Bulletin nº 134 Septembre-Octobre 1962

U. R. S. I.

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OBITUARY

Dr. E. W. R. Steacie

We express our deepest sympathy to our colleagues of the International Council of Scientific Unions for the loss of their President, Dr. E. W. R. Steacie, who died on August 28th, 1962.

Born in 1900, he studied chemical engineering at McGill University. After having achieved his Ph. D. in 1926, he started research in chemical kinetics which remained his major scientific interest. In 1939 he joined the National Research Council as Director of the Division of Chemistry and in 1952 he became President of the Council.

Dr. E. W. R. Steacie was elected President of the I.C.S.U. at the 9th General Assembly, London, 1961. Since this election, he took actively part in the work of the Council, and especially in the activities of the Committee on the Future Structure of the I.C.S.U.

Professor Fung Chien

Professor Fung Chien, the former national representative for Formosa of the Western Pacific Regional Committee on Ursigrams, died on a sudden heart attack on May 26th, 1962 at the age of sixty-six.

Professor Fung was born on May 3rd, 1897 at Chiating, Kiangsu, China. He received his B. S. Degree in Electrical Engineering from the Nanyang University, Shanghai, which was later known as Chiaotung University, in 1919. In 1921, he received the M. A. Degree from Cornell University, United States of America. In the same year, he entered the General Electric Company as an Engineer under the guidance of the Chief Engineer Dr. Charles P. Steimetz for about two years. In 1923, he proceeded to Germany to continue his study at Berlin Polytechnic Institute and worked in Siemens Company for a short period. He returned to China in the year of 1924.

After his return, he has been professor in several universities for more than thirty years. He contributed a great deal to the radio wave research in China, especially in the field of ionospheric research for more than fifteen years despite of the chaotic conditions due to wars within and without China during that period.

Professor Fung is the first Chinese who went in 1947 to the Arctic Region for testing the long distance high frequency radio propagation via the Polar area.

Before his death, he was Professor of National Taiwan University and concurrently, Director of Radio Wave Research Laboratories, Ministry of Communications, Consultant to Broadcast Corporation of China and Member of Board of Directors of both Taiwan Power Company and Taiwan Television Corporation. In a word, he was a quiet but famous man in China, with a sense of humour in his daily life. He won the success by « Aiming at the macroscopic but starting from the microscopic ».

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Secretary : Dr. A. P. MITRA, Officer in Charge, Radio Propagation Unit, National Physical Laboratory of India, New Delhi 12.

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Président : Mr. Jacques SABBAH, Directeur de Cabinet au Ministère des PTT, Rabat.

Secrétaire : Mr. BERRADA, Chef du Service Technique de la Radiodiffusion marocaine, Rabat.

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Secretary : Mr. G. J. BURTT, Radio Research Committee, Dominion Physical Laboratory, Private Bag, Lower Hutt.

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Norway :

President : Eng. F. LIED, Norwegian Defence Research Establishment, Kjeller near Lillestrom.

Secretary : Dr. LANDMARK, Norwegian Defence Research Establishment, Kjeller near Lillestrom.

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Secretary : Dr. Krystyn BOCHENEK, ul. Swietokrzyska, 21, Varsovie.

Portugal :

Président : Prof. H. Amorim FERREIRA, Servico Meteorologico Nacional, rua Saraivo de Carvalho, 2, Lisboa.

République Sud-Africaine :
Republic of South Africa :

The Secretary-Treasurer, South African Council for Scientific and Industrial Research, POB 395, Pretoria, Tvl.

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Secretary : Eng. S. GEJER, Director of Department, Royal Board of Swedish Telecommunications, Brunkebergstorg, 2, Stockholm 16.

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U. S. A. :

President : Dr. J. P. HAGEN, Pennsylvania State University, Room 222, Electrical Engineering Building, University Park, Pennsylvania.

Secretary : Dr. M. G. MORGAN, Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire.

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Yugoslavia :

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Secretary : Dr. Ing. Dejan Bajić, Chief of the Ionospheric Observatory of the Institute Mihailo Pupin, E.T.A.N./U.R.S.I., 6, Vuka Karadzića, Belgrade.

Czechoslovakia

BIBLIOGRAPHY

The following papers have been issued by the Institute of Radio Engineering and Electronics, Czechoslovakian Academy of Science, Praha :

— The probability distribution of a random vector plus a Rayleigh distributed vector and its application, by P. Beckmann,

— The amplitude distribution of radio waves scattered by meteor trails, by P. Beckmann.

Pologne

COMPOSITION DU COMITE NATIONAL

Lors de la réunion du 18 juin 1962 les personnalités suivantes ont été élues au Comité National polonais de l'U.R.S.I. :

Président : Dr. Janusz Groszkowski, Vice-Président de l'Académie des Sciences de Pologne, Directeur de l'Institut des Problèmes Techniques de Base de l'Académie des Sciences, Professeur à l'Université Technique de Varsovie.

Secrétaire : Dr. Krystyn Bochenek, Chef de la Division Electromagnétique de l'Institut des Problèmes Techniques de Base, agrégé à l'Institut des Machines Mathématiques à Varsovie.

Membres :

Dr. Stanislaw RYZKO, Professeur à l'Université Technique de Varsovie.

Prof. Stefan MANCZARSKI, Directeur du Laboratoire Géophysique de l'Académie des Sciences de Pologne, Varsovie.

Dr. Stefan JASINSKI, Chef du Laboratoire de Propagation à l'Institut de Télécommunication de Varsovie.

Dr. Sylwester JARKOWSKI, Chef du Laboratoire de Télécommunication Micro-ondes à l'Institut de Télécommunication de Varsovie.

Dr. Wilhelmina IWANOWSKA, Membre-correspondant de l'Académie des Sciences de Pologne, Professeur à l'Université Nikola Kopernik de Torun, Directrice de l'Observatoire astronomique de Torun.

Dr. Pawel SZULKIN, Membre de l'Académie des Sciences de Pologne, Professeur à l'Université Technique de Varsovie.

Dr. Adam SMOLINSKI, Professeur à l'Université Technique de Varsovie.

Dr. Andrzej Jellonek, Professeur à l'Université Technique de Varsovie.

Dr. Roman KULIKOWSKI, Agrégé à l'Université Technique de Varsovie et à l'Institut des Problèmes Techniques de Base.

Dr. Julian LAMBOR, Directeur de l'Institut Hydrologique et Météorologique de Varsovie, Professeur à l'Université Technique de Varsovie.

Dr. Jozef LENKOWSKI, Professeur à l'Université Technique de Varsovie.

Dr. Bohdan RAJSKI, Professeur à l'Université Technique de Varsovie.

Dr. Czeslaw RAJSKI, Professeur à l'Université Technique de Varsovie.

Dr. Jerzy SEIDLER, Agrégé à l'Université Technique de Gdansk et à l'Institut des Problèmes Techniques de Base.

Dr. Marian SUSKI, Professeur à l'Université Technique de Wroclaw.

U. S. A. — Canada

JOINT MEETING OF U.R.S.I. UNITED STATES AND CANADIAN NATIONAL COMMITTEES AND THE INSTITUTE OF RADIO ENGINEERS

OTTAWA, 15-17 OCTOBER 1962

At the invitation of Dr. J. T. Henderson, Chairman of the Canadian National Committee, the President of U.R.S.I., Dr. R. L. Smith-Rose attended the Fall meeting organised by the Canadian and U. S. National Committees of U.R.S.I., in co-operation with the Ottawa section of the Institute of Radio Engineers. This three-day meeting was preceded on Sunday, 14th October, by separate meetings of the Canadian and U. S. National Committees which the President also attended. The general meetings were held in the Auditorium and adjacent rooms of the National Research Council of Canada, and they were attended by some 540 registered persons.

The opening session in the morning of Monday, 15th October began with an address of welcome by Dr. B. G. Ballard, acting President of the National Research Council. Prof. G. A. Woonton, Vice-President of U.R.S.I., then introduced Dr. Smith-Rose, who expressed his gratification at being able to attend this three-day meeting, and recounted some of the activities of U.R.S.I., including its publications (See Appendix I).

After a short recess, Dr. Smith-Rose presented his paper on « The Protection of Frequencies for Radio Astronomy » (1) and this was followed by a paper from Prof. R. A. Helliwell on « Artificially Stimulated VLF Electromagnetic Radiation from the Earth's Atmosphere ». Next, Dr. J. H. Chapman and his colleagues from the Canadian Defence Research Board described some of the preliminary results obtained with « Alouette, the Top-side Sounder Satellite », which is an ionospheric research equipment launched on September 29th, 1962.

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(1) This paper will be published in the Journal of Radio Propagation sponsored by the NBS and distributed as I.U.C.A.F. Document nº 39.

On Monday afternoon and the two succeeding days, the meeting was organised under the separate Commissions of U.R.S.I., and the authors and titles of the papers presented are given in Appendix II.

Of the several social events arranged both for the scientific participants and the ladies in attendance, two may be mentioned here. At an official luncheon held on Tuesday, October 16th, Dr. L. V. Berkner, immediate Past President of U.R.S.I., gave an excellent address on the aims and constitution of U.R.S.I., with a bref account of its history and future objectives as a participant in the field of scientific research in the space age. At a dinner arranged the same evening by the Institute of Radio Engineers, Mr. P. E. Haggerty, President, I.R.E., described the culmination of the work conducted over the past few years to amalgamate the I.R.E. with the American Institute of Electrical Engineers. The new body, which is to be known as the Institute of Electrical and Electronic Engineers (I.E.E.E.), will come into being on January 1st. 1963, with an estimated combined membership of more than 160,000.

In addition to attending some of the scientific sessions and the social occasions, Dr. Smith-Rose was able to visit the Research Laboratories of Northern Electric Co. Inc. and to participate in a motor trip on the Ottawa River on board the NRC Motor Vessel, RADEL II, which is equipped with various radar and echo-sounding devices.

APPENDIX I

The International Scientific Radio Union (U.R.S.I.)

by R. L. Smith-Rose, *President*

Mr. Chairman and Gentlemen,

I was very honoured to be invited to attend this three-day meeting; and indeed, I am very glad to have this opportunity to participate in this assembly of what, perhaps, I may call the North American section of U.R.S.I.

As many of you will know I was present at the XIIth General Assembly of U.R.S.I. in Boulder, Colorado, in 1957; and I have attended at least one, if not two, of the periodical meetings of the

U. S. section of U.R.S.I. in Washington. But although I have been to Canada on several occasions, on both national and international business, this is the first occasion on which I have had the privilege of participating in an U.R.S.I. meeting in your country.

But I have not neglected your country, Mr. Chairman. You may perhaps have known that I was here in Ottawa in May 1961, with four other members of a British Committee on Broadcasting appointed by Her Majesty's Postmaster General to make recommendations as to the future organization and development of sound and television broadcasting in the United Kingdom. We found our visit to Ottawa and Toronto and also to New York and Washington, most stimulating and instructive. Our report was published in London last June, and shortly afterwards the Government published, what we call a « White Paper » agreeing to many but not all of our recommendations. A further « White Paper » is expected shortly concerning other aspects of the future television services in our country.

The Growth of U.R.S.I.

But I did not come here to talk about broadcasting; let us return to scientific radio and the affairs of U.R.S.I.

The origin of U.R.S.I. goes back to 1913, when a small meeting was held in Brussels to discuss the formation of an international committee to organize and conduct scientific experiments in « wireless telegraphy » — as it was then called. It was later given its present name — the International Scientific Radio Union — as a member body of the International Council of Scientific Unions (I.C.S.U.), which is a special organization under the United Nations. The aims of U.R.S.I. are to foster international co-operation in radio research, and to promote the use of agreed methods of measurement and nomenclature. Its work covers a whole range of scientific subjects, including Measurements and Standards, Wave Propagation through the Troposphere and Ionosphere, Radio Noice of Terrestrial Origin, Radio Astronomy and the radio and allied aspects of Space Research. It co-operates with other related scientific bodies, and particularly with the International Astronomical Union (I. A. U.) and the International Committee on Space Research (C.O.S.P.A.R.), all members of the parent council, I.C.S.U.

U.R.S.I. has had two General Assemblies in the United States ; one in Washington in 1927 and the second, to which I have already referred, in Boulder in 1957. It has been my good fortune to participate in every General Assembly after that in Washington : they were in Brussels (1928), Copenhagen (1931), London (1934), Venise (1938), Paris (1946), Stockholm (1948), Zurich (1950), Sydney (1952), The Hague (1954), Boulder (1957) and London (1960) and the next, which will be the fourteenth, will be in Tokyo in September 1963.

You will see that U.R.S.I. has taken its participants round the world, with rather a high concentration in European towns. But may I draw your attention, Mr. Chairman, to the fact that on an international basis, U.R.S.I. has not yet visited Canada. Perhaps this is something we may look forward to in the future ! In the meantime, may I congratulate everybody concerned in the success attained recently by the provision of the Canadian scientific exploring satellite — S 27, known here as ALOUETTE — for the top-side sounding of the ionosphere.

As an indication of the rate at which U.R.S.I. has grown in popularity among radio scientists, I may mention that at the London meeting in 1934 there were fewer than 50 delegates ; 26 years later, at the 1960 meeting in London, there were over 600 in attendance.

But I do not want you to think that the success of a General Assembly is to be judged solely by the size of its attendance ; nor does it depend upon the discussion of the widest possible range of subjects within our field. The Board of Officers of the Union, in consultation with the Chairmen of its seven Commissions, now draw up a restricted programme of subjects which are topical and of current interest in each three year term. We endeavour to find acknowledged leaders or experts to present opening papers on these subjects, which are then freely discussed by the interested delegates. The opening and supporting papers are published by U.R.S.I., in addition to the Proceedings, which comprise the progress reports of the National Committees as well as an account of the meetings of each Commission.

Publications

I would like in conclusion to say a few words about the publications policy of U.R.S.I.

In the early days of the Union the publications were confined to the Proceedings of General Assemblies, in which were printed in full the scientific papers presented together with an account of the discussion at each session of the Commissions. These Proceedings were in theory sold to the National Committees; but as most of these forgot to pay the bill, it was decided to distribute them free of charge. The *U.R.S.I. Information Bulletin* was started on a small scale before the Second World War; and was later revived on an enlarged and more interesting basis. From 1950 to 1960, two issues, one in English and one in French were published : but since 1960, only a bilingual issue is published, and more than 1,300 copies are distributed free of charge.

Moreover, previous to 1960, five Special Reports on subject of particular interest to radio scientists, were printed and distributed free of charge to National Committees. In 1960, the scientific publications of U.R.S.I. were augmented by starting a series of Monographs published by a commercial firm. Those that have already been issued deal with Ionospheric Results obtained during the I.G.Y., Radio Observations on Aurora, The Characteristics of Terrestrial Radio Noise, Measurements and Standards and Tropospheric Propagation.

Here, I should like to pay a special tribute to the loyalty and enthusiasm of Col. E. Herbays, who has been the Secretary General of U.R.S.I. for some thirty years or more. He also serves as the business Editor of most of the above publications, the scientific content of which is provided and edited by a small number of enthusiastic scientists directly interested in U.R.S.I. affairs.

Conclusion

Altogether the International Scientific Radio Union is very active in co-ordinating research programmes in scientific radio throughout the world, and disseminating the results in a widely publicised form, and this work is considerably assisted by the holding, between the General Assemblies, of National meetings such as the present one.

I should like, Mr. Chairman, to thank you and your Canadian and United States Committees, together with the Professional Groups of the Institute of Radio Engineers, for the excellent organization of this meeting, which I trust will proceed during the next three days with the great success it deserves.

APPENDIX II

List of Authors and Titles of Papers presented at Commissions I to VII

TECHNICAL SESSIONS

Monday, October 15, 1962, *a. m.*

Combined Session : *Chairman* : John T. HENDERSON, Chairman of Canadian National Committee U.R.S.I.

Address of welcome by Dr. B. G. BALLARD, Vice-President, National Research Council, Ottawa.

Address by Dr. R. L. SMITH-ROSE, International President, U.R.S.I.

Address by Dr. G. A. WOONTON, International Vice-President, U.R.S.I.

1. The protection of frequencies for radio astronomy - R. L. SMITH-ROSE.
2. Artificially stimulated VLF electromagnetic radiation from the earth's atmosphere - R. A. HELLIWELL, Stanford Univ., Stanford, California.

Monday, October 1962, *p. m.*

Commission 1 : *Session* 1 - *Frequency and Related Measurements. Chairman* : J. S. BELROSE.

1. A survey of atomic frequency and time - John RICHARDSON, NBS, Boulder, Colorado.
2. Measurement standards for other than CW quantities - E. W. CHAPIN. Federal Communications Commission, Laurel, Md.

3. Phase and group delays in VLF propagation - D. D. Crombie, NBS, Boulder, Colorado.
4. A study of long-term stability in the ionosphere using the 18.0 kc/s signal from Panama to Boulder, Colorado - A. H. Brady and A. C. Murphy, NBS, Boulder, Colorado.
5. The estimation of antenna radiation patterns from limited near-field measurements - E. V. Jull, NRC, Ottawa, Ont.

Commission 2 : *Session* 1 - *Radio Refraction and Path Length. Chairman* : D. R. Hay.

1. Measurements over a 188-mile path at 2290 Mc/s using 1/10 micro-second pulse transmissions - J. F. Roche, P. J. Kintner, Sylvania Electric Products, Inc., Buffalo, N. Y., and J. H. Chisholm, L. P. Rainville, Lincoln Laboratory, MIT, Lexington, Mass.
2. Comparison of observed atmospheric radio refraction effects with values predicted through the use of surface weather observations - B. R. Bean, B. A. Cahoon and G. D. Thayer, NBS, Boulder, Colorado.
3. Radio horizon distribution variation on 108 Mc/s measured with satellite signals - P. R. Arendt and H. Soicher, U. S. Signal Research and Development Laboratory, Fort Monmouth, New Jersey.
4. Phase and amplitude measurements of an experimental tropospheric scatter circuit - C. M. Beamer, Collins Radio Company, Cedar Rapids, Iowa.
5. Long-distance UHF propagation measurements using an air-borne transmitting terminal - R. S. Kirby and A. P. Barsis, NBS, Boulder, Colorado.

Commissions 3 *and* 5 : *Session* 1 - *E-Region Ionozation, Meteors and Solar Flares - Chairman* : D. W. R. McKinley.

1. The Theoretical amplitude and duration of echoes from large meteors - L. A. Manning, Stanford Univ., Stanford, Calif.
2. Theoretical Fresnel patterns of radio meteors - R. B. Southworth, Harvard College Observatory, Cambridge, Mass.

3. The correlation of visual and radar meteor records - P. M. MILLMAN, NRC, Ottawa, Ontario.
4. The formation and limitation of turbulance at meteor heights - C. O. HINES, Defense Research Board, Ottawa, Ontario.
5. A study of solar flare produced VLF sudden phase anomalies utilizing multiple path observations at great ranges - C. J. CHILTON and F. K. STEELE, NBS, Boulder, Colorado.
6. Doppler studies of the ionospheric effects of solar flares - D. M. BAKER and K. DAVIES, NBS, Boulder, Colorado.

Commission 3 : *Session* 2 - *Commission* 4 : *Session* 1 - *Upper Ionosphere and Magnetosphere* - *Chairman* : P. A. FORSYTH.

1. The cross-section and the spectrum for scattering of electromagnetic waves from an ionized gas in thermal nonequilibrium in the presence of a magnetic field - J. RENAU, H. CAMNITZ, W. A. FLOOD, Cornell Aeronautical Laboratories, Inc., of Cornell University, Buffalo, New York.
2. Artificial heating of the electrons in the F region of the ionosphere - D. T. FARLEY, Jr., NBS, Boulder, Colorado.
3. An accretive model for the ionospheric F2 layer - S. A. BOWHILL, University of Illinois, Urbana, Illinois.
4. Magnetospheric radio whistler attenuation by electrons with an $E^{-2.5}$ distribution - H. B. LIEMOHN, Geo-Astrophysics Laboratory, Boeing Scientific Research Laboratories, Seattle, Washington, and F. L. SCARF, University of Washington, Seattle, Washington.
5. Changes in the shape of the geomagnetic field outer boundary for varying solar wind pressures - R. J. SLUTZ, NBS, Boulder, Colorado.
6. Magnetospheric sheath oscillations - W. C. HOFFMAN, Boeing Scientific Research Laboratories, Seattle, Washington.

Commission 6 : *Session* 1 - *Space Communications* - *Chairman* : S. DARLINGTON.

1. Results of the « Telstar » experiment - R. H. SHENNUM, Bell Telephone Laboratories, Murray Hill, New Jersey.

2. Experimental data on the reflection characteristics of the Echo I satellite - G. T. BERGEMANN, Collins Radio Company, Cedar Rapids, Iowa.
3. Experimental results in the deep space instrumentation facility program - E. RECHTIN, Jet Propulsion Laboratory, Pasadena, California.
4. Radio interferometer phase channel combiner - M. G. KAUFMAN, U. S. Naval Research Laboratory, Washington DC.
5. A study of overseas commercial satellite communications systems, 1965-1975 - J. S. GREENBERG, S. GUBIN and M. HANDELSMAN, RCA Research Labs., Princeton, New Jersey.

Commission 7 : *Session* 1 - *Radio Electronics* - *Chairman* : J. R. WHITEHEAD.

1. Theory of detection of reflex klystrons - Koryu ISHII, Marquette University, Milwaukee, Wisconsin.
2. Terminal properties of negative conductance amplifiers - A. C. MACPHERSON, U. S. Naval Res. Lab., Washington, DC.
3. Ring structures in ruby laser beams - B. P. STOICHEFF and A. SZABO, NRC, Ottawa, Ontario.
4. Microwave breakdown of air at high altitudes in an unbounded medium - W. SCHARFMAN, W. TAYLOR and T. MORITA, Stanford University, Stanford, California.
5. An inexpensive time-resolving interferometer system for optical masers - G. R. HANES, NRC, Ottawa, Ontario.

Tuesday, *October* 16, 1962, *a. m.*

Commission 2 : *Session* 2 - *Radio Reflections in the Troposphere* - *Chairman* : B. R. BEAN.

1. Radio meteorology - P. M. AUSTIN, MIT, Cambridge, Mass.
2. The specification of a weather radar system - K. L. S. GUNN, McGill University, Montreal, Quebec.
3. Statistics of radio-rainfall parameters - J. S. Marshall, Mc Gill University, Montreal, Quebec.

4. The environment of persistent and transitory angels - D. R. Hay, M. B. Belland, R. W. Johnston, University of Western Ontario, London, Ontario.
5. Measurements of the scattering coefficient of rain at X-band - L. H. Doherty, NRC, Ottawa, Ontario.
6. The radar polarization matrix of a small circular disc, with applications to the sea clutter problem - M. Katzin and J. C. Katzin, Electromagnetic Research Corp., College Park, Maryland.

Commission 3 : *Session* 3 - *The Polar Ionosphere* - *Chairman* : *C. G. Little.*

1. Ionospheric maps over Antarctica - R. Penndorf, AVCO Corp., Wilmington, Mass.
2. Electron content in the E region of the auroral ionosphere - J. L. Hook and L. Owren, University of Alaska, College, Alaska.
3. Auroral absorption in northern Canada - L. E. Montbriand, T. R. Hartz and E. L. Vogan, Defense Research Board, Ottawa, Ontario.
4. Ionosphere current patterns in high latitudes - D. H. Fairfield, Penn. State Univ., University Park, Pennsylvania.
5. Antarctic magnetic variations in longitude sector 60 E - 110 E - G. F. Rourke, AVCO Corp., Wilmington, Mass.
6. Mesospheric electron densities at Ottawa during the July 1961, PCA events - J. S. Belrose and L. W. Hewitt, Defense Research Board, Ottawa, Ontario, and E. Cetiner, Directorate of Signal Factory, Ankara, Turkey.

Commission 5 : *Session* 2 - *Radio Astronomy Techniques* - *Chairman* : G. A. Harrower.

1. Absolute flux measurements of discrete radio sources at 320 Mc/s - E. R. Seaquist, J. D. McNeill and W. H. Clarke, University of Toronto, Toronto, Ontario.
2. Interpretation of the lunar scattering diagram - W. H. Peake and R. H. Ott, Ohio State University, Columbus, Ohio.

