Bulletin N° 91 May-June 1955

International Scientific Radio Union

U. R. S. I.

CONTENTS

NATIONAL COMMITTEES

Austria

We have been informed by the Secretary of the Academy of Science of Austria that the Academy in agreement with the Federal Ministry of Education, decided in its session of March 10th to apply for adhesion to U.R.S.I.

Germany

Dr. Ing. H. Fleischer Darmstadt, Rheinstrasse 110, has been appointed as Secretary of the German National Committee to replace Dipl. Ing. W. Menzel who has left Germany to take over office at the International Frequency Registration Board in Geneva.

U.S.A.

REPORT ON THE XIth GENERAL ASSEMBLY

The U. S. A. National Committee edited a « Report to the National Research Council on the XIth General Assembly of U.R.S.I. at the Hague, Netherlands, August, 23-September, 3, 1954 ».

JOINT MEETING OF THE U.S.A. NATIONAL COMMITTEE AND THE INSTITUTE OF RADIO ENGINEERS

(Professional Groups on the Antennas and Propagation, Circuit Theory, Instrumentation, Microwave Theory and Techniques)

The meeting was held at the National Bureau of Standards Washington, D.C., on May 1955.

The following papers were read during the technical sessions.

Abstracts of the papers are available at the General Secretariat of U. R. S. I.

COMMISSION I

Gradmeter — Martin GRAHAM, *Brookhaven National Laboratory.*

A method for measurement of a two-terminal impedance — B. SALZBERG, K. W. BEWIG, *Naval Research Laboratory.*

Measurement of signal generator modulation factor — Herbert S. INGRAHAM, Jr., *Radio Corporation of America.*

A recording amplitude distribution analyzer — H. D. HERN, I. H. GERKS, *Collins Radio Company.*

An automatic record chart analyzer — Harold AHRENS, *Navy Electronics Laboratory.*

A probability computer for noise measurement — J. D. WELLS, A. W. SULLIVAN, *University of Florida.*

Propagational and jamming advantage of compressed signals — H. S. MARSH.

A method of wavelength measurement for the microwave and millimeter wave region — W. W. BALWANZ, *Naval Research Laboratory.*

A self balancing D-C bolometer bridge — Glenn F. ENGEN, *National Bureau of Standards.*

Antenna pattern measurements by aircraft — Helmut BRUECKMANN, *Coles Signal Laboratory.*

Standing wave line for UHF measurements of high dielectric constant materials — E. M. WILLIAMS, *Carnegie Institute of Technology,* James H. FOSTER, *Erie Resistor Corporation.*

Scattering measurements using a 10 cm parallel plate region — John E. KEYS, Albert W. ADEY, *Defence Research Board (Canada).*

A new direct reading frequency measuring system utilizing a frequency synthesizer — R. C. HESS, *Federal Telephone and Radio Company.*

Studies in noise by the Liouville theorem — G. HELD, *University of Washington.*

COMMISSION II

Investigations of angular scattering and multipath properties of tropospheric propagation of short radio waves beyond the horizon — J. H. CHISHOLM, P. A. PORTMANN, J. T. de BETTENCOURT, J. F. ROCHE, *Massachusetts Institute of Technology.*

Summary of refractive index fluctuation and profile measurement over Southestern Colorado in August 1954 — C. M. CRAIN, *University of Texas,* C. A. HINES, *Wright Air Development Center.*

Propagation Measurement at 4.3 mm wavelength — A. W. STRAITON, C. W. TOLBERT, *University of Texas.*

Refraction effects by atmospheric inhomogeneties — Ming S. WONG, *Wright Air Development Center.*

Direct Ray Line of sight propagation phenomena — R. B. MUCHMORE, A. D. WHEELON, *Ramo-Wooldridge Corporation.*

Scattered field line of sight propagation phenomena — A. D. WHEELON, R. B. MUCHMORE, *Ramo-Wooldrige Corporation.*

Multipath signal distorsion in scatter propagation — O. J. JACOMINI, *General Electric Company.*

Phenomenological vector model of reflection of microwaves from the Ocean surface — C. I. BEARD, I. KATZ, L. M. SPETNER, *Johns Hopkins University.*

On the radar measurement of angle-arrival in the presence of many plane wave interference — H. B. BREWER, R. D. WHETERINGTON, *Georgia Institute of Technology.*

