Bulletin nº 163 Juillet-août 1967

URSI

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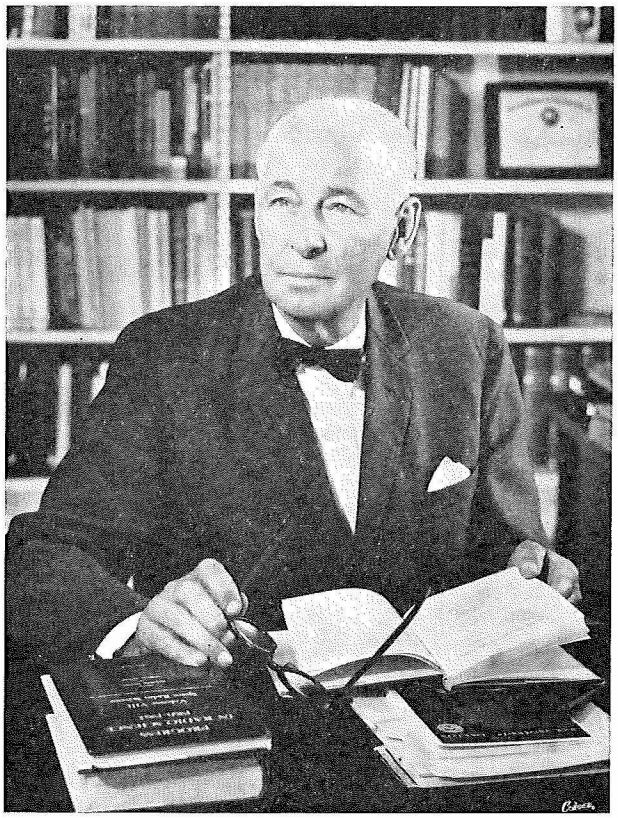
OBITUARY

Dr. Lloyd V. BERKNER



As already announced in *Information Bulletin* No. 162, Dr. Lloyd Viel Berkner, the senior Past President of URSI, died on June 4, 1967, following a heart attack the previous day while attending a meeting of the Council of the United States National Academy of Sciences. He was buried in the U.S. National Cemetery at Arlington with full military honours. His passing will be mourned by a very large number of scientists and administrators for the work he

accomplished personally, and for the inspiration he gave to others over the whole field of geophysics in general, and to that of radio science in particular.

His varied career included that of an Antarctic explorer, a pioneer radio physicist, chairman or president of numerous organisations, both national and international, a fellow of many learned academies, and leader of a group of universities as well as a consultant to the electronics industry. Many scientists throughout the world have derived stimulating encouragement from his lively contributions over an extensive range of research during several decades.

Dr. Berkner was born in Milwaukee, Wisconsin, on 1st February, 1905; and he grew up at Sleepy Eye, Minnesota where, early in the 1920's, he built and operated his first amateur radio station. His interest in this activity led to his becoming a commercial marine operator travelling in ships to various parts of the world. Later, he returned to the University of Minnesota, where he obtained a degree in electrical engineeering in 1927. In this year also, he joined the U.S. Naval Reserve and trained to become a pilot. A year later he accompanied Admiral Byrd on his first South Polar expedition, for which he engineered and operated the short wave radio communication and navigation systems. It was during this period that he first became interested in some of the phenomena of radio wave propagation at high frequencies.

His scientific career began at the U.S. Bureau of Standards in Washington, where he engaged in research on radio wave propagation and the study of the ionosphere. In 1933, Berkner was appointed physicist at the Department of Terrestrial Magnetism of the Carnegie Institute in Washington : and it was here that he and his colleagues designed and operated a swept frequency ionospheric recorder for the automatic registration of signals reflected from the ionosphere at vertical incidence. His work during the next few years was concerned with study of the effects of solar activity on radio wave propagation, and with confirmation and extension in the United States of the pioneer discoveries of ionospheric phenomena made by the late Sir Edward Appleton and his colleagues in England. In 1938, Berkner installed and operated an ionosonde apparatus at Watheroo in Western Australia; and later, he set up equipment for radio geomagnetic and auroral research at a station — College — which subsequently became

the Geophysical Institute of Alaska. A few years later, Berkner was called to active duty in the U.S. Navy, where he organised and directed the section responsible for the development of airborne radar and the proximity fuse. He ended the world war in the rank of Captain; and later retired from the Navy as a Rear-Admiral.

It was very early in his career that Dr. Berkner became interested in the field of international science as the only means of organising geophysical research concerning the earth and its environment. He was a delegate to the General Assembly of IUGG in Edinburgh in 1936; he organised the following Assembly in Washington (1939), and was actively concerned with the U.S. delegations to subsequent Assemblies up to 1963.

In the affairs of URSI, he was elected chairman of the U.S. National Committee in 1948, and participated in the General Assemblies in Zurich (1950), Brussels (1952), and the Hague (1954) where he was elected a Vice-President of the Union. The next General Assembly was held in Boulder, Colorado in 1957; and it was here that Dr. Berkner was elected President of URSI for the ensuing three years, culminating in the XIIIth General Assembly in London in 1960. Three years later, in Tokyo, he was elected an Honorary President of the Union.

Now URSI is one of the 15 international scientific bodies organised within the International Council of Scientific Unions (ICSU); and Dr. Berkner was a U.S. delegate to the meetings of this Council in Amsterdam in 1953 and in Oslo, 1955. At the latter he was elected President of ICSU for the term ending at the General Assembly in Washington in 1958. But before this, he was instrumental in initiating the proposal to organise and sponsor the extensive observational programmes which were conducted during the International Geophysical Year of 1957-1958, a period of maximum sunspot activity. The proposal was promptly endorsed by ICSU and its relevant member Unions; and a special committee for the International Geophysical Year (CSAGI) was appointed, with Professor Sydney Chapman as President, and Dr. Berkner as Vice-President. The year was opened on June 30th, 1957, with an international television programme in which Berkner appeared with Prince Philip of the United Kingdom who launched the programme. It was envisaged that rockets and satellites would play a part in this programme; and it was while Berkner presided

over a conference at the Soviet Embassy in Washington, that he was able to announce in a dramatic manner the successful launching of the first Russian satellite — Sputnik I — on October 4, 1957.

From 1951 to 1960, Dr. Berkner was President of Associated Universities Inc., which was formed by nine universities to direct the development and research programme of the Brookhaven National Laboratories for the U.S. Atomic Energy Commission. While holding this post, he was also responsible for the inauguration of the National Radio Astronomy Observatory at Greenbank, West Virginia, and associated very large radio telescopes. After some nine years intense activity with Associated Universities, he left to become President of the newly-established Graduate Research Centre of the South-West in Dallas, Texas, which was founded under his inspiration to counterbalance the growing scientific pre-eminence of California and the East coast of the United States. This institution, which has a staff of some 400, is concerned with inter-disciplinary programmes of basic research for the purpose of fostering the expansion of graduate education in the natural and life sciences in the area of north central Texas.

It is hoped that this brief review of some of Dr. Berkner's outstanding activities will serve to demonstrate the energy and enthusiasm with which he tackled a wide range of problems of both national and international character. All who worked with him in either scientific or administrative matters, and particularly those of direct interest to URSI, have been stimulated by his friendly, yet direct, approach; and the world of international science mourns the loss of one of its ablest exponents.

R. L. Smith-Rose.

30th September 1967.

NATIONAL COMMITTEES

Canada

1967 SPRING MEETING

(see p. 9)

Germany

MEMBERSHIP

Honorary President : Prof. Dr. W. Dieminger.

President : Dr. W. Becker.

Secretary : Dipl.-Phys. A. Ochs.

Official Members :

Comm. I — Prof. Dr. U. Adelsberger.
Comm. II — Dr. J. Grosskopf.
Comm. III — Dr. B. Beckmann.
Comm. IV — Prof. Dr. G. Elwert.
Comm. V — Prof. Dr. O. Hachenberg.
Comm. VI — Prof. Dr. Ing. Piefke.
Comm. VII — Dr. W. Veith.
Comm. VIII — Dr. H. Volland.

Israel

MEMBERSHIP

The Israel National Committee for URSI held its first meeting on April 23, 1967 and appointed the following official members to URSI Commissions I, III, VI and VII :

Commission I. — Mr. J. Ziv (Zussman), Department of Radio and Communications, Israel Post Office, Jerusalem.

Commission III. — Dr. J. MASS, Scientific Department, Israel Ministry of Defence, POB 7063, Hakyrya, Tel Aviv.

Commission VI. — Prof. I. CEDERBAUM, Faculty of Electrical Engineering, Technion, Haifa.

Commission VII. — Prof. M. ZAKAI, Faculty of Electrical Engineering, Technion, Haifa.

Sweden

MEMBERSHIP

The Swedish National Committee has made the following nominations for the period 1967-1969 :

President : Dr. Håkan STERKY, Former Director General, Sibyllegatan 43-45, Stockholm Ö.

Vice-President : Prof. Nicolai HERLOFSON, Royal Institute of Technology, Stockholm 70.

Secretary : Mr. Per ÅKERLIND, Chief Engineer, Royal Board of Swedish Telecommunications, Farsta 1.

Official Members of the Commissions of URSI :

I. — Mr. Per Olov LUNDBOM, Chief Engineer, Research Institute of National Defence, Div. 3, Stockholm 80.

II. — Mr. Folke EKLUND, Chief Engineer, Research Institute of National Defence, Div. 3, Stockholm 80.

III. — Prof. Bengt HULTQUIST, Kiruna Geophysical Observatory, Kiruna.

IV. — Prof. Stig LUNDQUIST, Institute of High Tension Research, Uppsala.

V. — Prof. Per Olof LINDBLAD, Stockholm Observatory, Saltsjöbaden.

VI. — Prof. Carl-Georg AURELL, Chalmers Institute of Technology, Sven Hultins gatan, Göteborg S.

VII. — Prof. Sven Olving, Chalmers Institute of Technology, Sven Hultins gatan, Göteborg S.

VIII. — Prof. Stig Lundquist, Institute of High Tension Research, Uppsala.

United Kingdom

CHANGE OF ADDRESS

As from 19 June 1967 all correspondence should be addressed to : The Royal Society, 6 Carlton House Terrace, London, S.W.1 (Telephone : 01-839 5561).

USA

1967 SPRING MEETING

Ottawa, Ontario, Canada, May 23-26, 1967.

Sponsored by

The Canadian National Committee.
The United States National Committee.

with the cooperation of

The National Research Council of Canada, and
Six Groups of the Institute of Electrical and Electronics Engineers.

Opening remarks to the joint meeting
of Canadian and US National Committees of URSI

May 23, 1967

Dr. Ballard, Professor Morgan, Ladies and Gentlemen :

I am honored to be here as President of the Union to bring greetings from the Board of Officers to this joint meeting of the Canadian and US Natinonal Committees of URSI. The relationship between our two national committees and — here, of course,

I must also speak as an American — our spirit of cooperation exemplifies the highest ideals of our Union. Our members collaborate in many research projects, notably in space radio research, and I know that the URSI through the national committees has helped generate these activities. In this day, when the world seems to be headed for chaos through blindness and the persistence of focussing on differences and disaffection, this community of spirit of our national committees is especially significant and precious. We must treasure it highly.

This joint meeting is a fitting way for scientists to celebrate this centennial anniversary of the establishment of Canada. It is fitting as a tribute to the accomplishments of this young country in science and engineering. The dynamic spirit of the country has evidenced itself in our international meetings. The Canadian National Committee has played, and will continue to play, an important part in our Union and I am sure that we can look to Canada for great contributions to all facets of life in the next one hundred years. It is my pleasure, Dr. Ballard, to express for the officers of URSI our felicitations to Canada on this centennial anniversary and I hope that we might stretch the concept of the centennial by two years so that all of URSI can join in the celebration when we are your guests at the General Assembly in 1969.

List of Papers

Opening Session.

Welcoming address. — Dr. B. G. Ballard, President, National Research Council of Canada, Ottawa, Ontario.

Remarks by the President of URSI. — Prof. S. Silver, Director, Space Sciences Laboratory, University of California, Berkeley, California.

Long baseline interferometry. — L. Y. Yen, University of Toronto, Toronto, Canada.

Space communications at millimeter wavelengths. — D. C. Hogg, Bell Telephone Laboratories, Inc., Crawford Hill Laboratory, Holmdel, New Jersey.

Upper atmosphere rocket research in Canada. — A. G. McNamara, National Research Council, Ottawa, Ontario.

Survey of HARP atmospheric measurements program. — G. V. Bull, C. H. Murphy; Space Research Institute, McGill University, Montreal, Quebec; Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland.

Commission I

Radio Measurements Methods and Standards

Measurements I

Microwave power measurement by use of the Hall effect in indium arsenide. — Prof. J. C. Beal, Elect. Engineering, Colorado State University, Fort Collins, Colo.

A microwave differential phase shifter. — J. E. Keys, Defence Research Telecommunications Establishment, Ottawa, Canada.

Quarter wavelength sections of waveguide as standards of reflection coefficient. — R. W. Beatty, B. C. Yates, US Dept. of Commerce, National Bureau of Standards, Boulder, Colorado.

Laboratory standard connector dimensions for series N, TNC, C, BNC, SC, and BRM. — N. Anderson, Amphenol RF Division, 33 E. Franklin, St. Danbury, Conn.

Measurement of noise parameters S and π of an electron beam using a sealed-off tube « Espitron ». — T. Okoshi. K. Ninomiya, Dept. of Electronic Engineering, University of Tokyo, Bunkyo-ku, Tokyo, Japan.

Measurements II

Dispersivity studies of the 1.35 cm H_20-line. — H. J. Liebe, M. C. Thompson, Jr., M. J. Vetter. — Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

A microwave dispersometer for gases. — H. Liebe, M. J. Vetter, M. C. Tompson, Jr., — Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

On the international coordination of atomic time scales. — J. T. Henderson, A. G. Mungall, National Research Council, Ottawa, Canada.

A low-resolution power spectrum technique for measuring complex permittivity of low-loss materials at millimeter and submillimeter wavelengths. — K. H. Breeden, A. P. Sheppard, Engineering Experiment Station, Georgia Institute of Technology.

Measurement of amplitude and phase of electromagnetic fields. — R. J. King, Dept. of Elect. Engineering, University of Wisconsin, Madison, Wisconsin.

Commission II

Radio Propagation in Non-Ionized Media

Guided propagation at the Earth's surface.

Solution of a boundary value problem for a superrefractive surface layer. — I. H. Gerks, Collins Radio Company, Cedar Rapids, Iowa.

Mechanism of propagation in the jungle. — Chas. R. BURROWS, Radio Eng. Laboratories, Washington, D. C.

