electrons between heights of about 80 and 100 km has been deduced. A similar version of the same experiment, using ferrite-cored loop aerials instead of dipoles, should be fired in May 1963. Other experiments being prepared are directed towards investigating the behaviour of an antenna immersed in the ionosphere, and the use of a « resonance rectification » probe to measure electron densities.

The Mullard Radio Astronomy Observatory, University of Cambridge, is preparing to measure low frequency cosmic radio waves using simple aerial systems mounted in rockets and satellites and the use of the ionospheric focusing effect as a radio telescope is being considered. Investigations are proceeding into the impedance of a long-wire dipole which will be used in a Skylark rocket to measure the field strength of a terrestrial transmitter in the D region.

Ground-based investigations of the ionosphere by the Universities of Exeter, Manchester and Wales using observations of radio wave transmissions are described under « ground-based activities ».

This work contains also detailed information on Satellite Experiments and a Selected List of Publications by U. K. authors.

I. Q. S. Y.

(*Reprint from I.Q.S.Y. Notes, No. 4, September* 1963)

Oblique incidence soundings of the Ionosphere

Professor Dr. W. Dieminger, I.Q.S.Y. Reporter for Ionosphere, has submitted a report on an informal meeting which was held in May 1963 at Lindau (Germany) to consider the present state of oblique incidence ionospheric soundings and to make recommendations for future work. The meeting was attended by 19 scientists who are actively engaged in this type of work in Canada, Czechoslovakia, Finland, Federal Republic of Germany, Netherlands, Norway, U. K. and U. S. A.

The recommendations made at this meeting, together with supplementary information, are given below.

1. — Data Interchange,

Scaling Procedures and Terminology

1.1. — *Data exchange.*

It is recommended that small amounts of data, for periods of special interest, be made available by those organizations operating oblique sounders. For this purpose, it is recommended that all such organizations inform the I.Q.S.Y. Reporter for the Ionosphere of their sounding schedules and equipment characteristics (power level, make of sounder, antenna details) ; this information will be published in I. Q. S. Y. Notes. Requests for data should then be made directly to the organization concerned.

1.2. — *Terminology.*

It was recognized that, for purposes of data interchange, a need exists for the standardization of certain terms. As a first step in this direction, the following recommendations are made.

1.2.1. — That capital letters be used in oblique-incidence work in contrast to the small letters agreed upon in vertical-incidence work ;

1.2.2. — In view of the ambiguity in the meaning of « usable », the term maximum usable frequency (MUF) should be eliminated in the description of oblique-incidence ionograms ;

1.2.3. — The use of the word « virtual path » should refer to the time of flight (group delay) in oblique propagation work ;

1.2.4. — In ray tracing, the following symbols are suggested :

$\varnothing_o$: the angle of incidence at the botton of the ionosphere.

$\varnothing_r$: the angle of incidence, at the real height of reflection, of the extension of the linear ray path below the ionosphere.

$\varnothing_i$: the angle between the ray path and the vertical at any point along the path.

$\triangle$: the angle of elevation at the ground.

1.2.5. — For propagation paths involving reflections by different layers, the reflections (or hops) should be specified in order of their position with respect to the transmitter. Thus 5E — 3F2 indicates 5 reflections from the E layer near the transmitter followed by 3 reflections from the F2 layer.

1.2.6. — For the description of path structure, the use of a dash is conventient for the representation of a ground reflection. The absence of a dash will then show up M-type ray paths and « supermodes ». For example F — E*s* — F2 represents an F-layer hop followed by ground reflection to the lower side of the E*s* layer, reflection back to the ground, then reflection to the lower side of the F2 layer and finally back to the ground. On the other hand, F E*s* F2 represents an M-type path in which the ray is reflected from the F layer to the upper side of the E*s* layer, back up to the lower side of the F2 layer and down to the ground. The symbol F2F2 means an F2 reflection without an intermediate ground reflection (supermode).

1.3. — *Scaling Procedures.*

The following terms are suggested for the description of oblique ionograms.

1.3.1. — MOF (maximum observed frequency) means the highest frequency on which the signals transmitted from a sounder are *observed* on the ionogram, regardless of the propagation path involved.

1.3.2. — LOF (lowest observed frequency) means the lowest frequency on which the signals transmitted from a sounder are *observed* on the ionogram, regardless of the propagation path involved.

1.3.3. — These terms (MOF and LOF) may be used also to describe identifiable modes. For example 2F2 LOF means the lowest frequency (observed on the ionogram) which is propagated by two reflections at the F2 layer and an intermediate ground reflection. The 2F2 MOF means the highest observed frequency which is associated with two-hop F2 propagation, regardless of whether the signal is propagated by refraction, by scatter, or by a combination of both mechanisms.

1.3.4. — The lowest observed frequency of the high-angle ray may be distinguished from that of the low-angle ray by the letters H and L respectively. Thus 2F2 HLOF is the lowest frequency (observed on the ionogram) of the signal which is propagated via the high-angle two-hop F2 path and 2F2 LLOF is the lowest frequency (observed on the ionogram) of the signal which is propagated by the low-angle two-hop F2 path.

1.3.5. — The one-hop modes do not need the number 1 (one) in front. For example, F2 LLOF means the low-angle ray LOF for the one-hop F2 path.

1.3.6. — When it is required to distinguish between the ordinary and extra-ordinary ray paths, an « *o* » or « *x* » may follow in parantheses. The F2 MOF (*x*) is the maximum observed frequency of the extraordinary wave which is reflected once at the F2 layer.

1.3.7. — Often the MOF for an identifiable path is greater than the frequency on which the regularly refracted components of the high- and low-angle rays join. It is suggested that the latter frequency be called the « junction frequency » and that it be denoted by JF.

2. — Equipment

2.1. — *Catalogue.*

A catalogue of transmitters used in making oblique soundings, including descriptive information concerning equipment characteristics and operating schedules, is being prepared and will be made available at a later date. Organizations wishing to make use of such transmissions (eavesdropping) are requested to contact directly the institutions concerned.

2.2. — *Frequency Sweep.*

In order to facilitate overlay scaling, the use of a logarithmic frequency scale is desirable.

2.3. — *Sweep Duration.*

A fast sweep has the advantage of quick response to ionospheric changes and relatively low interference to other services. On the other hand, a slow sweep has the very considerable advantage of an improvement in signal-to-noise ratio. A compromise of 5 min for the sweep duration is recommended.

2.4. — *Frequency Range.*

A frequency range of 3 to 30 Mc/s will provide useful information for communication purposes. Extension, particularly on the high-frequency side, is desirable when it is wished to follow variations of the MOF and to determine the ability of the ionosphere to support propagation. Extension of the frequency range below 3 Mc/s is desirable also for scientific purposes.

2.5. — *Antenna Systems.*

Log periodic antennas have the advantage of a wider bandwidth and a polar-diagram which is less dependent on frequency as compared, for instance, with rhombic antennas.

3. — Ray Tracing

In the interpretation of oblique ionograms, it is necessary to rely on some form of ray tracing. A partial list of ray-tracing methods is given in Appendix I, which also includes certain of the assumptions made and the relative advantages of the different methods.

The list of references given is intended to illustrate the various methods and is in no way exhaustive.

An intercomparison between certain of these methods is proposed.

4. — Scientific Uses

Oblique soundings are valuable in revealing the importance of certain phenomena (e.g. equatorial scatter, ionospheric gradients) not emphasised in vertical soundings. This is due, to a large extent, to the fact that in oblique soundings the characteristics of a much greater volume of the ionosphere are sampled than is the case with vertical soundings. In absorption measurements, oblique sounding may be helpful since the influence of deviative absorption is much less at oblique incidence that at vertical incidence. In the foreseeable future, oblique soundings will be essential for the determination of the necessary propagation characteristics without which a scientific interpretation of oblique propagation is impossible.

Some problems which need further study are :

(1) Absorption and attenuation.

(2) Characteristics of the ionosphere :

(*a*) Structure of Es.

(*b*) Field aligned ionisation.

(*c*) Gradients in the ionosphere.

(3) Propagation characteristics :

(*a*) Reciprocity.

(*b*) Statistics of fading.

(*c*) Path structure.

(*d*) Polarisation.

(*e*) Selective fading.