Long distance V.H.F. fields — F. H. NORTHOVER, *Memorial University of Newfoundland.*

Measurement of atmospheric attenuation at millimeter wavelengths — A. B. CRAWFORD, D. C. HOGG, *Bell Telephone Laboratories, Inc.*

Obstacle gain in the diffraction region — K. A. NORTON, P. L. RICE, *National Bureau of Standards.*

A study of fading rate in long distance tropospheric wave propagation — A. P. BARSIS, *National Bureau of Standards.*

Obstacle gain measurements over pikes peak at 60 to 1046 Mc — R. S. KIRBY, H. T. DOUGHERTY, P. L. MCQUATE, *National Bureau of Standards.*

COMMISSION III

The effect of tides and electric currents in the upper atmosphere on the ionospheric characteristics in equatorial regions — G. J. GASSMANN, *Air Force Cambridge Research Center.*

Forecasting radio propagation conditions — A. G. MCNISH, *National Bureau of Standards.*

A study of the relative merits of horizontally and vertically polarized skywave signals near the gyromagnetic frequency — C. S. WRIGHT, A. D. RING and Associates.

Ionospheric layer heights — L. A. MANNING, *Stanford University.*

Sweep frequency pulse measurements of ionospheric propagation over a 2400 km path — V. AGY, P. G. SULZER, *National Bureau of Standards.*

The role of ionospheric forward scatter in oblique incidence MUF — D. K. BAILEY, *National Bureau of Standards.*

Theory of the distribution of meteor trail lengths — V. R. ESHLEMAN, *Stanford University*.

Forward scatter from meteor trails — E. L. VOGAN, P. A. FORSYTH, C. O. HINES, *Defence Research Board (Canada)*.

The role of meteoric ionization in extended-range VHF propagation — V. R. ESHLEMAN, L. A. MANNING, A. M. PETERSON, O. G. VILLARD, Jr., *Stanford University*.

Long range meteoric echoes via F-layer reflections — W. A. WHITCRAFT, Jr., *Raytheon Manufacturing Company*, and J. T. de BETTENCOURT, *Massachusetts Institute of Technology*.

The contribution of meteors to long-range back-scatter — P. G. GALLAGHER, A. M. PETERSON, *Stanford University*.

The use of sweep-frequency backscatter data for determining vertical and oblique incidence ionosphere characteristics — R. SILBERSTEIN, *National Bureau of Standards*.

Methods of determining long wave reflection coefficients for a specific ionospheric model — J. D. WOLF, J. J. GIBBONS, *Pennsylvania State University*.

The amplitude and phase variations of 150 kc/s signals reflected from the E-layer — R. E. JONES, R. W. PARKINSON, *Pennsylvania State University*.

A low frequency long range propagation problem — J. SHMOYS, *New York University*.

A study of recent VHF oblique incidence propagation data, J. L. HERITAGE, S. WEISBROS, *Navy Electronics Laboratory*.

Study of LF propagation path characteristics in the Alaskan area — John E. BICKEL, *Navy Electronics Laboratory*.

Heights of irregularities giving rise to fading of 150 kc/s waves — R. B. BANERJI, *Pennsylvania State University*.

Simultaneous scatter sounding observations of sporadic-E clouds at two separated locations — O. G. VILLARD, Jr., A. M. PETERSON, R. L. LEADABRAND, *Stanford University*.

Some irregularities in sporadic-E obtained from vertical incidence data, — E. K. SMITH, *National Bureau of Standards*.

An improved method for determining predicted sky wave maximum usable frequencies using sporadic-E prediction charts — S. M. OSTROW, *National Bureau of Standards*.

Auroral echoes observed north of the auroral zone on 51.9 Mc/s — R. B. DYCE, *Cornell University*.

Aurora borealis studied using VHF radio echoes — K. L. BOWLES, *Geophysical Institute of the University of Alaska* and *Cornell University*.