The quasi-near fields of dipole antennas. — P. R. BANNISTER, US Navy Underwater Sound Laboratory, Fort Trumbull, New London, Conn.

Very low frequency propagation below the surface of the earth from buried dipole sources, A. W. BIGGS, Missile and Information Systems Division, The Boeing Company, Seattle, Washington.

The propagation of medium frequency radio waves over ice-covered sea water. — I. A. BOURNE, D. B. Ross, B. SEGAL, Defence Research Telecommunications Establishment, Ottawa, Ontario.

Surface wave propagation over media of small index of refraction. — R. J. KING, Department of Electrical Engineering, University of Wisconsin, Madison, Wisconsin.

RADIO SCATTERING BY PLANETARY SURFACES.

Depolarization of radio fields by terrain. — J. B. SMYTH, P. A. HICKS, SMYTH Research Associates, San Diego, California.

A study of earth radar returns from Alouette satellite, R. C. CHIA, H. H. DOEMLAND, R. K. MOORE, Center for Research in Engineering Science, University of Kansas, Lawrence, Kansas.

Backscatter of radio waves from progressive and standing waves in the ocean. — J. G. STEELE, Dept. of Electrical Engineering, Queen's University, Kingston, Ontario.

Rough surface scattering parameters on a communication link, — H. STARAS, RCA Laboratories, Princeton, New-Jersey.

Scattering of electromagnetic waves from a slightly rough dielectric layer. — A. K. FUNG, Center for Research in Engineering Science, University of Kansas, Lawrence, Kansas.

Relationship between scattering of EM waves from a weakly inhomogeneous medium and a slightly rough dielectric surface, — A. K. FUNG, C. M. TU, Center for Research in Engineering Science, University of Kansas, Lawrence, Kansas.

Radar reflectivity model for LEM. — H. S. HAYRE, A. TONG, Dept. of Electrical Engineering, University of Houston, Houston, Texas.

RADAR AND REFRACTOMETER PROBING.

Probing the clear atmosphere by radar. — I. KATZ, Applied Physics Laboratory, The John Hopkins University, Baltimore, Maryland.

Local stratification in the lower troposphere. — D. R. HAY, Dept. of Physics, University of Western Ontario, London, Ontario.

Estimation of the number of unresolvable targets producing a single radar return, — P. BECKMANN, Electrical Engineering Department, University of Colorado, Boulder, Colorado.

An airborne refractometer for continuous recording of refractivity profiles. — W. von Hagen, D. R. Hay, Northern Electric Co., Ltd., Box 3511, Station C, Ottawa, Ontario.

Polarization study of clear air echoes using bistatic and monostatic radar measurements, — A. H. LaGrone, Dept. of Electrical Engineering, University of Texas, Austin, Texas.

Analysis of spectra of atmospheric refractive index differences. — A. W. Straiton, A. P. Deam, J. L. Dodd, Electrical Engineering Research Lab., The University of Texas.

A report on the work of the radio and acoustics group in the Institute of Atmospheric Physics, Moscow. — J. W. Strohbehn, Radiophysics Laboratory, Thayer School of Engineering, Dartmouth College.

Atmospheric absorption, emission and scatter at millimeter wavelengths.

Atmospheric emisssion and absorption at millimeter wavelengths. — V. J. Falcone, K. N. Wulfsberg and S. Gitelson, Microwave Physics Laboratory, Air Force Research Laboratories, Laurence C. Hanscom Field, Bedford, Mass.

Measurements of rainfall attenuation at 8 and 15 GHz, 1966. — R. M. Dohoo, K. S. McCormick and J. I. Strickland, Defence Research Telecommunications Establishment, Defence Research Board, Ottawa, Canada.

Rain attenuation statistics at random antenna elevation. — P. Christopher, System Sciences Corporation, Falls Church, Va.

A dense rain gauge measuring system for attenuation studies of radio propagation. — R. A. Semplak, Bell Telephone Laboratories, Inc., Crawford Hill Laboratory, Holmdel, New Jersey.

Calculations of precipitation scatter interference. — F. J. Altman, Communication Systems, Inc., Falls Church., Virginia.

Research memory in geophysics, E. K. Smith, Jr., ITSA, US Dept. of Commerce, ESSA, Boulder, Colorado.

Theories of forward reflection and scatter.

Multiple scattering in a random continuum : High frequency approximations. — D. A. De Wolf, RCA Laboratories, Princeton. New Jersey.

A deduction about the propagation mechanism from tropo fading rates. — Thomas J. Carroll, Bendix Radio Div., Baltimore, Md.

Exact solutions for a class of simplified transhorizon scatter problems. — W. S. Ament, Naval Research Laboratory, Washington, D. C.

E-M waves in turbulent media — Dielectric theory. — L. S. Taylor, Case institute of Technology, Cleveland, Ohio.

Spectra of troposcatter signals. — H. S. Merrill, O. S. Anderson, W. P. Birkemeier, Dept. of Electrical Engineering, University of Wisconsin, Madison, Wisconsin.

Cross polarization of waves as a bulk statistical measure of the perturbation of tropospheric structure. — J. W. Wick, Propagation Research Group, Collins Radio Company, Cedar Rapids, Iowa.

Experiments in forward transmission and scatter.

Relation of communication channel parameters to atmospheric structure. — O. S. Anderson, H. S. Merrill, W. P. Birkemeier, Dept. of Electrical Engineering, University of Wisconsin, Madison, Wisconsin.

Multi-data-gathering antenna array for transhorizon propagation. — D. C. Cox, A. T. Waterman, Jr., Stanford Electronics Laboratories, Stanford University, Stanford, California.

Wave-front observations at 35 GHz on a line-of-sight path. — R. W. Lee, A. T. Waterman, Jr., Stanford Electronics Laboratories, Stanford University, Stanford, Calif.

Terrain scattered signals on obstructed paths. — Rajendra Vikramsingh, ITT Microwave, Mountain View, Cal.

Predictability of Loran-C propagation characteristics. — R. V. Gould and J. A. Walsh, Systems Management, Polaris, Sperry Gyroscope Company, Division of Sperry Rand Corporation, Great Neck, New York.

Observation of wind-produced Doppler shifts in troposcatter. — D. H. Sargeant, College of Engineering, University of Wisconsin, Madison, Wisconsin.

Preliminary results of tropospheric scatter predetection combining with a novel signal processor. — W. J. Bickford, J. T. de Bettencourt, H. J. Rowland, J. F. Roche, R. G. Gease, Raytheon Co., Waltham 54, Mass.

Commission III

Ionospheric Radio.

Oblique soundings.

Preliminary results from the ITSA coordinated HF ionospheric propagation experiment. — L. H. Tveten, R. D. Hunsucker, Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

The usable time-delay resolution in HF oblique sounding, — R. B. Fewick, Radioscience Laboratory, Stanford University, Stanford, California.

Sequential measurements of absolute time delay with an HF sweep frequency FM-CW oblique sounder. — R. B. Fenwick, Radioscience Laboratory, Stanford University, Stanford, California.

Time-frequency correlation of the 21.73 MHz path Fredrikstad, Norway to Port Canaveral, Florida. — A. M. Manders, University of Florida, Electrical Engineering, 300 University Drive, Port Canaveral, Florida.

Mode reliability at high frequency. — R. Swanson, D. Olmsted, F. Wilson, Department of the Air Force, Headquarters Rome Air Development Center (AFSC), Griffis Air Force Base, New York 13440.

Computer prediction of the effects of HF oblique-path polarization rotation with frequency. — M. R. Epstein, Radioscience Laboratory, Stanford University, Stanford, California.

Experimental measurements of the variation of wave polarization with HF frequency, — M. R. Epstein, Radioscience Laboratory, Stanford University, Stanford, California.

Detection of abrupt changes in the ionosphere using a Doppler technique, — P. F. Weaver, R. T. Tsunoda, P. C. Yuen, Dept. of Electrical Engineering, University of Hawaii.

Radio observations of a nighttime traveling ionospheric disturbance. — K. Toman, Upper Atmosphere Physics Laboratory, Air Force Cambridge Research Laboratories, Bedford, Mass.

The upper ionosphere.

Topside electron density morphology for the Southern Hemisphere during an M region storm. — A. H. Katz, G. F. Rourke, AVCO Research and Technology Laboratories, Space System Division, AVCO Corporation, Wilmington, Mass.

Electron number density (Alouette II orbit). — P. L. Timleck, Defence Research Telecommunications Establishment, Ottawa, Ontario.

Ionospheric electron content space variations over Texas as calculated from Faraday fading of radio waves from satellites. — J. P. German, Dept. of Electrical Engineering, Texas A and M University, College Station, Texas.

Ionospheric electron content and large-scale irregularities near the minimum of the solar cycle. — R. G. Merrill, R. S. Lawrence, Institute for Telecommunications Sciences and Aeronomy, ESSA, Boulder, Colorado.

Determinations of the rates of production and loss of electrons in the F Region. — F. L. Smith, III, Stanford Electronics Laboratories, Radioscience Laboratory, Stanford University, Stanford, Calif.

Ionospheric integrated electron content for use with pioneer interplanetary spacecraft. — R. P. Merritt, M. J. Baron, Center for Radar Astronomy, Stanford University, Stanford Research Institute, Stanford, Calif.

Theoretical studies of the nighttime behaviour of the protonosphere. — P. Bauer, A. F. Nagy, E. G. Fontheim, Space Physics Research Laboratory, Department of Electrical Engineering, University of Michigan.

Mapping of AC electric fields on OV3-3. — F. L. Scarf, R. W. Fredricks, G. M. Grook, Space Sciences Laboratory, TRW Systems, Redondo Beach, Calif.

INCOHERENT SCATTER AND SCINTILLATION.

Some evidence concerning the distribution of irregularities responsible for radio aurora. — G. F. LYON, University of Western Ontario, London, Ontario.

Correlation analysis of radio auroral scatter signals. — F. H. PALMER, Dept. of Physics, The University of Western Ontario, London, Ontario.

A study of scattering cross-sections in the lower ionosphere at 448 MHz. — L. A. MAYNARD, Dr. A. KAVADAS, Defence Research Telecommunications Establishment, Ottawa, Ontario, Canada.

Nighttime ionic composition over Arecibo, Puerto Rico. — D. R. MOORCROFT, Dept. of Physics, University of Western Ontario, London, Ontario.

Incoherent scatter measurements of temperature and electron densities from 130 to 430 kM. — R. WAND, Arecibo Ionospheric Observatory, Arecibo, Puerto Rico.

Variation of radio star and satellite scintillations with sunspot number and geomagnetic latitude. — R. B. STREETS, Jr., The Boeing Company, Seattle, Washington.

Observations of 448 MHz electromagnetic radiation from the ionosphere. — E. A. SEAMAN, Defence Research Telecommunicatons Establisment, Ottawa, Ontario.

F AND E REGIONS.

An analysis of high ionosphere positive ion ram probes. — B. A. PONTANO, The Pennsylvania Sate Univesrity, Ionosphere Research Lab., University Park, Pennsylvania.

The vertical and oblique incidence reflection coefficients of the ionosphere. L. E. PETRIE, Radio Physics Laboratory, Defence Research Telecommunications Establishment, Ottawa, Ontario.

Ion temperature variations around a circular polar orbit below the F-peak. — K. K. HARRIS, W. G. SHARP, Lockheed Palo Alto Research Laboratory, Palo Alto, Calif.

Electron density of intense sporadic E at temperature latitudes. — E. K. SMITH, Jr., ITSA, US Dept. of Commerce, Boulder, Colorado.

Solar cycle variation of sporadic E. — C. A. REDDY, S. MATSUSHITA, High Altitude Observatory of NCAR, Boulder, Colorado.

Studies of sporadic E characteristics by rockets. — M. MUKUNDA RAO, Aeronomy Laboratory, Dept. of Electrical Engineering, University of Illinois, Urbana, Ill.

Factors affecting interpretation of ionospheric radio drift measurements, I : On the validity of conventional diffraction treatments of weak radio scattering at vertical incidence. — J. W. WRIGHT, Institute for Telecommunication Sciences and Aeronomy; ESSA, Boulder, Colorado.

Factors affecting interpretation of ionospheric radio drift measurements : II : On the convection of ionospheric irregularities by the neutral wind. — L. S. FEDOR, Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

F REGION MORPHOLOGY AND PREDICTIONS.

Development of local area ionospheric maps by numerical methods. — M. LEFTIN, F. STEWART, Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

Short-term forecasting of ionosphere MUFs for equatorial regions. — R. J. SLUTZ, Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

The ionospheric response during the 12 November 1966 eclipse. — G. J. GASSMANN (Air Force Cambridge Research Laboratories, Bedford, Mass.). — K. BIBL., J. BUCHAU, J. R. HERMAN, Lowell Tech. Inst. Research Foundation, Lowell, Mass., R. W. GOWELL (Air Force Cambridge Research Laboratories, Bedford, Mass.).

Horizon focusing observed on a one hop F2 horizon limited path. — L. C. HUMPHREY, Electronics Laboratory, General Electric Co., Syracuse, New York.

A study of the behaviour of the Fl layer. — E. D. DUCHARME, L. E. PETRIE, Defence Research Telecommunications Establishment, Ottawa, Ontario.

On the theory of signal distortion due to ionospheric dispersion. — L. WETZEL, Institute for Defense Analyse, Arlington, Va.

A new machine program for ionospheric propagation mode predictions, — U. R. EMBRY, V. R. ARENS, Electronic Defense Laboratories, Sylvania Electronic System — Western Operations, Mountain View, Calif.

Radio wave propagation to the antipode. — N. C. GERSON, Trapelo Road, South Lincoln, Mass., J. C. HENGEN, R. M. PIPP, J. B. WEBSTER, US Department of Defence.

E AND D REGIONS.

Airborne measurements of reflection heights of medium-frequency continuous wave signals. — G. J. GASSMANN, Air Force Cambridge Research Laboratories, Bedford, Mass., J. R. HERMAN, Lowell Tech. Inst. Research Foundation, Lowell, Mass.

Ionospheric electron density and collision frequency from IQSY NIKE APACHE rocket measurements of Faraday rotation differential absorption and probe current. — E. A. MECHTLY, S. A. BOWHILL, Aeronomy Laboratory, University of Illinois, Urbana, Illinois, L. G. SMITH, GCA Corporation, Bedford, Mass.

Motions of an electron cloud released from a gun launched projectile. — C. H. MURPHY, Ballistic Research Laboratories, Aberdeen Proving

Ground, Maryland, G. V. BULL, Space Research Institute, McGill University, Montreal. P. Q.

Rocket observations of electron temperature in the E Region. — L. G. SMITH, L. H. WEEKS, GCA Technology Div., GCA Corporation, Bedford, Mass.