5. — Application to Communicatiion Systems

5.1. — *Introduction.*

As a result of technical advances in recent years, the use of oblique sounders in communication systems has become feasible. The use of these sounders should improve the reliability of the circuits

involved ; this may at present be very low (say 80 %) and a considerable fraction of the outage (20 %) could often be saved by the *proper* use of sounders.

5.2. — *The Concept of References.*

Because of the differences between a sounder and a communication system, it is necessary to define a reference sounder and a reference communication system. Real sounders and communication systems can be defined in terms of these references. Details of possible references are given in Appendix II.

5.3. — *Data required from Ionogram.*

The data that the communicator needs from an ionogram are listed below in order of importance :

(*a*) MOF.

(*b*) LOF.

(*c*) Variation of multipath time delay with frequency.

(*d*) Variation of signal amplitude with frequency.

(*e*) Estimate of direction of arrival of signal (angle of elevation).

The MOF is probably the most important since it is likely that the greatest benefit which will accrue from the use of the sounder will be to reveal the possibility of using frequencies considerably higher than those predicted, especially at the most difficult times, such as late night and early morning.

5.4. — *Proposed Experiments.*

It is strongly felt that there is a great need for more controlled experiments in which a sounder system is run in conjunction with a communication system. One such experiment has been noted and it is desirable that it should be repeated in many other circumstances.

APPENDIX I

Ray Tracing Techniques

Class	Assumptions	Advantages
1. Equivalence Method 1.1.	Plane earth; plane ionosphere. No magnetic field.	Extreme simplicity, enabling one to obtain an order of magnitude calculation of time delay and distance even when no ionogram is available Useful on short paths.
1.2.	Plane earth; plane ionosphere.	Allows determination of the effect of the earth's magnetic field.
2. Overlay Methods 2.1.	Concentric layers with no magnetic field. Empirically corrected, angle curves are, however, based on Martyn's equivalence theorem.	Enables use of a slider in calculating apparent ray paths. Use of sliders in scaling the M 3000 factor from vertical incidence ionograms is important since these data are used by C.R.P.L. in their prediction techniques.
2.2.	Concentric layers.	Corrects for magnetic field in generating a slider for any given ionospheric profile. Particularly useful in analyzing long-distance propagation paths with low angles of elevation.

Class	Assumptions	Advantages
2.3. Inverse slider	Same as that of slider used.	This is an inverse slider technique which enables the modes to be identified quickly on an oblique incidence ionogram and the vertical incidence ionogram, at the path midpoint, to be determined.
3. Concentric ionosphere		
3.1.	Parabolic layers; no magnetic field.	Reference to the published ionograms provides a simple method of ray tracing in a parabolic layer.
3.2.	Synthesis of ionospheric profiles with line segments.	Profile may be accurately represented.
3.3.	Approximately constant magnetic field; can use any profile as in 3.2. above.	A general expression is developed enabling direct calculation of the ray path length using a simple ray treatment.
3.4.	Parabolic layers; no magnetic field; constant ratio for ym/ho; fixed foF1 = 1.4 × foE; foE = O for $\chi = 70^{o}$. Otherwise foE = $g(\cos^{u} \chi)$	By assuming concentric ionosphere for each hop, but calculating each layer as it is first encountered, one is able to include the first order effects of a horizontal gradient in electron density. Homing-in on receiver is provided. This allows a rapid calculation to be made to identify modes of propagation and to predict MUF's and ray paths from the C.R.P.L. predictions.

Class	Assumptions	
4. Skewed ionosphere	Same as in 3.4. above.	Inclusion of tilts by correction of $\varnothing_o$ at entry into and exit from the layers may give a refinement to the method described above in 3.4.
5. Isoionic contours 5.1.	Hazelgrove equations	The ray path can be approached more realistically; thus more accurate ray paths in the regions of extreme tilts or gradients along the great circle can be determined.
6. Three dimensional 6.1.	Uses tilting mirror reflector in the ionosphere. Martyn's equivalence theorem.	Gives a first-order approximation to supermodes and off great-circle path propagation. Nomograms are available for some heights and distances. Others can be calculated and plotted by use of a 7090 computer.
6.2.	Hazelgrove equations	Most thorough analysis when ionosphere can be specified in great detail. Has homing-in feature incorparated.

REFERENCES

This list is intended to be representative of the above methods and is not exhaustive. Questions regarding the availability of computer programmes should be directed to the authors given. When no comment is supplied, the use of existing graphs or sliders is implied.

1.1. — MARTYN, D. F. — The Propagation of medium radio waves in the ionosphere. *Proc. Phys. Soc.*, **47**, 323-339 (1935).

1.2. MILLINGTON, G. — The relation between ionospheric transmission phenomena at oblique incidence and those at vertical incidence. *Proc. Phys. Soc.*, **50**, 801-825 (1938).

2.1. SMITH, N. — The relation of radio sky-wave transmission to ionospheric measurements. *Proc. Inst. Radio. Engrs.*, **27**, 332-347 (1939).

2.2. MALIPHANT, R. G. and MULDREW, D. B. — Accurate transmission curves for vertical incidence ionograms and the production of a general transmission slider (to be published in *Proc. Inst. Elect. Engrs*).

2.3. MÖLLER, H. G. — Experiments with pulse transmissions with oblique incidence and variable frequency over 1000 km and 2000 km. Forschungsbericht des Landes Nordrhein-Westfalen Nr. 1149, Westdeutcher Verlag GmbH, Köln and Opladen, 1963.

3.1. APPLETON, E. and BEYNON, W. J. C. — The application of ionospheric data to rdio communication problems. Part I and II. *Proc. Phys. Soc.*, **52**, 518-533 (1940); and **59**, 58-76 (1947).

3.2. DE VOOGT, A. H. — The calculation of the path of a radio ray in a given ionosphere. *Proc. Inst. Radio Engrs.*, **41**, 1183-1196 (1953).
MULDREW, D. B. — An ionospheric Ray-Tracing Technique and its application to a Problem in long distance Radio Propagation. *Inst. Radio. Engrs. Trans.*, A and P., *AP*-7, No. 4 (1959).
MALIPHANT, R. G. — To be published (*I.E.E.E. Trans.* A-P).

3.3. CHVOJKOVA, E. — The refraction of radio waves by a spherical ionized layer. *J. Atmos. Terr. Phys.*, **16**, 124-135 (1959).

3.4. KIFT, F. — The Propagation of High-Frequency Radio Waves to Long Distances. *Proc. Inst. Elect. Engrs.*, **107**, Part B. No. 32 (1960).

3.5. FOOKS, G. F. — HF Propagation Programme. Radio Research Station, Ditton Park, Slough, England I.M. 32, 28 June 1962.

4.1. THOMAS, J. A. and MCINNES, B. A. — Transequatorial Propagation Analysis : Ray Tracing and Mode Analysis. Radio Research Section, University of Queensland, Brisbane, Australia. *Scientific Report* No. 10, March 1962. Contract No. AF 64(500)-9.

5.1. DAVIES, K. and FINNEY, J. W. — A Method for ray tracing in the ionosphere with oblique incidence. National Bureau of Standards. Report 7275A, June 1962.

6.1. Fenwick, R. B. — Round-the-World High-Frequency Propagation. *Technical Report No.* 71. Radioscience Laboratory, Stanford, Cal., Contract No. 225(64), April 1963.

6.2. Grossi, M. D. — Study of HF Frequencies for Exo- and Endo-Ionospheric Communications. Raytheon Company, Bedford, Mass., October 1962. *Report No.* ASD-TDR-62-768.

Appendix II

Reference Sounder and Communication System

The power signal-to-noise ratio $\frac{S}{N} = \frac{P_{av}}{NF_R} \cdot \frac{1}{BT}$

where N = noise power per unit bandwidth,
F_R = rate of occurrence of elementary symbol,
B = noise bandwidth,
T = pulse width.

Inserting typical values for a sounder and a communication system the following is obtained :

(*a*) Sounder :

Peak power = 15 kW,
F_R = 20 cps,
T = 1.0 ms,
p_{av} = 300 watts,
B = 3 kc/s ;

$$\text{hence SNR} = \frac{300}{N_s\,(20)\ (3.10^3)\ (10^{-3}]} = \frac{5}{N_s} \simeq 7 \text{ dB},$$

where N_s is the noise power per unit bandwidth of the sounder.