Commission IV

The effect of atmospheric noise on a frequency-shift radioteletype, system — Samuel P. Hersperger, Jr., *University of Florida.*

The effect of atmospheric noise on a manual radiotelegraph system — R. F. Brown, *University of Florida.*

Lightning discharge atmospheric interference in aircraft communications — N. M. Newman, *Lightning and Transients Research Institute.*

Characteristics of high frequency discharges from severe storms — Herberts L. Jones, *Oklahoma, Agricultural and Mechanical College.*

Atmospheric noise characteristics — A. W. Sullivan, *University of Florida.*

A statistical model of atmospheric noise — John M. Barney, *Convair Corporation.*

The measurement of recurrent impulsive noise — A. Eckersley, D. B. Geselowitz, *University of Pennsylvania.*

A probability computer for noise measurement — J. D. Wells, A. W. Sullivan, *University of Florida.*

Commission V

Absorption of galatic radio waves at 21 cm wavelength — John P. Hagen, *Naval Research Laboratory.*

High resolution radio astronomy at 13.5 m — K. L. Franklin, B. F. Burke, *Carnegie Institution of Washington.*

Absorption effects in the spectra of radio stars produced by interstellar hydrogen — A. E. Lilley, *Naval Research Laboratory.*

Recent 21 cm absorption measurements in the direction of the galactic center — E. F. McClain, *Naval Research Laboratory.*

21 cm studies of interstellar clouds in intermediate galactic latitudes — R. S. Lawrence, *National Bureau of Standards.*

Extension of radio source spectra to a wavelength of 3 cm — F. T. Haddock, T. P. McCullough, *Naval Research Laboratory.*

Theoretical determinations of sporadic meteor rate and radiants — V. R. Eshleman, *Stanford University.*

Brightness distribution of the sun at 207 Mc/s — John W. Firor, *Carnegie Institution of Washington.*

The 1954 occultation of M1 by the solar corona — B. F. Burke, J. W. Firor, and H. L. Helfer, *Carnegie Institution of Washington.*

Polarization of solar radio bursts — T. Hatanaka, *Cornell University* and *University of Tokyo.*

Solar Flares and atmospheric noise — E. I. King, *University of Florida.*

Title to be announced — J. H. Texler, *Naval Research Laboratory.*

The influence of noise in radio reception — S. Matt, O. J. Jacomini, *General Electric Company.*

Commission VI

Circuit components in dielectric image lines, — D. D. King, *John Hopkins University.*

The ultra-bandwidth finline coupler — S. D. Robertson, *Bell Telephone Laboratories.*

Phase shift by periodic leading of waveguide and its application to a broadband circular polarization — A. J. Simmons, *Naval Research Laboratory.*

A combination crystal switch circuit — F. S. Coale, *Sperry Gyroscope Company.*

E-Plane forked hybrid-T junction — W. K. Kahn, *Wheeler Laboratories, Inc.*

Applications of the turnstile junction — M. A. Meyer, H. B. Goldberg, *Laboratory of Electronics.*

Microwave traveling wave tube millimicrosecond pulse generators — A. C. Beck, G. D. Mandeville, *Bell Telephone Laboratories.*

The regeneration of binary microwave pulses — O. E. Delange, *Bell Telephone Laboratories.*

Investigation of VHF non-optical propagation — Sardinia-Minorca, José Maria Clara, *Compania Telefonica Nacional de Espana,* Albino Antinori, *Ministro delle Poste e delle Telecommunicazioni* (Rome, Italy).

900 Mc PTM over the horizon radio link — F. J. Altman, R. E. Gray, A. G. Kandoian, W. Sichak, *Federal Telecommunication Laboratories.*

A method for the accurate measurement of the noise temperature ratio of microwave mixer crystals — R. E. Davis, R. C. Dearle, *University of Western Ontario.*

Data on the temperature dependence of X-band fluorescent lamp noise sources — W. W. Mumford, R. L. Schafersman, *Bell Telephone Laboratories.*

Noise measurements in the UHF Range — E. Maxwell, B. J. Leon, *Massachusetts Institute of Technology.*

The high frequency behavior of certain artificial dielectrics — W. S. Ament, *Naval Research Laboratory.*

On the determination of the electrical properties of a radium from the reflection coefficient — Irvin Kay, *New York University.*

Pseudo resonance between parallel plates — Bernard G. King, Isamu Tatsuguchi, Elmer H. Scheibe, *University of Wisconsin* and Georg Goubau, *Signal Corps Engineering Laboratories.*

A geodesic analog of the Luneberg lens — A. H. Schaufelberger and L. F. Culbreth, *Georgia Institute of Technology.*