Results of rocket experiments in auroral absorption events. — J. C. ULWICK, W. PFISTER, Air Force Cambridge Research Laboratories (OAR), Bedford, Mass.

Ionization increases in the lower ionosphere as detected by high latitude partial reflection observations, — L. W. HEWITT, Defence Research Telecommunications Establishment, Ottawa, Ontario.

Determination of a D Region nitric oxide density profile by VLF radio propagation. — G. S. SALES, Air Force Cambridge Research Laboratories, D. P. HAYES, Lowell Techn. Inst. Research Foundation, Lowell, Mass.

A day-time positive ion measurement in the D Region. — D. C. BAKER, L. C. HALE, Ionosphere Research Laboratory, The Pennsylvania State University, University Park, Pennsylvania.

Interpretation of pre-sunrise electron densities in the D Region. — C. F. SECHRIST, Jr., Aeronomy Laboratory, University of Illinois, Urbana, Illinois.

IONOSPHERIC THEORY AND FINE STRUCTURE.

Calculation of Faraday rotation and absorption at HF as an adjunct to simplified computer raytracing. — T. A. CROFT, Radioscience Lab., Stanford University, Stanford, Calif.

Nighttime variations of F Region electron density profiles at Puerto Rico, seasonal and annual variations in temperature and drift velocity deduced from ionospheric data. — Tatsuo SHIMAZAKI, A. R. LAIRD, Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

F Region ionization perturbations produced by transport effects associated with acoustic gravity waves. — D. M. CUNNOLD, Sylvania Electronic Systems, Applied Research Lab., 40 Sylvan Road, Waltham, Mass.

Theoretical diurnal behaviour of a model ionosphere. — A. V. DA ROSA, Stanford Electronics Laboratory, Stanford University, Stanford, Calif.

Ionospheric structure investigated with frequency dependence of phase and group height of HF-pulses. — K. BIBL. B. W. REINISCH, Lowell Tech. Inst. Research Foundation, 450 Aitken Street, Lowell, Mass.

On the formation of small-scale irregularities in the F Region. — G. C. REID, Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

Measurements of fine scale structure of the winter ionosphere in auroral mid-latitude regions. — L. R. HUGHES, E. D. BOWEN, Smyth Research Associates, 355 Aero Court, San Diego, Calif.

Simultaneous observations of amplitude, frequency and polarization scintillations in the ionosphere. — P. R. ARENDT, Institute for Exploratory Research, Fort Monmouth, New Jersey.

VHF RADAR SOUNDINGS.

Studies of electron, ion and neutral temperatures in the F Region at the dip equator. — J. P. MCCLURE, T. E. VANZANDT, D. T. FARLEY, R. COHEN, Jicamarca Radar Observatory, Apart. 3747, Lima, Peru, W. B. HANSON, Southwest Center for Advanced Studies, Dallas, Texas.

Incoherent backscatter observations of the F Region during the November 12, 1966 solar eclipse. — V. L. PETERSON, D. T. FARLEY, J. L. GREEN, J. P. MCCLURE, D. J. STERLING, T. E. VANZANDT, Jicamarca Radar Observatory, Apart. 3747, Lima, Peru.

F Region traveling disturbances at the magnetic equator. — D. L. STERLING, Jicamarca Radar Observatory, Apart. 3747, Lima, Peru.

Radar echoes from turbulent structure in the equatorial electrojet. — B. B. BALSLEY, Jicamarca Radar Observatory, Apart. 3647, Lima, Peru.

Neutral winds in the equatorial electrojet. — R. COHEN, Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

VHF radar returns from the D Region of the equatorial ionosphere. — V. L. FLOCK, Dept. of Electrical Engineering, University of Colorado, Boulder, Colorado, B. B. BALSLEY, Jicamarca Radar Observatory, Apart. 3747, Lima, Peru.

Proton gyro-resonance observed in incoherent scattering from the ionosphere. — D. T. FARLEY, Jicamarca Radar Observatory, Apart. 3747, Lima, Peru.

GRAVITY WAVES AND VLF MEASUREMENTS.

Internal gravity waves. — C. O. HINES, D. FULTZ, University of Chicago, Chicago, Illinois.

Response of the ionosphere to the passage of acoustic-gravity waves generated by low altitude nuclear explosions. — D. P. KANELLAKOS, Radio Physics Laboratory, Stanford Research Institute, Menlo Park, Calif.

Resonances of a cylindrical earth-ionosphere cavity model with a dipolar magnetic field. — D. B. LARGE, J. R. WAIT, Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

Propagation of VLF waves below anisotropic ionosphere models with a dipping statis magnetic field. — J. GALEJS, Applied Research Laboratory, Sylvania Electronic Systems, A Division of Sylvania Electric Products, Inc. Sylvan Road 40, Waltham, Mass.

Scattering of VLF radio waves in the curved earth-ionosphere waveguide of variable effective height. — E. BAHAR, Department of Electrical Engineering, University of Colorado.

Whistler-mode transmissions by the Alouette II topside sounder. — D. B. MULDREW, Radio Physics Laboratory, Defence Research Telecommunications Establishment, Defence Research Board, Ottawa, Ontario.

VLF diurnal phase variations at short distances. — J. L. JESPERSEN, G. KAMAS, A. H. MORGAN, Radio Standards Physics Division, US Dept. of Commerce, Boulder, Colorado.

VLF phase heights of the lower ionosphere at Byrd Station, Antarctica, W. J. HELMS, H. M. SWARM, D. K. REYNOLDS, University of Washington, Seattle, Washington.

COMMISSION IV

Magnetospheric Radio

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The morphology of VLF radio noises observed with the Injun II satellite, — Wm. TAYLOR, Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa.

Equatorial VLF hiss. — D. A. GURNETT, Dept. of Physics and Astronomy, University of Iowa, Iowa City, Iowa.

On the generation of wideband electromagnetic noise above 1 kHz in the high latitude magnetosphere. — T. S. JORGENSEN, Radioscience Laboratory, Stanford, University, Stanford, Calif.

The artificial production of VLF hiss. — T. F. BELL, Radioscience Laboratory, Stanford, University, Stanford, Calif.

Simultaneous occurrence of ionospheric noise at medium and very low frequencies. — T. R. HARTZ and R. E. BARRINGTON, Defence Research Telecommunications Establishment, Ottawa, Ontario, Canada.

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On the generation of discrete VLF emissions. — R. A. HELLIWELL, Radioscience Laboratory, Stanford University, Stanford, California.

A cutoff at the plasmapause in whistlers observed on Alouette I and II, — D. L. CARPENTER, F. WALTER, Radioscience Laboratory, Stanford University, Stanford, Calif. and R. E. BARRINGTON, D. J. MCEWEN, Radio Physics Laboratory, Defence Research Telecommunications Establishment, Ottawa, Ontario.

Satellite observations of whistler ducts. — J. J. ANGERAMI, R. L. SMITH, Radioscience Laboratory, Stanford University, Stanford, Calif.

Measurements of whistler power spectra and their interpretations. — H. B. LIEMOHN, J. F. KENNEY, Boeing Scientific Research Laboratories, P. O. 3981, Seattle, Washington.

Asymmetric distortions of the magnetosphere observed by whistlers received by OGO-I. — J. J. ANGERAMI, Radioscience Laboratory, Stanford University, Stanford, Calif.

Automatic processing of whistler data. — J. N. Bloom, Defence Research Telecommunications Establishment, Ottawa, Ontario.

Incoherent scattering.

Ion velocity distribution functions in the ionosphere. — P. M. Banks, G. J. Lewak, Department of Applied Electrophysics, University of California, San Diego, La Jolla, Calif.

Electrostatic resonances in warm magnetized plasma. — R. W. Fredriks and F. L. Scarf, Space Sciences Laboratory, TRW Systems, Redondo Beach. Calif.

A new interpretation for resonance spikes observed by the top-side sounder « Alouette » — based on Cerenkov effect in a warm plasma. — Hiroshi Kikushi, Institute for Aerospace Studies, University of Toronto, Toronto, Ontario.

Observations of wave-like ionospheric perturbations associated with magnetic micropulsations. — G. Boyd, H. J. Duffus, Dept. of National Defence, Canadian Services College, Royal Roads, Victoria, B. C.

Magnetospheric phenomena and hydromagnetic waves.

Geometry of magnetospheric tail at large distances. — A. J. Dessler, F. C. Michel, Department of Space Science, Rice University, Houston, Texas.

Study of the temporal variations of 40 keV electrons during and after the magnetic storm on April, 18, 1965. — C. S. R. Rao, Dept. of Physics and Astronomy, University of Iowa, Iowa City, Iowa.

Synchrotron radiation from electrons trapped in the earth's magnetic field. — J. F. Vesecky, Center for Radar Astronomy, Stanford University, Stanford, California.

Jupiter's magnetosphere. — J. A. Gledhill, Laboratory for Space Sciences, NASA Goddard Space Flight Center, Greenbelt, Maryland.

Polarization of natural hydromagnetic signals of 0.2 to 3.0. — W. H. Campbell, Institute for Telecommunication Sciences and Aeronomy, Environmental Science Services Administration, Boulder, Colorado.

Comparison of dynamic spectra for natural ULF field variations at several world stations. — T. Saito, High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado and W. H. Campbell, Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

Commission V

Radio and Radar Astronomy

Solar system.

Meteor head echoes at 23 cm. — R. H. Todd, Radio Physics Laboratory, Stanford Research Institute, Menlo Park, California.

Radar astronomy aperture synthesis with application to lunar studies. — T. HAGFORS, B. NANNI, K. STONE, Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Mass.

Bistatic radar detection of scattering centers on the Moon using Lunar Orbiter I. — G. L. TYLER, Center for Radar Astronomy, Stanford University, Stanford, California.

A computer-program for making contour maps of extended radio sources, — H. R. DICKEL, University of Illinois Observatory, Urbana, Ill.

On the measurement of radio sources in the 1-5 MHz range using synthetic apertures. — R. FANTE, J. MODESTINO, J. MAHONEY, E. SHEFTELMAN, AVCO MSD, Wilmington, Mass.

Solar wind and coronal shock velocities as implied by radar. — J. C. JAMES, Massachusetts Institute of Technology, Center for Space Research, El Campo, Texas.

Interplanetary electron concentration and variabiity measurements with Pioneer VI and VII. — H. T. HOWARD and R. L. KOEHLER, Center for Radar Astronomy, Stanford University, Stanford, California.

Pioneer VII lunar occultation. — V. R. ESHLEMAN, B. B. LUSIGNAN, H. T. HOWARD, J. C. POMALAZA, and G. FJELDBO, Center for Radar Astronomy, Stanford University, Stanford, California.

Detailed analyses on the Mariner IV occultation data. — V. R. ESHLEMAN, G. FJELDBO, Center for Radar Astronomy, Stanford University, Stanford, California.

RADIO NEBULAE.

Progress report on a survey of galactic hydrogen 109 α recombination lines. — E. C. REIFENSTEIN, III, T. L. WILSON, B. F. BURKE, Department of Physics and Research Technology, Lexington, Mass. and P. G. MEZGER, National Radio Astronomy Observatory, Green Bank, West Virginia.

Studies of the hydrogen recombination line 137 β at 5005 MHz. — B. ZUCKERMAN, P. PALMER. H. PENFIELD, Harvard College Observatory, Cambridge, Mass.

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The nature of the radio source W49. — P. G. MEZGER, J. SCHRAML, National Radio Astronomy Observatory, Green Gank, West Virginia and Yervant TERZIAN, Arecibo Ionospheric Observatory, Arecibo, Puerto Rico.

The radio source W49 and anomalous OH emission. — V. A. HUGHES, R. BUTLER, Radio Astronomy Group, Queen's University at Kingston, Ontario.

High resolution radio observations of an intense HII region in Cygnus X. — M. RYLE, D. DOWNES, Mullard Radio Astronomy Observatory, Cambridge, England; Harvard Radio Astronomy Station, Fort Davis, Texas.

Observations of four HII regions at $\lambda = 2.8$ cm. — J. M. MACLEOD, L. H. DOHERTY, Radio and Electrical Engineering Division, National Research Council of Canada, Ottawa, Ontario.

Radio distances of gaseous nebulae. — L. A. HIGGS, Radio and Electrical Engineering Division, National Research Council of Canada, Ottawa, Ontario.

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Progress report of an 11 cm survey of the galactic continuum radiation. — W. ALTENHOFF, P. G. MEZGER, National Radio Astronomy Observatory, Green Bank, West Virginia.

A survey of the sky at 610.5 MHz. — J. R. DICKEL, Vermilion River Observatory, University of Illinois, Urbana, Illinois.

Observations of the galactic spur in the 20 to 40 MHz range using the Arecibo radio telescope. — D. A. GUIDICE, Radio Astronomy Branch, Space Physics Laboratory, Air Force Cambridge Research Laboratories, Bedford, Mass.

Spectra of radio sources at low frequencies. — T. A. CLARK, Marshall Space Flight Center, National Aeronautics and Space Administration, Huntsville, Alabama.

Observations of intense radio sources with a 10 cm array. — T. H. LEGG, M. B. BELL, Radio and Electrical Engineering Division, National Research Council, Ottawa, Ontario and C. BIGNELL, University of Western Ontario, London, Ontario.

Observations of the supernova remnant W44 at a wavelength of 2.8 cm. — B. H. ANDREW, C. R. PURTON, Radio and Electrical Engineering Division, National Research Council of Canada, Ottawa, Ontario.

Models of nine radio sources from lunar occultation observations. — J. H. TAYLOR, M. L. DE JONG, Harvard College Observatory, Cambridge, Mass., National Radio Astronomy Observatory, Green Bank, West Virginia.

Time variations in the intensity of radio sources at 2.8 cm. — J. L. LOCKE, W. J. MEDD, S. VAN DEN BERGH, Radio and Electrical Engineering Division, National Research Council of Canada, Ottawa, Ontario.

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The size of Jupiter's decametric radio source. — G. DULK, B. RAYHRER, University of Colorado, and R. S. LAWRENCE, ESSA, Boulder, Colorado.

Polarization of the Jupiter radiation at 18 MHz. — C. H. BARROW and D. P. MORROW, Florida State University Radio Observatory, Tallahasee, Florida.

42.5 MHz observations of the August 28, 1966 solar event. — S. R. Mosier, Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa.

Polarization characteristics of solar noise storms at 74 MHz. — L. R. McNarry, G. A. Harvey, Radio and Electrical Engineering Division, National Research Council of Canada, Ottawa, Ontario.

Solar observations at mm-wavelengths and their application for the forecasting outstanding occurrences. — G. Feix, Radiosternwarte der Universität Bonn, Bonn, Germany.