3. Radar reflections from the sun at 38 Mc/s - W. G. ABEL, J. H. CHISHOLM and J. C. JAMES, Lincoln Laboratory, MIT, Lexington, Massachusetts.

Commission 6 : *Session* 2 - *Antennas* (1) - *Chairman* : G. SINCLAIR.

1. An unusually simple method for sidelobe reduction - D. K. CHENG and B. J. STRAIT, Syracuse, New York.
2. Ultra-low sidelobes from time modulated arrays - T. S. FONG, W. H. KUMMER, F. G. TERRIO and A. T. VILLENEUVE, Hughes Aircraft Company, Culver City, California.
3. Optimum antenna array synthesis in terms of azimuthal angle - W. P. HARTHILL and H. M. SWARM, University of Washington, Seattle, Washington.
4. The exponentially spaced antenna array - Y. L. CHOW, Univ. of Toronto, Toronto, Ontario.
5. Radiation patterns of long notch antennas - S. W. BIGGS, Boeing Aircraft Company, Seattle, Washington and H. M. SWARM, University of Washington, Seattle, Washington.
6. A progressive phase-shifter for steering antenna arrays - G. AITKEN, Queen's University, Kingston, Ontario.
7. Radiation impedance of a dipole in an infinite array - L. STARK, Hughes Aircraft Company, Fullerton, California.

Commission 6 : *Session* 3 - *Frequency-Independent Antennas* - *Chairman* : V. H. RUMSEY.

1. Foreshortened log-periodic dipole array - C. T. ELFVING, Sylvania Electronic Systems, Mountain View, California.
2. The backfire bifilar helical antenna - W. T. PATTON, Univ. of Illinois, Urbana, Illinois.
3. Near-field measurements in backfire periodic dipole arrays - P. E. MAYES and P. G. INGERSON, Univ. of Ill., Urbana, Ill.
4. Automatic measurements of the phase center of frequency-independent antennas - J. D. DYSON and R. E. GRISWOLD, University of Illinois, Urbana, Illinois.
5. On source-excited spirals - A. ISHIMARU, University of Washington, Seattle, Washington.

6. A survey of continuously and log periodic transmission lines with application to antenna problems - K. E. JONES, Hughes Aircraft Co., Fullerton, California and R. MITRA, University of Illinois, Urbana, Illinois.
7. Waves supported by two parallel sinusoidally anisotropic planes - M. J. GANS, University of Calif., Berkeley, Calif.
8. *Panel Discussion* - Current problems in frequency-independent antennas.

Tuesday, October 16, *p. m.*

Commission 6 : *Session* 4 - *Scattering and Diffraction* - *Chairman* : K. M. SIEGEL.

1. The effect of a discontinuity in curvature in high-frequency scattering - V. H. WESTON, Conductron Corp., Ann Arbor, Michigan.
2. A new method for constructing asymptotic solutions to plane diffraction problems - R. B. KIEBURTZ, New York Univ., N Y.
3. Diffraction theory of aberrations : a new diffraction integral - Y. F. LUM and T. J. F. PAVLASEK, McGill Univ., Montreal, Quebec.
4. Near-zone diffracted field measurements - J. H. ZICKGRAF and D. R. BERNOTSKI, Boeing Aircraft Co., Seattle, Wash.
5. The excitation of surface waves on an unidirectionally conducing screen by a phased line source - S. N. KARP and F. C. KARAL, New York University, New York.

Commission 3 : *Session* 4 - *Commission* 4 : *Session* 2 - *VLF and Whistler Propagation* - *Chairman* : M. G. MORGAN.

1. Measured amplitude and phase of the antipodal fields of a VLF transmitter - W. E. GARNER and F. J. RHOADS, U. S. Naval Research Lab., Washington, D. C., J. E. BICKEL, Navy Electronic Lab., San Diego, California and R. W. PLUSH, DECO Electronics, Inc., Boulder, Colorado.
2. On the electric field of a VLF transmitter near its antipodes - D. D. CROMBIE, NBS, Boulder, Colorado.

3. Some characteristics of extremely low-frequency noise - C. Polk, J. Creedon and F. Huck, University of Rhode Island, Kingston, Rhode Island.
4. Triggering and tagging natural lightning atmospherics in VLF, ELF and « whistler » mode propagation researches - M. M. Newman, Lightning and Transients Research Institute, Minneapolis, Minnesota.
5. VLF and geomagnetic observations at State College during the July 9, 1962 high-altitude nuclear test - C. F. Sechrist Jr., HRB-Singer, Inc., State College, Pennsylvania.
6. Whistlers excited by nuclear explosions - R. A. Helliwell and D. L. Carpenter, Stanford Univ., Stanford, Calif.

Commission 5 : *Session* 3 - *Solar Emission* - *Chairman* : T. H. Legg.

1. Flare-associated active dark filaments and their relation to 2800 Mc/s bursts - Marion W. Haurwitz, NBS, Boulder, Colorado.
2. Some relationships between 10.7 centimetre solar noise bursts, flares and short-wave fadeouts - Gladys A. Harvey, NRC, Ottawa, Ontario.
3. Solar emission and atmospheric transmission at 70 and 94 kMc/s - C. W. Tolbert and A. W. Straiton, University of Texas, Austin, Texas.

Commission 6 : *Session* 5 - *Sources in Plasma Media* - *Chairman* : M. P. Bachynski.

1. Impedance of a thin, center-driven cylindrical dipole in a homogeneous magnetosphere - W. A. Ament, J. C. Katzin and M. Katzin, Electromagnetic Research Corporation, College Park, Maryland.
2. Field of a horizontal magnetic dipole in the presence of a magneto-plasma halfspace - G. Tyras, University of Arizona, Tucson, Arizona, and A. Ishimaru and H. M. Swarm, University of Washington, Seattle, Washington.
3. The radiation pattern of an antenna array immersed in a dissipative medium - C. T. Tai and S. N. C. Chen, Ohio State University, Columbus, Ohio.

4. Fields of a curved plasma layer excited by a slot - G. HASSERJIAN and T. P. HIGGINS, Boeing Scientific Research Laboratories, Seattle, Washington.
5. Excitation of plasma waves in an unbounded homogeneous plasma by a line source - S. R. SESHADRI, Harvard Univ. Cambridge, Massachusetts.
6. An open resonator method for electron density measurements in low pressure plasmas - N. A. McDONALD, H. TREIAL and J. L. YEN, University of Toronto, Toronto, Ontario.

Wednesday, October 17, 1962, *a. m.*

Commission 6 : *Session* 6 - *Communications Theory* - *Chairman* : J. ALMOND.

1. Optimizing information capacities in communication systems with switching - I. T. FRISCH, University of Calif., Berkeley, California.
2. Timing jitter in digital communication - B. K. KINARIWALA, Bell Telephone Laboratories, Murray Hill, New Jersey.
3. Subdivided quadrature detection - G. LEIBERMAN, Radio Corporation of America, Camden, New Jersey.
4. Differentially coherent phase detection in atmospheric noise - B. BARKER, Boeing Company, Seattle, Washington.
5. A new approach to reliable data transmission error location codes - J. K. WOLF, Rome Air Development Center, Griffiss AFB, New York.
6. Improvement of communication reliability by use of majority decision elements - L. S. SCHWARTZ, New York Univ., N. Y.
7. Detection and estimation problems for noise-like signals - P. SWERLING, Conductron Corporation, Ann Arbor, Michigan.

Commission 1 : *Session* 2 - *Measurements and Standards* - *Chairman* : N. L. KUSTERS.

1. Capacitance : the unit and its derivatives - A. F. DUNN, National Research Council, Ottawa, Ontario.

2. New type of computable inductor - C. Page, NBS, Wash., D. C.
3. A new method of measuring *r-f* cable performance - C. R. Wischmeyer, Rice University, Houston, Texas.
4. A photo-conducting probe for measuring electromagnetic fields - K. Iizuka, Harvard University, Cambridge, Mass.
5. Probe-reflector interaction in the measurement of electric field distribution - H. P. Hsu, Assumption University, Windsor, Ontario.
6. The *d-c*, *r-f* substitution error in certain bolometers - G. F. Engen, NBS, Boulder, Colorado.

Commission 2 : *Session* 3 - *Modes of Radio Propagation* - *Chairman*: J. S. Marshall.

1. On the statistical theory of electromagnetic field in fluctuating medium - K. Furutsu, NBS, Boulder, Colorado.
2. Ponomarenko's mode system for twilight propagation - T. J. Carroll, Bendix Corporation, Baltimore, Maryland.
3. An approach to solution of equation of wave propagation through troposphere by means of integral operators - M. Z. v. Krzywoblock, Michigan State Univ., Ann Arbor, Michigan.
4. The computation of a field amplitude by means of ray tracing techniques - I. Kay, Conductron Corp., Ann Arbor, Mich.
5. Terrain effect on radio propagation - K. W. Hollander, U. S. Naval Engineering Experiment Station, Annapolis, Maryland.
6. Non-reciprocal properties of the tellurics medium - S. W. Lichtman and R. O. Parker, Hughes Aircraft Company, Los Angeles, California.
7. Ground conductivities deduced from ground wave field strength curves - L. H. Doherty, NRC, Ottawa, Canada.

Commission 3 : *Session* 5 - *The Electron Content of the Ionosphere* - *Chairman* : J. H. Meek.

1. The rate of polarization rotation of satellite radio signals - Byron C. Potts, Ohio State University, Columbus, Ohio.

2. A comparison of methods used in the reduction of satellite data relating to the ionosphere - Fernando de MENDONCA and Owen K. GARRIOTT, Stanford Univ., Stanford, California.
3. Rocket measurements obtained on a multiple ionospheric experiment - J. C. ULWICK, W. PFISTER and R. P. VANCOUR, AFCRL, Laurence G. Hanscom Field, Bedford, Mass.
4. Diffusing electromagnetic radiation - G. L. NELMS and E. S. WARREN, Defense Research Board, Ottawa, Ontario.
5. The recombination coefficient of the nighttime F-layer - J. S. NISBET and T. P. QUINN, Pennsylvania State Univ., University Park, Pennsylvania.

Commission 6 : *Session* 7 - *Antennas* (2) - *Chairman* : J. R. WAIT.

1. The current distribution and impedance of an antenna in a parallel-plate region : theoretical and experimental studies - B. R. RAO, Harvard University, Cambridge, Massachusetts.
2. Reflections from linear antennas terminating a coaxial line when excited by a pulse - T. T. WU and R. W. P. KING, Harvard University, Cambridge, Massachusetts.
3. Efficiency of a horizontal antenna as a ground wave radiator - I. H. GERKS, Collins Radio Company, Cedar Rapids, Iowa.
4. Efficiency of excitation of dielectric coated transmission lines - L. W. ZELBY, Univ. of Penn., Philadelphia, Penna.
5. Surface-wave - leaky wave conversion at geometric discontinuities - J. KANE, Rhode Island Univ., Kingston, R. I.
6. New concepts of isolation in microwave junctions - R. S. POTTER, U. S. Naval Research Laboratory, Washington, D. C.

Commission 6 : *Session* 8 - *Information Theory* - *Chairman* : L. A. ZADEH.

1. Transmitted-reference techniques for random or unknown channels - C. K. RUSHFORTH, Utah State Univ., Logan, Utah.
2. Generalized-likelihood reception of binary-coded characters - B. B. BARROW, Sylvania Electric Prod., Waltham, Mass.
3. Properties of linear graphs based on trees - S. D. BEDROSIAN, University of Pennsylvania, Philadelphia, Pennsylvania.

4. Integral transforms and linear differential systems - L. WEISS, Johns Hopkins University, Silver Springs, Maryland.
5. A simple method for the predistortion of filter transfer functions - J. D. MACDONALD and G. C. TEMES, Northern Electric Research Laboratories, Ottawa, Ontario.
6. Proposed measurement scheme for the Youla-Weissfloch equivalent circuit for a lossless four-port - D. J. R. STOCK and L. J. KAPLAN, New York University, New York.

Commission 3 : *Session* 6 - *Ionospheric Propagation and Ionospheric Irregularities* - *Chairman* : S. A. BOWHILL.

1. HF non-reciprocity and polarization fading - G. W. JULL and G. W. E. PETTERSEN, Defense Research Board, Ottawa, Ontario.
2. Propagation mode and arrival time analysis of 10 and 20 Mc/s WWV signals at Seattle - D. H. SCHRADER, University of Washington, Seattle, Washington, H. M. SWARM and A. J. IVERSON, Boeing Company, Seattle, Washington.
3. The July 9, 1962 high altitude nuclear explosion as observed by HF at the NBS-CRPL North Pacific Radio Warning Service, Anchorage, Alaska - J. Virginia LINCOLN and Dale B. BUCKNAM, NBS, Boulder, Colorado.
4. Ionospheric VHF scattering near the magnetic equator during the International Geophysical Year - Robert COHEN and K. L. BOWLES, NBS, Boulder, Colorado.
5. The association of plane-wave electron density irregularities with the equatorial electrojet - Robert COHEN and K. L. BOWLES, NBS, Boulder, Colorado.
6. Vertical transport of ionized gas due to gravity waves in the ionosphere - W. I. AXFORD, Defense Research Board, Ottawa, Ontario.

Commission 6 : *Session* 9 - *Synthetic Aperture Antennas* - *Chairman* : *R. C. Hansen.*

1. Some early developments in synthetic aperture radar systems - C. W. SHERWIN, Aerospace Corp., El Segundo, Cal.

2. A comparison of the azimuth resolution capability of physical and synthetic antennas - L. J. Cutrona, Conductron Corporation, Ann Arbor, Michigan and G. O. Hall, Univ. of Michigan, Ann Arbor, Michigan.
3. Gain patterns of synthetic arrays - R. C. Heimiller, Hughes Aircraft Company, Culver City, California.
4. Three approaches to deriving synthetic antennas patterns - H. L. McCord, Hughes Aircraft Co., Culver City, Calif.
5. Effects of phase errors on synthetic array performance - C. A. Green, Hughes Aircraft Co., Culver City, Calif.
6. Aperture synthesis problems in radio astronomy - B. G. Clark, Owens Valley Radio Observatory, California Institute of Technology, Owens Valley, California.

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Commission III. — Radioélectricité Ionosphérique

PREVISIONS IONOSPHERIQUES

L'Ionospheric Prediction Service du Gouvernement Australian a publié une nouvelle édition du « Handbook for use with Ionospheric Predictions Series ».

Les lecteurs qui seraient désireux d'obtenir un exemplaire de cet ouvrage peuvent s'adresser au Secrétariat Général de l'U.R.S.I. ou à l'adresse ci-après : Ionospheric Prediction Service, Department of the Interior, 5, Hickson Road, Millers Point, N. S. W., Australia.

Commission III on Ionospheric Radio

IONOSPHERIC PREDICTIONS

The Ionospheric Prediction Service, Australian Government, has published a new issue of the Handbook for use with Ionospheric Predictions Series ».

Readers wishing to obtain a copy of this work may apply to U.R.S.I. General Secretariat or to the following address : Ionospheric Prediction Service, Department of the Interior, 5, Hickson Road, Millers Point, N. S. W., Australia.

Commission V on Radio Astronomy

DETAILS OF RADIO ASTRONOMY OBSERVATORIES IN THE U. S. A.

We call the attention of the members of Commission V to Document I.U.C.A.F./37 « Details of Radio Astronomy Observatories in the United States of America » published on page 43 of this Bulletin.

Comité pour les Recherches Radioélectriques dans l'Espace (SRR)

DOCUMENTATION

English text page 32

L'attention des membres du Comité est attirée sur les articles mentionnés ci-après qui ont été publiés dans le *Journal des Télécommunications*, Vol. 29, nº 9 (sept. 1962) :

— Réflexions sur un système mondial de communications par satellites, par D. W. Smythe.

— Prévision du volume des rapports de communication entre les collectivités, par A. Chemarin.

et dans le *Journal des Télécommunications*, Vol. 29, nº 10 (octobre 1962) :

— Les télécommunications spatiales. Nécessité et portée de l'action à entreprendre, par G. C. GROSS.
— Le satellite Telstar et son histoire, de l'American Telephone and Telegraph Company.
— Les problèmes des télécommunications spatiales, par M. JOACHIM et Y. Y. MAO.

Space Radio Research Committee

BIBLIOGRAPHY

Attention of the members of the Committee should be called to the following papers published in the *Telecommunication Journal*, Vol. 29, nº 9 (Sept. 1962) :

— Considerations on a world-wide communications satellite system, by D. W. SMYTHE.
— Prediction of the volume of communications between communities, by A. CHEMARIN.

and in the *Telecommunication Journal*, Vol. 29, nº 10, October 1962 :

— Space Communications. The need and scope for action, by G. C. GROSS.
— The Telstar story from the American Telephone and Telegraph Company.
— Ways to space communications, by M. JOACHIM and Y. Y. MAO.

A NEW PUBLICATION

Space Science Reviews,

Editor : C. DE JAGER.

Publisher : D. REIDEL, Publishing Co., Dordrecht, Holland.

Contents of Vol. I, n° 1 :

I. U. C. A. F.

Doc. I.U.C.A.F.-35

Protection of the Deuterium Line Frequency for Radio Astronomy

(Texte français page 38)

by R. L. Smith-Rose

Secretary General of the Inter-Union Committee for Frequency Allocations for Radio Astronomy and Space Science

September, 1962.

Note : This report was prepared at the request of the UK representatives in the European Radio Frequency Agency (E.R.F.A.) of N.A.T.O. It is being distributed for information to the members of the Inter-Union Committee.

The science of Radio Astronomy dates back to 1932 when Karl Jansky announced the discovery of radio waves from cosmic sources. It may be regarded as a logical development of the centuries-old science of optical astronomy, which has relied on the use of electromagnetic waves in the ultra-violet, visible and infrared regions of the spectrum.

In the Radio Regulations, Geneva, 1959, Radio Astronomy is defined (Art. 1, paragraph 74) as « Astronomy based on the reception of radio waves of cosmic origin ». From this it is clear that the radio astronomer conducts his research on a basis which causes no interference whatever to other users of the radio frequency spectrum. But in order to be successful in his search for the weaker radiations from various parts of the Universe, he seeks the co-operation of these users in securing protection from interference in certain bands of frequencies. In many cases, the precise frequencies to be used can be adjusted to suit the mutual convenience of the radio astronomers and other users. There are, however, some frequencies which are determined by the source of radiation in the Universe, such as the natural emissions from deuterium, hydrogen, oxygen and other gases. It is an important requirement in the study of the space around the planet, Earth, that the scientist should be afforded the utmost practicable facilities to study these radiations.

In the course of his work, the radio astronomer makes an effective contribution to applied science in two important respects. First, in his endeavour to detect and study the extremely weak radiations from natural phenomena, he has developed receiving equipment of the utmost sensitivity and highly directive antenna systems for use therewith. Secondly, the results of his work are rapidly increasing our knowledge of the physical conditions in space, and this will be to the ultimate benefit of space exploration and communications.

The Hydrogen Line at 1400-1427 *Mc/s.*

For more than half a century, astronomers have been interested in the radiation from interstellar space, and particularly in the emission and absorption properties of the gases which, with a luminous belt of stars, forms the Galaxy or Milky Way, the average visual brightness of which is about twice that of the remaining portion of the sky. Jansky's pioneer observation and the discovery of galactic radio waves were confirmed during the second World War ; and this formed the beginning of radio astronomy as we know it today.

In 1945, van de Hulst suggested the possibility that hydrogen gas in the galactic clouds might be a source of radio frequency waves ; and this was endorsed in 1949 by Shklovski, who concluded that the radiation would be of sufficiently high intensity to be detected. Two years later, in 1951, Ewell and Purcell of Harvard announced their successful detection of this radiation from the Galaxy, and this was immediately confirmed by the independent observations of Muller and Oort in Leiden, and of Pawsey in Australia.

In the ensuing decade, a great deal of research has been conducted by radio astronomers on the hydrogen band radiation received from various parts of the Universe, and this is undoubtedly making a considerable and worthwhile contribution to our knowledge of the space around us. The need for this work to be protected from interference was recognised at the Geneva, 1959, meeting of the International Telecommunication Union, which assigned the band of frequencies 1400-1427 Mc/s (wavelength 21 cm) on a primary basis for the exclusive use of the radio astronomy service.

The Deuterium Line at 322-329 *Mc/s.*

Following the research leading to the discovery of hydrogen line radiation, the radio astronomers have predicted the existence of radiation from Deuterium gas (an isotope of hydrogen of twice its atomic weight) in a band of frequencies 322-329 Mc/s. It is to be expected from the much lower concentration or « abundance » of this gas, that the radiation from it will be more difficult to detect and identify; but it is natural that the radio astronomer should expect to be provided with adequate opportunities to do so. Shklovsky in 1952 suggested that radiation from Deuterium at a frequency of 327 Mc/s (wavelength 91.6 cm) should be detectable even though it was to be expected that the concentration of interstellar deuterium is only about one-thousandth that of hydrogen. Experiments made in 1954 in Australia by Stanley and Price (described in 1959), appeared to confirm that the concentration was less than this value.

Early in 1957, the position was reviewed by Adgie and Hey, who referred to the measurements made during 1954-55 by Getmenzev, Stankevitch and Troitsky, indicating a deuterium concentration relative to hydrogen of about one part in 300, an abundance ratio some twenty times greater than the terrestrial value. But new experiments conducted by Adgie and Hey, with equipment estimated to have greater sensitivity than that used by Stanley and Price, led them to conclude that the abundance of deuterium does not exceed 1/2000 that of hydrogen. Two further attempts were made in 1959 by Adgie, using the 250 ft. radio telescope at Jodrell Bank, to detect the 327 Mc/s radio frequency line of galactic deuterium; but even when the bandwidth of the receiver was reduced to 6 kc/s, the experiments gave a negative result.

Further critical experiments will become possible when new radio telescopes of greater sensitivity have been built; and when the deuterium line can then be sought as an absorption line in the continuum radiation from a distant discrete source. It is of great fundamental importance that such experiments should be carried out.

Proposal for Future Investigations.

In the Radio Regulations, Geneva, 1959, there are primary allocations in the band 235-328.6 Mc/s to Fixed and Mobile Services, while the band 328.6-335.4 Mc/s is allocated to the Aeronautical Radionavigation Service, also on a primary basis. A footnote (No. 310) to these allocations reads :

> « Radio Astronomy observations on the Deuterium line (322-329 Mc/s) are carried out in a number of countries under national arrangements. Administrations should bear in mind the needs of the radio astronomy services in their future planning of this band ».

But, owing to the inherent weakness of the radiation from Deuterium, its scientific study is dependent first upon the use of the most advanced antennae and receiving equipment, and secondly on the protection, to the greatest possible extent, from interference by other radio services operating in or near the band 322-329 Mc/s. In order to justify the great expense involved in developing his equipment and techniques, the radio astronomer is justifiably seeking the co-operation of these other users in his investigations.

If it is not practicable within the European area, for example, to clear this band of all other transmissions, then opportunity should be afforded the radio astronomer to participate in a time-sharing scheme. It is suggested as a basis for discussion that a period of from 5-8 hours a day, with a probable preference for the night hours, might be kept clear of all transmissions, so that the radio astronomer can be assured of no interference from man-made sending stations. If some such arrangement could be made for a period of at least six, and preferably twelve months, the radio astronomer would welcome it as an opportunity to make a concentrated scientific attack on the problem of Deuterium emission. The results will undoubtedly be of great practical importance in the future of space communications and their use in the exploration of our universe.

Note : It is, of course, understood that should an international emergency occur, any arrangement suah as that proposed above could be suspended ; but it is hoped that the need for this would not arise.

Doc. I.U.C.A.F.-35

La protection de la fréquence de la raie du deutérium pour la radio astronomie

par R. L. Smith-Rose

Secrétaire Général du Comité Inter-Unions pour l'Attribution de Fréquences pour la Radioastronomie et la Science spatiale

Septembre, 1962.

Note : Ce rapport a été préparé à la demande des représentants du Royaume Uni à l'Agence Européenne des Fréquences Radioélectriques (E.R.F.A.) de l'O.T.A.N. Il a été distribué pour information aux membres du Comité Inter-Unions.

La science de la Radio-Astronomie date déjà de 1932, lorsque Karl Jansky annonça la découverte des ondes radioélectriques provenant de sources cosmiques. Ceci peut être envisagé comme un développement naturel d'une science vieille de plusieurs siècles, l'astronomie optique qui ne comptait que sur l'emploi des ondes électromagnétiques dans les gammes du spectre ultra-violet, visible et infra-rouge.