A three dimensional microwave Luneberg lens — M. C. Volk, *Emerson and Cuming, Inc.,* G. D. M. Peeler, *Naval Research Laboratory.*

Luneberg lenses utilizing void-dielectric materials — W. G. Scott, K. S. Kelleher, E. G. Kelso, *Melpar, Inc.*

Effect of arbitrary phase errors on antenna gain — D. K. CHENG, *Syracuse University.*

Systematic errors caused by the scanning of antenna arrays — L. A. KURTZ, R. S. ELLIOT, *Hughes Research and Development Laboratories.*

The assymetrically excited sperical antenna — Robert C. HANSEN, *University of Illinois.*

Development of a skip-range antenna — J. D. TILLMANN, W. T. PATTON, C. E. BLANKENY, F. V. SCHULTZ, *University of Tennessee.*

Radiation patterns of multiple and distributed sources — L. W. LECHTRECK, *Emerson Electric Manufacturing Company.*

A mechanically simple foster scanner — R. C. HONEY, E. M. T. JONES, *Stanford Research Institute.*

COMMISSIONS

Commission III on Ionospheric Radio

TERMINOLOGY

Attention is drawn to the recommendation made at the The Hague General Assembly by Commission III on the use of the term MUF (maximum usable frequency). This term should be applied only to an instantaneous state of a particular region of the ionosphere which is continually undergoing variation, and the term Median MUF, should be introduced for cases such as prediction graphs where a median value for a given hour of the day is meant.

(See p. 20, Doc. 34.III.16).

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

According to the decision of the Executive Committee (The Hague, 1954), the U.R.S.I.-A.G.I. Committee will meet at Brussels from September 8 to 10, under the Chairmanship of Sir Edward Appleton, President of the Committee.

The C.S.A.G.I. will also meet at Brussels from September 8 to 14.

IONOSPHERIC STATIONS

Belgian Congo

A second ionospheric sounder has been set up during February at Elisabethville at the Observatoire Géomagnétique, Karavia.

Characteristics.

Latitude : 11°39′ S.
Longitude : 27°28′ E.
Frequency band : 0-20 Mc/s.
Frequency band used : 1-16 Mc/s.
Aerials : two rhombic vertical aerials.
Duration of sweep : 7 seconds.
Duration of pulse : 70 microseconds.
Frequency of sweep : 100 par second.
Power input : 1 kVA.
Measurements every 20 minutes.
Time used : U.T.

Readers wishing to obtain copies of the publication giving the results of measurements may apply to the Secretary General of U.R.S.I. or to Mr. P. Herrinck, Chef du Bureau du Magnétisme Terrestre et de la Seismologie, Léopoldville, Belgian Congo.

Sweden

LULEÅ

Latitude 22°07′ E.

Longitude 65°36′ N.

a) Duration of sweep: 10 minutes.

b) Frequency range: 1.5 - 10.0 Mc/s.

(*e*) Local time 15° E.

(*d*) Starting at local time ± 5 minutes.

(*e*) Starting at the lowest frequency.

(*f*)

Time m	Time s	Frequency Mc/s
0	00	start
0	40	1.5
2	10	2.0
3	00	2.5
3	50	3.0
4	30	3.5
5	10	3.7 (bandswitching)
5	40	4.0
6	20	4.5
6	50	5.0
7	20	5.5
7	40	6.0
8	10	7.0
8	40	8.0
9	00	9.0
9	20	10.0
9	40	stop

g) The equipment was adjusted in May 1954, and then the times at which the frequencies are reached were slightly altered.

UPSALA

Address : Upsala Ionosphere Observatory, Upsala 10, Sweden.
Latitude : 59°48.1′ N. Geomagnetic latitude : 58.5° N.
Longitude : 17°36′ E. Magnetic dip. : 72.1° N.
Time : 15° E on all records.
The equipment has been in regular operation with one record each hour since January 1952.
Range of the recorder : 1.4 - 17 Mc/s.
Pulse power : 5 - 10 kW.
Pulse width : about 70 microseconds.
No changes have been made in the frequency sweep.

The recorder is started automatically each hour, and the time scale in table 1 is followed. The starting clock is checked with the time signal every day at 1300 MET. Maximum error in starting time is about 20 seconds. The clock is of high quality and is driven by spring work.