Calculations of apparent sky temperatures and of tropospheric absorption on solar radiation at 4.28-cm wavelength. — O. T. Matsuura, P. Kaufmann, Radio Astronomy Group, Mackenzie University, Sao Paulo, Brazil.

A high resolution, one-dimensional meterwavelength radioheliograph. — W. K. Klemperer, Institute for Telecommunication Sciences and Aeronomy, ESSA, Boulder, Colorado.

Commission VI

Radio Waves and Circuits

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Directivity functions for general array configurations of short and long dipoles. — T. O. Mottl, C. T. Tai, The University of Michigan, Radiation Laboratory, Ann Arbor, Michigan.

Current distribution for circular arrays of tangential dipoles. — J. L. Hilburn, C. E. Hickman, Elect. Engineering Dept., Auburn University, Auburn, Alabama.

Collinear arrays of closely-spaced cylindrical antennas. — A. L. Van-Koughnett, Dept. of Electrical Engineering, University of Toronto.

Arrays of unequal and unequally-spaced dipoles. — R. W. P. King, W. M. Cheong, Harvard University Cambridge, Mass.

Gain of electromagnetic horns. — M. A. K. Hamid, Dept. of Electrical Engineering, University of Manitoba, Winnipeg, Canada.

Loop antenna loaded with active elements. — C. W. Bostian, F. J. Tischer, North Carolina State University, Raleigh, North Carolina.

Theory of conical equiangular spiral antennas. K. K. Mei, Y. S. Yeh, Dept. of Electrical Engineering, University of California, Berkeley, Calif.

Characteristics and applications of LF dipoles in contact with the surface of the earth. — W. M. Evans, Defence Research Telecommunications Establishment, Ottawa, Ontario.

Wire antennas at high frequencies. — V. R. Arens, U. R. Embry, Electronic Defense Laboratories, Sylvania Electronic Systems — Western Operations, Mountain View, Calif.

An improvement to the Adcock detection finding system. — V. R. Arens, Electronic Defense Laboratories, Sylvania Electronic Systems — Western Operations, Mountain View, Calif.

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RF probe admittance in the ionosphere : comparison of theory and experiment. — K. G. Balmain, G. Oksiutuik, Dept. of Electrical Engineering, University of Toronto, Toronto 5, Onatorio.

Theoretical and experimental study of a finite cylindrical antenna in a plasma column. — C. Y. Ting, B. Rama Rao, Gordon McKay Laboratory, Harvard University, Cambridge, Mass.

Measurements of the impedance and radiation pattern of a quarter-wave monopole in an isotropic plasma. — D. L. Jassby, M. P. Bachinsky, RCA Victor Research Laboratories, Montreal, Canada.

The theoretical and experimental determination of the impedance of a small loop in an anisotropic plasma. — G. L. Duff, Dept. of Electrical Engineering, University of Washington, Seattle, Washington.

Effective radiation resistance of a short antenna in a lossy uniaxial medium. — J. Galejs, Applied Research Laboratory, Sylvania Electronic Systems. A Division of Sylvania Electric Products Inc., 40 Sylvan Road, Waltham, Mass.

The current distribution for a dipole antenna in a warm plasma. — A. David Wunsch, Gordon McKay Laboratory, Harvard College Observatory, Mass.

Impedance of cylindrical antennas in magnetoplasma under conditions of refractive index resonance. — J. P. Lafon, H. Weil, Observatoire de Paris, University of Michigan.

The admittance variation about the plasma frequency of an infinite dipole antenna in an ionospheric type plasma. — E. K. Miller, High Altitude Engineering Lab., Dept. of Aerospace Engineering, University of Michigan, Ann Arbor, Michigan.

Radiation from an electric dipole in an axially magnetised plasma column — dipolar modes. — G. L. Yip, S. R. Seshadri, Department of Electrical Engineering, University of Toronto, Toronto, Canada; Applied Research Laboratory, Sylvania Electronic Systems, A Division of Sylvania Electric Products, Inc., 40 Sylvan Road, Waltham, Mass.

Communications systems and circuits.

A variable rate binary communication system for uncontrolled sharing of a satellite repeater. — G. J. Clowes, G. R. Notley, N. G. Davies, Defence Research Telecommunications Establishment, Ottawa, Ont.

Some efficient feedback schemes for space communications. — T. Kailath, Stanford Electronics Labs., Stanford University, Stanford, Calif.

Swept frequency sounder receivers for the Isis satellites. — C. A. FRANKLIN, M. A. MCLEAN, T. ENDRESEN, R. J. BONNYCASTLE, Defence Research Telecommunication Establishment, Ottawa, Ontario.

A wideband VLF receiver for Alouette II and Isis-A. — C. A. FRANKLIN, T. NISHIZAKI and W. E. MATHER, Defence Research Telecommunications Establishment, Ottawa, Ontario.

Synchronization techniques in the processing of scientific data from satellites. — L. S. SCHWARTZ, New York University, New York.

Power supplies for topside sounder satellites. — C. A. FRANKLIN, Defence Research Telecommunications Establishment, Defence Research Board, Ottawa, Ontario.

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A proposed 1 mm-wavelength communication system using gas devices. — H. J. LIEBE, B. SENITZKY, TRG, A Division of Control Data Corporation, Melville, N. Y.

Communication-system blackout during reentry of large vehicles. — F. H. MITCHELL, Jr., W. R. GARRETT, Technical Papers Office, IBM, P. O. Box 1250, Hunstville, Alabama.

Hardpoint demonstration array radar. — P. J. KAHRILAS, D. M. JAHN, Sperry Gyroscope Company, Div. of Sperry Rand Corp., Great Neck, N. Y.

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The scattering effects of controlled ion acoustic wave instabilities. — J. T. COLEMAN, Battelle Memorial Institute, Columbus Laboratories, 505 King Avenue, Columbus. Ohio.

Microwave diagnostics of the plasma sheath produced by slot antenna breakdown : experimental observations and theory. — M. H. MENTZONI, R. V. Row and J. DONOHOE, Applied Research Laboratory, Sylvania Electronic Systems, Div. of Sylvania Electric Products Inc,. Waltham, Mass.

Radar interferometry as a measure of the distribution of scattered power from a turbulent plasma. — D. E. WEISSMAN, H. GUTHART and T. MORITA, Stanford Research Institute, Menlo Park, California.

Plasma profile investigations using a multi-mode cavity perturbation technique. — B. RAMA RAO and L. D. SCOTT, Gordon McKay Lab., Harvard University, Cambridge,, Mass.

Electrostatic coupling between a transverse-circularly polarized electromagnetic wave and a longitudinal wave in a finite temperature electromagneto-ionic medium. — H. C. HSIEH, Electron Physics Laboratory, Dept. of Electrical Engineering, The University of Michigan, Ann Arbor, Michigan.

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can Science and Engineering, Inc., Cambridge, Mass., C. DUBS, Air Force Cambridge Research Laboratories, Bedford, Mass.

Oblique incidence of an electromagnetic wave upon a plamsa layer. — V. H. WESTON, J. J. BOWMAN, The University of Michigan Radiation Laboratory, Department of Electrical Engineering, Ann Arbor, Michigan.

Electromagnetic wave scattering from a cylinder immersed in a warm plasma. — E. K. MILLER, High Altitude Engineering Laboratory, Dept. of Aerospace Engineering, University of Michigan, Ann Arbor, Michigan.

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The measurement of radar backscatter from extended wires and obstacles at 4.3 mm. — L. H. KOSOWSKY, A. HONIG, R. DIDOMIZIO, Norden Division of United Aircraft Corp., Norwalk, Connecticut.

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On the scattering from a long wire. — Chinlin CHEN, School of Electrical Engineering, Purdue University, West Lafayette, Indiana.

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Analysis of backscatter from a rough layer. — K. KRISHEN, W. W. KOEPSEL, D. H. LEHNERT, Electrical Engineering Department, Kansas State University, Manhattan, Kansas.

Scattering of a plane wave by a moving perfectly conducting sphere. — R. C. RESTRICK, C. T. TAI, The University of Michigan, Radiation Laboratory, Ann Arbor, Michigan.

Wave propagation in random media. — U. FRISCH, Courant Institute of Math. Sciences, 251 Mercer Street, New York, N. Y.

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Effective boundary conditions describing reflection and transmission by a conducting shell of arbitrary shape. — K. M. MITZNER, Northrop Norair, Hawthorne, California.

The time-dependent Green's function for electromagnetic waves in moving conducting media. — I. M. BESIERIS, Bell Telephone Laboratories, Inc., Whippany, New Jersey, R. T. COMPTON, Jr., Case Institute of Technology, Cleveland, Ohio.

DIFFRACTION.

Diffraction by a cylinder in a locally uniaxial medium with azimuthal optic axis. — J. SHMOYS, H. J. STALZER, Jr., Polytechnic Institute of Brooklyn, Electrophysics Department, New York, N. Y.

Theoretical and experimental investigations on the electromagnetic scattering by a conducting cylinder coated with an anisotropic ferrite sheath. — B. Rama Rao and M. Bharathi, Gordon McKay Laboratory, Harvard University, Cambridge, Mass.

Scattering of a dipole field by imperfectly conducting cylinders. — G. N. Tsandoulas, Dr. O. M. Salati, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pennsylvania.

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A new asymptotic solution to the diffraction by a wedge. — D. L. Hutchins, R. G. Kouyoumjian, Electro-Science Laboratory, Dept. of Electrical Engineering, The Ohio State University, Columbus, Ohio.

Asymptotic theory of diffraction by a curved interface. — B. Rulf, Courant Institute, New York University, New York. N. Y.

Approximate methods for electromagnetic diffraction by a planar aperture, — Chuang-Jy Wu, Research and Development Laboratories, Northern Electric Co., Ltd, Ottawa, Ontario; T. J. F. Pavlasek. Dept, of Electrical Engineering, McGill University, Montreal, Que.

Numerical solution of electromagnetic boundary value problems by means of the asymptotic anticipation method. — A. R. Neureuther, K. Zaki, Dept. of Electrical Engineering and Computer Sciences and Electronics Research Laboratory, University of California, Berkeley, Calif.

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The effects of temperature and collisions on surface wave propagation on plasma column. — N. Kolettis, R. E. Collin, Case Institute of Technology, Cleveland, Ohio.

Ray-optical description for modes in non-uniform waveguides. — S. J. Maurer, L. B. Felsen, Electrical Engineering Department, Electrophysics Department, Polytechnic Institute of Brocklyn, New York, N. Y.

Ray-optical calculation of reflection from an open-ended waveguide, — N. Y. Yee, L. B. Felsen, Electrophysics Department, Polytechnic Institute of Brooklyn, New York, N. Y.

Effects of dielectric sheaths on an infinite phased array of rectangular waveguides. — C. P. Wu and V. Galindo, Bell Telephone Laboratories, Inc., Whippany, New Jersey.

Compensation of the effects of a longitudinal slot in a rectangular waveguide. — F. J. Tischer, 2300-M4-Avent Ferry Rd., Raleigh, N. C.

Analytic and numerical investigation of the earth-ionosphere waveguide for VLF radio waves. — C. P. Bates, Bell Telephone Laboratories, Inc. Whippany, New Jersey.

Solution of waveguide discontinuities by modal analysis. — A. Wexler, University of Manitoba, Dept. of Electrical Engineering, Winnipeg, Man.

Smith-Purcell radiation from the narrow tape helix. — A. R. Neureuther, R. Mittra, Department of Electrical Engineering and Computer Sciences, University of California, Berkeley, California.

Evidence of coupled-mode behavior on a radiating periodic structure, — R. B. Kieburtz, D. Sun. Department of Electrical Sciences, State University of New York, Stony Brook, N. Y.

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Optimization of large data collection systems. — N. W. Perks, Pennsylvania State University, Philadelphia, Pennsylvania.

Optimization of linear communication channels. — D. A. George, Carleton University, Ottawa, Ontario.

A non-parametric approach to the detection of multiple signals in non-stationary noise. — G. R. Knight, Sylvania Electronic Systems-Western Operations, P. O. Box 205, Mountain View, California.

Detection of narrow-band Gaussian optical fields and the incoherent optical heterodyne. — J. N. Lahti, Bell Telephone Laboratories, Inc., Whippany, New Jersey.

The angular resolution of an optimum signal processing array. — A. A. Ksienski, Aerospace Group, Hughes Aircraft Company, Culver City, Calif.

Computer aided design techniques for integrated circuits. — R. A. Mammano, Arinc Research Corporation, Western Div., 1222 East Normandy Pl., Santa Ana, Calif.

A new tool in the analysis of random wave propagation noise theory, R. Bourret, McGill University, Physics Dept., Montreal, Quebec.

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Oblique incidence ionospheric reflections of 100 kHz pulses. Robert H. DOHERTY.

A note on the reflection coefficient of a sharply bounded ionosphere for VLF signals at the magnetic equator. J. M. DE LISLE.

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COMMISSIONS

Commission III — Ionosphère

INDICES FONDAMENTAUX DE LA PROPAGATION IONOSPHERIQUE

(Extrait du *Journal des Télécommunications*, Vol. 34, n° 8, août 1967)

Les tableaux ci-après, contenant les valeurs des indices fondamentaux de la propagation ionosphérique, ont été établis par le Scrétariat spécialisé du Comité consultatif international des radiocommunications (CCIR) conformément à la Résolution 4-1, à l'Avis 371 et au Rapport 246-1 de la XI[e] Assemblée plénière du CCIR (Oslo, juin-juillet 1966).

VALEURS OBSERVÉES :

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

Mois / Année	1	2	3	4	5	6	7	8	9	10	11	12
1966	28	31	34	37	41	45	50	56	63	67	69	71
1967	73											

● I_{F2} (indice ionosphérique)* :

Mois (année 1966)

1	2	3	4	5	6	7	8	9	10	11	12
15	20	34	37	46	54	54	53	42	46	64	68

Mois (année 1967)

1	2	3	4	5	6	7	8	9	10	11	12
78	93	113	114	115	92	89					

(*) Pour plus de détails, voir le *Journal des Télécommunications* (avril 1964, page 119, et janvier 1966, pages 43-47).

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

Année \ Mois	1	2	3	4	5	6	7	8	9	10	11	12
1966	88	84	90	97	98	96	107	106	111	109	113	125
1967	148	147	161	130	144	120	140					

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

PRÉVISIONS :

● R_{12}***

Année \ Mois	8	9	10	11	12	1 (1968)
1967	90	92	94	96	98	100

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

Estimation de l'erreur sur les prévisions, six mois d'avance, de R_{12} : ± 25.