Dans les Réglements des Radiocommunications Genève 1959, la Radio-Astronomie est définie (Article 1, paragraphe 84) comme « l'Astronomie basée sur la réception des ondes radioélectriques d'origine cosmique ». De ce qui précède, il est évident que le radio-astronome conduit ses recherches de manière à ne causer aucune interférence aux autres usagers du spectre de fréquences radioélectriques. Cependant, pour réussir dans sa recherche de très faibles radiations provenant de différentes régions de l'Univers, il doit chercher la co-opération de ces usagers pour s'assurer une protection contre l'interférence dans certaines gammes de fréquences. Dans beaucoup de cas, la fréquence exacte à employer peut être choisie de manière à convenir en même temps aux radio-astronomes et aux autres usagers. Il y a cependant des fréquences qui sont déterminées par les sources de radiation dans l'Univers, tel que les émissions naturelles du deuterium, de l'hydrogène, de l'oxygène et d'autres gaz. Une importante condition dans l'étude de l'espace autour de notre planète, la Terre, est que le savant puisse jouir de toutes les facilités pratiques pour étudier ces radiations.

Pendant son travail, le radio-astronome contribue effectivement aux sciences appliquées de deux manières principales. Premièrement par son effort dans la découverte et l'étude des radiations extrêmement faibles provenant des phénomènes naturels, il a développé des appareils de réception de la plus grande sensibilité et, pour leur usage, des systèmes d'antennes à haute directivité. Secondement, les résultats de son travail augmenteront rapidement nos connaissances sur les conditions physiques dans l'espace, et ceci contribuera grandement à l'exploration de l'espace et au développement des communications.

La Raie de l'Hydrogène de 1400-1427 *MHz.*

Depuis plus d'un demi-siècle les astronomes se sont intéressés aux radiations de l'espace interstellaire et surtout aux propriétés d'émission et d'absorption des gaz, qui, avec une ceinture lumineuse d'étoiles, forment la Galaxie ou la Voie Lactée, dont la clarté visuelle est environ deux fois celle du reste du ciel. Les premières observations de Jansky et la découverte des ondes radioélectriques de la Galaxie ont été confirmées pendant la Seconde Guerre Mondiale ; ce qui a formé le début de la radio-astronomie telle que nous la connaissons aujourd'hui.

En 1945, van de Hulst suggéra la possibilité que le gaz hydrogène dans un nuage galactique pourrait être la source d'ondes à fréquence radioélectrique ; et cette idée a été adoptée en 1949 par Shklovski qui tira la conclusion que les radiations seraient d'intensité suffisante pour être détectées. Deux ans plus tard, en 1951, Ewell et Purcell de Harvard ont annoncé leur succès dans la détection de cette radiation galactique, et ceci a été immédiatement confirmé par les observations indépendantes de Muller et Oort à Leiden, et de Pawsey en Australie.

Pendant la décade suivante, un grand nombre de recherches ont été faites par les radio-astronomes sur les radiations dans la bande de l'hydrogène reçues de différentes régions de l'Univers, et ceci représente certainement une très importante et très utile contribution à notre connaissance de l'espace qui nous environne. La nécessité de protéger ce travail de l'interférence fut reconnue à Genève, en 1959, lors de la Conférence de l'Union Internationale des Télécommunications, qui assigna la bande des fréquences 1400-1427 MHz (longueur d'onde 21 cm) en premier plan pour 'emploi exclusif du service de radio-astronomie.

La Raie du Deuterium sur 322-329 *MHz.*

Suivant les recherches conduisant à la découverte de la radiation de la raie d'hydrogène les radio-astronomes ont prédit l'existence de radiation du gaz deuterium (un isotope d'hydrogène de poids atomique double) dans une bande de fréquences de 322-329 MHz. Il faut s'attendre de la très basse concentration ou de « l'abondance » de ce gaz, qu'il sera plus difficile d'en détecter et d'en identifier les radiations ; mais il est naturel que le radio-astronome doive espérer des occasions favorables pour le faire. Shklovsky en 1952 suggéra que la radiation du deuterium à une fréquence de 327 MHz (longueur d'onde 91.6 cm) pouvait être détectée même si l'on supposait que la concentration du deuterium interstellaire était seulement environ un millième de celle de l'hydrogène. Des expériences faites en 1954 en Australie par Stanley et Price (décrites en 1959), semblaient confirmer une moindre valeur pour cette concentration.

Au début de 1957, la situation fut réexaminée par Adgie et Hey, qui se référaient aux mesures faites pendant 1954-55 par Getmenzev, Stankevitch et Troitsky, qui indiquaient une concentration du deuterium relative à l'hydrogène d'à peu près une part en 300, et d'un rapport d'abondance d'une vingtaine de fois plus grand que la valeur terrestre. Mais de nouvelles expériences conduites par Adgie et Hey, avec un équipement considéré de sensibilité supérieure à celui employé par Stanley et Price, les faisaient arriver à la conclusion que l'abondance du deuterium ne dépasse pas 1/2000 celle de l'hydrogène. Deux nouveaux essais furent faits en 1959 par Adgie, en employant le radio-télescope de 250 pieds (76 mètres) de Jodrell Bank, pour enregistrer la raie d'émission radioélectrique du deuterium galactique sur 327 MHz ; mais même lorsque la bande de fréquence du récepteur fut réduite à 6 kH/z, l'expérience donna un résultat négatif.

D'autres expériences critiques deviendront possibles lorsqu'on construira de nouveaux radio-télescopes de plus grande sensitivité et lorsque la raie du deuterium pourra être cherchée comme une raie d'absorption dans la radiation du continu d'une source discrète éloignée. Il est d'une grande importance fondamentale que ces expériences soient accomplies dans le futur.

Propositions pour des Investigations Futures.

Dans le Règlement des Radio Communications, Genève, 1959, il y a des allocations primaires dans la bande de 235-328.6 MHz pour les Services Fixes et Mobiles, tandis que la bande 328.6-335.4 MHz est assignée au Service de la Radionavigation Aeronautique également sur une base primaire. Une note (No. 310) concernant ces allocations dit :

> « Les observations de la Radio-Astronomie sur la raie du deuterium (322-329 MHz) sont faites dans un certain nombre de pays sous des arrangements nationaux. L'administration doit se rappeler les besoins des services de la radio-astronomie dans le développement futur de cette bande ».

Mais, à cause d'une faiblesse inhérente du deuterium, son étude scientifique dépend d'abord de l'emploi des antennes et des appareils de réception les plus modernes, et ensuite de la protection, aussi grande que possible, des interférences d'autres services radioélectriques opérant dans ou près de la bande 322-329 MHz. Afin de justifier la grande dépense nécessitée en développant son équipement et ses méthodes, le radio-astronome est justifié à chercher dans son investigation la co-opération d'autres usagers.

Si dans la zone européenne, par exemple, il n'est pas pratique d'éliminer de cette bande toutes autres transmissions, alors il faudra consentir au radio-astronome des facilités pour particper sur une base de division du temps. Il a été suggéré comme base de discussion qu'une période de 5 à 8 heures par jour avec probablement la préférence pendant les heures nocturnes pourrait être tenue libre de toutes transmissions, afin que le radio-astronome puisse être assuré de ne souffrir aucune interférence de l'homme provenant des stations émettrices. Si un tel arrangement pouvait être établi pour une période d'au moins six et préférablement douze mois, le radio-astronome accueillerait favorablement cette occasion de faire une attaque scientifique concentrée sur le problème de l'émission du deuterium. Les résultats seront sans doute de grande importance pratique dans l'avenir des communications de l'espace et de leur emploi dans l'exploration de l'univers.

Note : Il est bien entendu que dans le cas d'une crise internationale tout arrangement comme celui suggéré ci-dessus pourrait être interrompu ; mais il faut espérer que cette nécessité ne se présente pas.

Doc. I.U.C.A.F.-35

Draft Reports from U. S. A. to C.C.I.R. Study Group IV

This document will be distributed by the C.C.I.R.

Doc. I.U.C.A.F.-36

Details of Radio Astronomy Observatories in the United States of America

Site of radio telescope	Observatory	Sponsor	Longitude	Latitude	Altitude	Aerials type siz steering
Arecibo Puerto Rico	Arecibo Ionospheric Observatory	Cornell University	66°45'.2 W	18°20'47'' N	400 m	Fixed sphe reflector 3(with steer correcting
Derwood Maryland	Department of Terrestrial Magnetism	Carnegie Inst. of Washington	77°09'.1 W	39°07'15'' N		Paraboloid m equat steerable
Danville Illinois		University of Illinois	87°33'49'' W	40°03'38'' N		Parabolic tenna 122 183 m transit
Fort Davis Texas	Radio astronomy station of Harvard College Observatory	Harvard University (with USAF and NSF)	103°56'.7 W	30°38'09'' N	1605 m	26 m - dian steerable boloid 8.55 diameter rable parab
Goldstone, California	Jet Propulsion Laboratory	California Institute of Technology				Paraboloid m steerable azimuth equat.)
Greenbank, W. Virginia	National Radio Astronomy Observatory	Associated Universities Inc.	79°50'.2 W	38°26'17'' N	823 m	Paraboloid M equat mount

eam Scan	Type of observations	Operating frequencies	Type of receivers	ΔT in 1962	Remarks	Alternative frequency band to be used if necessary protection given	ΔT expected 1967
azimuth 0° zenith tance	Ionospheric studies, radar astronomy, radiation measurements of galactic sources	Up to 1420 Mc/s	Various	Not operating	Correcting feed as well as receiver must be changed for each frequency band		
. ± 6h :. +20±5h :.—50° to 0°	Galactic and extra - galactic sources	Up to 10 Gc/s	Multichannel hydrogen line spectrometer, various broad band radiometers	0.2° at 1420 Mc/s		Widebase interferometer observations planned for 1962-63 utilizing the bands 404-406 Mc/s and 608-614 Mc/s. ΔTe will be approximately 0.1°	
0° zenith ance	Galactic and extra - galactic sources	611 Mc/s					
± 6.5h . —50° to)° positions	Planetary, galactic and extra - galactic sources; the sun	950 Mc/s 5000 Mc/s Also sweeping frequency equipment 25-580 Mc/s, 2100 - 3900 Mc/s	Parametric (5000 Mc/s) sweep frequency, others	.02° for parametric			
positions	Planetary and deep space probes	2388 Mc/s	Maser	Over-all system temperature about 40° K			System 25° K
± 6h —52° to ¹⁰	Planetary galactic and extra - galactic sources	400 Mc/s 8000 Mc/s	TWT, parametric and crystal mixers maser being built	0.1° K at 400 Mc/s to 0.02° K at 3000 and 8000 Mc/s	TWT receivers at 3000 Mc/s (BW = 200 Mc/s) and 8000 Mc/s (BW = 1000 Mc/s)	10.68 - 10.70 Gc/s, 4990 - 5000 Mc/s, 1400 - 1427 Mc/s	.001° K

Site of radio telescope	Observatory	Sponsor	Longitude	Latitude	Altitude	Aerials : type size, steering
Greenbank, W. Virginia (continued)						Paraboloid 4 m equato mount unc construction
						Paraboloid m merid transit
						Paraboloid I m merid transit
						Paraboloid m alt-azim
						Standard g hor. 36.5 long, collect area 10 sq.
						Paraboloid m
						Paraboloid m
						Paraboloid m under cc truction
Hat Creek, California		University of California	121°28′.4 W	40°49′03″ N		Paraboloid m. Parabo 26 m equatc mount
Harvard, Mass.		Harvard University	71°33′.5 W	42°30′13″ N		Paraboloid m. Parabo 18.3 m equ rial mount

eam scan	Type of observations	Operating frequencies	Type of receivers	ΔT in 1962	Remarks	Alternative frequency band to be used if necessary protection given	ΔT expected 1967
± 6h c. —50° to)0°	Planetary galactic and extra-galactic sources				Not yet operating	10.68 - 10.70 Gc/s, 4990 - 5000 Mc/s, 1400 - 1427 Mc/s	.001° K
;0° zenith tance	»	Up to 1427 Mc/s	Crystal mixer and parametric	Probably 0.1° K at 1427 Mc/s	»	1400 - 1427 Mc/s. A band, if protected, near 600-700 Mc/s	.005° K
)0° zenith :ance	Selected radio sources	750 and 1400 Mc/s	Crystal mixer	0.1° K	Flux comparison experiment	None	0.1° K
sky	Interference monitor	Up to 3000 Mc/s	Crystal mixer	0.5° K		None	0.5° K
ed CAS. A ısits only	CAS A flux	600 - 1450 Mc/s	Crystal mixer	0.1° K		None	0.05° K
ed	Atmospheric radiation	8000 Mc/s	TWT	0.02° K		None	.001° K
ed	»	5000 Mc/s	TWT	0.02° K		None	.001° K
± 6h . —52° to)°	Planetary, galactic, extra-galactic and atmospheric radiation	250 Gc/s	Ge bolometer	0.02° K	Not yet operating	None	.002° K
positions	Galactic and extra-galactic sources	Up to 20 Gc/s	Various including parametric	0.02° K at 8 Gc/s, 0.1 at 1420 Mc/s		1400 - 1427 Mc/s plus bands up to 20 Gc/s	0.001° K
positions	Galactic and extra-galactic sources	Up to 3 Gc/s	Maser and others				

Site of radio telescope	Observatory	Sponsor	Longitude	Latitude	Altitude	Aerials type size steering
Westford, Mass.	Haystack Hill Millstone Hill	Lincoln Laboratory »	71°29′18″ W 71°29′33″ W	42°37′23″ N 42°37′09″ N	145 m 156 m	Paraboloid m alt-azim Paraboloid m alt-azim
Washington, D. C.	Naval Research Laboratory	U. S. Navy	77°01.′6 W	38°49′16″6 N	30 m	Paraboloid m. Paraboloid m
Maryland Point, Maryland	U. S. N. R. L. Maryland Point Observatory	U. S. Navy	77°14′ W	38°22′26″1 N	10 m	Paraboloid m
Sugar Grove, West Virginia	Naval Radio Research Station	U. S. Navy	79°16′49″ W	38°30′53″ N	670 m	Paraboloid m. Paraboloid 183.3 m
Bethany, Connecticut	Yale University Observatory	Yale University (NSF)	72°59′05″ W	41°25′40″ N	200 m	Two 24-ele helix a each 2 m m, transit rable in nation
Owens Valley California		California Institute of Technology	118°17′.6 W	37°13′.9 N		Two pa loids 27.4 alt-azimut
Stanford, California	Radio Astronomy Institute	Stanford University	122°11′19″.8 W	37°23′49″.8 N	95 m	Thirty fou equatorial raboloids i tended array Four 9.1 equatorial raboloids m ble

...am Scan	Type of observations	Operating frequencies	Type of receivers	ΔT in 1962	Remarks	Alternative frequency band to be used if necessary protection given	ΔT expected 1967
positions	Planetary and deep space	Up to 10 Gc/s	Maser		Operating late 1963		
»	»	Up to 1295, Mc/s	Parametric	$\sim 1°$ K	Operating 1 Jan. 1963		
positions ...ept 8° of ...th alt. az. positions ...r mount	Planetary galactic and extra-galactic	Up to 100 Gc/s	Maser, parametric and others	As low as .01° K		All assigned bands are probable plus others	.001° K
positions	Planetary galactic and extra-galactic	Up to 4 Gc/s	Maser, parametric and others	As low as .002° K		All assigned bands between 500 Mc/s and 4 Gc/s	.001° K
positions ...pt small ... around ...th	Galactic, extra-galactic and solar system	Up to 10 Gc/s Up to 2 Gc/s	Various	0.2° K	Under construction	All assigned bands up to 10 Gc/s	.001° K
. —20° to ...)°	Galactic and extra-galactic sources	200-300 Mc/s	Low noise vacuum tube; parametric	.002° K	Used as interferometer	300-350 Mc/s 600-650 Mc/s	.001° K
positions	Galactic and extra-galactic sources	Up to 3 Gc/s			May be used as interferometer		
...2h of HA ...een detections ...° and +	Solar system, galactic and extra-galactic	3292 ± 5 Mc/s (also wide-band)	Various	2° K in 1^s (0.1° K wide-band)	Fan beams as small as 0′.6 × 2°.3. Pencil beams as small as 3′.1 × 3′.1	Possibly 2695 Mc/s	
...2h of HA ...een detection ...° and +	Solar system, galactic and extra-galactic	3250 ± 250 Mc/s	Various	0.02° K in 1^s	0°.8 pencil beams used as elements of variable spacing interferometer		

Site of radio telescope	Observatory	Sponsor	Longitude	Latitude	Altitude	Aerials : type size steering
Cedar Rapids, Iowa	Collins Radio Company	U. S. Navy	91°44.8′ W	42°04′59″ N	275 m	2.4 m and 1. paraboloids azimuth altitude ste ble
Delaware, Ohio	Radio Observatory	Ohio State University	83°02′ W	40°01′ N		Standing p boloid 21.3 111 m reflec plane meri transit
Belmar, New Jersey	U. S. Army Electronics Research and Development Laboratory	U. S. Army	74°3′25″ W	40°11′5″ N	20 m	Paraboloid m. Paraboloid m alt-azim
Hamilton Mass.	Sagamore Hill Radio Observatory	USAF	70°48′55.4″ W	42°37′51.18″ N		Paraboloid equatorial s rable
						Paraboloid alt-azimuth
Fairbanks, Alaska	Gilmore Creek Data Acquisition Facility	NASA	147°30′ 54.421″ W	64°58′ 37.711″N	294.42 m	Steerable p boloid 25. diameter mount
Boulder, Colorado	Boulder Laboratories	National Bureau of Standards	105°13′.9 W	40°08′.9 N	1700	Two par loids ; E-W paration 66 18.3 m. meter eleva azimuth

eam scan	Type of observations	Operating frequencies	Type of receivers	ΔT in 1962	Remarks	Alternative frequency band to be used if necessary protection given	ΔT expected 1967
positions	Solar, lunar and atmospheric	15, 16 and 35 Gc/s	15 Gc/s TWT (under construction) and crystal mixers	$0.03/\sqrt{t}$ at 15 Gc/s (estimated) $1.0/\sqrt{t}$ at 16 Gc/s, $2.01/\sqrt{t}$ at 35 Gc/s	Automatic solar and lunar tracking available	All assigned bands from 10-40 Gc/s	
.°5 HA 0° zenith ance	Galactic and extra-galactic sources	Up to 2 Gc/s					
positions	Ionospheric studies, radar astronomy	Up to 3 Gc/s Up to 1420 Mc/s	Various				
positions	Ionospheric studies, lunar, planetary, solar, galactic and extra-galactic	Up to 10,000 Mc/s	Various	1° Ca 3000 Mc/s	Multi - frequency feed permits operation at 63, 113,225, 400, 1200 & 3000 Mc/s simultaneously	Will redesign feed to fit into protected bands	
positions	Ionospheric studies, radar astronomy, lunar, planetary, solar, galactic and extra-galactic	1500 Mc/s	Various	Not operating	Various feeds up to 1500 Mc/s	Will redesign feed to fit into protected bands	
sky appr. above ho-n	Planetary and deep space probes	136 Mc/s, 400 Mc/s, 1700 Mc/s	Parametric and low noise vacuum tube			2300 Mc/s	
positions	Planetary	900 - 1100 Mc/s	Crystal detectors	0.3° K			0.2°K

Site of radio telescope	Observatory	Sponsor	Longitude	Latitude	Altitude	Aerials type size steering
Dexter, Michigan	The Observatory University of Michigan	University of Michigan	83°56'12" W	42°23'54" N	321 m	Paraboloid m equat mount. Par loid 9.2 M e torial mou
Stanford, California	Stanford Center for Radar Astronomy	Stanford Univ. and Stanford Research Institute	122°10'43" W	37°24'32" N	152.4 m	Paraboloid, M, alt-azin
						335 m N- near phase ray (two r of 48 log-p dic ante
						610 m E-V near array (rows) of 96 antennas
						2 parabol 18.3 m, azimuth

* ΔT expected in 1967 : Unknown, limitation at centimetre wavelengths will be set by geophy factors not well known at present.

eam Scan	Type of observations	Operating frequencies	Type of receivers	ΔT in 1962	Remarks	Alternative frequency band to be used if necessary protection given	ΔT expected 1967
positions	Planetary, galactic and cosmic	200-580 Mc/s sweep freq. 2000 - 4000 Mc/s sweep freq. 750-850 Mc/s, 7500 - 8500 Mc/s, 9250 - 9350 Mc/s	Maser and other	0.05° K		750 - 1100 Mc/s, 7500 - 11000 Mc/s, 15000-16500 Mc/s	See foot-note *
positions	Lunar, planetary, solar and ionospheric radar ; bistatic radar with receivers in space probes	Up to 2 Gc/s	Various				
± 2h, . — 30° to 0°	Lunar and solar radar	20-60 Mc/s	Various				
± 5 min. . —30° to)°	meteor radar	23 Mc/s	Various				
positions	Lunar, meteor, ionospheric radar	Up to 3 Gc/s	Various				

Site of radio telescope	Observatory	Sponsor	Longitude	Latitude	Altitude	Aerials : type size, steering
Goldstone, California	Jet Propulsion Laboratory	California Institute of Technology				
Pioneer site (85′)			116°50′ 53.7″ W	35°25′ 22.2″ N	1037.54 m	25.9 m I steerable ec torial
Echo site (85′)			116°48′ 16.6″ W	35°17′ 59.5″ N	989.49 m	25.9 m I steerable e torial
Venus site (30′)			116°47′ 27.8″ W	35°14′ 50.2″ N	1201.32 m	25.9 m steerable azimuth
Venus site (85′)			116°47′ 38.4″ W	35°14′ 51.8″ N	1213.59 m	9.14 m steerable azimuth

Beam scan	Type of observations	Operating frequencies	Type of receivers	ΔT in 1962	Remarks	Alternative frequency band to be used if necessary protection given	ΔT expected 1967
A ± 90° ec. +90° to 55°	Lunar and planetary deep space probes. Lunar and planetary radar	Transmit 890.046 ± 2 Mc/s. Receive 960.05 ± 2Mc/s. Transmit and receive 2388 Mc/s. In addition after 1963: Transmit 2115 ± 5 Mc/s. Receive 2295 ± 5 Mc/s	Maser and parametric amplifiers, total power and switched radiometers, phase lock with information BW of 1600 and 5000 cp/s at 960 Mc/s and 3.3 Mc/s at 2295 Mc/s	0.1° at 2388 Mc/s for 1 sec. integrating time	Maser and Cassegrain feed	8450 ± 50 Mc/s	0.01° at 2388 Mc/s for sec. integrating time
± 90° c. +90° to 55°	»	»	»	»	Parametric and focal point feed	8450 ± 50 Mc/s	»
0° to 360° 0° to 90°	Lunar and planetary deep space probes. Lunar and planetary radar	Transmit 890.046 ± 2 Mc/s. Receive 960.05 ± 2Mc/s. Transmit and receive 2388 Mc/s. In addition after 1963: Transmit 2115 ± 5 Mc/s. Receive 2295 ± 5 Mc/s	Maser and parametric amplifiers, total power and switched radiometers, phase lock with information BW of 1600 and 5000 Cp/s at 960 Mc/s and 3.3 Mc/s at 2295 Mc/s	0.1° at 2388 Mc/s for 1 sec. integrating time	Primarily used for research and development	8450 ± 50 Mc/s	0.01° at 2388 Mc/s for 1 sec. integrating time
0° to 360° 0° to 90°	»	»	»	»	»	»	»

Doc. I.U.C.A.F.-38

C.O.S.P.A.R. Resolutions 10, 11 and 12

The following resolutions have been adopted by C.O.S.P.A.R. at its Fifth meeting in Washington, May 1962, upon recommendation of Working Group 1 on Tracking and Telemetry.