(*b*) Communications system :

p_{av} = 10 kW in 12 frequency-shift-keying 50 baud telegraph channels,
= 835 watts per channel (assuming that the channel power is derived on a basis of power addition),
F_R = 50 baud,
T = 20 ms,
B = 170 c/s ;

$$\text{hence SNR} = \frac{835}{N_c\ (50)\ (170)\ (20.10^{-3})} = \frac{4.9}{N_c} \simeq 7 \text{ dB},$$

where N_c is the noise power per unit bandwidth of the communication system. At this point, for the example cited, the sounder and communications circuit provide roughly equal average power signal-to-noise ratios.

Several additional points should be considered before any conclusions are drawn :

(*a*) Sounder detection is dependent on the peak signal-power to mean noise-power ratio and only indirectly on average power signal to noise ratio.

(*b*) The required operating signal-to-noise ratios for each system must be considered separately.

(*c*) The sounder can transmit more than one pulse per frequency thus permitting signal integration.

(*d*) The mean background interference over the swept band of the sounder (N_s) may be, and probably will be, greater than the interference on the allocated frequencies used by the communications system. No allowance is made for this in the following.

Taking (*a*) and (*b*) into account, we have the required signal-to-noise ratios as follows :

Sounder : 5 dB average signal to mean noise power assuming an empirical required peak signal to noise ratio of 8 dB.

Communications : 15 dB is assumed for a character error rate of 1 in 10^4 for reception of 5-unit telegraphy.

As regards (*c*), no integration is possible for the communications circuit but, assuming that the sounder emits 10 pulses per frequency and that the integration efficiency is 50 %, an improvement of 5 dB is obtained.

The comparison now emerges in this way :

Sounder

Signal/noise ratio	$\simeq$ —7 dB
Operator observation efficiency	= —2 dB
Integration gain	= 5
Total available signal/noise	= 10
Required signal noise	= 5
Net signal/noise	= +5 dB

Communication

Signal/noise ratio	≃ 7 dB
Operator loss	= 0
Integration gain	= 0
Total available signal/noise	= 7
Required signal/noise	= 15
Net signal/noise	= —8 dB

The conclusion is therefore drawn that the sounder shows an overall benefit of 5 + 8 = 13 dB.

Interim report from the N(h) profile sub-committee

(*Reprint from I.Q.S.Y. Notes No. 4, September* 1963)

The following report should be regarded as Annex V to the report of Working Group V on Ionosphere. The main report will be found in *Information Bulletin*, n° 139, pp. 113-147 and in *I.Q.S.Y. Notes* n° 3, pp. 23-45.

* * *

After recent ad-hoc discussions between various members of the sub-committee and others the following viewpoints have been expressed :

1. — Sweep frequency vertical soundings, when converted to N(h) distributions, continue to be an outstandingly important source of the data necessary for modern problems, and necessarily represent an essential part of programmes planned for the I.Q.S.Y.

2. — N(h) profiles permit the derivation of new ionospheric parameters (e.g. electron content, layer thickness), the variations of which convey information about the ionosphere not previously available from non-N(h) measurements.

3. — The I.G.Y. N(h) surveys conducted for special stations and published by Cambridge, Slough, Pennsylvania State University, National Bureau of Standards, and others, have already proved to be of sufficient value to justify the costs involved.

4. — The methods used in these surveys, while probably not capable of definitive accuracy, were at least adequate to reveal many new points of interest ; the profiles do not seem to have been misleading to any serious degree, where they have been used with insight regarding their possible uncertainties.

5. — During the forthcoming I.Q.S.Y., N(h) surveys on a scale comparable to those of the I.G.Y., and using comparable methods, will be of great value and are strongly to be encouraged.

6. — The « median virtual height curve » short cut to obtain monthly average profiles is acceptable for this purpose, but the calculation of individual profiles (even by methods of uncertain accuracy) should not be discouraged, since when used with awareness of their possible errors they may be averaged in other useful ways (e.g. for lunar tides, storms, etc.).

7. — The development and application of definitive N(h) methods, in which the « valley » and « starting » ambiguities may be significantly reduced, are strongly encouraged. Such methods will permit accurate studies of the shape and location of the lower edge of the F region, of the E region (including Es), and of the curvature of the F2 peak, and are necessary for joint use with new rocket and incoherent scatter experiments.

8. — The most common, yet unnecessary, problem in successful N(h) analysis arises from the generally inadequate quality of the average ionogram. Irrespective of immediate plans for N(h) analysis of ionograms obtained in a systematic or special soundings programme, it is clear that the ionograms should at least be suitable for such analysis at a later time. The quality requirements are considerably beyond those accepted in the past for simple measurements of critical frequencies, etc., but are by no means beyond the inherent capabilities of the technique.

9. — Since the world-wide network of sounding stations, despite its considerable size, is nevertheless not even approximately of the size necessary for a complete world morphology of the ionosphere, the relative value of an individual station may be greater for the individual studies done there, than for merely a contribution to a routine observing programme. From this it follows that certain key stations, well distributed geographically, should be encouraged to produce ionograms and N(h) profiles of high quality, rather than with emphasis on quantity.

I.Q.S.Y. Manuals

(*Abstract from I.Q.S.Y. Notes No. 4, September* 1963)

Various Instruction Manuals and Handbooks will be used during the I.Q.S.Y. to ensure uniformity of, for example, observation techniques and methods of data reduction.

The following list of Manuals approved for use during the I.Q.S.Y. has been prepared by the Chairman of the C.I.G.-I.Q.S.Y. Publications Sub-Committee.

I. — World Days

I.Q.S.Y. Instruction Manual No. 1, by A. H. Shapley.
Source : C.I.G.-I.Q.S.Y. Secretariat.

Code Handbook of Synoptic Codes for the I.Q.S.Y.
Source : I.U.W.D.S. or C.I.G.-I.Q.S.Y. Secretariat.

V. — Ionosphere

(1) Ursi Handbook of Ionogram Interpretation and Reduction by W. R. Piggott and K. Rawer.
Source : Elsevier Publ. Co., Amsterdam (70/-d.).

(2) (*a*) Annals of the I.G.Y., III (Part I), 1-167 (for vertical incidence).

(*b*) I.Q.S.Y. Instruction Manual No. 4, Part I - Vertical Incidence.
Source : C.I.G.-I.Q.S.Y. Secretariat.

(3) (*a*) Annals of the I.G.Y., III (Part II), 173-217 (for absorption).

(*b*) I.Q.S.Y. Instruction Manual No. 4, Part II - Absorption.
Source : C.I.G.-I.Q.S.Y. Secretariat.

(4) (*a*) Annals of the I.G.Y., III (Part III), 231-287 (for drift).

(*b*) I.Q.S.Y. Instruction Manual No. 4, Part III - Drift.
Source : C.I.G.-I.Q.S.Y. Secretariat.

(5) Annals of the I.G.Y., III (Part IV), 293-387 (for atmospheric radio noise, whistlers, radio-aurora, radio meteors, forward scatter, back scatter).

National Programmes

(Abstracts from I.Q.S.Y. Notes No. 4, September 1963)

GHANA

The Ghana Academy of Sciences has set up a Working Party to recommend and co-ordinate research projects for the International Quiet Sun Years. Reports on research have been received from the University of Ghana, Legon, Kwame Nkrumah University of Science and Technology, Kumasi, the Meteorological Service and the Survey Division. They are summarised below.

V. — Ionosphere

The following measurements are planned by the Universities at Legon (L) and Kumasi (K) :

Scintillation of radio star signals (L) ;

Doppler fading and signal fading-rate of BBC signal (L) ;

Faraday rotation and scintillation of signals from a Beacon satellite (L) ;

Diffraction pattern from satellite radiation (L) ;

Drifts and irregularities using spaced receivers (L) ;

Fluctuations in extra-galactic noise using a riometer (L) ;

Total electron content by Faraday rotation (K and L) ;

Ionosonde (at one or two stations) (K and L) ;

Scattered signal strength for *q*-type E*s* along two paths.

A multi-channel tape recorder and apparatus for analysis will be used to process the data.

Address : Dr. D. G. Osborne, Department of Physics, University of Ghana, Legon, Accra.