ERREUR MOYENNE SUR LES PRÉVISIONS DE R_{12} BASÉE SUR LES 12 MOIS PRÉCÉDANT LE MOIS QUI SUIT CELUI POUR LEQUEL A ÉTÉ CALCULÉE LA LA DERNIÈRE VALEUR DE R_{12} :

Temps de prévision (mois)	0	1	2	3	4	5
Erreur moyenne	—8,4	—9,5	—10,2	—10,7	—11,4	—12,7
Ecart-type de l'erreur	±2,4	±1,6	±2,0	±3,2	±4,7	±5,9

● I_{F_2}****

Année \ Mois	7	8	9	10	11	12	1 (1968)
1967	103	115	119	123	126	129	(132)

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

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

ERREUR MOYENNE SUR LES PREVISIONS DE I_{F_2}, BASÉE SUR LES 12 MOIS PRÉCÉDENTS :

Temps de prévision (mois)	0	1	2	3	4	5	6
Erreur moyenne	—3,7	—6,2	—8,4	—10,9	—13,3	—15,0	—16,2
Ecart-type de l'erreur	±11,9	±15,3	±16,5	±16,3	±15,1	±13,8	±13,3

● Φ^{*****}

Mois	8	9	10	11	12	1968 1	2	3	4	5
Année										
1967	(145)	(147)	(148)	(149)	(150)	(151)	(151)	(152)	(152)	(152)

(*****) Prévision selon une méthode d'extrapolation envisagée au Secrétariat du CCIR en application de la Résolution 30 de la XI[e] Assemblée plénière du CCIR (Oslo, 1966). Pour les valeurs mises entre parenthèses, l'erreur dépasse probablement la valeur de ± 10 unités de Φ.

ERREUR MOYENNE SUR LES PRÉVISIONS DE Φ BASÉE SUR LES 12 MOIS PRÉCÉDENTS :

Temps de prévision (mois)	0	1	2	3	4	5	6	7	8	9
Erreur moyenne	+5,6	+7,3	+7,6	+7,2	+5,0	+2,2	—1,0	—3,8	—6,2	—8,9
Ecart-type de l'erreur	±16,1	±18,9	±22,1	±21,6	±19,3	±17,2	±16,4	±19,6	±25,4	±9,22

BASIC INDICES FOR IONOSPHERIC PROPAGATION

(Reprint from the *Telecommunications Journal*, Vol. 34, n° 8, August 1967)

The following tables giving values of the basic indices for ionospheric propagation, have been prepared by the Specialized

Secretariat of the International Radio Consultative Committee (CCIR) in accordance with Resolution 4-1, Recommendation 371 and Report 246-1 of the XIth CCIR Plenary Assembly (Oslo, June-July 1966).

PARAMETERS :

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

Month / Year	1	2	3	4	5	6	7	8	9	10	11	12
1966	28	31	34	37	41	45	50	56	63	67	69	71
1967	73											

● I_{F_2} (ionospheric index)* :

Month (year 1966)

1	2	3	4	5	6	7	8	9	10	11	12
15	20	34	37	46	54	54	53	42	46	64	68

Month (year 1967)

1	2	3	4	5	6	7	8	9	10	11	12
78	93	113	114	115	92	89					

(*) For further details, see the *Telecommunication Journal*, April 1964, page 119, and January 1966, pages 43-47.

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

Month / Year	1	2	3	4	5	6	7	8	9	10	11	12
1966	88	84	90	97	98	96	107	106	111	109	113	125
1967	148	147	161	130	144	120	140					

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

FORECASTS :

● R_{12}***

Month / Year	8	9	10	11	12	1 (1968)
1967	90	92	94	96	98	100

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

Estimated error in forecats of R_{12} six months in advance : ±25

MEAN ERROR ON R_{12} PREDICTIONS BASED ON THE 12 MONTHS PRECEDING THE MONTH FOLLOWING THAT FOR WHICH THE LAST R_{12} VALUE WAS CALCULATED :

Prediction time months	0	1	2	3	4	5
Mean error	—8.4	—9.5	—10.2	—10.7	—11.4	—12.7
Standard deviation	±2.4	±1.6	±2.0	±3.2	±4.7	±5.9

● $I_{F_2}f$****

Month / Year	7	8	9	10	11	12	1 (1968)
1967	103	115	119	123	126	129	(132)

(****) Data kindly supplied by the Department of Scientific and Industrial Research, Radio and Space Research Station, Slough.

The figure in brackets is the value forecast six months in advance.

MEAN ERROR IN I_{F_2} PREDICTIONS CALCULATED OVER THE 12 PRECEDING MONTHS :

Period of prediction (months)	0	1	2	3	4	5	6
Mean error	—3.7	—6.2	—8.4	—10.9	—13.3	—15.0	—16.2
Standard deviation of the error	±11.9	±15.3	±16.5	±16.3	±15.1	±13.8	±13.3

● Φ*****

Month	8	9	10	11	12	1968 1	2	3	4	5
Year										
1967	(145)	(147)	(148)	(149)	(150)	151()	(151)	(152)	(152)	(152)

(*****) Prediction by a method of extrapolation devised by the CCIR Secretariat, pursuant to Resolution 30 of the XIth CCIR Plenary Assembly (Oslo, 1966). For the values in brackets, the error probably exceeds the value of ±10 units of Φ.

MEAN ERROR IN Φ PREDICTIONS CALCULATED OVER THE 12 PRECEDING MONTHS :

Period of prediction months	0	1	2	3	4	5	6	7	8	9
Mean error	+5.6	+7.3	+7.6	+7.2	+5.0	+2.2	—1.0	—3.8	—6.2	—8.9
Standard deviation of the error	±16.1	±18.9	±22.1	±21.6	±19.3	±17.2	±16.4	±19.6	±25.4	±29.2

Commission VI

Ondes et Circuits radioélectriques

SYMPOSIUM SUR LES ONDES ELECTROMAGNETIQUES

STRESA (Italie) 3-8 Juin 1968

Comité d'organisation (provisoire) :

G. BARZILAI,
M. BOELLA,
F. CARASSA,
N. CARRABA

Sous le patronage de :

Union Radio Scientifique Internationale (URSI),
Conseil National des Recherches,
Comité National Italien URSI.

PREMIERE ANNONCE

Du lundi 3 à samedi 8 juin 1968 aura lieu à Stresa un Symposium sur les Ondes Electromagnétiques.

Ce Symposium poursuit la série qui comprend : le « Symposium on Microwave Optics » Montreal, Canada, 1953; le « Symposium on Electromagnetic Wave Theory » Ann Arbor, Michigan, USA 1955; le « Symposium on Electromagnetic Theory » Toronto, Canada, 1959; le « Symposium on Electromagnetic Theory and Antennas » Copenhagen, Denmark, 1962; et le « Symposium on Electromagnetic Wave Theory », Delft, Netherlands, 1965.

Au cours de ce Symposium auront lieu des discussions sur les progrès dans le domaine de la propagation des ondes électromagnétiques et des antennes. Des communications seront acceptées sur les sujets suivants :

1. Propagation dans les milieux non homogènes ou anisotropes.
2. Propagation dans les milieux aléatoires.
3. Propagation des très basses fréquences.
4. Phénomènes non-linéaires dans la propagation des ondes.
5. Antennes (en particulier panneaux avec distribution non uniforme des éléments et les effets du couplage entre eux).
6. Applications des élaborateurs à la solution de problèmes électromagnétiques.

En règle générale, au début de chaque séance, un orateur sera invité à donner lecture d'une communication introductive; le reste de la séance sera consacré à des communications brèves.

Les communications devront être adressées à M. G. P. Bava, secrétaire du comité organisateur, c/o Istituto di Elettronica e Telecomunicazioni, Politecnico, C.so Duca degli Abruzzi, 24 — 10129 Torino, Italy.

Les auteurs sont invités à présenter un résumé de 800 à 1 600 mots de leur communication. Ces résumés devront être rédigés avec le plus grand soin, parce qu'ils seront utilisés pour la sélec-

tion des communications; ils devront parvenir au secrétaire du Comité organisateur avant le 31 janvier 1968.

Les langues officielles du Symposium sont le français et l'anglais.

Les communications devront être présentées au cours du Symposium par l'auteur ou l'un des auteurs.

SYMPOSIUM ON ELECTROMAGNETIC WAVES

STRESA, Italy, June 3 to 8, 1968.

Organizing committee (provisional) :

G. BARZILAI,
M. BOELLA,
F. CARASSA,
N. CARRARA.

Sponsored by :

The International Scientific Radio Union (URSI),
National Research Council (CNR),
Italian National Committee of URSI.

FIRST ANNOUNCEMENT

From Monday, June 3rd to Saturday, June 8th 1968 a « Symposium on Electromagnetic Waves » will be held at Sresa.

The symposium will be the next one in the series, which includes : the « Symposium on Microwave Optics » Montreal, Canada in 1953, the « Symposium on Electromagnetic Wave Theory » Ann Arbor, Michigan, USA in 1955, the « Symposium on Electromagnetic Theory » Toronto, Canada in 1959, the « Symposium on Electromagnetic Theory and Antennas » Copenhagen, Denmark in 1962, and lastly the « Symposium on Electromagnetic Wave Theory » Delft, Netherlands in 1965.

The aim of the symposium is to discuss progress in the field of electromagnetic wave propagation and antennas. Papers will be welcomed in the following sectors :

1. Propagation in inhomogeneous or anisotropic media.
2. Propagation in random media.

3. Very low frequency propagation.
4. Non linear phenomena in wave propagation.
5. Antennas (with particular reference to non uniform arrays and mutual coupling effects between elements).
6. Application of computers for solving electromagnetic problems.

As a rule the sessions will be opened by an invited paper, followed by a series of shorter papers.

Papers should be sent to G. P. Bava, Secretary of the organizing committee, c/o Istituto di Elettronica e Telecomunicazioni, Politecnico, C.so Duca degli Abruzzi, 24, 10129 Torino, Italy.

Authors are requested to submit a summary, containing not less than 800 and not more than 1600 words. Since these summaries form a basis for the selection of papers, authors are advised to write them most carefully. The summaries must have reached the secretary of the organizing committee before 31st January 1968.

Admitted languages are English or French.

Papers must be presented at the symposium by the authors or by one of the authors.

INTER-UNION COMMISSIONS

Inter-Union Commission on Frequency Allocations for Radio Astronomy and Space Science (IUCAF)

REPORT OF THE EIGHTH MEETING OF THE COMMISSION

held in the National Academy of Sciences, Washington, U.S.A., during the period 5th to 9th June, 1967

(Doc. IUCAF/113)

Present : Professor F. G. SMITH (in the Chair), Dr. E. J. BLUM, Dr. J. W. FINDLAY, Dr. J. P. HAGEN, Mr. A. J. HIGGS, Mr. F. HORNER, Professor H. C. VAN DE HULST — (part-time), Mr. T. NISHIZAKI, Dr. R. L. SMITH-ROSE (Secretary General).

1. — In opening the meeting, the Chairman welcomed Messrs. BLUM, FINDLAY and NISHIZAKI as new members of the Commission ; and announced apologies from various members who were unable to attend.

2. — *Representation of IAU.*

The Chairman reported that he had received a letter from Professor Unsold stating his wish to resign from IUCAF as one of the representative of IAU; and suggesting that Professor Hachenberg of Bonn University Observatory would be a suitable successor.

In accepting his resignation the Commission expressed their appreciation of the assistance given by Professor Unsold, who had been a member of IUCAF from its first meeting in October 1961.

It was agreed that the appointement of a successor was a matter for IAU to determine in consultation with IUCAF; and that this should be done at the forthcoming General Assembly of IAU in Prague (1967).

3. — *Report of seventh meeting in Munich* (1966) *and agenda for present meeting.*

The report of the meeting in Munich, circulated as DOC. IUCAF/95 was accepted; as was also the agenda for the present meeting (IUCAF/108) with the addition of the following items :

(*a*) Frequencies for world-wide communications;

(*b*) Revised bandwidths and new line frequencies;

(*c*) Interference from television stations and industrial sources.

4. — *Finance.*

The audited statement of income and expenditure for the year ended 31 December 1966 given in DOC. IUCAF/106 was accepted : and the budget estimates for 1967 and 1968 detailed in DOC. IUCAF/110 were also adopted.

5. — *The Registration of Frequencies for Radio Astronomy.*

The Commission observed that in Document IUCAF/101, some observatories had notified their use of frequencies which were not allocated to radio astronomy in the frequency register of the International Telecommunication Union (ITU).A considerable discussion took place on the advantages or otherwise of advertising the use by radio astronomers of frequencies outside the bands allocated to astronomy.

Dr. Findlay suggested that national bodies should be free to register frequencies in use, whether or not these are in the allocated bands. But Dr. Sterky considered that it might be dangerous to disclose the use of too many frequencies outside the allocated bords. Mr. Higgs stressed the fact that radio astronomers should be strongly encouraged to use the allocated bands first; but in agreement with some other members, there appeared to be no harm in registering the use of other frequencies. Dr. Hagen, in agreeing with this outlook, recommended that no radio astronomer should register with the International Frequency Registration Board (IFRB) any out-of-band frequency which has not been approved by the appropriate national administration. As Dr. Findlay remarked, on a national basis some astronomers have the facility of working at good sites; and they may wish to choose frequencies which are locally free from interference and for which

there is a strong scientific reason for their use. In supporting this viewpoint, Dr. Blum suggested that on the whole very few « out-of-band » frequencies are actually in use.

6. — The *Chairman*, in summarising the discussion, stated that there appeared to be no case for suggesting any change in the International Regulations or procedure; but he stressed the need for radio astronomers to keep their national administrations and the IUCAF informed as to the frequencies actually in use at the various observatories. He proposed to draft a summary of the commission's attitude in suggesting that astronomers should :

(*a*) concentrate first on the internationally allocated bands;

(*b*) use other frequency bands only if there are strong scientific reasons for doing so;

(*c*) enquire of their colleagues in other countries the reasons justifying (*b*).

A circular letter to be sent to radio astronomers was prepared by the Chairman and is reproduced in DOC. IUCAF/114.

7. — It was further proposed that *Dr. Smith-Rose* should periodically circulate a questionnaire to extend and keep up-to-date the information given in DOC. IUCAF/101; and that he should publicise the work of the IFRB in compiling their registers of frequencies in use for both radio astronomy and space research.

Mr. Nishizaki distributed to the members present copies of Supplement No. 1 to the « List of Stations in the Space Service and in the Radio Astronomy Service (1st May 1967). » published by ITU, Geneva.

8. — *The use of the Standard Frequency Guards Bands.*

Considerable discussion took place on the attitude to be taken as to the use of the guard bands to the standard frequency allocations at 2.5, 5, 15 and 25 MHz, and the COSPAR Resolution No. 5 (see DOC. IUCAF/92). The commission was reminded of previous discussion of this matter at Munich (see DOC. IUCAF/95, para. 5); and Mr. Horner stressed the needs of COSPAR for the use of such frequencies for propagation studies under conditions that would cause no interference with the standard frequency services. It was agreed that the views of the radio astronomers and space research scientists should be co-ordinated; and Dr.