Res. 10. — *Definition of « space research service » and allocation of separate frequency bands.*

« C.O.S.P.A.R., *considering* that

(*a*) it is probable that an Extraordinary Administrative Radio Conference of the I.T.U. will be held in 1963 to allocate frequencies for space radio communications and for space research,

(*b*) frequencies assigned to space research will be needed for tracking, command, and telemetry of engineering and technological data, as well as for the main telemetry of scientific results,

(*c*) frequencies assigned to operational communications systems will be needed for tracking, command, and telemetry of engineering and technological data, as well as for the main purpose of communications,

recommends that

1. a space research service should be defined a space service or earth-space service providing for the transmission of scientific and technological information acquired by or pertaining to earth satellites or spacecraft. Technological information is defined here as those research and development data required for the development of future scientific satellites and spacecraft. Engineering status information from development or use of *operational* satellites or spacecraft would not be considered a part of the space research service ;
2. frequencies should be assigned to the space research service and to operational communications systems in separate bands. »

RES. 11. — *Allocation of frequencies for the space research service.*

« C.O.S.P.A.R., *considering* that

(*a*) at the I.T.U. Conference held in Geneva in 1959 C.O.S.P.A.R. presented in outline a list of the frequencies required for space research ;

(*b*) the U. S. A. has proposed and circulated a document entitled « Preliminary Views on Frequencies required for Space Research » ;

recommends that an allocation of frequencies similar to that in the « Preliminary Views », but with the addition of a telemetry band 401-402 Mc/s, is necessary and sufficient for the space research service. »

RES. 12. — *Allocation of frequencies on a world-wide exclusive basis.*

« C.O.S.P.A.R., *considering* that the techniques of space science are developing so rapidly and the requirements for telemetry are so stringent,

recommends that allocation of frequencies for space science should be made on a world-wide exclusive basis. »

Note : These Resolutions have already been forwarded, on behalf of I.U.C.A.F., to the Director, C.C.I.R., for submission to the C.C.I.R. Plenary Assembly in New Delhi, January, 1963.

Doc. I.U.C.A.F.-39

The Protection of Frequencies for Radio Astronomy [1]

by R. L. SMITH-ROSE

ABSTRACT

The International Telecommunications Union in its Geneva, 1959, Radio Regulations recognises the Radio Astronomy Service in the two following definitions :

(1) The full paper will be published in the Journal of Radio Propagation, National Bureau of Standards, U. S. A.

No. 74. *Radio Astronomy* : Astronomy based on the reception of waves of cosmic origin.

No. 75. *Radio Astronomy Service* : A service involving the use of radio astronomy.

This service differs, however, from other radio services in two important respects :

(i) It does not itself originate any radio waves, and therefore causes no interference to any other service ;

(ii) A large proportion of its activity is conducted by the use of reception techniques which are several orders of magnitude more sensitive than those used in other radio services.

In order to pursue his scientific research successfully, the radio astronomer seeks protection from interference first, in a number of bands of frequencies distributed throughout the spectrum; and secondly, more complete and specific protection for the exact frequency bands in which natural radiation from, or absorption in, cosmic gases is known or expected to occur.

The International Regulations referred to above give an exclusive allocation to one frequency band only — the emission line of hydrogen at 1400-1427 Mc/s. In all other cases, allocations are made on a basis of sharing with other radio services.

Considering the expensive nature of the equipment in use and under development by radio astronomers throughout the world, it is important that the protection of certain bands of frequencies for this science should receive serious attention by all those engaged in both local and world-wide radio services.

COMITÉ DE L'ANNÉE INTERNATIONALE DU SOLEIL CALME

Nous informons nos lecteurs qu'à partir du 20 septembre 1962, l'adresse du Secrétariat du Comité de l'I.Q.S.Y. sera : 6, Cornwall Terrace, London, N. W. 1.

Téléphone : Welbeck 7139.

Télégrammes intérieurs : IKSYCOM PHONE LONDON.

Télégrammes d'outremer : IKSYCOM LONDON NW1.

Le Secrétaire de ce Comité est le Dr. C. M. Minnis.

COMMITTEE FOR THE INTERNATIONAL YEAR OF THE QUIET SUN

We inform our readers that as from September 20th, 1962, the address of the Secretariat of the I.Q.S.Y. Committee will be : 6, Cornwall Terrace, London N. W. 1.

Phone : WELBECK 7139.

Inland Telegrams : IKSYCOM PHONE LONDON.

Overseas Cables : IKSYCOM LONDON NW1.

The Secretary of the Committee is Dr. C. M. Minnis.

INTERNATIONAL YEAR OF THE QUIET SUN (IQSY)

Abstract from the *I.U.G.G. Chronicle* (n° 45, August 1962)

The International Geophysical Year (I.G.Y.) coincided with a period of exceptionally high solar activity. During the analysis of the data obtained during this period, it became clear that the results would be of even greater significance if similar but complementary data could be obtained during a period when solar activity was very low.

The desirability of such programme, in at least the radio-physics field, was briefly discussed at an U.R.S.I.-A.G.I. meeting in Edinburgh in 1958. At an informal C.I.G. meeting in Helsinki in August 1960, a working group was formed which made preliminary proposals for a sunspot minimum programme of observations in 1964 and 1965. This programme was accepted by C.I.G. at its Third Meeting in Paris in January 1961 and the C.I.G. proposals for I.Q.S.Y. were approved by the Ninth General Assembly of I.C.S.U. in London in September 1961. At the Fourth Meeting of C.I.G. in Paris in March 1962, the I.Q.S.Y. programme in each discipline was discussed in detail by specialist groups and an I.Q.S.Y. Committee was formed to organize the enterprise in all its aspects.

The pages which follow contain an account of this meeting and of the discussions about the I.Q.S.Y. Since the meeting, the Secretariat of the I.Q.S.Y. has been established in London, at 6 Cornwall Terrace, London, N.W.1.

First Plenary Session, 26 March, 1962

The first meeting on the International Year of the Quiet Sun (I.Q.S.Y.) was opened at 10.15 a. m. on 26 March by Professor W. J. G. Beynon, President of the Comité International de Géophysique.

Professor Beynon welcomed the delegates and the members of the staff of U.N.E.S.C.O. present. He gave a special word of thanks to U.N.E.S.C.O. for their generosity, not only in making available premises for the first I.Q.S.Y. meeting but also for the help this organization had given to C.I.G. and to its predecessor, the Comité Spécial de l'Année Géophysique Internationale.

Dr. P. I. Erchov, Assistant Director General of U.N.E.S.C.O. expressed the wishes of U.N.E.S.C.O. for the success of the I.Q.S.Y.

Prof. J. Van Mieghem, Secretary General of I.C.S.U., recalled the resolution adopted by the Ninth General Assembly of I.C.S.U. approving the proposal for I.Q.S.Y. and recommending the fullest participation in it by the Scientific and National Members of I.C.S.U.

The President of C.I.G. gave the following address :

« It is now nearly twelve years since a few of us, meeting in Brussels at what was called the « Mixed Commission on the Ionosphere » received from two of our colleagues, Professor Sydney Chapman and Dr. Lloyd Berkner, the suggestion that a world-wide enterprise in geophysics should be organized for the following period of sunspot maximum. Thus was sown the seed, which seven years later, blossomed into the gigantic cooperative experiment of the International Geophysical Year. As we now know, the impact and appeal of the I.G.Y. extended far outside the bounds of geophysical science and it has left its mark on all manner of national and international affairs. The initials « I.G.Y. » « A.G.I. », or their equivalents — have become familiar in every corner of the world, and I think we shall presently find that they are given a permanent place in those lists of abbreviations to be found in our various national dictionaries.

« During the planning and operational phases of the I.G.Y. we scientific workers of 67 nations set aside our national frontiers, took no account of different political systems and gave all our energies to cooperation in the common cause. And so productive was this wonderful cooperation — productive not merely of scientific knowledge but productive too of international goodwill — that the International Council of Scientific Unions found it worthwhile to establish a number of permanent international organizations whereby this cooperation in science could be maintained and indeed still further extended. One such organization, which has come out of the I.G.Y., is the Committee which has sponsored the present meeting — the International Committee for Geophysics (C.I.G.). I have no doubt that all the nations represented here today played their part in ensuring the overall success of the I.G.Y. and the opening of this meeting may be an opportune moment on which to say a word or two about C.I.G., the Committee which has been established to coordinate geophysical work in the international field.

« C.I.G. is an inter-Union Committee with representation from four Scientific Unions — Geodesy and Geophysics, Radio Science, Astronomy, Pure and Applied Physics — In addition there are representatives of other Special or Scientific Committees of I.C.S.U. and of certain other international organizations such as the World Meteorological Organization. C.I.G. is the successor to the Special Committee for the I.G.Y. (C.S.A.G.I.) and indeed one of the objects of the Committee is to ensure the proper completion of the I.G.Y. enterprise by taking care of I.G.Y. publications. The following summarizes the recent activity of C.I.G. in this matter of I.G.Y. publications. In the past twelve months some nine volumes totalling four thousand pages have been published. At the moment a further four volumes of data are with the publishers and it is estimated that another sixteen volumes or so will required. It is anticipated that the manuscripts for at least ten volumes will be available in 1962 and C.I.G. has decided to attemps completion of the publication programme, including bibliographies, indexes, etc., before August 1963. In this not inconsiderable task C.I.G. is greatly indebted to its reporters and others who have contributed, but the Committee is especially grateful to the General Secretary, Ing. Gen. G. Laclavère, and to Mr. Baker who are carrying the main burden of this work.

« However this « rounding off » of the I.G.Y. is not the only task of the Committee. According to its rules C.I.G. is also charged with « the d velopment and coordination of plans for future cooperation in geophysics and related sciences » — and it is to discuss one such future project that the present meeting has been called.

« The suggestion for a sunspot minimum geophysical programme is not new. The need for such an enterprise was clearly foreseen by the U.R.S.I.-I.G.Y. Committee in 1958 and a formal proposal for such a project was made at a meeting here in Paris in 1961 and we agreed that the project, to be called by the elegant title « The International Year of the Quiet Sun » (I.Q.S.Y.), should be planned for the period 1 April 1964 to 31 December 1965.

« In bringing this proposal before the nations there are one or two points which we are not unaware of the danger of making observations for their own sake. C.I.G. is fully conscious of this danger and aware too of its responsibilities for bringing the I.G.Y. to a really successful conclusion by itself publishing, and encouraging others to publish the results of the I.G.Y. The enormous amount accomplished already in that direction is adequate proof of the unquestioned success of the I.G.Y. and of the attention which C.I.G. is still giving to that aspect of its duties. But, as I have mentioned, there is undoubtedly a very real need for a comparable set of measurements at sunspot minimum in those disciplines which are affected by solar changes. Satisfactory and full completion of the I.G.Y. calls for a comparable and complementary set of measurements at solar minimum activity.

« Secondly there is a very real advantage in making these minimum activity measurements at the next solar minimum which is expected in 1964-65. We have the invaluable experience of the I.G.Y. with us, most of the new stations established in the I.G.Y. are still operating and it would be sound economics, as well as being sound science, to use these same stations in 1964-65. We would not propose that this International Year of the Quiet Sun should be a simple repetition of I.G.Y. observations but we propose making the fullest possible use of all new and improved techniques developed during and since the I.G.Y.

« At the recent international symposium on the Earth Storm and Cosmic Rays, I took the opportunity to call an informal meeting to consider further the proposal for I.Q.S.Y. No fewer than 55 delegates representing 19 nations attended the meeting and there was unanimous and very warm support for the project. As Dr. Erchov and Professor Van Mieghem have stated, the project has the full support of U.N.E.S.C.O. and of I.C.S.U. but, as we all know, its implementation and success must in the end, depend on the cooperation we get from the nations.

« The Committee for Geophysics expresses its appreciation of your presence at this meeting and of your response to this initial invitation to cooperate in this new enterprise. If we approach this task with goodwill, mutual understanding and unity of purpose, then I am sure that the International Year of the Quiet Sun 1964-65 will be a worthy complement and follow-up to the I.G.Y. ».

Working Groups

The following Working Groups were then set up :

I. *World Days* :

A. H. SHAPLEY (Reporter),
C. W. ALLEN,
W. BLEEKER,
W. DIEMINGER,
M. NICOLET,
N. PUSHKOV,
J. ROEDERER,
O. SCHNEIDER,
J. VELDKAMP.

II. *Meteorology.* — Reporter : J. VAN MIEGHEM.

III. *Geomagnetism.* — Reporter : V. LAURSEN.

IV. *Aurora and Airglow.* — Reporter : D. BARBIER.

V. *Ionosphere* :

W. DIEMINGER (Reporter),
W. J. G. BEYNON,
M. BOELLA,
F. DU CASTEL,
J. A. DELLOUE,
P. DORE,
R. A. HELLIWELL,
A. LEBEAU,
J. LUGEON,
S. MANCZARSKI.

VI. *Solar Activity.* — Reporter : M. A. Ellison.

VII. *Cosmic Rays.* — Reporter : S. Vernov.

VIII. *Aeronomy.* — Reporter : M. Nicolet.

Space Research :

J. Bartels (Reporter),
M. A. Ellison,
W. Kellogg,
M. Nicolet,
N. Pushkov,
S. Vernov.

World Data Centres. — Reporter : H. Odishaw.

The Working Groups met from 26 to 29 March and prepared the following Reports and Recommendations, which were presented to the final plenary session of I.Q.S.Y. on 29 March. The recommendations were later adopted by C.I.G. at its final session.

Report of Working Group II, Meteorology

4.3. — World Days

4.3.1. — « Regular World Days » (RWD's) : Particular efforts shall be made to obtain the maximum quantity of data on each Wednesday UT. These days shall be designated Regular World Days. Rocket ascents and ozone and radiation sonde ascents shall be made on these days. Maximum altitude balloon ascents shall be made at 0000 and 1200.

4.3.2. — « World Geophysical Intervals » (WGI's) (1) Specification of WGI's : In accordance with the recommendations of the WMO Aerological Commission (Rec 20-CAe III) it is recommended that C.I.G. propose as World (instead of Special) Geophysical Intervals the second and third full weeks, starting on Monday (UT), in the following months :

1964 (January), April, July, October ;
1965 January, March, June, September, December.

5. — COOPERATION WITH OTHER DISCIPLINES

5.3. — *Ionosphere*

5.3.1. — Certain aspects of the electron density in the D and E layers may throw light on the wind field at these levels.

5.3.2. — It is probable that rockets capable of reaching a height of 120 km will be used for synoptic meteorological observations at some stations during I.Q.S.Y. The attention of ionosphere-scientists is drawn to this.

5.3.3. — Ionosphere scientists have an interest in the propagation of atmospherics. Meteorological services operating atmospherics networks may be able to assist in this programme. Arrangements for such cooperation should be made at a national level.

Report of Working Group V, Ionosphere

The ionospheric programme to be prepared for I.Q.S.Y. may be divided into sub-disciplines, somewhat as for I.G.Y. In addition it may be divided into major synoptic programmes and into special experiments. These two categories of work support each other and both are necessary for the fulfillment of the I.Q.S.Y. programme. For purposes of this report the ionospheric programme is outlined as given below; in many cases, the U.R.S.I.-C.I.G. Committee has already designated « sub-reporters » for components of the programme and these names are appended for information purposes.

MAJOR SYNOPTIC PROGRAMME

VI : Vertical Incidence Soundings (Worldwide Soundings Committee),

A : Ionospheric Absorption,
A1 Pulse-echo method (W. R. PIGGOTT),
A2 Cosmic noise method (C. G. LITTLE),
A3 CW Field Strength (W. R. PIGGOTT),

D : Ionospheric Drifts (K. RAWER),
D1 Pulse echo feeding,
D2 Radio meteor,
D3 Radio star feeding,

N : Atmospheric Noise Statistics (HORNER),

W : Whistlers and VLF Emissions (R. HELLIWELL, G. M. ALLCOCK).

SPECIAL EXPERIMENTS

Vertical Incidence Experiments

Scatter sounding,

Partial reflections,

Cross modulation,

Absorption A4 (gated pulses),

Special HF vertical soundings for regional studies, close-space networks, control for other ionospheric experiments, e. g. rockets,

Special multi-frequency riometer,

Oblique Incidence Experiments

Backscatter B-1, fixed frequency,

Backscatter B-2, multifrequency,

Radar Aurora,

Forward scatter,

Oblique HF pulse transmissions,

Oblique CW, VLF and LF transmissions for N(h) of lower ionosphere.

Atmospheric Radio Noise

Spectral distribution of radiated energy,

Sferics,

Conjugate Point Experiments

Simultaneous measurements by several techniques,

Satellite Experiments

Topside soundings,

LF and VLF receiver,

Probes,

Beacon transmitters : Faraday rotation and Doppler, *Rocket Experiment*

Dynamics of ionosphere and exosphere,
Jackson-Seddon dispersion experiment,
Medium frequency radio absorption,
Langmuir probe,
r. f. resonance probe,
ion trap
r. f. mass spectrometer,
X-ray photometer,
ultra-violet photometer,
Lyman-alpha photometer,
Topside sounding from rocket.

Vertical Incidence Sounding (VI)

Objectives

The vertical sounding programme objectives are similar to those of the I.G.Y. with the following major additions :

(*a*) The solar cycle variation of all types of ionospheric behaviour deduced from vertical sounding data when I.Q.S.Y. and I.G.Y. results are compared.

(*b*) Increased emphasis on electron density profile determinations on a regional and world basis.

(*c*) Application of vertical sounding observations in conjunction with rocket and satellite ionospheric observations on the ionosphere.

1. — Observing Programme

It is recommended that vertical sounding stations follow the observing schedule recommended for the I.G.Y. It is particularly emphasized that I.G.Y. experience has demonstrated that for most scientific and practical purposes the maximum interval between soundings should not exceed fifteen minutes. The plan to take soundings at 5-minute intervals on RWD and SWI should be continued. It is noted that, during the I.G.Y., many stations found the *f*-plot to be a satisfactory and sufficient method of reduction for those soundings which are not represented in tables of hourly values.

2. — Observing Techniques

It is recognized that new techniques will form an essential part of I.Q.S.Y. ionospheric measurements, but it is to be remembered that one of the primary objectives of I.Q.S.Y. is to obtain measurements during the solar minimum period which can be compared with those obtained during the solar maximum of the I.G.Y. It is essential that this latter point be borne in mind whenever new techniques and/or methods of data reduction developed during and since the I.G.Y. are employed.

It is recommended that the instrumentation at vertical sounding stations be improved wherever possible by extending the lower limit of the frequency range to 250 kc/s and improving antenna efficiency particularly for the lower part of the frequency range.

3. — Distribution of Stations

General.

Since a main purpose of the I.Q.S.Y. is to provide complementary data of the I.G.Y., it is recommended that the overall world coverage be not less than that during the I.G.Y.

As a general principle, it is important that stations started since the last sunspot minimum operate during the I.Q.S.Y.

All stations which are to be started or re-established for the I.Q.S.Y. should commence operation well in advance, as it is important fully to cover the minimum period.

The necessity is stressed for maintaining a consistent system of station identification coding, particularly to facilitate mechanical data handling, and accordingly responsible administrations are requested to inform the W.D.C.s or the U.R.S.I.-C.I.G. of any new stations set up for the I.Q.S.Y., so that standard identification numbers and letters can be assigned.

As a result of the operation of one or more topside sounding satellites during I.Q.S.Y. considerably more information on the spatial variations in *fo*F2 will undoubtedly be available from certain regions of the world. However, since data storage facilities are not likely to be incorporated into the early satellites, coverage will generally be limited to regions within about 2000 km of the rather small number of existing telemetry stations. There is little doubt that in the future the topside sounding technique will provide much of the information on *fo*F2 required for mapping purposes.

A partial list of vertical sounding stations planned to be operated during I.Q.S.Y. has been prepared. This list is based on responses to a questionnaire distributed by the Reporter for Ionosphere, supplemented by national programme documents and by special information given to the Reporter. The list will not be complete until all national reports have been received.

Having reviewed the prospective distribution of stations during I.Q.S.Y., the Working Group calls attention to the following considerations :

Meridional Chains.

It is particularly important that the four meridional chains of stations, identified in the I.G.Y. programme, be as complete as possible during I.Q.S.Y. Highest priority should be given to completing the meridional chains by ensuring that observations are made at the following locations :

(i) 70°-80° *W Chain* (*the Americas*).

Panama - N. Columbia area. Large F-region electron density gradients occur in this general location and a station is needed to fill the gap of 15° in latitude between Bogota and Puerto Rico.

(ii) 10°-20° *E Chain* (*Europe, Africa*).

Tsumeb - an important station in the transition zone of the south equatorial chain.

Grahamstown - needed for East-West studies in an anomaly zone.

Marion Island - a station at this location would extend the chain to the south and also increase the coverage in the Antarctic region. This location takes an increased scientific importance because it is conjugate to the high density of stations in western Europe.

Tamanrasset - essential from both geographic and magnetic considerations.

Bangui - needed to define the equatorial trough in this zone.

Teneriffe - this proposed station would help define the big gap between Tamanrasset and Rabat, and is important to European-African communications.

Longyearbyen - extends the chain to the north and also provides important information about the secular movements of the auroral zone.

Leopoldville, Elisabethville, Bunia and Lwiro - the value of the chain would be very much reduced without these stations in an area important for the understanding of ionospheric behaviour around the southern maximum of *fo*F2.

Nigeria, on magnetic equator - this location should be occupied for regional studies in conjunction with Ibadan, linking ionospheric and magnetic phenomena.

(iii) 70°-90° *E Chain* (*U. S. S. R., India*).

Ceylon - important in the study of the longitude changes in ionospheric gradients close to the magnetic equator.

(iv) 130°-150° *E Chain* (*Australia, Japan, U. S. S. R.*).

Cebu - close to the magnetic dip equator in a region where the dip equator is furthest north of the geographic equator, and thus of special value in comparison with Huancayo.

Djakarta - full I.Q.S.Y. operation is most desirable since this location is close to the suspected position of one of the latitudinal peaks in ionization density.

North of Singapore - it would be most valuable if measurements were available from a station in latitude 10°-15° N in the longitude zone of Singapore for use jointly with Singapore data to define the transequatorial profile in this zone.

Other Stations.

In addition to strengthening the meridional chains, it is important that, as far as possible, stations be located for the I.Q.S.Y. in the following areas from which vertical soundings have not been available previously :

Gough Island - this location defines the extent of the Weddell Sea - Capetown anomalies in height and critical frequency parameters.

Easter Island - this seems the only possible practical location for a station in the Southeast Pacific Ocean. Data from this region are very desirable for morphological studies.

East Africa, Uganda, Kenya - this area is particularly suitable for the detailed study of the sensitivity of equatorial ionospheric behaviour to moderate changes in longitude.

Addis Ababa - this would contribute to the study of the fine structure of the equatorial ionosphere in this zone.

Antarctica. The I.Q.S.Y. represents the first opportunity for obtaining any appreciable information on the behaviour of the Antarctic ionosphere during a minimum sunspot period, and bearing in mind the extensive use alrady made of I.G.Y. data from this area it is obviously very important that as many as possible of the stations that were operated during and since the I.G.Y. be continued during I.Q.S.Y. Whenever possible, stations which operated during I.G.Y., but which are not now active should be re-established for I.Q.S.Y. and in addition observations from some new sites would help solve scientific problems raised by I.G.Y. studies ; these include :

Syowa - Data during I.Q.S.Y. from this point will help fill out the map of the Antarctic ionosphere and complement previous measurements from this location.

Vostok - it is extremely important to obtain the solar cycle dependence of ionospheric parameters near the geomagnetic pole.

South Ice (about 80° S, 30° W) - data from this location would throw light on the physical mechanisms operating in the major Weddell Sea anomaly.

Maudheim - if existing studies at this station could be extended to include ionospheric observations this would help fix the eastern boundary of the Weddell Sea anomaly.

Roi Baudouin - an especially important location which contributed to the delineation of south polar ionospheric phenomena during the I.G.Y.

Sentinel Mts. - a station at this location would be valuable for (*a*) sub-auroral conjugate point studies, (*b*) additional ionospheric information in a region of Antarctica where marked spatial variations exist.

In addition to their invaluable contribution to the scientific experiments, ionospheric data from Antarctic stations, as recommended above, will contribute to the safety and efficiency of station and expedition operations, since almost no data exist for solar minimum on which to base radio propagation predictions for practical communications within Antarctica and to the outside world.

Ocean Areas.

In order to gain more information about the ionosphere over the large ocean areas it is recommended that greater emphasis be placed on the use of shipboard ionosondes. This is a technique which has matured during and since the I.G.Y. Soundings from research vessels at relatively fixed locations for extended periods (of at least one week's duration) would be most suitable. Observations from a moving ship are also useful, for example for transequatorial F-region studies.