SWEDEN

Provisional Programme for the I.Q.S.Y. (August 1963:

The following Programme is only very provisional since full information about the definitive programme for Sweden will not be available until early next year. Additions or amendments will be published in future issues of I.Q.S.Y. Notes.

V. — Ionosphere

Uppsala (59.8° *N*, 17.6° *E*).

1. Vertical soundings of the ionosphere each hour, during RWD and SWI every quarter hour. Frequency range 0.3-20 Mc/s.
2. Riometer recordings at frequency 27.6 Mc/s.
3. Recording of the 16 kc/s transmitter of Rugby.
4. Geomagnetic H-intensity recording (Askania direct recorder).

Lycksele (64.7° *N*, 18.8° *E*).

1. Vertical soundings of the ionosphere each hour, during RWD and SWI every quarter hour. Frequency range 0.3-20 Mc/s.
2. Riometer recording at frequency 27.6 Mc/s.
3. Recording of the 16 kc/s transmitter of Rugby.
4. Geomagnetic H-intensity recording (Askania direct recorder), photographic recording of all three components.

Kiruna (67.8° *N*, 20.4° *E*).

Ionospheric ionization :

1. Panoramic ionosonde, together with continuous soundings on two fixed frequencies.
2. Riometers (vertical and oblique).
3. Radio-astronomic swept frequency interferometer.

Radio-wave propagation :

1. VLF Transmission Rugby - Kiruna and Panama - Kiruna (incl. phase measurement).
2. Recordings of transmissions from satellites.
3. Transpolar transmissions from NW U. S. A. recorded and analyzed in Kiruna.
4. Communication Stockholm-Kiruna on 50 Mc/s via meteor ionization.

Lulea (65.6° *N*, 22.2° *E*) Ionospheric vertical soundings.

Enköping (59.6° *N*, 17.1° E) Recordings of atmospheric noise.

A special research group of the University of Uppsala will record atmospherics over Europe continuously at two stations, Uppsala in Sweden and Ankara in Turkey. Film speed about 100 m/day.

General

The Radio Department of the Royal Board of Telecommunication is represented in the European Regional Ursigram and World Days Committee and has a geophysical communication centre in Stockholm, which will serve as an Associate Regional Warning Centre in the world-wide warning system during I.Q.S.Y. From this Centre, Ursigrams and warnings are distributed to Swedish observatories and institutions, and to Finland. Data of observations (ionosphere, aurora, riometer, major solar events) are collected and forwarded in Ursigrams to the European centres.

Address : Dr. C. C. Wallén, Secretary, Swedish Meteorological and Hydrological Institute, P. O. Box 12108, Stockholm 12.

UNITED STATES

Statment of Proposed Programme, February 1963

(Revised as of May 1963)

I. — World Days

Alerts and Special World Intervals.

Notices of Geophysical Alerts and Special World Intervals (SWI) are distributed by telegram and radio broadcasts on a current basis by the IUWDS Regional Warning Centers ; the U. S. station co-operating in this programme is AGIWARN, Fort Belvoir, Virginia. It may also prove possible to broadcast basic warning information in Morse code on the standard time and frequency broadcasting stations such as WWV and WWVH.

V. — Ionospheric Physics and Radio Astronomy

1. — *Synoptic Programmes.*

Vertical Incidence Network. — The network of stations operated by C.R.P.L. (J. W. Wright) will continue through I.Q.S.Y., many of them operated cooperatively with the U. S. Army Signal Radio Prop. Agency and scientists and agencies in other countries. It is hoped for selected stations to increase the frequency coverage by lowering the initial frequency from 1.0 Mc to 0.25 Mc 16.

Stations operated by the U. S. are : Adak, Anchorage, Barrow, and College, Alaska ; Thule, Greenland, Ft. Belvoir, Va. ; Boulder, Colo. ; Ft.Monmouth, N. J. ; White Sands, N. Mex. ; Grand Bahama, Island ; Maui, Hawaii ; Okinawa ; Ramey AFB, P. R. (uncertain) ; Amundsen-Scott, Byrd and Eights Station, Antarctica. Stations operated in other countries in cooperation with C.R.P.L. are : Godhavn and Narssarsuac, Greenland ; Rejkavik, Iceland ; Kingston, Jamaica ; Talara and Huancayo, Peru ; Bogota, Colombia ; La Paz, Bolivia ; Concepcion, Chile ; Natal, Brazil ; Manila, Philippines ; Hallett, Wilkes and Ellsworth Stations, Antarctica.

Topside Sounder. — Plans are underway for launching of a fixed frequency topside sounder (C.R.P.L., R. Knecht) and consideration is being given by N. A. S. A. in cooperation with Canadian scientists to follow-on flights of the sweep-frequency sounder, Alouette.

Incoherent Backscatter from High Power Radar. — Four radar sites are in operation by U. S. groups for studies of the ionosphere and geomagnetosphere ; the installations also make possible certain studies of the solar corona and nearby planets.

(i) Jicarmarca, Peru — established by scientists from C.R.P.L. (K. Bowles and R. Cohen in association with colleagues in Peru).

(ii) Stanford, California (V. R. Eshleman) ; it is hoped to install by 1964 a half-megawatt (average power) transmitter operating at 400 Mcs for use in conjunction with the 30 metre steerable paraboloid at Stanford.

(iii) Arecibo, Puerto Rico, Cornell University and University of Puerto Rico (W. Gordon) ; a 300-metre diameter fixed antenna is being constructed. The antenna will also be used as a radio telescope for radio astronomical work ; profiles of electron density and temperature, density fluctuations and motions of the medium will be obtained from the lowest ionospheric heights to several thousand kilometers.

(iv) Westford, Mass., Massachusetts Institute of Technology, Lincoln Laboratory (J. V. Evans).

Fixed-Frequency Backscatter. — The Stanford (A. M. Peterson) backscatter station will be reactivated and data will be reduced from the stations at Fort Monmouth, Thule and Adak, which have

been kept in operation by the U. S. Army Radio Propagation Agency.

Radio Noise Network. — The stations operated during I.G.Y. by C.R.P.L. (W. Crichlow) have been kept in routine operation since and will continue during I.Q.S.Y., thus providing a continuous study of the noise distribution from solar maximum to minimum. Noise parameters are measured at 15, 51, 170, 535 kcs ; 2.5, 5, 10, 20 Mcs. U. S. stations are : Balboa, Canal Zone ; Bill, Wyoming ; Boulder, Colo. ; Byrd Station, Antarctica ; Front Royal, Va. ; Kekaha, Hawaii ; Thule, Greenland ; Warrensburg, Mo. ; and aboard the antarctic research ship USNS ELTANIN. Stations operated in other countries cooperatively with C.R.P.L. are : Cook, Australia ; Enköping, Sweden ; Ibadan ; Nigeria ; New Delhi, India ; Ohira, Japan ; Pretoria, Republic of South Africa ; Rabat, Morocco ; Sao Jose dos Campos, Brazil ; Singapore.

Riometers. — Some riometers installed for the I.G.Y. have been kept in operation. Improvements have been made in the design of the instruments and transistorized equipment has been installed in many new locations. Multi-frequency riometers have also been used to study absorption profiles in the ionosphere, and techniques have been developed for antenna switching to permit scanning. In Alaska, an atenna network was established to study the movements of an absorbing patch ; the arrangement is a square array of 16 Yagis that have half power beam widths of 10° (E plane) and 12° (H plane). The beam is electrically swung every minute from 12° N of zenith to 12° S. The Geophys. Inst. programme (Parthasarathy) includes Barrow, Fort Yukon, King Salmon, College, Kotzebue and Farewell, Alaska.

In Antarctica, riometers are operated by C.R.P.L. personnel (H. J. A. Chivers) at Pole, Byrd and Eights Stations, and also at McMurdo (Masley). At conjugate stations in Canada, arranged in cooperation with Canadian colleagues, riometers will be operated at Baie St. Paul, Quebec (conjugate to Eights), Great Whale River (conjugate to Byrd), Shepard Bay (conjugate to McMurdo), and Frgbisher Bay (conjugate to Pole).