Table 1

Time table for the frequency sweep of the recorder at Upsala Ionosphere Observatory

Mains power on (warming up)	54 m 37 s
The transmitter starts at 1.4 Mc/s.	
1.4 Mc/s	56 m 56 s
1.5 Mc/s	57 m 11 s
2.0 Mc/s	57 m 55 s
2.5 Mc/s	58 m 22 s
3.0 Mc/s	58 m 44 s
3.5 Mc/s	59 m 3 s
4.0 Mc/s	59 m 19 s
4.5 Mc/s	59 m 33 s
5.0 Mc/s	59 m 46 s
5.5 Mc/s	59 m 59 s
6.0 Mc/s	0 m 12 s
6.5 Mc/s	0 m 28 s
7.0 Mc/s	0 m 40 s
8.0 Mc/s	1 m 1 s
9.0 Mc/s	1 m 19 s
10.0 Mc/s	1 m 35 s
11.0 Mc/s	1 m 50 s
12.0 Mc/s	2 m 5 s
13.0 Mc/s	2 m 21 s
14.0 Mc/s	2 m 35 s
15.0 Mc/s	2 m 49 s
16.0 Mc/s	3 m 3 s
Stop	3 m 19 s

The motors for the frequency sweep are of synchronous type.

I. C. S. U.

Mixed Commission on the Ionosphere

PROCEEDINGS OF THE FOURTH MEETING, BRUSSELS, AUGUST 1954

The Proceedings of the Fourth Meeting held at Brussels, August 1954, are out of press. This book, of over 200 pages, with several figures, contains besides the minutes of the sessions, the full text of over 25 papers submitted to the meeting.

Copies have been distributed free of charge to National Committees (two per unit and one to every official member of Commission III). Supplementary copies are available at the General Secretariat at the price of B. francs 300, or £ 2/3/0, or U. S. dollars 6 (postage included).

C.C.I.R

List of U.R.S.I. documents

(Between brackets, reference to *U.R.S.I. Information Bulletin*)

Commission I

1.I.1. C.C.I.R. Recommendation nº 122. Standard frequency transmissions and time signals (**86**, 15-21).

2.I.2. C.C.I.R. Report nº 4. Methods of measuring field strength (**86**, 21-23).

27.I.3. Union of South Africa Observatory. Principal characteristics of standard frequency and time signal transmissions (**87**, 32).

28.I.4. Present state of the work of C.C.I.R. Study Group VII (**87**, 33-39).

Commission II

3.II.1. C.C.I.R. Recommendation nº 111. Tropospheric wave propagation curves (**86**, 23-25).

4.II.2. C.C.I.R. Question nº 85. Propagation data required for wide-band radio systems (**86**, 26-27).

5.II.3. C.C.I.R. Study Programme nº 55. Tropospheric propagation curves for distances well beyond the horizon (**86**, 28-29).

6.II.4. C.C.I.R. Study Programme nº 56. Tropospheric wave propagation (**86**, 29-30).

7.II.5. C.C.I.R. Study Programme nº 57. Investigation of multipath transmission through the troposphere (**86**, 30).

Commission III

8.III.1. C.C.I.R. Recommendation nº 59. Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings (**86**, 31-33).

9.III.2. C.C.I.R. Recommendation n° 11. Study of absorption in the ionosphere (**86**, 33-34).

10.III.3. C.C.I.R. Report n° 7. Long distance propagation of waves of 30 and 300 Mc/s by way of ionization in the E and F regions of the ionosphere (**86**, 35-39).

11.III.4. C.C.I.R. Report n° 26. Exchange of information for the preparation of short term forecasts and the transmission of ionospheric disturbance warnings (**86**, 39-42).

12.III.5. C.C.I.R. Resolution n° 12. Usage and meaning of MUF (**86**, 42-43).

13.III.6. C.C.I.R. Resolution n° 14. Investigation of circularly polarizes emitted waves propagated via the ionosphere (**86**, 43-44).

14. III.7.C.C.I.R. Study Programme n° 58. Choice of a basic solar index for ionospheric propagation (**86**, 44-45).

15.III.8. C.C.I.R. Study Programme n° 59. Identification of precursors indicative of short-term variations of ionospheric propagation conditions (**86**, 45-46).

16.III.9. C.C.I.R. Study Programme n° 60. Basic prediction information for ionospheric propagation (**86**, 46-48).