The possibility of using weather ships and other semi-stationary vessels as ocean ionosphere stations should be re-examined.

Special closely-spaced chains.

Special and co-ordinated closely-spaced chains of equatorial stations are recommended for operation during I.Q.S.Y.

As a result of I.G.Y. experience, it is realized that it is important to locate stations in such a way that studies can be made of phenomena occurring along the magnetic equator as well as across it. For example the study of temporal variations in the occurrence of equatorial Spread F would be greatly aided by a suitable triangular network of stations in order to resolve the directions of the equivalent drifts. Three particularly suitable areas are in Peru, Ghana-Nigeria, and India-Ceylon.

Floating Ice Stations.

The floating Arctic ice stations operated during the I.G.Y. seem to have been successful where the severe technical difficulties were overcome. Complementary data for I.Q.S.Y. from the area of the interior of the Arctic basin would be most valuable to the I.G.Y.-I.Q.S.Y. world geophysical experiment.

Magnetically Conjugate Pairs.

The value of pairs of geophysical stations within 300 km of magnetically conjugate points is becoming increasingly apparent, operated either as synoptic stations or for short term experiments. Vertical soundings should be included in the programme for such conjugate pairs. It seems opportune to use existing stations as one station of each pair. A partial list of pairs which are certainly scientifically desirable and perhaps logistically practical, would include :

Byrd (existing)	Great Whale River (conjugate)
Lander	Unalaska
Kerguelen	Archangelsk
Mirny	Murmansk
Dumont d'Urville	Fairbanks
South of France	Capetown
Vostok	Thule

4. — Data Flow to W.D.C.s

4.1. — *Vertical Soundings Data*

It is recommended that the flow of I.Q.S.Y. vertical soundings data to the W.D.C.s follows the principles of the I.G.Y. Guide, with suitable modifications to take into account the revisions in the programmes of observation and reduction outlined below. It is recommended that the ionogram interchange part of an I.Q.S.Y. Guide follow the recommendations made previously by U.R.S.I.-C.I.G. for the years 1959, 1960, etc. It is further recommended that the Guide contain proposals for a plan to enable W.D.C.s to maintain an index of the periods of observation of special and temporary vertical sounding stations, and the location of the ionograms and any regularly reduced data from stations if these are not deposited in the W.D.C.s.

Recommended Programmes of Ionogram Reduction and Presentation of Data.

Synoptic Stations : It is recommended that stations undertake reduction programmes A, B, C or D, depending on criteria such as latitude of station, the average accuracy of the ionograms, access to computing facilities, the programmes being undertaken at neighbouring stations, special regional plans, etc. It is recommended that stations notify the C.I.G. Reporter of their tentative plans for reduction in order to achieve, by informal co-ordination, well-balanced reduction plans along the meridional chains of stations and within regions.

A. — *Programme for high latitude stations.*

Hourly values.

(*a*) *fo*F2, *fo*F1, *fo*E*s*, *fb*E*s*, *f*min,
(*b*) *h'*F, *h'*E*s*, *h'*E where height accuracy allows,
(*c*) M3000F2 or MUF 3000F2,
(*d*) E*s* types,
f-plots,
All days,
Profile Parameters.

Attention is drawn to the possibility of obtaining monthly median profiles at high latitude stations using the median *h'f* technique. It is to be hoped that at least representative sample profiles will be produced and interchanged.

B. — *Basic Programme for temperate and low-latitude stations.*

Hourly values,

(*a*))
(*b*))
(*c*)) as above
(*d*))
f-plots
(*a*) S.W.I.s, all stations.
(*b*) All days at selected representative stations in each region.

Where an organization operates several stations, at least one should produce *f*-plots for each day.

C. — *Composite basic and profile programme for temperate and low latitude stations.*

Hourly values,

(*a*) *fo*F2, *fo*F1, *fo*E, *fo*E*s*, *fb*E*s*, *f*min,
(*b*) - - - - -

(*c*) M3000F2 or MUF 3000F2,

(*d*) E*s* type,

Profile parameters,

Average profiles from monthly median *h'f* pattern for at least 12 hours (00,02, - - - UT).

D. — *Mainly Profile programme for temperate and low latitude stations.*

Hourly values,

(*a*) Direct scaling from ionograms : *fo*F1, *fo*E*s*, *fb*E*s*, *f*min,

(*b*) Indirect computed values from the profile data : *fo*F2, *fo*E,

(*c*) From either direct scaling or computed curves, as is most convenient : M3000F2,

(*d*) Profiles of ionization with height for every hour.

4.2. — *Top-side Sounding Data*

Hitherto, no plans have been drafted by the U.R.S.I.-C.I.G. Committee for the flow to W.D.C.s of ionospheric data obtained by topside sounding techniques. It may well be that during I.Q.S.Y. such topside sounding experiments will constitute a significant part of the total data on the ionosphere. It is strongly recommended that these data, in suitable form, should be deposited within a reasonable time in the W.D.C.s.

Absorption observations (A)

1. — OBJECTIVES

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

(*a*) To complement the data obtained during the I.G.Y. so that the solar cycle variations of absorption can be determined.

(*b*) To delineate geographic areas in which comparable absorption phenomena occur.

(*c*) To study diurnal, seasonal and solar cycle variations of absorption in each such geographic area and the connection with local and worldwide magnetic activity.

2. — Methods

The methods of measuring ionospheric absorption fall into the following main groups :

A-1 Measurement of the amplitudes of pulses reflected from the ionosphere.

A-2 Measurement of the absorption of extra terrestrial radio noise.

A-3 Measurement of the field strength of sky wave signals at oblique incidence.

In addition, relative changes in absorption can be measured qualitatively using ionogram parameters, in particular *f*-min.

3. — Distribution of stations during I.Q.S.Y.

It is important that the stations which operated during I.G.Y. continue during I.Q.S.Y.

(*a*) *Equatorial latitudes.*

Absorption measurements obtained during the I.G.Y. indicate that considerable changes of absorption with longitude occur between Malaya and Africa. It is important that suitable similar measurements be made in other longitude zones, such as in South America.

(*b*) *Temperate latitudes.*

The existing distribution of A1 stations in Europe and Asia is adequate. The situation in North America is not so satisfactory, and in the southern hemisphere it appears that only one A1 station is likely to be operating. Since less accurate methods of measuring absorption can only be calibrated against A1-type data it is clear that some additional A1 stations should operate during I.Q.S.Y.

In this connection it is relevant to note that I.G.Y. data have shown that in the northern hemisphere between about 40° and 60° magnetic latitude abnormally high winter absorption in Europe or Asia was associated with relatively low absorption in America. It would be valuable to know whether a similar phenomenon occurs in the southern hemisphere, and modest A1 or A3 measurements would be sufficient for this purpose.

(*c*) *Sub-auroral and high latitudes.*

Although the intense absorption sometimes present during disturbed periods is best measured by the A2 method, analysis of I.G.Y. data has shown that there are occasions when methods A1 and A3 detect changes in absorption to which method A2 appears relatively insensitive. It is therefore desirable that methods A1 and A3 should be employed at least at some stations, particularly in the Antarctic polar cap where no such observations have yet been made.

(*d*) It is strongly recommended that riometers (A2) be used at magnetically conjugate points wherever this is possible.

e.g. Byrd	Great Whale
Lander	Unalaska
Kerguelen	Archangelsk
Mirny	Murmansk
Dumont d'Urville	Fairbanks
Vostok	Thule
South of France	Capetown

4. — Programme of observations

For A1 measurements the programmes generally adopted during the I.G.Y. are suitable and adequate. Where facilities are available it is desirable to make measurements on a group of frequencies in quick succession so as to allow a fuller analysis of the frequency variations.

In those cases where the full A1 method is not applicable a simplified A1 method may be used. In this method the amplitude of a gated pulse is recorded continuously. The record may be used to give the diurnal variation of absorption.

Both A2 and A3 measurements involve little effort to maintain and should be more widely used where manpower limitations preclude the use of method A1.

Existing A3 stations should continue with their I.G.Y. programmes. New A3 experiments should be planned to use the 1E ordinary wave mode.

Daily recording should be maintained for as many hours as possible and measurements should be made at least at the following times :

(*a*) Near noon to give the maximum normal absorption for the day.

(*b*) At night, for calibration purposes, when ionograms show that E region reflections are likely to be dominant and the absorption is low.

(*c*) At other times during the day, to give the diurnal variation of absorption. It should be noted that the value of diurnal changes in field strength depends on the accuracy of calibration and on whether changes due to additional modes can be identified, and measurements are thus useful only when these conditions are fulfilled.

5. — Special programmes

It is recommended that special programmes are initiated for better knowledge of D and lower E layer by means of :

(*a*) Partial reflection techniques,

(*b*) Cross modulation techniques combined with suitable measurements with rockets.

It is desirable to attempt to discover the geomagnetic cut-off for the cosmic radiation which generates the normal ionization at low heights in the ionosphere, by A2 methods.

Drift Observations (D)

1. — Objectives

(*a*) To resume measurements of ionospheric drifts at as many as possible of those stations which operated during the I.G.Y.

(*b*) To set up other stations in locations specified broadly in section 2.3. below.

(*c*) To measure drifts by several methods, such as those specified below, and to inter-compare the results.

2. — Programme of observations

2.1. — *Synoptic*

Evaluation of I.G.Y. drift observations has shown that, in order to obtain satisfactory statistical results, it is necessary to have a large number of observations spread in time. It is therefore recommended that, during I.Q.S.Y., drift observations should be made according to the following schedule :

(i) About 10 days every month according to an international calendar containing (*a*) World Synoptic Intervals, (*b*) Regular World Days, (*c*) Two observation days in the middle of every week not covered in (*a*) or (*b*).

(ii) Every station should aim at taking observations at least once an hour on each frequency used. Uniform coverage should be attempted over the 24-hours.

2.2. — *Special Projects*

It is particularly emphasized that drift experiments be made simultaneously at those sites where the rocket technique of producing artificial clouds is applied, either optical or radio methods being used to track the cloud.

3.2. — *Distribution of Stations*

2.3.1. — The geophysical distribution of stations proposed for I.Q.S.Y. is such that mapping should become possible in certain zones of the world for D1-type stations. This should be the case, in particular, for the European and Western areas.

It is recommended that efforts should be made to make observations in Africa between the Mediterranean sea and an area to the south of the equatorial belt.

2.3.2. — It is strongly recommended that drift observations be made at as many as possible of the Arctic and Antarctic stations.

3. — Instruments and Techniques

3.1. — *Standard methods*

Measurements may be made by the following methods which are listed below in the order of importance attached to them :

D1 Fading intercomparison at three or more antennae spaced at about one wavelength.

D2 Radio observations on drifting meteor trails.

D3 Radio star fading with three or more antennae spaced at about 10 km.

3.2. — *Intercomparison*

3.2.1. — All those methods of drift observation given in 3.1. were successfully used during the I.G.Y. but there is need for detailed inter-comparison at certain common locations.

3.2.2. — Intercomparisons should be made using method D1 on different frequencies in order to obtain information on the D, E and F regions.

3.2.3. — It is not yet clear what features of the fading pattern are drifting with the ionospheric plasma. It is important that the two main methods of record analysis, i.e. those of similar fades and of correlation analysis, be intercompared more seriously by experimental work on the same samples, as well as by all other possible ways. This is applicable to methods D1 and D3.

3.2.4. — It is important, in the case of method D2, that the sensitivity of the equipment should be high enough to permit a satisfactory statistical coverage. This has not always been the case in the past.

Investigations of Atmospheric Noise (N)

1. — Objectives

The objectives of the work proposed for the I.Q.S.Y. are to :

(*a*) Explain the generation of noise and evaluate the energy radiated from lightning discharges at all frequencies.

(*b*) Describe quantitatively the distribution of the incidence of lightning discharges over the whole world, in statistical terms.

(*c*) Use current knowledge of propagation to assess the probable noise intensities at a number of receiving locations of particular interest, including those where regular measurements of noise are in progress. Allowance would be made for the directivity of the receiving antenna.

2. — Programme of Observations

2.1. — *Synoptic*

It is recommended that effort should be concentrated on observations designed to provide information on the following items to extend the work performed during the I.G.Y. :

(*a*) The statistical distribution of the incidence of lightning discharges. The extensive use of simple lightning flash counters would probably be suitable for this purpose.

(*b*) The spectral distribution of the radiated energy.

(*c*) The integrated noise level as carried out during the I.G.Y.

(*d*) The waveform of atmospherics.

2.2. — *Special Projects*

(*a*) Noise measurements might well be extended into the ELF range. The theory that noise at these frequencies, measured at any station, is a good index of the total noise generated over the whole world, should be checked at several stations.

(*b*) Should any experiments be performed in rockets and satellites consideration must be given to the provision of the appropriate supporting ground organization.

2.3. — *Distribution of Stations*

(*a*) Item 2.1 (*a*) should be carried out in co-operation with WMO, as this organization is interested in problems involving the use of lightning flash counters.

(*b*) Item 2.1 (*b*) has been performed hitherto in temperate regions only. Work should be extended to the tropics.

3. — INSTRUMENTS AND TECHNIQUES

Particular attention should be given to the accurate calibration of apparatus used for measuring integrated noise levels. A rapid interchange of data between stations making such measurements should be arranged so that a continual comparison and check on accuracy may be made.

Whistlers and VLF Ionospheric Noise (W)

1. — INTRODUCTION

During the I.G.Y. tape recordings of whistlers and V.L.F. ionospheric noise were collected from many stations in the northern and southern hemispheres. Auroral 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 V.L.F. ionospheric noise and whistlers have been better defined. New relations have been discovered between V.L.F. ionospheric noise and other phenomena such as aurorae 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 V.L.F. ionospheric noise. In addition, new special programs on E.L.F. noise, continuous V.L.F. noise observation, fixed-frequency whistler-mode observations, and satellite observations of whistlers and V.L.F. ionospheric noise are recommended.

2. — Synoptic Observations

It is recommended that the I.G.Y. whistler programme be repeated at selected stations for which data of good quality were obtained during the I.G.Y. These stations should be selected to provide good geographical coverage, including low, medium and high geomagnetic latitudes. Special emphasis should be given to pairs of magnetically conjugate stations. It is further recommended that the frequency range 15-20 kc/s be included so that V.L.F. code transmissions will be available for accurate relative timing.

3. — Data

It is recommended that numerical values of whistler dispersion for each hourly sampling period of each day be supplied to the world data centres for both the I.G.Y. and the I.Q.S.Y. at as many of the synoptic stations as possible. Complete information on the method of data reduction should also be supplied.

4. — Continuous V.L.F. noise recording

To obtain a full picture of the time variation of V.L.F. 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. — E.L.F. noise

Between the lower frequency limit of the standard whistler recorder (about 300 cps) and the upper frequency limit of observations of geomagnetic field fluctuations (about 10 cps) is a region where strong ionospheric noise can be observed. It is recommended that continuous recordings in the band 10-300 cps be carried out at stations engaged in continuous V.L.F. noise recording, particularly those at high latitudes.

6. — 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 just outside, in and inside the auroral zones.

7. — Fixed-frequency whistler-mode propagation

The properties of whistler-mode propagation can be studied using pulses from high power V.L.F. transmitters. It is recommended that whistler stations make regular measurements of the relative intensity and group delay of any V.L.F. pulse transmission which can be received in the whistler mode.

8. — Rocket and satellite observations

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

9. — Related disciplines

It is recommended that wherever possible whistlers and V.L.F. ionospheric noise be recorded at locations where other ionospheric and magnetic measurements are made. Phenomena which are thought to be connected with whistlers and V.L.F. ionospheric noise include auroral fluctuations, both visual and optical, geomagnetic micropulsations, magnetic storms, F region electron density, and ionospheric absorption. Measurement of all of these phenomena will therefore be of interest at whistler stations.

Diffusion électronique incohérente (Scatter sounding)

La possibilité d'utilisation de la diffusion électronique incohérente, mise en évidence depuis l'A.G.I., offre un important moyen d'étude de l'ionosphère et de l'exosphère.

Les stations en état de fonctionnement pendant l'A.I.S.C. sont :

— Lima, Pérou (N.B.S., U. S. A.).

— Porto Rico, Porto Rico (Cornell University, U. S. A.).

— Stanford, California (Stanford University, U. S. A.).

— Cambridge, Massachusetts (M.I.T., U. S. A.).

— Nançay, France (C.N.E.T., France).

— Malvern, England (R.R.E., U. K.).

Toutes ces stations peuvent procéder à des mesures du profil de densité et il est souhaitable que ces mesures puissent être comparées entre elles et aux mesures provenant des sondages verticaux classiques pour l'ionosphère intérieure et aux autres mesures possible pour l'ionosphère extérieure (satellites de sondage par en haut notamment). Il est également recommandé que les heures de mesure tiennent compte des horaires adoptés pour les sondages verticaux classiques.

Les caractéristiques particulières des diverses stations permettent d'autres types de mesures (température, composition, mouvements de l'ionosphère).

De telles mesures sont fortement recommandées pendant l'A.I.S.C. et il est souhaitable que leur mise en œuvre soit coordonnée et permette dans la mesure du possible une comparaison avec d'autres méthodes d'approche des mêmes paramètres.

Radars auroraux (Radar Aurora)

L'étude continue des aurores par des échos radar est fortement recommandée et devrait être faite en conjonction avec d'autres méthodes d'étude des aurores.

Les stations de radar auroraux prévues pendant l'A.I.S.C. sont :

— U. R. S. S. : Mourmansk, Tixie Bay, Dikson I, Mirny.

— U. S. A. : Barrow (Alaska), Cold Bay (Alaska), College (Alaska), Kenai (Alaska), Kodice (Alaska), Pullman (Washington).

— France : Port aux Français (Kerguelen), Dumont d'Urville (Terre Adélie).

— Grande Bretagne : Halley Bay (Weddell Sea).

— Australia : Tasmanie.

— Nouvelle Zélande : Invercarghill.

Diffusion ionosphérique (Forward Scattering)

Pendant l'A.G.I. l'exploitation de liaisons en ondes métriques en pratique dans les régions de haute latitude a fourni des renseignements importants sur l'occurence et l'extension des absorptions anormales liées aux arrivées de particules dures (P.C.A.).

Aux latitudes moyennes, les mêmes techniques fournissent des indications sur les trainées ionisées produites par les météorites, sur l'occurence des couches E sporadiques, et sur les mouvements de la basse ionosphère.

Il est fortement recommandé :

1) Que l'effort entrepris pendant l'A.G.I. pour l'exploitation scientifique des liaisons en pratique soit continué et étendu pendant l'A.I.S.C.

2) Qu'un effort de coopération internationale soit entrepris pour la création dans la zone antarctique d'un réseau de liaison, à caractère purement scientifique, susceptible de compléter les indications fournies par les riomètres.

Oblique Incidence and Back-Scatter Experiments

Taking into account the importance of oblique incidence and back-scatter observations for a better knowledge of long-distance propagation and ionospheric phenomena, it is recommended that :

(*a*) Oblique incidence and back-scatter experiments should systematically be repeated during I.Q.S.Y. as they have been done during I.G.Y. and possibly incremented, by all suitable techniques, including accurate determination of propagation time of signals, by utilizing continuous time signals transmissions or special transmissions.

(*b*) The necessity of a statistical evaluation of data should be emphasized and continuous signal intensity records should be made during selected time intervals, thus permitting a subsequent analysis.

Attention is drawn to the « Preliminary Directory of Oblique Incidence Sounding Activities » compiled by O. Sandoz, ad hoc Correspondent on Oblique Soundings for U.R.S.I.-C.I.G. Committee and giving a complete account and details on experiments conducted during I.G.Y.

Recommendations

1. — It is recommended that the I.Q.S.Y. organization develop a plan for improved coordination of special vertical sounding experiments during I.Q.S.Y. It is very desirable that there be good channels for information flow to ionospheric organizations for such items as the selection of intervals of unusual interest for special data reduction and interchange. The World Data Centres might play a role in this coordination.

2. — It is recommended that the reports of the U.R.S.I.-C.I.G. groups studying ionosondes and antennas for vertical soundings be circulated as soon as possible to all groups concerned with the relevant I.Q.S.Y. programme.

3. — It is recommended that participating I.Q.S.Y. Committees planning ionospheric experiments from ocean research vessels coordinate their plans through the Reporter for Ionosphere such that, as far as possible, the ocean measurements will be coordinated in time, for example the second half of 1965, and in location.

World Data Centres

4. — Pre-I.Q.S.Y. Period.

For the period between the present time and the beginning of the I.Q.S.Y. it is recommended that no change should be made in the organization of World Data Centres for the ionosphere.

5. — I.Q.S.Y. Period.

5.1. — It is considered that the proposals of the Soviet Union as given in a Draft Guide to World Centres of Geophysical Data were received too late for consideration by National Committees. It is therefore suggested that a reasonable period should be allowed for the consideration of these proposals by all national Committees. In the meantime the tentative views of the Working Group are given below.

5.2. — The Working Group saw no objection to the proposal to maintain World Data Centres A and B as the only centres, provided all necessary collections of data are available at other centres which might be termed World Data Processing Centres. It is considered that in the case of the ionospheric programme, the necessary data in each type of centre is the same.

It was suggested that the centres named at the head of the I.Q.S.Y. Guide for each discipline should read :

W.D.C.-A	World Data Collection Centre - A
W.D.C.-B	World Data Collection Centre - B
W.D.C.-C1	World Data Processing Centre - C1
W.D.C.-C2	World Data Processing Centre - C2

etc.

The Guide for data flow should specify to which centre or type of centre each individual type of data should be sent.

5.3. — Suggestion to designate certain stations as « key » stations.

In view of earlier experience in categorising observing stations it is not recommended that stations be designated as proposed in the Soviet document referred to above and that the objective be attained in some other way. This may well be possible by categorising programmes as « synoptic » and « special ». The stations participating in special programmes would be undertaking for example, regional studies, from part of close-spaced networks, or be control stations for rocket experiments.

It is suggested that, in any case, this topic be referred for consideration to National Committees.

I.Q.S.Y. Publications

6. — It is recommended that since there is a requirement for a short Instruction Manual on absorption method A3 and as

this can be most expeditely published by the Reporter for Ionosphere in the Proceedings of Max-Plank-Institut für Aeronomie it should not be delayed for inclusion in an I.Q.S.Y. series of publications.

7. — It is recommended that a decision as to whether I.Q.S.Y. data should be published internationally should be deferred until experience has been obtained, especially from workers in other disciplines, from the publication of the I.G.Y. Ionosphere Volume.

8. — It is recommended that all results and conclusions from I.Q.S.Y. work should be published in the scientific press and not in any I.Q.S.Y. publication series.

Working Group on World Days

1. The requirements for each discipline were presented in the following categories : (*a*) I.Q.S.Y. Calendar of Regular World Days and Intervals, (*b*) Alerts or warnings of geophysical events, (*c*) special intervals declared as I.Q.S.Y. progresses, (*d*) rapid dissemination of current data, (*e*) calendar record, and (*f*) other. The requirements for each discipline are given in each working group report. It was decided that the Reporter, in consultation with the I.U.W.D.S., should combine the requirements into a draft World Days program for I.Q.S.Y., made final as soon as possible after contact with the discipline Reporters or, if practical, at a later plenary meeting on I.Q.S.Y.

2. It is recommended that the World Day Program developed for I.Q.S.Y. be put into effect as much as possible beginning in 1963 both in order to gain experience prior to I.Q.S.Y. and to assist programs and experiments which will already be running.

3. It is recommended that the I.Q.S.Y. Calendar be made final during 1962 and given wide distribution so that discipline and national planning can take into account the specified World Days and intervals. The full final World Day program document should if possible also be completed in 1962.

4. It is recommended that the World Days program document for I.Q.S.Y. include full information on the partial, annular and total eclipses of the sun in the years 1964 and 1965, including predictions of the tracks, times and other relevant data for ground

level and for 100, 200 and 300 km in the atmosphere, and the cooperation of the ephemeris offices is requested in this connection.

5. Considering that a rapid dissemination of a daily solar index is of great usefulness for a preliminary analysis of various geophysical observations during I.Q.S.Y., it is recommended that a preliminary determination of the solar flux at a wavelength of the order of 10 cm be distributed over the telegraphic system coordinated by the World Days organization.