Sterky suggested that a new question should be submitted to the International Radio Consultative Committee (CCIR) and designed to stimulate the pursuit of radio propagation studies with the aid of space vehicles. The form of the question as finally agreed is given in Appendix II; and it was decided to seek the co-operation of COSPAR to form a working party to prepare an answer to this question.

Dr. Hagen suggested that the radio astronomers should not give up their rights to use the standard frequency guard bands, until they were satisfied as to the prior needs of the space scientists. He also informed the Commission that NASA was now conducting a survey on the frequencies needed for the future space research programme; and suggested that any action towards the request for additional frequency allocations should await the outcome of this survey. Dr. Smith-Rose emphasised the importance of radio astronomers and space scientists presenting a united front in recommendations made to CCIR and the International Frequency Registration Board (IFRB) of the ITU.

After further discussion of the matter with Dr. Hagen and Mr. Horner, it was decided to inform the constituent bodies, URSI, IAU and COSPAR, that since the standard frequency sidebands are generally too narrow for use in radio astronomy, the IUCAF is prepared to support the case for using these for space research on a secondary basis. To ensure that there is no interference with the standard frequency service, it is essential that any space research allocations should not include the centre positions of the bands. A copy of the letter prepared by Mr. Horner is included as Appendix I.

9. — *The Deuterium Frequency Band* (322-329 MHz).

Following the review of this matter at the Munich meeting (see para. 6 of DOC. IUCAF/95), Dr. Smith-Rose reported on discussions he had had with the appropriate national and international authorities on this subject. He said that it was clear that there was little hope at present of obtaining an improved status for the Deuterium frequency band (322-329 MHz), beyond the existing coverage by footnote No. 310 of the Radio Regulations, Geneva 1959. He recalled that no change in the form and provisions of this footnote was made at the Extraordinary Administrative Radio Conference at Geneva in 1963.

It was decided that the matter should be reviewed by IUCAF at some time in the future. In the meantine, the Commission took note of the first recommendation by URSI in DOC. IUCAF/98, and agreed to report this decision at the next General Assembly of URSI.

10. —*Radio Astronomy in the Band* 404-410 *MHz* (see *Appendix II*).

The Chairman referred to the letter he had addressed to all radio astronomers as members of IAU Commission 40 (see DOC. IUCAF/105). A summary of the replies received up to 31 May 1967 was given in DOC. IUCAF/112.

Drs. Findlay and Hagen drew attention to the apparently unique position of the US astronomers in confining their observations to the band 404-406 MHz although for Region 2, wich includes the whole American continent, the allocation is 404-410 MHz in accordance with footnote No. 317 to the Radio Regulations. The replies summarised in DOC. IUCAF/112 show that many observatories use, or will in the future use, the band 406-410 MHz for radio astronomy.

Considerable discussion took place on this difference in present practice ; and it was decided that IUCAF should take all possible steps in the future to securing a greater uniformity on an international scale in the use of this portion of the spectrum by radio astronomers.

The secretary was requested to continue his correspondence with radio astronomers throughout the world; and particularly to take up the matter with the national committee of URSI in the United States.

11. — *The Frequency Band* 606-614 *MHz.*

Dr. Hagen drew attention to the revised footnote No. 332 of the Final Acts of the EARC Geneva, 1963. This states that «in Region 2, the band 608-614 MHz is reserved exclusively for the radio astronomy service until the first Administrative Radio Conference after 1 January 1974.... ». The same footnote refers to the reservation of the band 606-614 in Region 1, and of 610-614 MHz in Region 3 for radio astronomy, but on the basis that the powers used for broadcasting at these frequencies shall not cause harmful interference to radio astronomy observations.

The Chairman stated that the position was reasonably satisfactory in the United Kingdom, but might deteriorate in the future : while, Dr. Blum said that conditions in France for radio astronomy at these frequencies were not good. Dr. Sterky emphasised the need to encourage scientists to take a long-term view, and to press forward with their case for the protection of the band 606-614 MHz. In agreeing with this, Dr. Findlay said that there is widespread use of this band for radio astronomy, and every effort should be made to strengthen the position in Regions 1 and 3 towards that prevailing in Region 2, up to and beyond 1974.

There was also discussion on the approach that should be made to encourage national administrations to implement the agreement with the broadcasting services described in footnote No. 332, mentioned above.

12. — *Protection of Frequencies of the OH radical.*

The Commission noted URSI's support of the recommendation of CCIR (Oslo 1966) concerning the protection of frequencies for observation of the natural line radiation from the OH radical at 1666 MHz. (Recommendation 2 in DOC. IUCAF/98).

It was agreed that Dr. Findlay would prepare an appreciation of the present position or observations on OH-line radiation, designed to justify a claim that the protected band should be increased from the present range of 1664.4 to 1668.4 MHz (Geneva 1963).

A measure of support to this was given at the Plenary Assembly of CCIR (Oslo 1966), where it was recommended that the band width for « all practicable protection should be at least 5, preferably 10, MHz. ».

With reference to recommendation 3 of URSI (in DOC. IUCAF/98), it was decided that IUCAF need not conduct a separate study of the protection desired at the line frequencies of 1612.2 and 1720.5 MHz. It does, however, wish to encourage studies in those countries, particularly Australia and the USA, which have been pioneers in research in this part of the spectrum.

13. — *Interference with Radio Astronomy and Space Research.*

A general discussion took place on the arrangements made by the US National Aeronautics and Space Administration (NASA) to clear interference from the bands assigned to space research and radio astronomy and to prevent a repetition of the recent

experience with the ATS satellite at the frequency of 408 MHz. Dr. Findlay outlined the precautions normally taken to ensure that no interference arises from the operational transmissions from satellites.

In emphasising the importance of the footnote provisions in the ITU Regulations, Dr. Hagen stated that in future NASA will notify the IFRB of the revised arrangements associated with satellites; and these arrangements should give adequate protection to research workers in radio astronomy and space science.

But there still remained the problem of informing not only the IFRB, but also national administrations, and the individual research organisations. While it is difficult to ensure that the experience with the ATS satellite will not recur, Dr. Sterky suggested that IUCAF could help by approaching its constituent bodies, URSI, IAU and COSPAR, asking them to take up the question of the use and misuse of various frequencies, and to get this subject discussed at national committees.

It was also suggested that IUCAF might assist by the preparation of an appropriate article on the suject for publication in the Telecommunication Journal of the ITU. This would help to stress the importance of maintaining good relations between scientists and their national administrations.

14. — *Need for Additional Frequencies for Space Research.*

Following paragraph 3 of the report of the meeting in Munich (DOC. IUCAF/95), Dr. Hagen and Mr. Horner had prepared a new question on «Radio Propagation Studies using Space Vehicles ». The revised form in which it will be submitted by IUCAF to the CCIR is reproduced in Appendix III to this report.

The Commission further agreed that it would be desirable for a report to be prepared in answer to this question for submission to the next Plenary Assembly of the CCIR. While a document drafted by the Real Time Telemetry Panel of COSPAR provides a partial answer to the question, it was agreed that a more complete report should be prepared by a small working group representing COSPAR and IUCAF.

15. — *Publications on Progress of IUCAF.*

The members of the Commission felt that there was a need for further publications describing its work, and outlining the progress

made in recent years in securing greater protection for the frequencies used by radio astronomers and space scientists. Following the article published in Nature in July, 1964, it was now necessary to review the present status of frequency allocations and to emphasise the matters that still need attention by both national and international authorities.

Dr. Sterky also suggested the need for an article on the bandwidths required to take account of Doppler effects in, for example, observations on H and OH line radiation. The Telecommunication Journal of the ITU was a suitable medium for such an article, which might also stress the very low level of received power at which radio astronomy observatories operate.

Mr. Higgs also offered to consider the preparation of an article on radio astronomy designed to inform communication engineers.

16. — *Co-operation with ESRO.*

In pursuance of paragraph 8 of DOC. IUCAF/95, Dr. Smith-Rose was asked to communicate with Dr. Lines of the European Space Research Organisation (ESRO) to discuss the clearance of frequencies, on both a national and international basis, for use in space research projects. The commission thought it might be useful to invite Dr. Lines to a future meeting of IUCAF to discuss this subject.

17. — *Frequencies for World-wide Communications.*

Dr. Sterky introduced a brief discussion on the future of world-wide communications by means of satellite relays; and said that US State Department will convene a meeting with the object of drafting a treaty by 1969, on the operation of such communications. This would raise the question as to which body or country should become the registering authority for the frequencies to be used in international communications by way of satellites : and it may become advantageous or desirable for the United Nations to act as this authority. The matter is obviously of great interest to the International Council of Scientific Unions (ICSU), with which IUCAF is so closely associated; and Dr. Sterky offered to keep this Commission informed as to future developments in this connection.

18. — *Revision of Frequency Requirements for Radio Astronomy.*

Dr. Blum introduced a discussion on the long-range policy to be pursued by IUCAF in connection with new lines in the spectrum of interest to radio astronomers; and also concerning increased bandwidths which may become desirable to facilitate future research.

The Chairman suggested that enquiries should be made through URSI, IAU and COSPAR with regard to future requirements : while Dr. Findlay remarked that it was useful to have a committee which in effect was the national equivalent of IUCAF. The United States already had such a committee; and Dr. Sterky said that Denmark, Norway and Sweden had a simple arrangement to meet the same objective.

The Commission was reminded that Commission V of URSI, under the chairmanship of Dr. Blum, would form a good co-ordinating body on an international basis, so far as radio astronomy is concerned. Dr. Blum said that the need for specific requirements for radio astronomy at the higher frequencies was becoming urgent; and the Chairman invited him to prepare a paper on this matter for a future meeting.

In the meantime, it was agreed that the Chairman and Dr. Findlay should draft a memorandum indicating the route of procedure which should be followed by astronomers and space scientists in dealing with their national administrations on matters of frequency allocations. Such a memorandum might also be addressed to the members of Commission 40 of the IAU. This might help to stimulate a discussion among radio astronomers, who should be asked to re-examine their requirements as to the actual frequencies and bandwidths they wish to be protected in the future. The original request for a series of bands at approximately octave intervals should be re-examined in the light of our present state of knowledge of this subject.

19. — *Sources of Harmful Interference.*

A review of sources of harmful interference to radio astronomy and space science was given by Mr. Horner, who stated that in connection with the technique of broadcasting from satellites, there appears to be a need for improvement in the suppression of harmonics and cross-modulation effects. Dr. Sterky suggested

that the Commission should prepare reports on existing CCIR questions relating to the suppression of harmonics : and Mr. Horner and the Secretary were asked to draft a suitable report for presentation to the appropriate Study Groups of the CCIR.

The matter of interference from electrical power supply networks was also discussed briefly; and the Chairman was invited to discuss with Mr. Horner, as Chairman of URSI Commission VIII, the actual levels of noise which were of interest to radio astronomers throughout the frequency spectrum.

20. — *Next Meeting.*

Attention was drawn to the fact that the next interim meeting of CCIR Study Group IV was scheduled to be held during the first three weeks of August 1968, probably in Geneva; and it would be appropriate for members of IUCAF attending this to meet at this time.

The next full meeting of the Commission should be held well in advance of the Plenary Assembly of CCIR and the General Assembly of URSI, both of which are due to take place during 1969.

21. — *Visits by Commission in USA.*

Interspersed with the business meetings described above the Commission was enabled to make visits in the Washington area as follows :

(*a*) to the headquarters of the National Aeronautics and Space Administration, where a series of lectures was presented reviewing the recent work of this organisation;

(*b*) to the National Radio Astronomy Observatory at Greenbank, West Virginia;

(*c*) to the Goddard Space Sciences Laboratory, near Washington, and

(*d*) to the U. S. Naval Research Laboratory, Washington D. C..

22. — *Vote of Thanks to Dr. Hagen.*

The Commission was unanimously enthusiastic in supporting the Chairman's vote of thanks to Dr. Hagen, for all the detailed organisational work he had conducted in connection with this meeting and the associated scientific visits. The Secretary is

particularly grateful to Dr. Hagen for subsequently conveying the Commission's gratitude to the twelve individuals in the various laboratories, observatories and administrations who contributed so much to the success of this meeting of IUCAF to Washington.

3 JULY 1967.

Appendix I : Letter addressed to the General Secretaries of URSI, IAU and COSPAR covering a note entitled : « Comments by IUCAF on the possible use of standard frequency side-bands for space research ».

Appendix II : Extract from the Final Acts of the Extraordinary Administrative Radio Conference (1963) of the International Telecommunication Union, Geneva.

Appendix III : Draft new question to be submitted to CCIR by IUCAF under the title : « Radio Propagation Studies using Space Vehicles ».

LIST OF ACTIONS TO BE TAKEN.

Chairman : Paragraphs 2, 6, 13, 15, 18 and 19.
Secretary : Paragraphs 6, 7, 8, 13, 15 and 16.
Dr. Blum : Paragraph 18.
Dr. Findlay : Paragraphs 12 and 18
Mr. Higgs : Paragraph 15.
Mr. Horner : Paragraph 19.

APPENDIX I

Comments by IUCAF on the possible use of standard frequency side-bands for space research

At the seventh meeting of the Commission, held in September 1966, the possible use of the standard frequency bands for space research was discussed (see DOC. IUCAF/95). It was then considered that the rights of radioastronomers in these bands should not be jeopardised by any proposed usage for space research (see DOC. IUCAF/94). The topic has now been reconsidered by the Commission at its eighth meeting held in June 1967. The present view is that although there is still a requirement in this part of

the spectrum, the bands are unlikely to be usable for radio astronomy in the foreseeable future, owing to their limited width and to the continued presence of unauthorised transmissions. It is therefore not expected that radioastronomers will object to the use of the bands for space research, and such use may be technically feasible for those applications in which only narrow bandwidths are required.

In these circumstances IUCAF is prepared to support requests for using the bands for space research on a secondary basis. To ensure that there is no interference with the standard frequency service it would be essential that any space research allocations should not include the centre positions of the bands. However the technical factors involved in the use and sharing of these and other bands are the subject of a draft question which has been prepared by IUCAF for submission to CCIR; and these factors can no doubt be thoroughly explored before the next frequency allocation conference which could deal with a request for additional frequency protection.

Appendix II

Extract from the Finals Acts of the Extraordinary Administrative Radio Conference (1963) of the International Telecommunication Union, Geneva.

Footnote No. 317.