An A.F.C.R.L. network of 30-Mcs riometers (except as noted) (Horowitz) has recently been established and is expected to continue through I.Q.S.Y. Stations are operated at Hamilton and

Rockport, Mass. ; Sacramento Peak, N. Mex. ; Maui, Hawaii ; Thule, Greenland ; Palo Alto, Calif. ; Chicago, Ill. ; and Canton Island ; and in cooperation with colleagues in other countries at Huancayo, Peru ; Natal, Brazil ; Accra, Ghana ; Addis Adaba, Ethiopia ; Jamaica ; Hallett, Antarctica ; Manila, Philippines ; Athens, Greece (30, 60 Mcs) ; Haifa, Israel ; New Delhi, India (20, 30 Mcs) ; Copenhagen, Denmark ; Rome, Italy ; Madrid, Spain ; Hermanus, Republic of South Africa ; and Kerguelen Island (France). One station will soon be installed in northern Maine for studies in conjunction with observations at Eights Station, Antarctica, and at some other locations such as : Kiruna, Sweden ; Punta Arenas, Chile ; Palmer Pen., Antarctica ; Kerala, India ; Christchurch, N. Z. ; Ushuaia, Argentina ; and Garchy, France.

A special multi-frequency, dual-polarization unit is operated at College, Alaska (Lefald).

Whistlers and Ionospherics. — The Stanford synoptic stations will include : Stanford, Calif. ; Byrd Station and Eights Station, Antarctica ; and the USNS ELTANIN. Stations operated in other countries through cooperative arrangements with colleagues include : Carde (Quebec City), Great Whale River, and Suffield Experimental Station, Canada ; Santiago, Chile ; and Ushuaia, Argentina. Two stations are operated in New Zealand under the supervision of G. McK. Allcock, in cooperation with the Stanford programme : Lauder and Wellington. Finally, stations at Greenbank, W. Va. (Nat. Radio. Astron. Obs.) and Logan, Utah will operate during the time of satellite experiments on NASA spacecraft EGO and POGO.

Dartmouth stations will be : Norwich, Vermont (formerly Hanover, N. H.) and Adak, Alaska. Stations operated cooperatively in other countries are : Halley Bay and Argentine Islands, Antarctica (cooperation with U. K.) ; Ushuaia, Argentina ; Bermuda ; Knob Lake, Canada ; Frobisher Bay, Canada ; Moisie, Canada.

C.R.P.L. scientists (R. M. Gallet) will operate whistler and atmospheric recorders at Eights and Byrd Station, Antarctica and their respective conjugate locations, Baie St. Paul, Quebec and Great Whale River, Canada.

2. — *Special Experiments.*

Eights station (L = 4) was reoccupied in the 1962-63 season on a semi-permanent basis and collaborative Canadian-U. S. programmes

are underway at the conjugate site. This pair of stations lies equatorward of the auroral zones. To give additional coverage, arrangements were concluded with Canadian colleagues to undertake collaborative programmes at Great Whale River, conjugate to Byrd Station (L = 7, approx.) lying on the auroral zone, and at Frobisher Bay (L = 15 approx.) (conjugate to the South Pole) well inside the auroral zone. Limited coordinated observations (riometers) are also planned for McMurdo (L = 20 approx.) (Masley, Douglas Aircraft) and Shepard Bay, Canada, also lying well inside the auroral zone. Observations include absorption by riometers, vertical incidence soundings, geomagnetic variations and micropulsations, all-sky camera photographs and auroral photometry. Certain accessible stations (in a range of L values of 2 to 7(in Alaska are conjugate to Macquarie Island, Campbell Island, and South Island of N.Z. ; programmes in Alaska are planned with coordination in mind and some preliminary coordinated programmes have been conducted in cooperation with Australian scientists at Macquarie Island.

Monitor of the D-Region. — Scientists at the State University of Pennsylvania (A. J. Ferraro) plan a cross-modulation wave-interaction experiment that will yield information on electron density, collision frequency, electron temperature and the energy-loss coefficient as a function of height. Workers at the Naval Ordnance Laboratory at Corona, Calif., have been able to develop a backscatter technique for monitoring the undisturbed D-region as well as to yield information on inhomogeneities and disturbances.

Study of Ionization Released by Low Energy Solar Flare Radiation. — It has been shown that valuable ionospheric information can be obtained by observing Doppler shifts in frequency (related or phase path changes) of oblique incidence propagation from stable high frequency radio transmissions, such as WWV, WWVH. A cooperative programme is planned with observations at Boulder (K. Davies), Stanford (O. G. Villard) and Hawaii (L.-L. Chan). C.R.P.L. is also arranging cooperative programmes with colleagues in other countries : Africa (Liberia, Ghana) and South America (Natal, Brazil) and India.

Satellite Beacon Observations. — A multi-frequency ionosphere beacon is planned by NASA and additional beacons are being considered for inclusion in a NASA ionospheric monitoring satel-

lite ; a technical description of receiving equipment has been prepared (G. Swenson, University of Illinois). Satellite radio receiving programmes are underway at Stanford (Garriott) ; University of Alaska (Owren) ; University of Illinois (Swenson) ; Pennsylvania State University (Ross) ; A.F.C.R.L. (Dieter) ; Boston College (Linehan) ; Dartmouth College (Morgan) ; and Thule, Greenland (Sales, Lowell Institute Research Foundation).

Cosmic Radio Noise Spectrum Studies. — In collaboration with University of Alaska, C.R.P.L. (C. G. Little) scientists are planning a multi-frequency, dual-polarization riometer programme at College, Alaska.

Moon Radar. — Using the « Diana » radar, scientists at the U. S. Army Electronics Research and Development Laboratory (F. Daniels) obtain radar echoes from the moon, the Faraday rotation effects of which can be used to determine ionosphere electron content. This work is done in collaboration with workers at the University of Illinois, who receive the reflected signals.

Miscellaneous Propagation Studies. — Among many specialized projects may be mentioned :

(i) Magnetic-duct propagation between magnetically conjugate points, with frequencies somewhat higher than the critical frequency in the vertical (U. S. Army Electronic Research and Development Laboratory).

(ii) Ionospheric propagation over Thule-Boston path to study spread-F (A.F.C.R.L.).

(iii) HF-VHF propagation by step-frequency sounder 4-64 Mcs, Norway to Pullman, Wash. (State Univ. of Wash.).

(iv) Extended range HF-VHF sounder circuits, Norway to Boston, Palo Alto to Boston, Puerto Rico to Uruguay (A.F.C.R.L.).

Special VLF-ELF Measurements. — Both the Stanford and Dartmouth whistler groups also study hiss and other emission phenomena on a special basis as well as synoptically. In addition, there are other workers, such as Etkind and Lewis, A.F.C.R.L., and Tepley, Lockheed, who are studying various aspects of ionospheric emissions.

Rocket and Satellite In-Situ Observations. — Details of such direct measurements in the ionosphere of electron and ion density and temperature, etc. are discussed in the section on Aeronomy.

Radio Astronomy. — Astronomers at University of Michigan (Haddock) and possibly at other locations will extend observations to lower frequencies during I.Q.S.Y. Workers at University of Florida (A. G. Smith) are undertaking a radio surveillance of the planets Jupiter, Saturn, Uranus, Venus and Mars, in association with photoelectric observations, to determine relation of bursts to luminous variations. Of particular interest is Jupiter, which is believed to have great zones of magnetically trapped radiation.

XVI. — World Data Centers

The regular exchange of synoptic type data on a timely basis, and their availability to scientists, is an integral part of the I.Q.S.Y. programme. Data and results from relevant fields — meteorology, geomagnetism, aurora, airglow, ionospheric physics, solar activity and cosmic rays as well as from rocket and satellite activities — are received by and available from the following archives of World Data Center A (there are actually eleven archives of WDC-A but three of these are not relevant to the I.Q.S.Y. programme):

I.G.Y. World Data Center A : Airglow and Ionosphere, Central Radio Propagation Laboratory, Boulder, Colorado, U. S. A.

I.G.Y. World Data Center A : Aurora (Instrumental), Geophysical Institute, U. of Alaska, College, Alaska, U. A. A.

I.G.Y. World Data Center A : Aurora (Visual), Hollister Hall, Cornell U., Ithaca, New York, U. S. A.

I.G.Y. World Data Center A : Cosmic Rays, School of Physics, U. of Minn., Minneapolis 14, Minnesota, U. S. A.