6. One of the innovations proposed for the I.Q.S.Y. World Days program is the retrospective designation of events of special interest selected for detailed study, the designation to be made within a few days of the event. The reporters for the scientific disciplines interested in this proposal are requested to designate an individual to assist the World Days organization in working out details of assistance which the World Days organization may be able to give to the plan.

Deuxième réunion, Rome, 18-22 mars 1963

La deuxième réunion aura lieu à Rome durant la semaine du 18 au 22 mars 1963.

Cette réunion constituera la dernière occasion, avant le début de l'I.Q.S.Y. en janvier 1964, qui permettra une discussion approfondie des programmes envisagés dans les différentes disciplines ainsi que l'examen des programmes scientifiques proposés par les pays. Le Comité de l'I.Q.S.Y. espère que tous les pays enverront des délégués à Rome pour prendre part aux travaux des Groupes de travail et aux discussions générales. La représentation nationale se trouvera assurée à travers une réunion du Comité Consultatif.

Second Meeting, Rome, 18-22 March 1963

The Second Meeting will take place in Rome during the week 18th to 22nd March, 1963.

This meeting will be the last occasion, before the start of the I.Q.S.Y. on 1st January 1964, for a full discussion of the programmes envisaged in the different disciplines and for reviewing the scientific programmes proposed by the different countries. The I.Q.S.Y. Committee hopes that all countries will send delegates to Rome to take part in the Working Groups and also in the general discussions. National representation will be ensured by a meeting of the Consultative Committee.

DEUXIEME REUNION DE L'I.Q.S.Y.

Rome, Italie ; le 18-22 mars, 1963

PROGRAMME PROVISOIRE

(English text on p. 92)

Lundi, 18 mars : Séance du Bureau et Membres Administratifs du Comité de l'I.Q.S.Y.

Mardi, 19 mars :

Matin : Première Séance Plénière des Délégués.

Après-midi : Groupes de Travail pour les Disciplines, etc. et, simultanément, Séance du Comité Consultatif (délégués principaux).

Mercredi, 20 mars : Groupes de Travail.

Jeudi, 21 mars :

Matin : Groupes de Travail.

Après-midi : Libre.

Vendredi, 22 mars :

Matin : Deuxième Séance Plénière.

Après-midi : Suite de la Séance Plénière (s'il le faut).

Le 20 et 21 mars, on envisage la possibilité de résumés présentés par les Rapporteurs des Disciplines sur les phénomènes les plus importants qui auront lieu pendant le minimum de l'activité solaire.

SECOND I.Q.S.Y. MEETING

Rome, Italy ; 18th-22nd March, 1963

PROVISIONAL PROGRAMME

Monday, 18th March : Meeting of Bureau and Administrative Members of the I.Q.S.Y. Committee.

Tuesday, 19th March :

Morning : First Plenary Meeting of Delegates.

Afternoon : Discipline and other Working Groups and, simultaneously, Meeting of the Consultative Committee (principal delegates).

Wednesday, 20th March : Working Groups.

Thursday, 21st March :

Morning : Working Groups.

Afternoon : Free.

Friday, 21st March :

Morning : Second Plenary Meeting of Delegates.

Afternoon : Continuation of Plenary Meeting, if necessary.

On 20th and 21st March it is possible that the Discipline Reporters will present short reports on the most important phenomena which will occur during the minimum in solar activity.

L'Organisation de l'I.Q.S.Y.

Le Comité de l'I.Q.S.Y. consiste en des représentants des Unions Scientifiques, des Associations et des Comités du Conseil International des Unions Scientifiques à l'exception des représentants de la Région Europe-Asie, de l'Inde et de l'O. M. M.

La représentation nationale est assurée par le Comité Consultatif qui consiste en un représentant de chacun des comités participants (C.I.G. News N. 6, p. 229). Ce Comité est analogue à l'ancien

« Advisory Council » du Comité Spécial de l'Année Géophysique Internationale.

Une réunion du Comité Consultatif aura lieu en même temps que la prochaine Réunion Plenière à Rome pendant laquelle les programmes scientifiques de l'I.Q.S.Y. seront discutés. Le Bureau du Comité de l'I.Q.S.Y. expédiera plus tard à chaque Comité participant une invitation formelle d'y envoyer un représentant.

Organisation of the I.Q.S.Y.

The I.Q.S.Y. Committee consists of representatives of the Scientific Unions, Associations and Committees of the International Council of Scientific Unions with the exception of the representatives of the Europe-Asia and Indian Regions and of the W. M. O.

National representation is assured by the Consultative Committee which consists of one representative from each of the participating Committees (C.I.G. News No. 6, p. 229). This Committee is analogous to the former Advisory Council of the Special Committee for the International Geophysical Year.

A meeting of the Consultative Committee will be held at the same time as the Plenary Meeting in Rome at which the scientific programmes for the I.Q.S.Y. will be discussed. The Bureau of the I.Q.S.Y. Committee will later issue a formal invitation to each participating Committee to send a representative.

Copy of a letter sent to National Committees

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

Dear Colleague,

During the period 1 January 1964 to 31 December 1965 it has been agreed to organise an international geophysical enterprise under the title « International Years of the Quiet Sun ». The original proposal for such an enterprise at a period of solar minimum activity was made by the U.R.S.I.-I.G.Y. Committee meeting at Edinburgh in 1958. The proposal has subsequently been endorsed by many scientific bodies and in September last the General

Assembly of the International Council of Scientific Unions unanimously pledged full support for the project. If the I.Q.S.Y. is to have the success which it merits it is vital that the world coverage of geophysical observations in this period be as complete as possible and I have been asked, as President of U.R.S.I., to help ensure this full world coverage. I understand that your country has not yet indicated that they will be participating in I.Q.S.Y. and I write now to invite your National U.R.S.I. Committee to take the initiative in stimulating the organisation of an I.Q.S.Y. Committee in your country. Since the I.Q.S.Y. is scheduled to start on 1 January 1964 it is desirable that action should be taken as soon as possible.

The international aspects of I.Q.S.Y. are being organised by a special Committee, the Secretariat of which has been established in London. The Secretary of the I.Q.S.Y. Committee Dr. C. M. Minnis will be pleased to supply any assistance or further information.

Enquiries should be addressed as follows : Dr. C. M. Minnis, *Secretary*, I.Q.S.Y. Committee, 6, Cornwall Terrace, London N. W. 1.

Yours sincerely,

R. L. Smith-Rose,
President, U.R.S.I.,
21, Tumblewood Road, Banstead, Surrey,
United Kingdom

COMITÉ INTERNATIONAL DE GÉOPHYSIQUE

The Minutes of the Meeting of the Comité International de Géophysique, Paris, 22, 24 and 29 March 1962, have been published in the I.U.G.G. Chronicle n° 45, August 1962.

COSPAR

Satellite Tracking Stations

C.O.S.P.A.R. World List of optical satellite tracking stations has been published in *C.O.S.P.A.R. Information Bulletin* nº 10, August 1962.

Fifth Meeting

Washington D. C., U. S. A., April 30 - May 9, 1962

REPORT OF THE MEETING

(Abstract)

U.R.S.I. was represented by Prof. W. J. G. Beynon and I.U.W.D.S. by Mr. A. H. Shapley.

At this meeting Prof. van de Hulst handed his resignation as President of C.O.S.P.A.R. He recalled that on several occasions he had expressed his desire to retire from the presidency. Referring to the rule that every officer has a term of three years, he remarked that when he accepted the nomination at the Nice meeting of C.O.S.P.A.R. in January 1960, he asked permission to consider his term of office to have started in November 1958. He thanked all the members of C.O.S.P.A.R. for their cooperation and mentioned that he had very much enjoyed his work as president. He asked the Executive Council to accept his resignation. The Executive Council deeply regretted Prof. van de Hulst's decision and accepted his resignation with great reluctance.

The Executive Council then nominated unanimously Professor Maurice Roy, representing the International Union of Theoretical and Applied Mechanics, as President for the year 1962-63. The Plenary meeting of C.O.S.P.A.R. unanimously approved this nomination. In order not to confuse the scheduling of elections, the term of Prof. Roy's appointment was made for one year, and next year there will be new elections for the entire Bureau.

The contents of the Report is as follows :

Reports of International Organizations

U.R.S.I., by Prof. W. J. G. BEYNON.

«At the XIIIth General Assembly held in London in September 1960, U.R.S.I. established a Committee for Space Radio Research the membership of which consists, in the main, of representatives from each of those U.R.S.I. Commissions concerned directly with space radio research. This Committee was given the responsibility of coordinating U.R.S.I.'s interest in space radio research and also charged with organizing, between General Assemblies, such specialist symposia as was considered desirable. Since the last meeting of C.O.S.P.A.R. one such symposium has been held, and a brief account of the meeting forms the main topic of the present report.

The symposium was devoted to a discussion of the scientific and research problem of satellite radio communication systems. By kind invitation of the French National Committee of U.R.S.I. the meeting was held in Paris over a period of 5 days in September 1961. A total of 116 delegates and about 50 observers from some 12 countries participated. Although the meeting was organized under the auspices of U.R.S.I., C.O.S.P.A.R. was kept fully informed of the arrangements and the President of C.O.S.P.A.R. was present at the meeting. Some 37 papers were presented and the main topics discussed were :

(i) the launching, attitude control and tracking of communication satellites ;

(ii) problems of radio frequency allocation, interference and propagation ;

(iii) radio equipment for communication satellites ;

(iv) ground based radio equipment for communication satellites

(v) modulation systems ;

(vi) specific communication systems (including satellites in random orbits, synchronous orbits, orbiting dipoles, etc.) ;

(vii) various aspects of communication satellites such as the economics of such systems and transmission-time problems.

It was generally agreed that the meeting was very successful and the full texts of the papers, together with an account of the discussions, is about to be published by U.R.S.I. in the form of a monograph entitled « Space Communication Research ».

Two other space radio research matters involving U.R.S.I. on which I wish to report to C.O.S.P.A.R. are the following :

The first concerns the application of information theory to space research experiments. At some time between now and the 1963 U.R.S.I. General Assembly, possibly during the Assembly itself, the U.R.S.I. Space Radio Research Committee plans to organise a meeting to discuss the problem of the most efficient transmission of information in space experiments — and a small group under the chairmanship of Professor Silver of the U. S. A. is being invited to consider organising such a meeting.

Secondly I think C.O.S.P.A.R. may wish to note the fact that, in the various Commission programmes which have just been drafted for the forthcoming Tokyo General Assembly of U.R.S.I., the subject of radio in space research figures quite prominently. Thus Commission II is scheduled to discuss tropospheric problems which may bear space communication ; Commissions III and IV will discuss the electron distribution to the greatest heights including all data obtained from rockets and from satellite top side sounders ; Commission V will discuss the radio astronomy of the solar system, including a consideration of radio astronomy from space vehicles ; Commission VI will discuss the topics I have already mentioned, viz., information theory and space research experiments and also problems of data processing, including circuits for data processing and the application of these in space experiments ; Commission VII topics include the applications of lasers and masers in radio science, the subject of plasmas in both geophysics and astrophysics and the question of satellite communication devices. From this brief report I hope it will be evident that U.R.S.I. is certainly active in its consideration of the many problems involving radio waves and space exploration. »

Inter-Union Committee on Frequency Allocations for Radio-Astronomy and Space Research (I.U.C.A.F.), by Prof. H. C. van de HULST.

Prof. van de Hulst mentioned that he had been asked to report on I.U.C.A.F. at the C.O.S.P.A.R. meeting as one of the representatives of C.O.S.P.A.R. on I.U.C.A.F. He recalled that this Committee brings together representatives of U.R.S.I., I.A.U. and C.O.S.P.A.R., and was formed to strengthen and coordinate the efforts to obtain sufficiently clear and sufficiently wide frequency bands allocated to radio astronomy and to space science.

Two meetings of I.U.C.A.F. were held in the past twelve months. I.U.C.A.F. maintains a continuous review of the situation with respect to proposed allocations and studies the requirements on tolerable levels of man-made interference, etc. There is some satisfaction in the facts that pure scientific research is now regarded as a service and that the European Broadcasting Conference made channel 38 in television band V (from 606-614 Mc/s) largely free for radio astronomy.

However, the main worries still remain and administrators and scientists in many countries should realize, that this is a matter of survival of these branches of science.

Most of the work in the recent I.U.C.A.F. meetings was directed to preparing for the Extraordinary Administrative Radio Conference of I.T.U. which will take place in Geneva in October 1963.

I.U.C.A.F. has pressed for placing Radio Astronomy also on the agenda of this meeting, which is primarily devoted to space communications.

International Ursigrams and World Days Service (I.U.W.D.S.), by Mr. A. H. SHAPLEY.

Dr. A. H. Shapley, I.U.W.D.S. representative to C.O.S.P.A.R., recalled that the I.U.W.D.S. is an inter-Union commission comprised of the following Unions : I.A.U., I.U.G.G., and U.R.S.I.

The basic program of I.U.W.D.S. comprises (1) issuance of International Geophysical Calendars, (2) development and operation of plans for Geophysical Alerts and Special World Intervals, and (3) preparation of Calendar Records of Solar and Geophysical highlights for each year.

Mr. Shapley explained that the cooperation of I.U.W.D.S. with C.O.S.P.A.R. had been with respect to the International Geophysical Calendars. For example in the 1963 Calendar, World Synoptic Intervals have been marked for synoptic meteorological rocket programs as designated by C.O.S.P.A.R. and W.M.O. He mentioned the close cooperation of I.U.W.D.S. with C.O.S.P.A.R. Working Groups.

He referred also to the use of the I.U.W.D.S. rapid communication arrangements for distributing satellite information known as the Spacewarn network.

Comité International de Geophysique (C.I.G.), by Prof. W. J. G. BEYNON, *President.*

« The International Committee for Geophysics (C.I.G.) was formed by the International Council of Scientific Unions in 1959. It is an inter-Union Committee with representation from four Scientific Unions, — those of Geodesy and Geophysics, Scientific Radio, Astronomy and Pure and Applied Physics. In addition there are representatives of others Special or Scientific Committees of I.C.S.U. and of certain other international organizations such as the World Meteorological Organization. Under its Rules (as formulated by I.C.S.U.) one of the main functions of the Committee is « to develop and coordinate international plans for the furtherance of cooperation in geophysics and related sciences, specially those of an inter-disciplinary nature ».

Just over a year ago C.I.G. made the formal proposal to I.C.S.U. that at the period of next solar minimum activity, in 1964-65, a renewed international enterprise should be organized and the title suggested for the project was « The International Quiet Sun Year (I.Q.S.Y.) ». The proposal was considered by the I.C.S.U. General Assembly meeting in London last September and received the unanimous and very warm support of that meeting and I.C.S.U. charged C.I.G. with the responsibility for organizing the International Quiet Sun Year.

A month or so ago C.I.G. called the first meeting of representatives of nations to consider the organization of I.Q.S.Y. and some 25 nations were represented. Arising from this meeting a recommendation has gone forward to I.C.S.U. that a new Committee be established under C.I.G., to organize I.Q.S.Y. with W. J. G. Beynon as President and with a special I.Q.S.Y. Secretariat established in London. The following disciplines are represented on the I.Q.S.Y. Committee — Meteorology, Geomagnetism, Aurora, Airglow, Astronomy, Ionosphere, Solar Activity, Cosmic Rays. All these disciplines will, of course, be concerned with space experiments during I.Q.S.Y. and to coordinate the space research aspects of the I.Q.S.Y. program, and to act as a link between the I.Q.S.Y. Committee and C.O.S.P.A.R., we nominated to the Committee two representatives from the space research field, viz., Dr. Friedman and Dr. Blamont. With these two representatives, one for rockets and one for satellites, we hope to ensure that a close liaison between the I.Q.S.Y. Committee and C.O.S.P.A.R. will be established.

One point should be mentioned here viz., that in view of the exceptionally rapid fall in solar activity we decided to start I.Q.S.Y. on 1 January 1964 instead of 1 April 1964. Hence the I.Q.S.Y. will now start on 1 January 1964 and end on 31 December 1965.

At our Paris meeting last month we established Working Groups in each of the disciplines and instructed each Group to give particular attention to the space research aspects of their I.Q.S.Y. proposals. Each discipline Working Group was also asked to supply the C.O.S.P.A.R. Correspondent on C.I.G. (Dr. Bartels) with a report covering space research discussion on their discipline so that Dr. Bartels would be in a position to report fully to C.O.S.P.A.R. on the many aspects of space research in relation to I.Q.S.Y. discussed at our Paris meeting.

At this meeting the relevant C.O.S.P.A.R. groups have considered further, and when necessary elaborated and added to, these suggestions which we, in C.I.G., put forward for space research work during I.Q.S.Y. As President designated of the I.Q.S.Y. Committee I should like to express now my complete confidence that the I.Q.S.Y. Committee and C.O.S.P.A.R. will cooperate closely to ensure that the International Quiet Sun Years of 1964-65 are a worthy successor to the I.G.Y. of 1957-58.

Resolutions

The following resolutions were adopted. Only those of direct interest to U.R.S.I. are given.

RES. 1. — *Consultative Group on Potentially Undesirable Effects on Space Experiments.*

In order to carry out the responsibility for careful, objective, quantitative studies of space experiments with potentially undesirable effects on scientific activities and observations, which C.O.S.P.A.R. has accepted in response to I.C.S.U. resolution, the Executive Council decides to establish a Consultative Group on Potentially Harmful Effects of Space Experiments, to consist of not more than six broadly competent scientists having among them specialized knowledge of Astronomy, Radiation Physics, Atmospheric Physics and Chemistry, Communications, Meteorite Penetration and Microbiology, to be named by the President of C.O.S.P.A.R.

It is expected that this Consultative Group will act as a focal point in I.C.S.U. for consideration of all questions regarding potentially harmful effects of space experiments on scientific activities and observations, and that in this capacity it would (1) examine in a preliminary way all questions relating to possibly harmful effects of proposed space experiments, including but not restricted to questions referred to it by any of the I.C.S.U. Unions ; (2) determine whether or not any serious possibility of harmful effects would indeed result from the proposed experiment; (3) in consultation with appropriate Unions, appoint and arrange for convening an ad hoc Working Group or Groups to study any expected effects which are considered to be potentially harmful, such Working Group or Groups to include competent scientists in the appropriate specialized disciplines ; (4) receive and consider conclusions or recommendations of those ad hoc Working Groups in a timely manner; and (5) prepare final recommendations to the C.O.S.P.A.R. Executive Council for its further action.

Positive or negative recommendations or studies considered appropriate by the Council for dissemination would then be made available to all C.O.S.P.A.R. adherents, the I.C.S.U. Bureau, the appropriate Unions of I.C.S.U., and to appropriate bodies of the United Nations or its specialized agencies.

Working Group 1. — *On Tracking and Telemetry*

Res. 2. — *Code numbers of Tracking Stations.*

C.O.S.P.A.R. considers that it is undesirable that a tracking station should have more than one code number and recommends that W.D.C.-C who is responsible for the compilation of the World List of Tracking Stations, should request the multiple numbered stations and co-ordinating centres concerned to come to an agreement on the use of a single number. It is also recommended that a number which has once been allocated to a station should not be reallocated to an-other station even if the original station has ceased to be operational.

Res. 9. — *Change in the title of Sub-Group on Radio Tracking.*

The Committee on Space Research (C.O.S.P.A.R.), *considering* that :

(*a*) the title of Working Group 1 is « Tracking and Telemetry »,

(*b*) there is a Sub-Group concerned with radio tracking but none concerned with telemetry,

decides, on the recommendation of Working Group 1, that the title of the Sub-Group on Radio Tracking be changed to « Sub-Group on Radio Tracking and Telemetry »,

Res. 10. — *Definition of « space research service » and allocation of separate frequency bands.*

C.O.S.P.A.R., *considering* that :

(*a*) it is probable that an Extraordinary Administrative Radio Conference of the I.T.U. will be held in 1963 to allocate frequencies for space radio communications and for space research, (*b*) frequencies assigned to space research will be needed for tracking, command, and telemetry of engineering and technological data, as well as for the main telemetry of scientific results,

(*c*) frequencies assigned to operational communications systems will be needed for tracking, command, and telemetry of engineering and technological data, as well as for the main purpose of communications,

Recommends that :

1. a space research service should be defined a space service, or earth-space service providing for the transmission of scientific and technological information acquired by or pertaining to earth satellites or spacecraft. Technological information is defined here as those research and development data required for the development of future scientific satellites and spacecraft. Engineering status information from development or use of *operational* satellites or spacecraft would not be considered a part of the space research service ;

2. frequencies should be assigned to the space research service and to operational communications systems in separate bands.

RES. 11. — *Allocation of frequencies for the space research service.* C.O.S.P.A.R., *considering* that :

(*a*) at the I.T.U. Conference held in Geneva in 1959 C.O.S.P.A.R. presented in outline a list of the frequencies required for space research ;

(*b*) the U. S. A. has proposed and circulated a document entitled « Preliminary Views on Frequencies required for Space Research » ;

Recommends that an allocation of frequencies similar to that in the « Preliminary Views », but with the addition of a telemetry band 401-402 Mc/s is necessary and sufficient for the space research service.

RES. 12. — *Allocation of frequencies on a world-wide exclusive basis.*

C.O.S.P.A.R., *considering* that the techniques of space science are developing so rapidly and the requirements for telemetry are so stringent,

Recommends that allocation of frequencies for space science should be made on a world-wide exclusive basis.

RES. 13. — *Definition of Radio Tracking Station.*
The Committee on Space Research (C.O.S.P.A.R.),

Considering that :

In accordance with C.O.S.P.A.R. Resolution 6 of the Florence meeting it was resolved that a world list of radio tracking stations should be compiled and that the preparation of such a list would be facilitated if there was a definition of a Radio Tracking Station,

Recommends that :

A Radio Tracking Station should be defined to be a radio station which has facilities for providing either positional or directional data for the purpose of obtaining orbital information about scientific earth satellites or information about the track of other scientific space vehicles, and which operates on a reasonably regular programme for such purposes.

RES. 14. — *Standardizing of frequencies in telemetry systems.*
C.O.S.P.A.R., *considering* :

(*a*) that it is often advantageous to receive the telemetry from satellites at several different ground stations, not necessarily belonging to the same organization, but

(*b*) that there is less advantage at present to be gained in standardizing the detailed carrier modulation systems,

Recommends :

That all who design telemetry systems should endeavor to standardize the frequencies on which they work, and the arrangements required for recording the transmissions, but not necessarily the detailed carrier modulation systems.

WORKING GROUP 2. — *For the I.Q.S.Y.*

RES. 15. — *C.O.S.P.A.R. Working Group for the I.Q.S.Y.*

The Committee on Space Research (C.O.S.P.A.R.), *considering* the importance of space research in the forthcoming I.Q.S.Y., and contemplating that separate Working Groups may be established for subjects such as space biology, lunar and planetary studies, space experiments having potentially undesirable effects on other scientific studies, etc.

Decides, on the recommendation of the Executive Council, that the existing title of Working Group 2 (Scientific Experiments) be discontinued and that it be replaced by the title « C.O.S.P.A.R. Working Group for the I.Q.S.Y. ». This new Working Group is to consist of the same members as the old Working Group 2 except for Prof. M. Florkin and Prof. J. Lederberg. It will also include the present Panels on « Synoptic Rocket Soundings » and « Polar Cap Experiments ».

It is contemplated that this new Working Group will consider all phases of space research associated with the I.Q.S.Y. and W.M.S., and in addition will give attention to preliminary plans for space research during the next period of maximum solar activity.

RES. 16. — *Telemetry on Real Time.*

C.O.S.P.A.R. recommends that satellites be instrumented to measure various basic geophysical parameters and to transmit such data in real time for reception by ground based observatories. These data would permit scientists in various countries to extract information of particular significance to their work, without delay and in the form in which they require. Examples of such fundamental data are :

(*a*) Solar activity studied by UV and X-Ray detectors.
(*b*) Geomagnetic activity measured by magnetometers.
(*c*) Auroral activity measured through auroral emissions.
(*d*) Particle radiations of $E > 100$ Mev for protons.
(*e*) Trapped radiations.
(*f*) Infrared emissions from the atmosphere.

It is believed that such real time telemetry can be provided with a relatively low power drain compared to the consumption by major missions of the satellites. Experience with continuous telemetry from satellites has shown that relatively simple ground based systems can be used for the acquisition of highly significant experimental data. This approach extends the benefits of satellite techniques directly to the great majority of countries unable to commit adequate resources to their own satellite programs. This calls for action by National Committees of countries which have capabilities of orbiting instrumented satellites and by National Committees of countries which are interested in receiving the data by establishing ground stations.