The band 404-410 MHz in Region 2 and the band 406-410 in Regions 1 and 3 are also allocated to the radio astronomy service. An appropriate continuous band within these limits shall be designated on a national or area basis. In making assignments to stations of other services to which these bands are allocated, administrations are urged to take all practicable steps to protect radio astronomy observations from harmful interference.

Appendix III

Draft New Question on the need for the allocation of additional frequencies for Space Research, to be submitted by IUCAF to CCIR.

Radio Propagation Studies using Space Vehicles

The CCIR,

Considering that :

a) Satellite radio beacons operating on two or more fixed, harmonically related, frequencies now provide a powerful technique for enhancing our knowledge of the nature of the ionospheric conditions which are relevant to space research;

b) Radio methods of measurement provide for the determination to a high degree of accuracy of :

(*a*) orbital elements of satellites, and

(*b*) terrestrial distances, particularly intercontinental distances over large oceans;

c) Studies are desirable in the field of radio propagation with the object of enhancing our knowledge of the transmission of radio waves by and through the ionosphere;

Decides that the following Questions should be studied :

1. What regions of the spectrum are suitable for :

(*a*) radio wave propagation studies to be carried out with the space vehicles?

(*b*) ionospheric measurements to be conducted with the aid of radio beacons?

(*c*) geodetic and tracking measurements to be made using space vehicles carrying radio beacons ?

2. Which of the above applications would require long-term observations ?

3. What specific relationships should exist between the various frequencies used for these applications ?

4. What is the maximum interference that can be tolerated in each of these applications ?

5. What are the factors affecting the sharing of the required frequencies with space research telemetry and other radio services?

6. What degree of co-ordination in the location of ground stations will be required if frequency sharing is deemed to be practicable.

SERVICES PERMANENTS

Bureau International de l'Heure

COMITE DE DIRECTION

Réunion du 18 mars 1967 a Paris

Etaient présents : MM. H. M. Smith (*Président*), B. Decaux (*Secrétaire*), W. Markowitz, B. Guinot (*Directeur du BIH*).

M. N. Pavlov, souffrant, s'était excusé.

Compte Rendu

1. — *Publications.*

A l'avenir, le Bulletin Horaire sera supprimé et les publications périodiques du BIH seront les suivantes :

Circulaire A annuelle donnant TU2-TU1.

Circulaire B/C mensuelle, donnant TU1-TUO, interpolé et extrapolé pour tous les observatoires participants.

Ciculaire D mensuelle, donnant l'heure définitive TU2 déf (et TU1 déf) TU2 déf — TUC ainsi que TU2 déf — T atomique. On donnera, de plus, l'écart entre TUC et les temps d'émission de quelques signaux horaires importants.

Rapport annuel : Ce rapport donnera les explications nécessaires pour l'usage des circulaires ci-dessus. Il décrira les méthodes de calcul, il donnera les résidus « observation-calcul » pour les stations participantes. De plus, on y répètera l'ensemble des circulaires D de l'année.

Les circulaires B/C et D seront envoyées par avion. Le retard de la publication sur les dernières observations sera d'environ un mois. Le BIH n'attendra pas les résultats d'observations qui ne seraient pas transmis en temps voulu.

2. — *Pôle - origine.*

Le Comité propose que le pôle de référence du BIH soit le pôle moyen de 1903°0. Une recommandation à cet effet sera soumise à l'UAI et à l'UGGI. Ce pôle de référence sera introduit le 1er janvier 1968. Au début de 1968, on publiera simultanément les valeurs rapportées au pôle moyen instantané et au pôle de 1903°0. Dans la mesure du possible, on publiera les corrections à apporter aux résultats antérieurs à 1968 pour les exprimer dans le nouveau système.

3. — *Temps des Ephémérides.*

Aucune décision n'a été prise à ce sujet, mais le BIH fait savoir qu'il est prêt à centraliser les mesures de TE, à les discuter et à en publier la valeur définitive.

4. — *Temps légaux.*

Le BIH ne donnera pas la liste des temps légaux utilisés sur le globe.

5. — *Tâches du BIH.*

Ces tâches sont définies par les statuts. Cependant le point *d* des statuts d'après lequel le BIH doit fournir toute information sur le temps, sur demande, n'est pas assez restrictif. On propose que le BIH soit astreint à ne donner que les informations scientifiques disponibles. Une nouvelle rédaction de ce point *d* sera proposée et soumise à FAGS et aux unions parentes du BIH.

6. — *Rôles respectifs du BIH et du SIMP.*

Il faut éviter toute duplication du travail dans le calcul de TU1 et des coordonnées du pôle. Le Comité propose le partage suivant des tâches :

a) Le BIH traite l'ensemble des observations de temps et de latitude à l'aide des programmes de calcul dont il dispose déjà, pour obtenir TU1 et les coordonnées du pôle, dans un délai d'un mois après les observations.

b) Le SIMP est chargé de la discussion des observations de temps et latitude faites par les instruments à programmes associés : chaînes sur parallèles communs, astrolabes.

7. — *Budget.*

L'allocation annuelle attribuée par FAGS couvre le salaire d'un calculateur, les frais postaux et l'achat des fournitures pour l'impression des publications. Le comité estime qu'elle devrait être maintenue à son niveau actuel, qui est de l'ordre de 6 000 dollars US.

Resolutions

Considering that there is a need in astronomy and geodesy for a fixed, common, origin of reference for the coordinates of the pole of rotation, the Directing Board of the BIH.

recommends that, beginning at 00 h UT on 1968 January 1, the BIH shall compute the corrections $\Delta\lambda$, used in correcting UTO to UT1 and UT2, from coordinates of the pole which are :

(1) derived by the BIH,

(2) referred to the mean pole of 1903^{o}0, and are

(3) systematically the same coordinates as derived by the IPMS from the ILS stations.

Note : any previous IAU instructions which contradict the above instructions are superseded.

Explanation.

1. The « mean pole of 1903^{o}0 » is a short term for the « mean pole of 1900-05 », derived by G. Cecchini. It is defined in practice by the following adopted initial latitudes for the epoch 1903^{o}0 :

Mizusawa	+39^{o}	08′	03″.602
Kitab			01″.850
Carloforte			08″.941
Gaithersburg			13″.202
Ukiak			12″.096

2. The polar motion derived by the IPMS from the five ILS stations with the above initial latitudes is fundamental; it is free of errors in star places. The polar motion derived by the BIH from time and latitude observations made at independent stations will be brought into agreement with the ILS polar motion by

correcting the star places of the independent stations, as often as is considered necessary by the BIH.

3. No change will occur in coordinated Universal Time (UTC) as a result of adopting the mean pole of 1903°0, although there will be discontinuities in UT1 and UT2, to be published by the BIH. The time transmitted by coordinated stations will not (for this reason) be changed at 00 h on 1968 January 1.

COSPAR

Report to COSPAR

by Professor Samuel Silver, President URSI

Mr. Chairman, President Roy, Ladies and Gentlemen :

The period May, 1966-July, 1967 has been an active one for the International Scientific Radio Union, marked especially by the Symposium on Solar-Terrestrial Physics held in Belgrade in August and the General Assembly of the Union held in Munich in early September. The Belgrade Symposium had its origin in the resolution passed by the General Assembly of the Union in Tokyo in 1963. It covered in depth virtually the whole domain of those solar terrestrial interactions which result in the complex phenomena observed in the upper atmosphere, the magnetosphere, and the interplanetary medium. This symposium was convened by the URSI and organized with the full collaboration of the IUGG, the IAU, and the COSPAR. The major invited papers have just been published by the Academic Press in a volume edited by Mr. J. W. King and Mr. W. S. Newman of the Radio and Space Research Station at Slough.

The General Assembly in Munich also directed the program of a number of technical sessions to space related topics. Illustrative of the scope of the technical program are the following :

Models of Atmosphere.
Coding, Modulation and Signal Processing.
Propagation and Radiometry for Millimeter and Submillimeter Wavelengths.
Ionospheric F-Region end the Magnetosphere.
Dynamics of the Ionosphere.
Planetary Radio and Radar Astronomical Observations.
Radiospectroscopy.

Extraterrestrial Astronomical Observations.

Interactions between Movements of Neutral Atmosphere and Ionosphere.

The plenary technical session of the Assembly arranged jointly by all the Commissions featured two subjects of special interest to space science : (1) Synchronization of Clocks by Means of Satellites; (2) Discrete Radio Frequencies from Space. The latter, covered by Prof. A. H. Barrett, dealt with OH lines, CO lines, CN lines and so on, in addition to the hydrogen line in the radio noise from space. All of the work points to many new experiments and studies in space science. The complete proceedings, that is, the invited papers and discussions have been published under the title Progress in Radio Science, 1963-1966. The two volume work was published for the URSI by the Space Sciences Laboratory of the University of California, Berkeley in February, 1967.

The subject of collaboration by the URSI with other ICSU bodies, in particular, the relations between the Union and the COSPAR and the launching of the new Inter-Union Commission on Solar-Terrestrial Physics, commanded much of our attention. The position taken by the URSI with respect to both the COSPAR and the IUCSTP was that we must cooperate as fully as possible and give full support to programs leading to the advancement of science. We are indeed happy that in the recent weeks prior to the opening plenary session of the COSPAR Assembly the major issues relating to the IUCSTP seem to have been resolved and the efforts of Dr. Friedman and his committee on solar-terrestrial physics are now coming to fruition. We look forward to an activity which should engage the URSI, the IUGG the IAU, and the COSPAR in a very exciting and dynamic program.

We also look forward to continuing collaboration with the COSPAR in programs in space reserarch. The resolutions passed by the URSI Assembly in Munich in September 1966 and reiterated by the Board of Officers at their meeting in February, 1967 have expressed our desire and intent to develop a closer partnership with COSPAR in the areas of common interest. The URSI Executive Committee passed a motion at the Munich Assembly calling for the attendance of the chairmen of its Commissions at the meetings of COSPAR according to the relevance of the programs of a given year. But we also feel that COSPAR

should take action to implement such closer personal relations by a formal association of members of the relevant Unions with the Working Groups of COSPAR.

There has been much discussion among the three Unions, the URSI, the IUGG, and the IAU, about the relations with COSPAR. These discussions have dealt with the structure of COSPAR and the charter as well as with various facets of the programs and modes of operations of COSPAR involving the Unions. In response to a proposal by Prof. Nicolet in the name of the Bureau of COSPAR the Board of Officers of URSI agreed readily to separate the consideration of the subject of changes in the charter and structure of COSPAR from that of establishing closer working relations with the Unions. In this connection I must say that we recognize that the wording of a charter does not necessarily insure effective cooperation. The success of joint enterprise depends far more on the spirit of the participants. There is a dignity to be maintained in human relations. It is more than speaking politely to one another. It is dignity of mutual respect, of defining and recognizing responsibilities, and of discharging those responsibilities in accordance with the principles on which they have been founded. This can and must be achieved in the relations between the Unions and COSPAR and we look forward with great confidence to the special sessions of the Executive Council called for this purpose. We look forward to fuller participation of the URSI and other Unions in the scientific work of COSPAR and to our common efforts being directed fully to the progress of science.

July 24, 1967.

Information Bulletin

COSPAR Information Bulletin 38, June 1967, has been issued.

We quote the following from its contents :

1. Treaty of principles governing the activities of state in the exploration and use of outer space, including the moon and other celestial bodies (English and French texts).
2. Notes from IUCAF — The registration of frequencies for radio astronomy — Memorandum addressed to radio astronomers

with the object of assisting them to secure improved protection from interference in the several bands of radio frequencies allocated to radio astronomy in the current Radio Regulations (1963) of the International Telecommunication Union.

Radio Astronomy : Conflict of Frequencies.

3. Publication — Space Research VII.

Proceedings of the Seventh International Space Science Symposium, Vienna, May 1966.

Edited by R. L. Smith-Rose, International Scientific Radio Union. 1967, 2 vols., 1 500 pages; fr. 180 (£ 18; $50).

This publication contains the majority of the papers — in full text or in abstracts — presented by scientists from various countries during the international symposium on Space Research held in Vienna in 1966. These papers form comprehensive and up-to-date account of the recent advances made in the exploration of the earth's atmosphere and the space beyond by means of rockets and satellites carrying various types of instruments measuring the physical properties of the space through which the vehicles travel.

The volume is the seventh in a series which provides each year a detailed account of the progress being made in this interesting branch of science.

On request the two volumes can be bought separately.

WORLD METEOROLOGICAL ORGANISATION

The text of the following Resolution which was adopted by the Fifth World Meteorological Congress (Geneva, 3-28 April 1967) has been forwarded to the URSI for information.

Resolution 6 (Cg-V)

RELATIONS WITH THE UNITED NATIONS AND OTHER INTERNATIONAL ORGANIZATIONS

The Congress,

Noting the purposes of the World Meteorological Organization set out in Article 2 of the Convention,

Considering :

(1) The fundamental role of the World Meteorological Organization as a co-ordinator in world meteorology,

(2) The broad field of activities of the United Nations and its related agencies and other international organizations in which meteorological considerations enter to some extent,

(3) The need for whole-hearted co-operation with all these organizations if the responsibilities of the World Meteorological Organization are to be fully discharged,

(4) The establishment of the World Weather Watch and the opportunities it provides for various international organizations to collaborate constructively with the World Meteorological Organization in the implementation of this important undertaking.

Notes with satifaction the conclusion of agreements and working arrangements listed in WMO Publication No. 60.BD. 4 entitled « Agreements and Working Arrangements with other International Organizations » and the granting of consultative status to non-governmental international organizations also listed therein ;

Decides :

(1) That the Executive Committee is authorized to enter into such working arrangements with other international organizations as may be necessary and to consider, when appropriate, the advisability of concluding formal agreements which shall be subject to the approval of the Members in accordance with Article 26 paragraph (*a*) of the Convention of the World Meteorological Organization;

(2) That full co-operation, which is one of the main aims of the World Meteorological Organization, to ensure the most effective application of the science of meteorology to human activities, shall be achieved according to the following principles :

(*a*) In the case of large projects the World Meteorological Organization should :

(i) Ensure that it is consulted in the planning stage;

(ii) Accept responsibility for selecting such meteorological staff as may be required;

(iii) Accept responsibility for participating in the periodic reviews of progress and in the directives for future action;

(*b*) In the case of small projects, there should be consultation with the other organizations so as to create the desire on their part to seek counsel and advice from the World Meteorological Organization on matters of a meteorological nature;

(*c*) If in any project the meteorological aspect can be separated as a sub-project, the World Meteorological Organization should accept responsibility for it;

(3) That in carrying out all these co-operative endeavours the following *modus operandi* should be applied :

(*a*) If a question involves important policy or organizational aspects, it should be referred to the Executive Committee which should decide on the action to be taken;

(*b*) If a problem submitted has broad scientific aspects it should be referred to the appropriate body of the World Meteorological Organization and ultimately to the Executive Committee for consideration and decision;

(*c*) If the project concerned conducted by a specialized agency or other international organization has such large meteorological aspects as to require the full-time services of an expert in meteorology, the secondment of an expert for work on the project with the other organization concerned should be considered;

(*d*) If financial implications are involved the foregoing should be dealt with on an individual basis in consultation with the agency of the organization concerned;

Reaffirms that the primary goal of such co-operation is effective and efficient collaboration with the United Nations and all other specialized agencies as well as with other international organizations whose interests or projects have meteorological aspects;

Directs the Executive Committee and the Secretary-General, as appropriate, to ensure compliance with this policy.