I.G.Y. World Data Center A : Geomagnetism Gravity and Seismology, U. S. Coast and Geodetic Survey, Washington 25, D. C., U. S. A.

I.G.Y. World Data Center A : Meteorology and Nuclear Radiation, National Weather Records Center, Asheville, North Carolina, U. S. A.

I.G.Y. World Data Center A : Rockets and Satellites, National Academy of Sciences, Washington 25, D. C., U. S. A.

I.G.Y. World Data Center A : Solar Activity, High Altitude Observatory, NCAR, Boulder, Colorado, U. S. A.

The activities of all archives, which together constitute WDC-A, are coordinated by the National Academy of Sciences (2101 Constitution Avenue, N.W., Washington 25, D.C., U. S. A.).

U. S. S. R.

Programme for I.Q.S.Y. (March 1963)

When working out the U. S. S. R. programme for the International Quiet Sun Years (I.Q.S.Y.) the recommendations of the I.Q.S.Y. Assembly, held in Paris in March of 1962, and of the Regional I.Q.S.Y. conference in Budapest in October 1962 have been taken into account. The programme provides for comparisons of the observational I.Q.S.Y. material with the material obtained during the I.G.Y. At the same time the possibility of studying certain particular phenomena, expected to occur during the periods of the minimum of solar activity is foreseen. All the stations participating in the I.Q.S.Y. took part in the I.G.Y.-I.G.C. A number of stations, however, will observe many more phenomena than during the I.G.Y.-I.G.C. All the stations fall into two categories : synoptic and research stations. Synoptic stations will forward observational material for all I.Q.S.Y. days to the World Data Centres ; research stations will provide observational material only for separate particular periods on the request of the WDC.

I. — World Days

During the I.Q.S.Y., the functions of the Regional Warning Centre, the announcement of World Days and special intervals of observations, will be performed by the Institute of Geomagnetism, Ionosphere and Radiowave Propagation under the U. S. S. R. Academy of Sciences (IZMIRAN).

Two subcentres will work side by side with the Regional Centre : a Western one in Prague under the Geophysical Institute, Academy of Sciences of Czechoslovakia ; and an Eastern one in Irkutsk in the Siberian Institute of Geomagnetism, Ionosphere and Radiowaves Propagation, the Siberian Department of the U. S. S. R. Academy of Sciences.

The Regional Centre will consult the World Warning Centre in Washington about the announcements of Alerts and the beginning

and the end of Special Observational Intervals. Alerts and Special Intervals will be announced during the periods when, judging from the solar activity forecast, the Quiet Sun can be expected or, vice versa, a considerable increase in its activity, which may lead to the disturbances of geomagnetic field, ionosphere, polar aurora and of other geophysical phenomena. The Regional Centre and its subcentres will transmit information on Alerts and special intervals to the National Collection Centres of the countries belonging to this region through telegraph connections and meteorological teletype system.

The National Connection Centres will, in their turn, transmit urgent information on the state of solar activity and other geophysical phenomena, based on the observations of some Regional stations, to subcentres and the Regional centre.

This information will be used for forecasting Alerts and special intervals and compiling cosmic data summaries to be transmitted by radio from Moscow.

The International Telegraph, the Ministry of Communications in Moscow and the Central Radio-communication office under the Great Northern Sea Way General Board, will assist in transmitting warnings about Alerts and special intervals to the U. S. S. R. stations. The latter will transmit information to Arctic and Antarctic stations.

The warnings about satellite and cosmic rocket lauchings will be issued by the Astronomical Council of the U. S. S. R. Academy of Sciences, through the centre « Cosmos ». The Regional centre will participate in determining, postfactum, the periods of the most interesting phenomena, the data on which will be collected in centres ahead of schedule.

Instructions to stations on sending observational material before the usual time on such phenomena to the World centres will be issued through the communication channels of the Regional centre.

V. — Ionosphere

Synoptic observations will be conducted in all types of ionospheric research in the same volume as during I.G.Y.-I.G.C. In some types of research, which did not have sufficient development during I.G.Y.-I.G.C., the network of stations will be enlarged (study of

cosmic radio-noises by means of radiometers). Data on each type of observation are reported separately.

(*a*) *Vertical sounding.*

Vertical sounding will be conducted at 25 stations, two of them mobile : one on drifting ice-floes and the second on the non-magnetic boat « Zarya ».

High latitude stations will carry out sounding on all days every 15 minutes. Copies of ionograms will be transmitted to the World Data Centres from all stations for regular days and special intervals only.

(*b*) *Absorplion.*

When measuring absorption two methods will be used : the measurement of pulse amplitudes, reflected from the ionosphere (method A1) and of extraterrestrial galactic noise by means of riometers (method A2).

Most of the riometers will make measurements at two frequencies in the range from 20 to 40 Mc/s. Absorption will be measured by method A1 at 9 stations and by riometers at 7 stations.

(*c*) *Ionospheric drifts.*

Ionospheric drift (wind) measurements will be carried out by two methods : observations of the fading pulses, reflected from ionosphere, on three spaced antennas (method D1), and radar observations of meteor trail drifts (method D2).

Drift observations will be carried out at the same stations as during the I.G.Y. Drift measurements in Moscow will be conducted by method D1 at two installations : with small bases (IZMIRAN) and large ones of about 30 km by Moscow University. In addition to radar observations at four points : Odessa, Kiev, Dushanbe, and Ashkhabad, photograph,c survey of meteor trails will be carried out ; the data on the latter will also be used for air flow determinations. Photographic studies of the height, speed and brightness of meteors will be used for determination of pressure, density and height of a homogeneous atmosphere in the meteor zone at a height of 60-120 kms.

(*d*) *Almospheric noises.*

Atmospheric noise measurements will be made at the same stations as during the I.G.Y.-I.G.C. Measurement methods and equipment (statistical analyses) will be the same. Most of the stations are under the Technical Control Centre, Ministry of Communications of the U. S. S. R.

It is planned to compare atmospheric noise levels with the data on the distribution of thunderstorm activity obtained using observations of cathode ray direction finder bearings of lightning discharges, data from local thunderstorm recorders and observations of thunderstorm activity carried out by a network of synoptic meteorological stations.

(*e*) *Atmospheric whistles and low-frequency emission.*

Observations of atmospheric whistler and low frequency emissions are undertaken at present at Moscow and Mirny. It is intended to put into operation some more stations in Murmansk and Irkutsk.

XI. — Rocket and Satellite Studies

The main objectives of the scientific research planned for the I.Q.S.Y. period are as follows :

(*a*) to obtain information on the structure of solar outer shells and the physical processes occurring in them ;

(*b*) to study the conditions of interplanetary space and their variations depending on the changes of solar activity ;

(*c*) to study the earth's upper atmosphere and its variations depending on processes occurring on the sun.

Solar researches during the period of minimum activity will make it possible to study solar radiation under quiet conditions and to obtain more accurate information on the dependence of a number of phenomena on solar activity.

To ensure the fulfilment of all the planned objectives, the following programme of scientific research should be carried out.

1. — *Study of electromagnetic solar radiation.*

(i) Measurement of solar short-wave (X-and ultra violet) radiation intensity and its variations.

(ii) Solar images in the ultra violet and X-rays.

(iii) Studies of the radiation of the solar corona at far distances from the sun in the visible and ultra-violet parts of the spectrum.

2. — *Corpuscular streams.*

3. — *Cosmic rays and the earth's radiation belts.*

4. — *Magnetic researches.*

5. — *The study of the earth's upper atmospheric and variations in it depending on the processes occurring on the sun.*

6. — *The exchange of scientific data.*

The exchange of scientific data will be carried out in a manner similar to that adopted during the International Geophysical Year.

XX. — World Data Centres

(for the collection, distribution and analysis of data)

The collection and distribution of observational data and results will be carried out by the World Data Centres (B1 and B2) for the collection and distribution of data.

1. *The World Data Centre B2* (WDC B2 Molodezhnaya 3, Moscow, U. S. S. R.) will collect and distribute data on :

Geomagnetism and earth currents ;
Aurora ;
Airglow ;
Ionosphere ;
Solar activity ;
Cosmic rays.