RES. 17. — *Determination of Conjugate Points of Geomagnetic Field Lines.*

C.O.S.P.A.R. establishes a « Preparatory Group on Determination of Conjugate Points of Geomagnetic Field Lines » to investigate experimental approaches to this problem (by injection of ions, radio methods, whistlers, etc.). This preparatory group consists of J. G. Roederer (Argentina, *Chairman*), R. Helliwell (U. S. A.), W. N. Hess (U. S. A.), J. Paton (U. K.) and E. H. Vestine (U. S. A.).

RES. 19. — *Probes through Comets.*

C.O.S.P.A.R. establishes a « Preparatory Group on Probes through Comets » to discuss the suggestion that Comets be studied by Space Probes. This Preparatory Group consists of R. A. Lyttleton (U. K., Convenor), L. Biermann (German Fed. Rep.), B. D. Donn (U. S. A.), P. Swings (Belgium), F. L. Whipple (U. S. A.) and one or two U. S. S. R. representatives to be designated.

RES. 20. — *Beacon-type Satellites.*

C.O.S.P.A.R. calls the attention of satellite launching organizations to the need for regular launchings of ionosphere beacon-type satellites especially during I.Q.S.Y. and recommends that observations of signals from such satellites be made on the widest possible geographical basis.

C.O.S.P.A.R. calls the attention of the U.R.S.I.-C.I.G. Committee to this resolution and invites the Committee to consider ways and means for the general coordination of a program of observations including the alerting of participants, the supply of orbital data, standardization of measurement techniques and the interchange of the results obtained.

Res. 21. — *Meteorological Rocket sondes.*

C.O.S.P.A.R. *recognizing* the valuable and unexpected results that have emerged from the present sporadic and localized launchings of meteorological rocket sondes, *strongly urges* an increase in the number of stations from the present or proposed 20-25 to at least 50, so that reasonable complete maps can be drawn of the wind and temperature patterns in the Northern Hemisphere. Launches should be scheduled in accordance with the program for aerological observations recommended by the C.I.G., to the extent that rockets and facilities are available.

To stimulate growth of the rocketsonde network and to insure coordination of launch schedules and exchange of data, it is proposed that Dr. H. Wexler, Meteorological Correspondent of W. G. 2, working in close cooperation with Dr. J. Blamont, Chairman of the Panel on Synoptic Rocket Soundings, contact the key individuals in each of the countries involved in rocket sondes. Names of such persons should be furnished by the National Committees to Dr. H. Wexler, U. S. Weather Bureau, Washington 25, D. C., U. S. A., as soon as possible.

Res. 22. — *Dynamics - Rocket measurements of winds.*

C.O.S.P.A.R. recommends that a series of simultaneous rocket measurements of winds in the lower ionosphere (up to about 200 km) be organized on, or during periods of 3 days starting 25 October 1962 and 24 February 1963.

The techniques employed should include grenades, sodium clouds and visible grenade glows.

C.O.S.P.A.R. also recommends that simultaneous ground-based measurements by radio methods also be made on the above dates.

C.O.S.P.A.R. further recommends that a similar series of simultaneous rocket and ground-based wind measurements should be organized at approximately 6-month intervals during I.Q.S.Y.

The precise dates for this work shall be determined in consultation with the I.Q.S.Y. correspondent for the International World Day Service.

RES. 23. — *Sunspot Minimum Ionospheric Rocket Sounding Programme.*

C.O.S.P.A.R. endorses the following proposal for a Sunspot Minimum Ionospheric Rocket Sounding Programme.

« An understanding of the physical processes in the D and E regions of the ionosphere, the relation between cause and effect, can at present best be obtained by rocket experiments.

With the approach of the International Year of the Quiet Sun in 1964-65, an opportunity will occur to obtain, for the first time, synoptic properties of the quiet ionosphere. To quote from the finds of the C.I.G. at their meeting in Paris in January 1961 : « Full advantage shall be taken (in the I.Q.S.Y.) of the new knowledge of solar-terrestrial relationships gained during the I.G.Y. and also of the improved and new techniques for geophysical research which have been, and will be, developed in the intervening years. »

It is proposed that a cooperative set of rocket experiments should be undertaken internationally during the I.Q.S.Y., planned in a way which will give a maximum of scientifically useful information, ensured by coordination of effort by the various interested groups. The concept of this experiment has been endorsed by C.I.G. at its first I.Q.S.Y. meeting in Paris in March 1962.

The detailed proposal is as follows :

1. The observations should cover a height range of 60 to 160 km. This range can be attained by various types of small rockets.

2. Useful locations for launch sites for study of this height region include auroral latitude, medium latitude in each hemisphere, and magnetic equatorial stations.

3. Because it is necessary to measure electron density simultaneously with other critical parameters of the atmosphere in the same rocket, the desirable measurements have been arranged in an order of priority. This order represents increasing order of complexity of the experiments, and does not necessarily corres-

pond to the order of scientific desirability. While a complete experiment would comprise all experiments (*a*) to (*i*), useful information could be obtained using a smaller number.

(*a*) Lyman-alpha photometer, for molecular oxygen densities at 70-80 km height;

(*b*) Ultraviolet photometer at 1425-1480 Å for molecular oxygen densities at 100-120 km height;

(*c*) Either an r. f. resonance probe or an ion trap, for E region electron and ion densities, respectively;

(*d*) Langmuir probe or r. f. impedance probe for electron density in the D and E regions;

(*e*) Magnetometer for current sheet measurements in the E region;

(*f*) Reverse Seddon-Jackson dispersion experiment, possibly including differential mode absorption for D and E region electron densities;

(*g*) Medium frequency radio absorption, for D region electron densities;

(*h*) X-ray photometer in the 44-60 Å band for air densities at 100-120 km height;

(*i*) R. F. mass spectrometer for E region ion composition.

4. It is essential that any rocket measurements should be accompanied by simultaneous measurements of ionospheric parameters near the launch point. Minimum measurements include :

(*a*) vertical incidence ionosphere sounder;

(*b*) cosmic noise riometer;

(*c*) sky photometer (for auroral stations only);

(*d*) partial reflection technique for D region soundings.

It might also prove desirable to have a magnetometer at each station.

5. Concerning the frequency of the observations, it is noted that the I.Q.S.Y. has eight quarters. To coordinate observations as far as possible, one day should be assigned in each quarter for simultaneous observations, to be called the Synoptic Rocket Day (S.R.D.). While various stations may have different numbers of

rockets available on any particular S.R.D., six significant times of day (local time) have been identified as follows :

1. 30 min before sunrise at 120 km level ;
2. half-way between sunrise at 120 km level and ground sunrise ;
3. 30 min after ground sunrise ;
4. noon ;
5. half-way between sunset at ground level and sunset at 120 km level ;
6. 30 min after sunset at 120 km level.

A complete program at four stations would involve a total of 192 rocket launchings.

6. Because the behavior of the D and E layers depends primarily on latitude and local time, launch programs should be coordinated between groups to give best coverage of the entire I.Q.S.Y.. »

C.O.S.P.A.R. suggests that the National Committees should, to the extent appropriate to each country, form their detailed plans for the I.Q.S.Y., within the framework of this proposal.

C.O.S.P.A.R. also requests that the Panel on Synoptic Rocket Soundings review the progress and report periodically on the implementation of this proposal.

RES. 24. — *Change in title of Panel.*

C.O.S.P.A.R. agreed on the recommendation of Working Group 2 to establish the ad-hoc Committee on Polar Cap Absorption Experiments on a long term basis and to give this Committee the new title of « Panel for Polar Cap Experiments ».

RES. 26. — *Communication channel between rocket launching facilities at Churchill and Kiruna.*

C.O.S.P.A.R. notes with considerable pleasure the proposed rocket launching facility to be built at Kiruna by the European Space Research Organization. The great advances in scientific knowledge about the lower ionosphere that will be made possible by cooperative experiments carried out et Churchill and Kiruna are so very apparent that detailed comment is not necessary here. One objective that would be an effective and very desirable stimulus to joint experiments would be a full time communication channel between Churchill and Kiruna. C.O.S.P.A.R. recommends that the countries concerned should investigate the best way of establishing such a link.

RES. 27. — *Balloon Experiment over Arctic Regions.*

C.O.S.P.A.R. *notes* :

(*a*) a proposal by Dr. J. R. Winckler of the University of Minnesota for a comprehensive balloon experiment over Arctic Regions;

(*b*) that this experiment would be of particular value to Polar Cap experiments;

and *recommends* international support for this proposed experiment.

RES. 28. — *International cooperation in balloon launched experiments.*

C.O.S.P.A.R. *notes* with pleasure the extent to which international cooperation is taking place in balloon launched experiments particularly by American and European scientists, some of the results of which have been presented at this meeting of C.O.S.P.A.R.

C.O.S.P.A.R. *recommends* continued cooperation in this field.

RES. 30. — *Desirability of experiments on polar events in South Polar Regions.*

The Committee on Space Research (C.O.S.P.A.R.),

considers that it is important that a comparison of absolute measurements in South polar as well as North polar regions be made with particular reference to phenomena related to radiation belts in which significant differences between the two regions may be expected;

notes that the coverage of the South polar region is very difficult in relation to that of the North;

recommends that all countries at high southern latitudes be urged to make every effort to perform experiments on polar events with sounding rocket balloons and ground experiments. These experiments should be coordinated through the Panel for Polar Cap Experiments and the information about facilities in Dr. Ortner's report should be expanded to include facilities in the South polar region.

Working Group 3. — *On Data and Publications*

Res. 31. — *Unified Synoptic Codes.*

C.O.S.P.A.R. calls attention to the Booklet on Unified Synoptic Codes for rapid communication of Satellite Orbital Data issued March 1962 in response to Florence Resolution No. 28, and recommends the use of these codes by space science laboratories, tracking stations and computing centers, wherever appropriate. C.O.S.P.A.R. requests the National Spacewarn Contacts to take suitable initiative for their countries. The codes are recommended both for communication via Spacewarn and by other channels.

C.O.S.P.A.R. acknowledges the contribution of the I.U.W.D.S. and of the many individuals and organizations in preparing the unified codes.

Res. 32. — *Radio Broadcasts of Satellite Information.*

C.O.S.P.A.R. welcomes the cooperation of the authorities in Japan, France, U. S. A. and U. S. S. R. in arranging for regular broadcasts of launching announcements and orbital predictions and thus aiding the international distribution of this information. C.O.S.P.A.R. notes that many of the necessary details of these broadcasts have appeared in the *C.O.S.P.A.R. Information Bulletin.* C.O.S.P.A.R. calls on the National Spacewarn Contacts for these countries, and any others which may later cooperate in this way, to make certain that the C.O.S.P.A.R. Secretariat and the C.O.S.P.A.R. Correspondent for Spacewarn are promptly informed of all changes in schedule, content and radio frequencies of these transmissions so that this information may be widely distributed through the *C.O.S.P.A.R. Information Bulletin.*

Res. 35. — *Revised W.D.C. Guide.*

C.O.S.P.A.R. adopts the Revised Guide to Rocket and Satellite Information and Data Exchange prepared by Working Group 3 and calls upon the World Data Centers to observe its provisions with immediate effect.

C.O.S.P.A.R. also calls the attention of the various international Unions and their associations, and in particular of the Comité International de Géophysique (C.I.G.) and the Committee for the

International Quiet Sun Year (I.Q.S.Y.), to this document and requests their cooperation for implementing these data-interchange agreements. C.O.S.P.A.R. also requests its adhering national committees to take the initiative in ensuring prompt flow of data from their countries to the World Data Centers in accordance with the provisions of this Guide.

RES. 36. — *Satellite Designation.*

C.O.S.P.A.R. considers that the scheme for designating earth satellites by Greek letters has become cumbersome as the number of satellites launched into orbit each year grows large and therefore recommends that beginning with 1963 a new scheme be adopted in which each successful launching which results in an object which orbits for more than 90 minutes be designated by the year of launch and an ordinal serial number.

It is further recommended that the orbiting components or objects be designated by letters A, B, C..., where A refers to the component carrying the principal scientific payload; B, C, etc., as needed first for any subsidiary scientific payloads and then for inert components in order of maximum brightness during the early life of the satellites.

Thus a satellite component which under the old designation scheme would have been known as 1963 β 2, would under the new scheme be known as 1963 2B (in case the number of components or objects of a satellite launching is large, the following convention will be used : the letters I and O will always be skipped ; the 25th component or object will be designated AA, the 26th AB, etc., the 49th BA, etc., etc.).

The designations would be tentatively assigned in the launching announcement. A copy of this announcement is sent to the C.O.S.P.A.R. Secretariat which would be responsible for making the final assignement according to the Universal Time of the launching, and for promulgating the information in the *C.O.S.P.A.R. Information Bulletin* or, in case of an error, by appropriate telegraphic notice to the originator of the launching announcement who will then promptly advise Spacewarn.

RES. 37. — *Contacts for C.O.S.P.A.R. Information Bulletin.*

The Committee on Space Research (C.O.S.P.A.R.),

considering that there has been a tendency for the material in the *C.O.S.P.A.R. Information Bulletin* to be supplied from only a few sources and that it is highly desirable that the *C.O.S.P.A.R. Information Bulletin* should contain space research information on a world-wide basis, *recommends* that contacts for the *C.O.S.P.A.R. Information Bulletin* should be appointed for each adhering country and for each Union with the responsibility of ensuring that the Secretariat is supplied with information on topics of interest within their country or organization.

WORKING GROUP 4. — *On International Reference Atmosphere*

RES. 38. — *Continuation of the work of Working Group 4.*

C.O.S.P.A.R. agreed that the scientists of Working Group 4 should continue their work with regard to the studies of upper atmosphere properties for the purpose of presenting the results of these studies in a coordinated and organized fashion and making these results available at the next C.O.S.P.A.R. meeting. Working Group 4 will use this material in making recommendations as to whether and when new tables for an International Reference Atmosphere can and should be prepared.

RES. 39. — *Appointment of rapporteurs and deputies in W. G. 4.*

C.O.S.P.A.R. agreed that there should be a rapporteur and a deputy each for the three altitude regions of immediate interest to Working Group 4, i. e.

(*a*) Region from $\sim$ 30 to $\sim$100 km ;

(*b*) Region from $\sim$100 to $\sim$200 km ;

(*c*) Region from $\sim$200 km and above.

The work of the rapporteurs will be to provide and coordinate results in their regions by collecting and making available the material relevant to the studies of Working Group 4, and to present reports to the Chairman and members of Working Group 4 before or at the next C.O.S.P.A.R. meeting. The deputy will assist the rapporteur in his work and, if necessary, take his place at meetings or on other occasions.

The recommendations made by the rapporteurs and deputies do not preclude contributions from scientists who are not members of Working Group 4 ; in fact, these scientists, whose work is relevant, are encouraged to participate in the work of C.O.S.P.A.R. Working Group 4.

S. C. A. R.

VIth Meeting, Boulder, Colorado, August 1962

REPORT OF THE WORKING PARTY ON FORWARD SCATTER OBSERVATION IN THE ANTARCTIC DURING THE I.Q.S.Y.

I. — Introduction

The Fifth meeting of S.C.A.R. in the report of the Working Group on the Upper Atmosphere, and the subsequent First I.Q.S.Y. meeting in Paris, recommended that ionospheric forward scatter observations be made in the Antarctic in addition to and usefully supplementing riometer observations. The purpose of the following report is to review the objectives of such observations and to guide the implementation of these recommendations.

II. — Objectives

A. — *Cosmic Rays*

The main objective of a program of ionospheric forward scatter observations in the Antarctic is to detect distinct solar cosmic-ray emission events, and to investigate their spectral, geographical, and temporal variations.

Ionospheric forward scatter observations provide continuous monitoring at fixed locations of the flux of protons and heavier nuclear in an energy range not accessible to other techniques. In particular the combination of a forward scatter program with a neutron monitor program permits complete coverage of the energy spectrum of solar produced cosmic rays from a few Mev upward. Although riometers detect ionization resulting from incoming solar particles in the same general energy range as scatter observations, the interpretation of riometer observations from the solar cosmic-ray viewpoint is complicated by the additional response of riometers to auroral ionization and solar radio noise. Forward scatter signals do not exhibit absorption effect associated with auroral phenomena. Thus, for example, at or near the auroral zone, records of forward scatter signal intensity show no confusing effects associated with the onset of geomagnetic storms, and hence permit the continued study of the decay in intensity of incident solar cosmic rays in the period after the onset of a magnetic storm. For this reason appropriately situated forward scatter links provide means for observing geomagnetic cutoff reduction effects.

B. — *Other objectives*

The operation of ionospheric forward scatter links in the Antarctic may have several additional objectives. Among these are the study of :

Seasonal and diurnal variation of the scatter signal intensity,

Sporadic-E propagation,

Phenomena associated with auroral ionization,

Meteoric ionization.

III. — Disposition of Station-pairs

To accomplish the objectives discussed under II A, several scatter links are proposed. Since it is possible that impact zone effects for low energy solar cosmic rays may occur within the polar cap, and be particularly marked during periods of low solar activity, as complete coverage as practicable is indicated. In considering a possible link two geographical conditions must be satisfied :

The separation between transmitter and receiver should be between about 1,000 and 2,000 kilometres, and,

The topographic features in the vicinity of each terminal must be suitable for the propagation path.

Subject to satisfying local topographic and logistic requirements, links between the following station pairs are needed.

Transmitter*	Receiver	Length, km	Approximate path midpoint values				
			Lat.	Long.	Geomag. Lat.	Vertical Cut-off***	
						Rigidity, bv	Proton Energy, MeV
South Pole	Halley Bay	1612	82°7 S	26°9 W	—73°	< 0.5 est.	< 130 est.
Byrd	South Pole	1113	85°0 S	120°0 W	—75°	~0. 35 est.	~ 60 est.
Byrd	McMurdo-Scott	1440	81°1 S	160°9 W	—72°	< 0.1 est.	< 5 est.
d'Urville	McMurdo-Scott	1493	72°6 S	149°0 E	—79°	< 0.001 est.	< 0.0005 est.
Wilkes	d'Urville	1305	67°3 S	125°2 E	—78°	0.0082	0.04
d'Urville	Hallett	1310	70°2 S	152°9 E	—76°	0.012	0.08
d'Urville	Cape Adair	1290	69°7 S	153°4 E	—75°	0.015	0.11
Macquarie	d'Urville	1680	60° S	153° E	—67°	0.147	11.
d'Urville**	Campbell	2200	60°5 S	157°6 E	—66°	0.164	16
Hallett**	Campbell	2110	62° S	170° E	—65°	0.232	21
Cape Adair	Campbell	2000	61°5 S	170° E	—65°	0.240	22
Hobart	Macquarie	1550	49° S	153° E	—56°	0.99	420
South Pole	Vostok	1285	84°2 S	106°8 E	—85°	< 0.001 est.	< 0.0005 est.
Vostok**	Mirnyy	1380	72°6 S	97°6 E	—82°	< 0.001 est.	< 0.0005 est.
Vostok	McMurdo-Scott	1277	79°7 S	137°6 E	—83°	< 0.001 est.	< 0.0005 est.
Mawson**	Kerguelen	2030	59° S	67° E	—66°	0.47	120
Mawson	Syowa	967	68°7 S	51°6 E	—72°	0.245	24
Wilkes	Mawson	2000	68°8 S	87°1 E	—79°	0.045	1.1

* Although essentially identical data would result from transmission in either direction, there are logistic or special technical advantages to operation in the direction implied by the first two column headings.

** No clear arguments available as to more desirable direction of transmission over path.

*** According to J. J. Quenby and G. J. Wenk « Cosmic Ray Threshold Rigidities and the Earth's Magnetic Field », Phil. Mag. (in press), 1962.

IV. — Equipment

In order that the Antarctic scatter links may be particularly sensitive to the very small, but highly interesting solar cosmic-ray events occurring at the minimum phase of the solar cycle, the equipment proposed below departs significantly in several characteristics from that previously employed in the Arctic. Since the proposed Antarctic links are solely intended for scientific observations the transmissions are in one direction only. Furthermore, the transmitter power levels and receiver bandwidths are significantly reduced, thus effecting considerable economy. Final the operating frequencies are substantially lower than those which would be appropriate for observing the large solar cosmic-ray events which appear to occur only during periods of moderate and high solar activity. In this way the sensitivity will be significantly increased, thereby permitting the detection of a much lower flux of low-energy solar-produced cosmic rays than hitherto.

The following characteristics for the scatter links are specified :

Frequency : 20-25 Mc/s (preferably between 22 and 24 Mc/s).

Frequency stability : Maximum system detuning not to exceed 2 cps per day or not more than about $\frac{1}{2}$ part in 10^7 per day at each end.

Emission : Continuous wave.

Antennas : Single 5-element Yagi's cut to assigned frequencies erected at a height correct for local foreground topography and for length of link (assuming 85-kilometer scattering height).

Transmitter *rf* power Output : 500 watts (to be monitored).

Receiver bandwidth : 40 cps.

Recorders : 1. Pen and ink type with mechanical drive ; 2. Time constant : 30 seconds ; 3. Chart speed : 3 inches per hour.

Calibration : A suitable signal generator to be provided ; in addition provision for automatic periodic interruption of transmission should be made to permit observation of background noise level as a part of the calibration procedure. Time should be known at all times on the recordings to within 30 seconds.

Reliability : Unattended operation for a period of one day should be standard ; little sacrifice in quality of observations, in event of emergency unattended periods of as much as three days, should be tolerated.

Power demands : Transmitter : 1 kilowatt (including voltage regulator). Receiver : 500 watt (including voltage regulator).

Space required : One rack each for receiving and transmitting installations.

Coordination of Antarctic Forward Scatter Project Activities

As the project for ionospheric forward scatter observations in Antarctica during the I.Q.S.Y. involves station pairs not always under the operational control of one nation, there will arise needs for direct and rapid exchange of information concerning plans and activities of several nations that may contemplate taking part in the project.

Recommendation

To formalize this need, it is recommended that :

1. The S.C.A.R. National Committees of each nation intending to participate in the scatter project shall designate a representative to be responsible for providing to the other representatives so designated, and receiving from them information and assistance necessary for the efficient establishment of the project.

2. The National Committees of the nations concerned will notify the Secretary of S.C.A.R. of the name of their representative. The Secretary will then circulate the list of such representatives to the national committees.

3. To facilitate the work of establishing the project, the designated representatives shall deal directly among themselves, as appropriate, sending copies of their correspondence to the Secretary of S.C.A.R.

4. In the event of a need arising for a direct meeting of representatives designated above, the Secretary of S.C.A.R. shall make the necessary arrangements.

REPORT OF THE WORKING GROUP ON THE UPPER ATMOSPHERE

(Abstract)

The Working Group met five times. Members present were : W. H. WARD (New Zealand), A. LEBEAU (France), P. STOKER (South Africa), S. EVANS (U. K.), D. BAILEY (U. S. A.), F. JACKA (Australia). Active participants also included T. NAGATA (Japan), C. LOMNITZ (Chile), S. RUTTENBERG (U. S. A.), F. ROACH (U. S. A.), M. POMERANTZ (U. S. A. - C.I.G.), G. CARTWRIGHT (W.M.O.), V. LINCOLN (I.U.W.D.S.), C. COLLINS (Canada), and S. CHAPMAN.

One meeting was held jointly with the Working Group on Geomagnetism.

Joint Meeting with Working Group on Geomagnetism

DISTRIBUTION OF ALERTS

Miss V. Lincoln (I.U.W.D.S.) outlined the nature and scheme of distribution of advice on Geoalerts and Special World Intervals.

Recommendation.

The Working Groups consider prompt receipt of advice of Geoalerts and Special World Intervals at Antarctic Stations desirable. Existing broadcasts from WWV/H and facilities for direct communication with home countries are considered adequate to meet the requirements.

The Working Groups further recognize the great importance of antarctic data to the World Warning Agency and recommend that information on outstanding geophysical events be forwarded with the highest possible priority through the existing radio communications network via McMurdo and Sydney or through any other available channels.

The types of observations which might be made and which would be of particular interest are as follows (not necessarily in order of priority).

Vertical incidence soundings.

Geomagnetic variations including micropulsations.