NOTE : This resolution replaces Resolution 5 (Cg-IV) which is no longer in force.

URSI PUBLICATIONS

The following URSI publications are available by Elsevier Publishing Company, P. O. Box 211, Amsterdam, The Netherlands.

Manuel des stations ionosphériques — Ionospheric stations manual (10 × 11", 460 pages, 1958).

The main part of this volume is concerned with vertical incidence sounding stations, separate pages being given to each with detailed information on one side and the table of solar zenith angles on the other. Data on stations carrying out observations and measurements of phenomena connected with ionospheric research have also been given; a series of maps illustrates the distribution of stations. For the convenience of workers at ionospheric stations the following material has also been included : tables of Chapman functions, mean moon phases and solar rotation numbers for 1957-1958, a list of vertical incidence scaling symbols, and the IGY calendar of Regular World Days and World Meteorological Intervals. To keep the Manual up to date periodic supplements will be sent to subscribers.

BEYNON. — *Some Ionospheric Results obtained during the International Geophysical Year.* Proceedings of a Symposium organized by the URSI-AGI Committee, Brussels, 1959. Edited by W. J. G. Beynon, Department of Physics, University College of Wales, Aberystwyth, Great Britain. 6 × 9", xi + 401 pages, 24 tables, 266 illus., 1961.

BROWN. — *Space Radio Communication.* A Symposium held under the auspices of URSI in Paris, September, 1961. Edited by G. M. Brown, Department of Physics, University College of Wales, Aberystwyth, Great Gritain. 6 × 9", xii + 631 pages, 59 tables, 233 illus., 1962.

PIGGOTT-RAWER. — *URSI Handbook of Ionogram Interpretation and Reduction.* Edited by W. R. Piggott, Radio Research Station, Slough, Great Britain; and K. Rawer, Ionospherics Institute, Breisach/Rh., Germany. 6 × 9", xii + 192 pages, 16 tables, 88 illus., 1961.

URSI XIIIth GENERAL ASSEMBLY

BEYNON. — *Monograph on Ionospheric Radio.* Proceedings of Commission III during the XIIIth General Assembly of URSI, London, 1960. Edited by W. J. G. BEYNON, Department of Physics, University College of Wales, Aberystwyth, Great Britain. 6 × 9", viii + 264 pages, 2 tables, 49 illus., 1962.

DECAUX. — *Monograph of Radioelectric Measurements and Standards — Monographie sur les Mesures et Etalons Radioélectriques.* XIIIth General Assembly of URSI, London, 1960. Edited by B. Decaux, Vice-President of URSI. 6 × 9", vi + 117 pages, 14 tables, 6 illus., 1961.

HORNER. — *Monograph on Radio Noise of Terrestrial Origin.* — Proceedings of Commission IV during the XIIIth General Assembly of URSI, London, 1960. Edited by F. Horner, Radio Research Station, Department of Scientific and Industrial Research, Slough, Great Britain. 6 × 9", vii + 203 pages, 4 tables, 34 illus., 1962.

SAXTON. — *Monograph on Radio-Wave Propagation in the Troposphere.* Proceedings of Commission II on Radio and Troposphere during the XIIIth General Assembly of URSI, London, 1960. Edited by J. A. Saxton, Radio Research Station, Department of Scientific and Industrial Research, Slough, Great Britain. 6 × 9", viii + 200 pages, 7 tables, 55 ills., 1962.

SILVER. — *Monograph on Radio Waves and Circuits.* Proceedings of Commission VI during the XIIIth General Assembly of URSI, London, 1960. Edited by Samuel Silver, Space Sciences Laboratory, University of California, Berkeley, California. U. S. A. 6 × 9", viii + 379 pages, 4 tables, 101 illus., 1963.

URSI XIVTH GENERAL ASSEMBLY

(*Progress in Radio Science* 1960-1963)

BEATTY. — *Radio Standards and Measurements.* Progress in Radio Science 1960-1963, Volume I. Proceedings of Commission I on Radio Measurements and Standards during the XIVth General Assembly of URSI, Tokyo, September, 1963. Edited by Robert Wm. Beatty, Radio Standards Laboratory, National Bureau of Standards, Boulder, Colorado, USA. 6 × 9", viii + 111 pages, 3 tables, 9 illus., 1965.

The text comprises a full account of the review papers presented at the Tokyo General Assembly of 1963 relevant to the topics under discussion; abstracts of papers on special topics; and selected discussions. This volume is unique in presenting on an international basis, a complete survey of progress in all phases of radio standards and measurement techniques in the last three years. The invited survey papers are by well known authors in their field in various countries of the world. It also serves to record the recommendations adopted by the Assembly.

CONTENTS: List of abbreviations. General summary. Introductory remarks. Brief summary of the sessions of Commission I. Survey and introductory report of the Chairman. I. Atomic and molecular standards of frequency and time. II. Frequency and time broadcats, frequency measurements, quartz clocks. III. Radio measurements and standards to about 1 Gc/s. IV. Radio measurements and standards for microwaves. V. Precision measurements of distance and velocity of light, using lasers. Recommendations adopted at

the XIVth General Assembly. Chairman's report summarizing the activities of Commission I during the XIVth General Assembly. Author index.

DU CASTEL. — *Radio and Troposphere.* Progress in Radio Science 1960-1963, Volume II. Proceedings of Commission II on Radio and Troposphere, during the XIVth General Assembly of URSI, Tokyo, September, 1963. Edited by François du Castel, C.N.E.T., Issy-les-Moulineaux (Seine), France.
6 × 9'', vi + 292 pages, 6 tables, 99 illus., 1965.

The task of Commission II of URSI comprises, on the one hand, the study of the earth's surface and the lower atmosphere or « troposphere » by means of radio waves and, on the other hand, the investigation of the propagation of radio waves within and upon the earth's surface, in the troposphere, and, for the purposes of communications with outer space, also through the troposphere. This review volume will especially appeal to geophysicists (particularly meteorologists) and radio-electrical engineers.

CONTENTS : Introduction. Rapport du président de la Commission II. I. Models of atmosphere. II. Radioclimatology. III. Influence of irregular terrain and vegetation on propagation. IV. Tropospheric propagation affecting space communication. V. Radiometeorology and cloud physics. VI. Propagation of millimeter and sub-millimeter waves. Resolutions. Author index.

BROWN. — *The Ionosphere.* Progress in Radio Science, 1960-1963, Volume III. Review papers presented at Commission III on Ionospheric Radio during the XIVth General Assembly of URSI, Tokyo, September, 1963. Edited by Geoffrey M. Brown, Department of Physics, University College of Wales, Aberystwyth, Great Britain. 6 × 9'', vii + 196 pages, 7 tables, 73 illus., 1965.

The full text of each of the ten review papers presented at Commission III meetings at the XIVth General Assembly of URSI is given in this book. The chairman of Commission III, Mr. J. A. Ratcliffe, has also included in his summary of progress in ionospheric physics over the period 1960-1963 the main points which arose during the discussions.

CONTENTS : Advances in ionospheric physics 1960-1963. 2. The distribution of electrons in the lower and middle ionophere. 3. A survey of topside sounding of the ionosphere. 4. Some results of USSR experiments in the ionosphere and interplanetary space. 5. Whistler measurements of the equatorial profile of magnetopsheric electron density. 6. Geomagnetism and the ionosphere. 7. Some comments on the ionosphere and geomagnetism. 8. Ionospheric studies during the IQSY 1964-1965. 9. Ionizing radiation and constitution of the atmosphere. 10. The history of growth of oxygen in the earth's atmosphere.

HORNER. — *Radio Noise of Terrestrial Origin.* Progress in Radio Science 1960-1063, Volume IV. Proceedings of Commission IV during the XIVth General Assembly of URSI, Tokyo, September, 1963. Edited

by F. Horner, Radio Research Station, Department of Scientific and Industrial Research, Slough, Great Britain. 6 × 9", vi + 133 pages 2 tables, 14 illus., 1965.

This volume deals with radio noise of terrestrial origin, which is taken to include the study of characteristics of noise from lightning discharges and the interference caused to radio communications. Currently this branch of radio science is exciting widespread interest, as the use of noise recording proves successful in exploring the nature of the ionised regions of the earth's atmosphere. and as challenging theories are advanced on the mechanisms by which noise may be generated in the outer regions of the atmosphere by the influx of charged particles from the sun.

CONTENTS : Report of the Chairman of Commission IV. I. Properties of the lightning flash source. II. IGY results and IQSY programmes. III Whistlers. IV. VLF and noise phenomena. V. Guided waves in the troposphere and the ionosphere. Author index.

HERBAYS-WARWICK-COUTREZ-GONZE. — *Radio Astronomy.* Progress in Radio Science 1960-1963, Volume V. Report of Commission V on Radio Astronomy during the XIVth General Assembly of URSI Tokyo, September, 1963. Edited by E. Herbays, Secretary General of URSI; in collaboration with J. W. Warwick, R. Coutrez, and R. Gonze. 6 × 9", vii + 140 pages, 4 tables, 13 illus., 1966.

The Proceedings of Commission V on Radio Astronomy were divided into seven sessions, each dealing with a different aspect of the subject In each area a speaker presented a comprehensive account of the previous three years. These accounts are given here in full and are followed by résumés of the shorter papers subsequently contributed. In this way a complete picture of the period was built up.

CONTENTS : I. Radio astronomy of the Galaxy. II. Radio sources. III Radio astronomy of the quiet Sun. IV. Radio astronomy of the active Sun. V. Radio astronomy of the solar system. VI. Observational techniques and measurements in radio astronomy. VII. Miscellaneous subjects in radio astronomy. Author index.

STUMPERS. — *Radio Waves and Circuits.* Progress in Radio Sciences 1960 1963, Volume VI. Proceedings of Commission VI on Radio Waves and Circuits during the XIVth General Assembly of URSI, Tokyo September, 1963. Edited by L. H. M. Stumpers, Philips Research Laboratories, Eindhoven, The Netherlands. 6 × 9", vi + 327 pages 4 tables, 66 illus., 1966.

This monograph contains the report of the chairman of Commission V and most of the invited papers. Commission VI covers a very wide field of research. To keep the participants up to date on as broad a front as possible, topics were chosen to bring together more than one area, or to present the same subject (for example time-varying channels and stochastic aspect of radiation) from more than one side. With its wide scope

this volume will appeal to electronic and electrical engineers, physicists and mathematicians alike.

CONTENTS : General introduction. Activités de la Commission VI (1960-1963). Part. I. Circuit theory : 1. Graph theory; 2. Non-linear circuits. Part II. Information theory : 3. Coding and pattern recognition; 4. Time-varying channels. Part III. Electromagnetic theory : 5. Stochastic aspects of radiation; 6. Diffraction, mathematical methods; 7. Antennae and miscellaneous. Rapport sur les activités de la Commission pendant l'Assemblée Générale. Résolution, Author index.

BURGESS. — *Radioelectronics.* Progress in Radio Science 1960-1963, Volume VII. Proceedings of Commission VII during the XIVth General Assembly of URSI, Tokyo, September. 1963. Edited by R. E. Burgess, Department of Physics, University of British Columbia, Vancouver, B. C. Canada. 6 × 9", v + 168 pages, 6 tables, 20 illus., 1965.

The triennium 1960-1963 has been a period of unusual significance for those whose scientific interests fall within the purview of Commission VII of URSI. Remarkable developments have occurred in both fundamental and technological areas exemplified by the rapid advances in quantum electronics. The activity in plasma physics has continued at a vigorous pace yielding substantial advances in a difficult and complex subject.

CONTENTS : Activities of Commission VII (1960-1963). I. Plasmas — geophysical and astrophysical scale. II. Plasmas — laboratory scale. III. Physics of masers and lasers. IV. Applications of masers and lasers. Author index.

MAEDA-SILVER.— *Space Radio Science.* Progress in Radio Science 1960-1963, Volume VIII. Edited by Ken-ichi Maeda, Department of Electronics. Kyoto University, Kyoto, Japan; and Samuel Silver, Space Sciences Laboratory, University of California, Berkeley, California USA. 6 × 9", vii + 235 pages, 17 tables, 110 illus.. 1965.

There are a tremendous amount of research results in the field of space science and technology reflecting the rapid progress achieved by sounding rockets and earth satellites. At the Tokyo General Assembly ten engineering physicists representing all the important facets of space science and technology treated comprehensive problems both past and anticipated. The collection of papers in this volume makes a most important contribution to space radio science.

CONTENTS : Part. I. Space Radio Research : 1. Report of the Space Radio Research Committee; 2. Ionospheric research by means of rockets and satellites; 3. Planetary research in the millimetre and infrared region of the spectrum; 4. Space communication systems — results and problems; 5. Data processing and its relation to the communication of deep-space experiments. Part. II. Satellite Communication Systems : 6. Satellite communication devices; 7. A commentary on satellite communication devices; 8. Attitude, orbit and antenna control for a spinning satellite;

9. Stabilisation électronique du pinceau d'énergie électromagnétique rayonné par un satellite; 10. Long-range communication by orbiting dipole belts.

URSI Special Reports

Special Report nº 2. — *Tidal Phenomena in the Ionosphere.* 6 × 9"l 72 pages, 18 illus., 1951.

Rapport spécial Nº 2. — *Les Phénomènes de marée dans l'Ionosphère.* 6 × 9", 80 pages, 18 illus., 1951.

Special Report No. 3. — *Discrete Sources of Extra-Terrestrial Radio Noise.* 6 × 9", 56 pages, 16 ills., 1954.

Rapport spécial Nº 3. — *Les Sources discrètes d'émission radioélectrique extra-terrestre.* 6 × 9", 60 pages, 16 illus., 1954.

Rapport spécial Nº 4. — *Distribution de la brillance radioélectrique sur le disque solaire.* 6 × 9", 48 pages, 16 illus., 1954.

Rapport spécial Nº 5. — *L'hydrogène interstellaire.* 6 × 9", 28 pages, 6 illus., 1954.

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