2. *The World Data Centre B1* (WDC B1 Molodezhnaya 3, Moscow B-296, U. S. S. R.) will collect and distribute data on meteorology and the results of observations and researches with rockets and satellites.

For the convenience of scientists working in Siberia and the Far East of the U. S. S. R., copies of materials from Centre B will also be dispatched to Irkutsk, to the Siberian Institute of Geomagnetism, Ionosphere and Radiowaves Propagation. In Moscow under Centre B, all publications concerning the I.Q.S.Y. will be gathered.

The Soviet Geophysical Committee, together with scientific institutions participating in the I.Q.S.Y., has taken upon itself the organization of work in the following World analytical centres :

II. — *Meteorology.*

Actinometric observations : The Main Geophysical Observatory.

Observations of luminous clouds : The Institute of Physics and Astronomy under the Estonian SSR Academy of Sciences.

Atmospheric electricity : The Main Geophysical Observatory.

III. — *Geomagnetism.*

Earth current variations during 24 hours : The Institute of Earth Physics.

V. — *Ionosphere.*

Ionosphere drifts : The Institute of Earth Magnetism, Ionosphere and Radio wave Propagation.

Aurora : Spectral Patrol Researches.

VI. — *Solar Activity.*

Magnetic fields of the sun : The Crimean Astrophysical Observatory.

Photometric index of flares : The Crimean Astrophysical Observatory.

VII. — *Cosmic Rays.*

Underground recording.

Address : The Secretary, Soviet Geophysical Committee, Academy of Science of U. S. S. R., Molodezhnaya 3, Moscow B-296.

YUGOSLAVIA

Provisional programme for the I.Q.S.Y. (March 1963:

V. — IONOSPHERE

Institute « Mihajlo Pupin » (Institut za elektronikumtelekomunikacije i automatizaciju « Mihajlo Pupin », Beograd, Volgina 15) will undertake :

hourly vertical incidence soundings at the ionospheric observatory :

Beograd	44°48'	20°31'

Address : R. Turajlic, National Committee for Geophysics, Beograd, Božidara Adžij 11.

NATIONAL WARNING CONTACTS

We give below the names and addresses of the National Warning Contacts received so far by the C.I.G.-I.Q.S.Y. Secretariat.

Australia : Mr. F. E. Cook, Ionospheric Prediction Service, Commonwealth Centre, Elizabeth Street, SYDNEY, N.S.W.
Cables : IPSO SYDNEY.
Telephone : 20340.

Belgium : Professor M. Nicolet, C.N.R.E., 3, Avenue Circulaire, Bruxelles 18.
Cables : CENTRESPACE BRUXELLES.
Telephone : 02-74.27.28.
Telex : 2-21563. — CENTRESPACE BRU.

Canada : Mr. C. Collins, Division of Pure Physics, National Research Council, Ottawa 2.
Cables : RESEARCH OTTAWA.

France : M. R. Michard, Service Solaire, Observatoire de Paris, Meudon (S-et-O).

German Democratic Republic : Dr. H. Runge, Hauptwetterdienstelle, Potsdam.
Cables : WETTER POTSDAM.
Telex : 015 116.

Ghana : Chief Meteorological Officer, Meteorological Office, P.O. Box 744, Accra.

Greece : Denis Metaxas, Meteorological Centre, Hellenikon Airport, Athens.
Cables : IQSY ATHENS.
Special : LGGMYM METAXAS.

Guatemala : Engr. Haroldo Duarte VILLELA, Chief of Geophysics Section, Dirección General de Cartografía, Avenida « Las Américas » 5-76. Zona 13, Guatemala City, C. A.
Telephone : 63281-2-3.

Iceland : Dr. Th. SAEMUNDSSON, Bolstadarhlid 14, Reykjavik.

India : Mr. P. R. Krishna RAO, Director-General of Observatories, India Meteorological Department, New Delhi 3.

Ireland : Dr. Doporto, Director, Meteorological Service, 44, Upper O'Connell Street, Dublin.

Japan : Radio Research Laboratories, Ministry of Posts and Telecommunications, Kokubunji P O, Koganei-shi, Tokyo.

Cables : DEMPA KOKUBUNJI.

Supervisory : Hiroyuki Uyeda.

Immediate Charge : Toshio Takiguchi.

New Zealand : The Director, New Zealand Meteorological Service, P.O. Box 722, Wellington.

Cables : WEATHER WELLINGTON.

Portugal : The Director, Servicio Meteorológico Nacional, Rua Saraiva de Carvalho, 2, Lisboa 3.

Cables : METEOLISB.

Telephone : 662188 and 663543.

Pakistan : Mr. Muhammed Samiullah, Deputy Director, Pakistan Meteorological Service, Secretariat Blocks 1-3, Frere Road, Karachi-3.

Cables : METEOR.

Peru : Major Juan Ernesto BARREDA, Instituto Geofisico del Peru, Ministerio de Fomento, Apartado 3747, Lima.
Cables : AGI LIMA.

Philippines : The Director, Weather Bureau, Department of Commerce and Industry, Manila, P.O. Box 2277.

Rhodesia and Nyasaland : Mr. A. C. GAULD, Federal Department of Trigonometrical and Topographical Surveys, P.O. Box 8181, Causeway, Salisbury.

Cables : SURVEYS SALISBURY.

Telephone : 27691.

South Africa : Mr. G. H. OOSTHUIZEN, Science Cooperation Division, C.S.I.R., Scientia, Pretoria.

Cables : NAVORS.

Telephone : 4-6011.

Taiwan : Mr. Miao TSAO-VONG, Directorate General of Telecommunications, Ministry of Communications, Taipei, Taiwan, Republic of China.

United Kingdom : Mr. A. F. WILKINS, D.S.I.R. Radio Research Station, Ditton Park, Slough, Bucks.

Cables : RADSEARCH SLOUGH.

Telephone : Slough 24411.

United States of America : Miss J. Virginia LINCOLN, Chief, Radio Warning Services, National Bureau of Standards, Boulder, Colo.

Austria : Professor Dr. Ferdinand STEINHAUSER, Director, Zentralanstalt für Meteorologie und Geodynamik, Hohe Warte 38, Vienna 19.

Telex : 07-4337.

PROVISIONAL LIST OF I.Q.S.Y. IONOSPHERIC STATIONS

A provisional list of I.Q.S.Y. ionospheric stations has been published in *I.Q.S.Y. Notes*, No. 4, September 1963.

INTER-UNION COMMITTEES

I.U.C.A.F.

BIBLIOGRAPHY

Attention of the members is drawn to a letter from Prof. P. Swings, of Liège University, stressing the need of frequency protection for radio astronomy. This letter has been published in *Telecommunication Journal*, Vol. 30, No. 10, October 1963.

COSPAR

Fifth International Space Science Symposium

The fifth International Space Science Symposium will be held in Florence, Italy (May 12-16, 1964). This meeting will comprise the following topics :

I. — Interaction of energetic particles with the atmosphere.

II. — Life sciences and space research.

III. — Latest significant results.

Further information may be obtained at the COSPAR Secretariat, 55, boulevard Malesherbes, Paris 8e, France.

BIBLIOGRAPHIE

Commission Electrotechnique Internationale

Publication 145 : *Première édition.* — Compteurs d'énergie réactive (varheure-mètres).

Prix : Fr. S. 15.— l'exemplaire.

Publication 147-1 : *Première édition.* — Valeurs limites et caractéristiques essentielles des dispositifs à semi-conducteurs et principes généraux des méthodes de mesure. Première partie : Valeurs limites et caractéristiques essentielles.

Prix : Fr. S. 6.—.

Publication 147-2 : *Première édition.* — Valeurs limites et caractéristiques essentielles des dispositifs à semi-conducteurs et principes généraux des méthodes de mesures. Deuxième partie : Principes généraux des méthodes de mesures.

Prix : Fr. S. 18.—.

Publication 56-5 : *Première édition.* — Règles pour les disjoncteurs à courant alternatif. Guide pour l'essai en réseau des disjoncteurs en ce qui concerne la mise en et hors circuits des lignes aériennes à vide.

Prix : Fr. S. 6.—

Publication 56-6 : *Première édition.* — Règles pour les disjoncteurs à courant alternatif. Guide pour l'essai des disjoncteurs en ce qui concerne la mise en et hors circuit des câbles à vide.