ELF and VLF emissions.
Ionospheric absorption (using riometers).
Distribution of auroras (using all-sky cameras).
Auroral emissions at 3914 (or 4279), 5577 and 6300 Å (using zenith photometers).
Low energy particle radiations (using rocket and balloon-borne detectors).
Neutron monitors.

Conjugate Point Studies

Recommendation.

The Working Groups consider that simultaneous geophysical observations should be made on either a synoptic or short term basis at or near geomagnetically conjugate points in the antarctic and arctic regions. It would be opportune to select one of the conjugate points of each pair to be located, if possible, at an existing geophysical observatory. It may be desirable to have a small close-spaced network of stations at one or two of the selected conjugate points. A minimum of four pairs of conjugate points would be desirable (at least one being well inside, two near the maximum, and one somewhat outside the auroral zone) each pair being equipped with closely comparable equipment.

A partial list of approximately conjugate points is as follows; existing stations are indicated by *

Macquarie Island*	Kotzebue or Healy
Campbell Island*	Anchorage or Farewell*
Syowa	Reykjavik
Little America	Baker Lake
Byrd*	Great Whale River
Kerguelen*	Archangelsk*
Mirny*	Murmansk*
Vostok*	Thule*
Hallett*	68° N 104° E
Scott*	68° N 89° W

Ionospheric Physics, etc.

(*a*) Vertical Incidence Soundings.

The Upper Atmosphere Working Group briefly reviewed the program recommended by C.I.G. for the I.Q.S.Y. The meeting was advised that South Africa would be prepared to operate ionosondes at Marion Island and Gough Island if the equipment could be made available from other sources.

(*b*) Forward Scatter Propagation.

The scientific value and technical requirements of VHF forward scatter propagation studies were discussed. It was agreed that a quite specific proposal for joint action by interested parties should be formulated and a small working party was formed (with D. K. Bailey as convenor) to draw up such a proposal. Their report is presented in Appendix 1. The Working Group recommends that S.C.A.R. adopts the report as a guide to the development of a programme of forward scatter observations in the Antarctic during the I.Q.S.Y.

(*c*) Riometers.

Dr. C. G. Little (Reporter for C.I.G. on riometers) outlined a method of determining electron density profiles in the D region from the records of several riometers operating at frequencies between 5 and 50 Mc/sec. Further analysis might permit the determination of energy spectrum of the ionizing radiation. He referred also to very interesting results obtained in conjugate point studies ; in particular he indicated the possibility from such studies to determine the nature of the solar control over absorption.

For ship-board operation Dr. Little pointed out that with only one channel it was not feasible, because of movement, to determine the quiet day curve. This difficulty can be overcome by using two channels on widely different frequencies. The ratio of the two records, in the absence of absorption is then constant.

Mr. Wells pointed out that a riometer type equipment with simple tracking antenna can also be used to record solar activity. Such activity at low frequencies is a useful indicator of geophysical disturbance.

It was stated that riometers may now be purchased in U. S. A. for about $ 2500.

The meeting agreed that a network of riometers in conjunction with forward scatter equipment was highly desirable for the study of morphology of ionospheric absorption during I.Q.S.Y.

Recommendation.

In view of the plans of many groups to conduct riometer investigations in Antarctica and in order to insure maximum homogeneity of the data obtained, it is recommended that C.I.G. be requested to prepare a requirement specification for a standardized riometer system for synoptic studies.

(*d*) VLF EMISSIONS.

Reported studies of VLF emissions and propagation were briefly discussed. Attention was drawn to difficulties encountered in arranging for transmission of signals suitable for propagation studies.

Recommendation.

In view of the value of whistler observations in investigating the propagation of VLF radiation, S.C.A.R. urges National Committees to cooperate in the implementation of requests from other National Committees for arranging pulsed transmissions.

(*e*) SATELLITE OBSERVATIONS.

The Working Group requests that the S.C.A.R. Secretary communicate a revised version of VI/S.C.A.R./21 adding the following :

(iv) The study of the upper atmosphere,

(v) The study of particle radiations.

COSMIC RAYS

The Upper Atmosphere Working Group reviewed the report of the Working Group on Cosmic Rays of the First I.Q.S.Y. Meeting, and is in accord with its recommendations. In particular, the specific reference to the need for filling the serious gaps in the neutron monitor network, and the note that every effort should be exerted to install additional neutron monitors in the Antarctic, were endorsed. The Working Group was informed that the antarctic high counting rate super neutron monitor called for by S.C.R.I.V. and specified by the I.Q.S.Y. Working Group is scheduled to be installed at McMurdo at the end of 1963. Cosmic ray observations which, according to current information, are planned to be conducted in the Antarctic during I.Q.S.Y. are :

(*a*) *Synoptic Program. Neutron Monitors.* — McMurdo (Super) Vostok (conventional), Mirny (conventional), Dumont d'Urville (conventional), Ellsworth (conventional), Wilkes (conventional), Mawson (conventional), S.A.N.A.E. (conventional), Pole (conventional), Kerguelen (conventional).

Meson Telescopes. Mawson.

(*b*) *Special Projects.* — Wilkes - balloon flights, Macquarie Island - balloon flights, U.S.N.S. *Eltanin* - High counting rate meson telescopes, R.S.A. Antarctic Relief Vessel - Neutron Monitor, U. S. Project Magnet Aircraft - Neutron Monitor and Meson Telescopes McMurdo - rocket flights, McMurdo - High counting rate meson telescopes, Pole - High counting rate meson telescopes.

All-Sky Camera for I.Q.S.Y.

The Working Group reconsidered the exposure sequence to be used by the standard all-sky cameras during the I.Q.S.Y. It was felt that a 1 minute interval between exposures is too long to observe the most rapid development of an auroral display or to measure the movement of individual auroral features. On the other hand it is much shorter than is necessary to survey the probability of occurrence of aurora. For this latter investigation, exposure durations of 2 ½, 10 and 40 seconds are required and it is sufficient to repeat the sequence four times per hour. The views of interested organizations not represented at the meeting are to be sought by the Chairman with a view to recommending that the 1 minute repetition interval be optional. (The cost of film for full program is not a trivial fraction of the cost of the whole undertaking — approximately 30,000 feet of film are required per season for each camera).

Analysis of Data

The Working Group has formulated specific proposals for standardization of instruments and observing procedures in connection with a number of projects planned for the duration of I.Q.S.Y. An important aspect of these projects is the study of synoptic data from the whole network of stations.

It was considered that such studies could most effectively be carried out by small (two to four) groups of named individuals. Such « Study Groups » would be responsible for the effective analysis and interpretation of data culminating in the publication of research papers and for recommendations on further experiments.

Following is a tentative list of participants in the proposed Study Groups :

(1) Proton initiated absorption events as recorded with forward scatter propagation links and riometers :

D. K. Bailey (U. S. A.) (Convenor),

A. Lebeau (France),

B. Sandford (New Zealand),

Participant from U. S. S. R. if that country is involved in the observations.

(2) Morphology of ionospheric absorption recorded with riometers :

H. Chivers (U. S. A.) (Convenor),

P. Sulzberger (Australia).

(3) Distribution of auroras recorded with all-sky camera :

F. Jacka (Australia) (Convenor),

T. N. Davis (U. S. A.),

Ya. Feld'stein (U. S. S. R.).

(4) Morphology of auroral emissions recorded with vertical photometers :

F. Jacka (Australia) (Convenor),

F. Roach (U. S. A.),

G. Weill (France).

B. Sandford (New Zealand).

The Chairman was instructed to communicate these proposals to all members of the Working Group to seek their confirmation or suggestions for revision.

Recommendation.

The Working Group recommends that the International Geophysical Data Center of the Science Council of Japan be invited to prepare and publish synoptic maps of auroras recorded with all-sky cameras during I.Q.S.Y. in the Antarctic.

PRESENTATION OF AURORAL DATA.

The Chairman was instructed to communicate to the I.Q.S.Y. Committee the text of the S.C.A.R. IV recommendation published under the title « Auroral and Airglow Physics » part (*b*) in *S.C.A.R. Bulletin*, No. 7, page 95.

OTHER BUSINESS.

Recommendation.

The Working Group recommends that S.C.A.R. invites the appropriate U. S. authorities to consider the possibility of using Nimbus satellites to record the distribution of auroras on the dark side of the earth.

Statement on I.Q.S.Y. Requests for Antarctic Stations

Roi Baudouin (Geomagnetism)	The Belgian National Committee is making efforts to re-open this station. The Secretary of S.C.A.R. will request a statement from the Belgians concerning the current position.
Syowa (Geomagnetism & Ionosphere)	The Japanese National Committee is making every effort to re-open this station. Japanese delegate is requested to keep the Secretary of S.C.A.R. informed.
Macquarie Island (Geomagnetism)	Will continue for duration of I.Q.S.Y. at least.
Marion Island (Geomagnetism & Ionosphere)	The South African I.Q.S.Y. Committee is planning to provide geomagnetic equipment alone on these islands and would consider operating.

Gough Island (Geomagnetism & Ionosphere)	Ionospheric equipment should another country wish to make it available on loan.
Vostok (Ionosphere & Geomagnetism)	It is understood that this station will be re-opened for ionosphere and geomagnetism during 1963.
South Ice (Ionosphere)	This has been discussed by U. K. National Committee who considered the logistic difficulties involved would not permit them to open a station in this area. So far no other nations have reported a study of this proposal.
SANAE Station (*Maudheim area*) (Ionosphere)	The South African Antarctic Expedition is commencing ionospheric studies and cosmic ray studies.
Iles Crozet (Geomagnetism)	New geomagnetic station will be established if financial provision, for which application has been made, is forthcoming.
Sentinel Mts. (Geomagnetism & Ionosphere)	The U. S. will establish a station in this region (Eights Station) during 1963. The scientific program will include studies of ionosphere, geomagnetism and aurora.

UNESCO

Listes des documents et publications de l'U.N.E.S.C.O.

(English text on p. 134)

L'U.N.E.S.C.O. a distribué deux listes (i) 1er janvier - 31 mars 1962, et (ii) 1er avril - 30 juin 1962.

Ces listes comprennent :

a) un répertoire des documents et des publications classés par ordre alphabétique des cotes de documents ou de titres de publications ;

b) un index unique par auteur et par sujet des documents et des publications énumérés.

Les publications sont classées en trois catégories selon le mode de diffusion :

A. par la voie commerciale exclusivement,

B. à titre gratuit et par la voie commerciale,

C. à titre gratuit seulement.

Les publications parues chez d'autres éditeurs sont réparties en trois groupes :

I. Traductions d'ouvrages déjà publiés par l'U.N.E.S.C.O.,

II. ouvrages publiés pour l'U.N.E.S.C.O.,

III. ouvrages publiés avec l'aide de l'U.N.E.S.C.O.

Célébration d'anniversaires de personnalités éminentes et d'événements historiques

LE PASSE VIVANT

(English text on p. 135)

Les grands hommes et les hauts faits appartiennent à tous les peuples, ils sont de tous les siècles. Et le fait que l'on reconnaît de plus en plus la nécessité de l'unité de la race humaine nous conduit à prendre plus clairement conscience de notre dette envers les génies du passé qui ont contribué à élaborer la civilisation qui est ajourd'hui la nôtre.

Depuis 1954, l'U.N.E.S.C.O. établit chaque année un calendrier des anniversaires de personnalités éminentes et d'événements historiques appartenant au domaine de l'éducation, de la science et de la culture, et le soumet à ses Etats membres en vue d'organiser les célébrations qui conviennent.

Cependant, afin de faciliter l'organisation de ces manifestations commémoratives, le calendrier sera établi, à partir de cette année, pour une période de deux ans et publié quelques mois avant le commencement de la période envisagée.

On trouvera ci-joint le premier calendrier biennal, qui couvre les années 1963 et 1964 ; il ne s'agit nullement d'une liste exhaustive de toutes les personnalités et de tous les événements dont le centenaire coïncide avec l'une de ces deux années, mais d'une synthèse des suggestions présentées par les Etats membres de l'U.N.E.S.C.O. Le critère retenu dans chaque cas a été le caractère universel de la personnalité ou de l'événement dans le domaine de l'éducation, de la science ou de la culture.

Il n'a pas été possible au Secrétariat de l'U.N.E.S.C.O. de faire plus que d'établir une simple liste de noms et de dates de personnalités et d'événements. De plus amples renseignements pourront, toutefois, être fournis par les Commissions nationales des Etats membres intéressés.

Les Annexes I et II donnent la liste des anniversaires qui tombent respectivement en 1963 et en 1964. L'Annexe III contient quelques suggestions pratiques en vue des manifestations commémoratives. L'Annexe IV rassemble les adresses des Commissions nationales

ANNEXE I

Anniversaires tombant en 1963

Nom	Renseignements biographiques	Date	Etat membre qui a proposé la célébration
1. *Personnalités éminentes*			
Leo Hendrik Baekeland	Docteur ès Sciences de l'Université de Gand. Inventeur de la résine synthétique connue sous le nom de « bakélite »	Né le 14 novembre 1863	Belgique
Dimitri Alexandrovitch Gravé	Mathématicien et académicien ukrainien	Né en 1863	République socialiste soviétique d'Ukraine
Paul Painlevé	Mathématicien français	Né en 1863	République argentine
2. *Evénements historiques*	—	—	—

ANNEXE II

Anniversaires tombant en 1964

1. *Personnalités éminentes*			
Galileo Galilei	Physicien et astronome italien	Né le 14 février 1564	République argentine
Vladimir Andreyevitch Steklov	Mathématicien soviétique	Né en 1864	République socialiste soviétique d'Ukraine
2. *Evénements historiques*	—	—	—

auxquelles les demandes de renseignements pourront être envoyées.

Les annexes publiées dans ce Bulletin ne donnent que les renseignements sur les événements intéressant directement ou indirectement les activités de l'U.R.S.I.

ANNEXE III

Suggestions en vue de la célébration d'anniversaires

Les manifestations commémoratives doivent faire ressortir le caractère universel de la personnalité ou de l'événement historique en l'honneur desquels elles sont instituées et relier cet événement ou l'œuvre de cette personnalité aux buts de l'Unesco ou à une partie de son programme en cours.

Dans tous les cas (personnalités et événements) ces manifestations peuvent prendre les formes suivantes : films, films fixes, émissions de radio et de télévision illustrant la vie de la personnalité, sa carrière, le cadre historique de son œuvre ou de l'événement en cause, la portée de cette œuvre ou de cet événement et, le cas échéant, un mouvement scientifique ou artistique. Emissions de timbres commémoratifs. Réunions, Conférences. Stages d'études. Publications d'articles dans les journaux ou périodiques. Etudes critiques. Ouvrages biographiques et historiques. Organisation de programmes d'études dans les établissements d'enseignement. Affiches. Eléments d'expositions, notamment à l'usage des écoles. Concours de rédactions pour écoliers et étudiants. Manifestations locales. Spectacles historiques. Institution d'une journée officielle en l'honneur de la personnalité ou de l'événement en cause. Bandes dessinées pour les enfants. Excursions à prix réduit au lieu de naissance de la personnalité, aux sites historiques et aux musées en rapport avec la personnalité ou l'événement célébré. Manifestations spéciales dans des établissements appropriés, de caractère technique, social, scientifique ou culturel.

ANNEXE IV

Adresses des Commissions nationales des Etats membres qui ont proposé des célébrations

République argentine : Sr. Presidente de la Comision Nacional Argentina para la Unesco, Avenida Alvear 1690, Buenos Aires.

Belgique : M. le Secrétaire général de la Commission nationale belge de l'Unesco, Ministère de l'instruction publique, Résidence Palace, rue de la Loi, Bruxelles.

République socialiste soviétique d'Ukraine : M. le Président de la Commission nationale de la R. S. S. U. Ulitsa Karla Liebknechta 15, Kiev.

UNESCO

Lists of U.N.E.S.C.O. documents and publications

(French text on p. 130)

U.N.E.S.C.O. has distributed two lists (i) 1 January - 31 March 1962, and (ii) 1 April - 30 June 1962.

These lists comprise

(*a*) a list of documents and publications arranged in alphabetical order of symbols of documents or titles of publications ;

(*b*) a combined author and subject index of all documents and publications listed.

The publications are classified into three categories according to their distribution :

A. exclusively through commercial channels,

B. both gratis and through commercial channels,

C. entirely gratis.

Publications issued by other publishers appear under three headings :

I. Translations of U.N.E.S.C.O. publications and documents.

II. Works published for U.N.E.S.C.O.

III. Works published with the assistance of U.N.E.S.C.O.

Commemoration of anniversaries of great personalities and events

THE LIVING PAST

(French text on p. 131)

Great men and great ideas belong to all peoples and to all centuries. Increasing recognition of the essential unity of mankind has brought with it an increasing awareness of the debt we owe to those giants of the past who helped shape the civilization we share.

Each year since 1954, Unesco has published a calendar of anniversaries of great men and major events in the history of education, science and culture, proposed for commemoration by the Member State of the Organization.

Beginning this year, in order to facilitate advance planning of anniversary celebrations and publications, the calendar will cover a two-year period and will be issued some months before the beginning of the period covered.

The first of these biennial calendars, for the years 1963 and 1964, is attached. The list does not include all the great leaders and events whose centenaries fall within these years ; it merely presents the suggestions of U.N.E.S.C.O.'s Member States. The criterion for inclusion is universal significance in the fields of education, science or culture.

It is impossible for the Secretariat to furnish more than a simple listing of names and dates proposed for commemorations in the next two years. Further information may be obtained, however, from the National Commission for U.N.E.S.C.O. of the Member State concerned.

Annex I lists the anniversaries occurring in 1963, and Annex II those in 1964. Annex III contains some suggestions for commemorative celebrations. Annex IV gives the addresses of National Commissions to which requests for documentation may be sent.

Annexes published in this Bulletin give only information on events directly or indirectly related to U.R.S.I. activites.

ANNEX I

Anniversaries in 1963

Name	Biographical data	Date	Proposed by
1. *Great personalities*			
Leo Hendrik Baekeland	Doctor of sciences of the University of Ghent. Inventor of the synthetic resin known as « bakelite »	Born 14 Nov. 1863	Belgium
Dimitri Alexandrovitch Gravé	Ukrainian mathematician and academician	Born 1863	Ukrainian Soviet Socialist Republic
Paul Painlevé	French mathematician	Born 1863	Argentine Republic
2. *Great events*	—	—	—

ANNEXE II

Anniversaries in 1964

1. *Great personalities*			
Galileo Galilei	Italian physicist and astronomer	Born 14 Feb. 1564	Argentine Republic
Vladimir Andreyevitch Steklov	Soviet mathematician	Born 1864	Ukrainian Soviet Socialist Republic
2. *Great events*	—	—	—

ANNEX III

Suggestions for commemorative celebrations

Commemorative activities should be designed to show the universal significance of the personality or event and to relate the event on the achievements of the personality concerned to the achievement of the purposes of U.N.E.S.C.O. or to a particular part of its current programme.

For all personalities and events : Films, filmstrips, radio and television programmes, illustrating the lives, careers, historical backgrounds, significance and, when relevant, scientific or artistic processes. Commemorative stamps. Conferences. Lectures. Seminars. Articles in newspapers and periodicals. Critical studies. Biographies and histories. Organization of school programmes. Posters. Display materials, particularly for use in schools. Essay contests for schoolchildren and students. Civic events. Pageants. Designation of an official day in honour of a personality or event. Cartoon strips for children. Low-cost tours to birthplaces, historic sites and museums. Special events at appropriate technical, social, scientific or cultural institutions.

ANNEX IV

Addresses of national Commissions
in countries having submitted proposals

Argentine Republic : Senor Presidente de la Comision Nacional Argentina para la U.N.E.S.C.O., Avenida Alvear, 1690, Buenos Aires.

Belgium : Monsieur le Secrétaire général de la Commission nationale belge de l'U.N.E.S.C.O., Ministère de l'Instruction publique, Résidence Palace, rue de la Loi, Bruxelles.

Ukrainian Soviet Socialist Republic : The President, National Commission of the Ukrainian Soviet Socialist Republic, Ulitsa Karla Liebknechta, 15, Kiev.

BIBLIOGRAPHIE

Commission Electrotechnique Internationale

Publication 64 *A* : *Deuxième édition.* — Supplément à la Publication 64, Lampes à filament de tungstène pour l'éclairage général. Lampes avec une durée de 2500 heures.
Prix : Fr. S. 3 - l'exemplaire plus frais de port.

Publication 94 : *Deuxième édition.* — Systèmes d'enregistrement et de lecture sur bandes magnétiques : Dimensions et caractéristiques.
Prix : Fr. S. 10 - l'exemplaire plus frais de port.

Publication 140 : *Première édition.* — Verrerie pour appareils d'éclairage.
Prix : Fr. S. 4,50 - l'exemplaire plus frais de port.

Publication 138 : *Première édition.* — Méthodes pour les mesures des propriétés électriques essentielles des antennes de réception dans la gamme de fréquence de 30 MHz à 1000 MHz.
Prix : Fr. S. 10 - l'exemplaire plus frais de port.

Cette publication a pour objet la normalisation des conditions et des méthodes de mesure sur les antennes de réception, de façon à permettre la comparaison des résultats des mesures obtenus par différents observateurs. Elle constitue un catalogue de mesures sélectionnées, recommandées pour évaluer les propriétés électriques d'un type donné, mais ne comporte pas l'étude critique des résultats de mesures. Elle ne présente aucun caractère obligatoire ni limitatif, et l'utilisateur est libre de faire son choix parmi la liste des essais décrits. La publication est divisée en cinq principales sections, à savoir : généralités, terminologie, méthode de mesure, emplacement de mesure et fréquence de mesure. Elle comprend 12 figures.

Publication 122-2 : *Première édition.* — Quartz pour oscillateurs. Section trois : Guide d'emploi des quartz pour oscillateurs.
Prix : Fr. S. 15 - l'exemplaire plus frais de port.

Publication 142 : *Première édition.* — Enregistrement sonore magnétique sur les films de 16 mm et de 35 mm pour l'échange international des programmes de télévision.
Prix : Fr. S. 7,50 - l'exemplaire plus frais de port.

Cette publication fait état de l'adoption par la Commission Electrotechnique Internationale des Avis n° 264 et 265 du Comité Consultatif International des Radiocommunications adoptés par le C.C.I.R. lors de son Assemblée Plénière tenue à Los Angeles en 1959. Ces Recommandations du C.C.I.R. sont reproduites sans modification dans la Publication 142.

BIBLIOGRAPHY

International Electrotechnical Commission

Publication 64 *A* : *Second edition.* — Supplement to Publication 64, Tungsten filament lamps for general service. Lamps with a life of 2500 hours.

Price : Sw. Fr. 3 - per copy plus postage.

Publication 94 : *Second edition.* — Magnetic tape recording and reproducing systems : Dimensions and characteristics.

Price : Sw. Fr. 10 - per copy plus postage.

Publication 140 : *First edition.* — Glassware for lighting fittings.

Price : Sw. Fr. 4.50 - per copy plus postage.

Publication 138 : *First edition.* — Methods of measurement of essential electrical properties of receiving aerials in the frequency range from 30 MHz (Mc/s) to 1000 MHz (Mc/s).

Price : Sw. Fr. 10 - per copy plus postage.

This publication has as its object the standardization of the conditions and methods of measurement on receiving aerials, so as to make possible the comparison of the results of measurements obtained by different observers. It constitutes a catalogue of selected measurements recommended for assessing the electrical properties of a given type, and no qualification of the results of measurement are included. It is not intended to be either mandatory or limiting and the user is free to make his choice from the list of tests described. The publication is divided into five main sections, viz. : general, terminology, methods of measurements, measuring site and measuring frequencies. It is illustrated by 12 figures.

Publication 122-2 : *First edition.* — Quartz crystal units for oscillators. Section three : Guide to the use of quartz oscillator crystals.

Price : Sw. Fr. 15 - per copy plus postage.

Publication 142 : *First edition.* — Magnetic sound recording on 16 mm and 35 mm film for the international exchange of television programmes.

Price : Sw. Fr. 7.50 per copy plus postage.

This publication records the endorsment by the International Electrotechnical Commission of the International Radio Consultative Committee's Recommendations nº 264 and 265 which were adopted by the C.C.I.R. at its Plenary Assembly held in Los Angeles in 1959. These C.C.I.R. Recommendations are reproduced without change in I.E.C. Publication 142.

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