Prix : Fr. S. 6.—

Publication 95-2 : *Première édition.* — Batteries d'accumulateurs de démarrage au plomb. Deuxième partie : Dimensions des batteries.

Prix : Fr. S. 6.—

Publication 95-3 : *Première édition.* — Batteries d'accumulateurs de démarrage au plomb. Troisième partie : Dimensions et marquage des bornes.

Prix : Fr. S.3,75.

Modification n°1 à la Publication 129 (1961). — Sectionneurs à courant alternatif et sectionneurs de terre.

Prix : Fr. S. 1,50.

Les prix ci-dessus ne comprennent pas les frais de port et d'emballage. Les publications sont en vente au Bureau Central de la C.E.I., 1 rue de Varembé, Genève, Suisse.

Union Internationale des Télécommunications

L'U.I.T. vient de publier la 2e *édition de la Liste internationale des fréquences.* Elle a été établie dans la forme prévue à l'Appendice 9 au Règlement des radiocommunications (Genève, 1959).

La 2e édition de la Liste internationale des fréquences comprend les états signalétiques des assignations de fréquences inscrites dans le Fichier de référence international des fréquences à la date du 1er février 1963. Elle est tenue à jour au moyen de suppléments récapitulatifs trimestriels.

Ce document comprend une préface et quatre volumes. La Préface a été publiée séparément en langues française, anglaise et espagnole. Le Volume IV a été édité en quatre fascicules distincts qui peuvent être livrés séparément. Les titres et en-têtes des colonnes des Volumes I à IV figurent en langues française, anglaise, espagnole, russe et chinoise.

Le prix de vente a été fixé comme il suit :

Préface aux quatre volumes, en langues française, anglaise ou espagnole : 9 francs suisses.

Volume I. — Assignations de fréquence dans les bandes comprises entre 10 et 4995 kHz : 65 francs suisses.

Volume II. — Assignations de fréquence dans les bandes comprises entre 4995 et 9995 kHz : 67 francs suisses.

Volume III. — Assignations de fréquence dans les bandes comprises entre 9995 et 28 000 kHz : 70 francs suisses.

Volume IV, Partie A. - Assignations de fréquence dans les bandes comprises entre 28 et 50 MHz, à l'exclusion des stations de radiodiffusion : 9 francs suisses.

Volume IV, Partie B. — Assignations de fréquence de la Région 1 dans les bandes comprises entre 50 et 40 000 MHz, et assignations de fréquence aux stations de radiodiffusion de la Région 1 dans les bandes comprises entre 28 et 50 MHz : 25 francs suisses.

Volume IV, Partie C. — Assignations de fréquence de la Région 2 dans les bandes comprises entre 50 et 40 000 MHz : 18 francs suisses.

Volume IV, Partie D. — Assignations de fréquence de la Région 3 dans les bandes comprises entre 50 et 40 000 MHz, et assignations de fréquence aux stations de radiodiffusion de la Région 3 dans les bandes comprises entre 28 et 50 MHz : 12 francs suisses.

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

L'U.I.T. a également publié la 2e édition de la *Nomenclature des stations de radiodiffusion fonctionnant dans les bandes au-dessous de* 5950 *kHz.*

Cette Nomenclature comprend les stations de radiodiffusion fonctionnant dans les bandes au-dessous de 5950 kHz dont les assignations de fréquence figurent dans la Liste internationale des fréquences, autre document publié par l'U.I.T. Elles sont publiées dans la forme prévue à l'Appendice 9 au Règlement des radiocommunications de Genève (1959).

Ce document trilingue (français, anlais, espagnol) d'environ 170 pages sera tenu à jour par des suppléments récapitulatifs semestriels. Chaque volume est accompagné d'Observations et Explications qui figurent en français, en anglais et en espagnol.

Le prix de vente d'un exemplaire de cette publication a été fixé à 11 francs *suisses* ; ce prix comprend les frais de port pour envoi par la poste ordinaire dans le monde entier, l'emballage et l'abonnement aux suppléments semestriels qui paraîtront jusqu'à la prochaine édition, dont la publication n'est pas envisagée avant 1966.

BIBLIOGRAPHY

International Electrotechnical Commission

Publication 145 : *First edition.* — Var-hour (reactive energy) meters.
Price : Sw. Fr. 15.—

Publication 147-1 : *First edition.* — Essential ratings and characteristics of semiconductor devices and general principles of measuring methods. Part 1 : Essential ratings and characteristics.
Price : Sw. Fr. 6.—

Publication 147-2 : *First edition.* — Essential ratings and characteristics of semiconductor devices and general principles of measuring methods. Part 2 : General principles of measuring methods.
Price : Sw. Fr. 18.—

Publication 56-5 : *First edition.* — Specification for alternating-current circuit-breakers. Guide to the field testing of circuit-breakers with respect to the switching of overhead lines on no-load.
Price : Sw. Fr. 6.—

Publication 56-6 : First edition. — Specification for alternating-current circuit-breakers. Guide to the testing of circuit-breakers with respect to the switching of cables on no-load.
Price : S. Fr. 6.—

Publication 95-2 : *First edition.* — Lead-acid starter batteries. Part 2 : Dimensions of batteries.
Price : Sw. Fr. 6.—

Publication 95-3 : First edition. — Lead-acid starter batteries. Part 3 : Dimensions and marking of terminals.
Price : Sw. Fr. 3.75.

Amendement No. 1 to Publication 129 (1961). — Alternating current isolators (disconnectors) and earthing switches.
Price : Sw. Fr. 1.50.

Postage and packing are not included in these prices. The publications re on sale at the Central Office ofthe I.E.C., 1, rue de Varembé, Geneva, witzerland.

International Telecommunication Union

The I.T.U. has just published the *2nd edition of the International Fre- iency List,* in the form specified in Appendix 9 to the Radio Regulations ieneva, 1959).

The 2nd edition of the International Frequency List gives particulars of the frequency assignments entered in the Master International Frequency Register as on 1 February 1963 and is kept up to date by quarterly recapitulatory supplements.

The List comprises a preface and four volumes. The Preface has been published separately in English, French and Spanish. Volume IV consists of four sections which can be purchased separately. The titles and column headings in Volumes I to IV appear in English, French, Spanish, Russian and Chinesc.

The sale price of this document is as follows :

Preface to the four volumes, in English, French or Spanish : 9 Swiss francs.

Volume I. — Frequency assignments in the bands between 10 and 4995 kc/s : 65 Swiss francs.

Volume II. — Frequency assignments in the bands between 4995 and 9995 kc/s : 67 Swiss francs.

Volume III. — Frequency assignments in the bands between 9995 and 28 000 kc/s : 70 Swiss francs.

Volume IV, Part A. - Frequency assignments in the bands between 28 and 50 Mc/s, excluding broadcasting stations : 9 Swiss francs.

Volume IV, Part B. — Frequency assignments in Region 1 in the bands between 50 and 40 000 Mc/s, and assignments to broadcasting stations in Region 1 in the bands between 28 and 50 Mc/s : 25 Swiss francs.

Volume IV. Part C. — Frequency assignments in Region 2 in the bands between 50 and 40 000 Mc/s : 18 Swiss francs.

Volume IV, Part D. — Frequency assignments in Region 3 in the bands between 50 and 40 0 0 Mc/s, and assignments to broadcasting stations in Region 3 in the bands between 28 and 50 Mc/s : 12 Swiss francs.

These prices include carriage costs by ordinary mail throughout the world, as well as the cost of all supplements issued prior to the next edition.

The I.T.U. has also published the second edition of the *List of Broadcasting Stations operating in bands below* 5950 *kc/s.*

The List includes the broadcasting stations working in the bands below 5950 kc/s and having their frequency assignments in the International Frequency List, another document published by the I.T.U. They appear in the form prescribed in Appendix 9 to the Radio Regulations (Geneva, 1959).

This three-language document (in English, Spanish and French) of some 170 pages will be kept up to date by recapitulatory supplements every month. In each volume Remarks and Explanations appear in French, English and Spanish.

The price per copy will be *eleven Swiss francs,* including postage by ordinary (surface) mail to any address. This figure also includes the supplements which will appear every six months until the next edition. The latter is not expected to be issued before 1966.