17.III.10. C.C.I.R. Study Programme n° 61. Non linear effects in the ionosphere (**86**, 48-49).

18.III.11. C.C.I.R. Study Programme n° 63. Radio propagation at frequencies below 1500 kc/s (**86**, 49-50).

19.III.12. C.C.I.R. Study Programme n° 66. Study of fading (**86**, 50-52).

20.III.13. C.C.I.R. Study Programme n° 67. Pulse transmission tests at oblique incidence (**86**, 52-53).

Commission IV

21.IV.1. C.C.I.R. Recommendation n° 120. Revision of radio noise data (**86**, 53-56).

22.IV.2. C.C.I.R. Question n° 79. The responses of radio receiver to quasi-impulsive interference (**86**, 56-57).

23.IV.3. Study Programme n° 65. Measurement of atmospheric radio noise (**86**, 58-59).

Commission V

24.V.1. C.C.I.R. Recommendation n° 118. Protection of frequencies used for radio astronomical measurements (**86**, 59-60).

Commission VI

25.VI.1. C.C.I.R. Recommendation n° 107. Communication theory (**86**, 60-61).

26.VI.2. C.C.I.R. Study Programme n° 47. Communication theory (**86**, 61-63).

Comments by International Scientific Radio Union at 1954 General Assembly in The Hague

COMMISSION I

29.I.5. — On C.C.I.R. Recommendation 122 « Standard Frequency Transmissions and Time Signals » (1)

In order to assist C.C.I.R. to answer Question n° 87, which concerns the establishment and operation of a world wide standard frequency and time service, members of U.R.S.I. are recommended to make observations on the service areas and mutual interference zones of standard frequency transmissions, and also on the type of modulation used by the stations at present in operation.

The observations should be made in accordance with C.C.I.R. Study Programme n° 68, and the results obtained should be communicated to the President of Commission I of U.R.S.I. as soon as possible.

Full details of six stations are given in C.C.I.R. Recommendation n° 122 (1). An additional experimental station providing a restricted service is now in operation at Uccle, Belgium

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(1) *Inf. Bull.*, **86**, 15-21.

COMMISSION II

30.II.6. — On C.C.I.R. Question 85 « Propagation Data Required for Wide-Band Radio Systems »(1)

All National Committees are requested to supply through the Secretariat such results from propagation measurements that can be used for establishing answers to the questions formulated in this C.C.I.R. Question.

3.II.7. — On C.C.I.R. Study Programme 56 « Tropospheric Wave Propagation » (2)

In view of the situation revealed by this Study Programme it is recommended that :

(*a*) Study of the received field within or about the radio horizon receive particular attention.

(*b*) Research should be directed towards establishing a better undestanding of the correlation between readily available synoptic meteorological data and radio propagation characteristics.

(*c*) Such work should be conducted at all wavelengths below 10 metres.

(*d*) It should also include study of the effect of the fine structure of the atmosphere.

COMMISSION III

32.III.14. — On C.C.I.R. Recommendation 59 « Exchange of Information for the Preparation of Short-Term Forecasts and the Transmission of Ionosphere Disturbance Warnings » (3)

The U.R.S.I. joins with the C.C.I.R. in recommending the immediate use of the arrangements contained in Recommendation 59. The following special Resolution was adopted.

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(1) *Inf. Bull.*, **86**, 26-27.
(2) *Inf. Bull.*, **86**, 29-30.
(3) *Inf. Bull.*, **86**, 31-33.

The special permanent Ursigram Committee is further charged with the elaboration of the quality of the traffic on radio circuits and with description of the ionospheric disturbances. It il also requested to inform the U.R.S.I. delegation to the C.C.I.R., of all reports and publications on this subject which might be submitted to the VIIIth C.C.I.R. Assembly.

The Ursigram Committee, in view of the Ursigrams being designed to transmit daily geophysical and solar data in an abridged form to users throughout the world with the shortest possible delay, recommends that :

1. The present organization of broadcasting of Ursigrams by France (Pontoise station) continue to function on a regional European basis, incorporating certain data originating in the United States and Japan.

2. The codes now used for certain messages (SOLER) be revised by the Ursigram committee by correspondence with view to furnishing the most useful information for short-term predictions.

3. That the codes used in all regions for the same data be identical, as far as possible.

4. That the permanent telegraph circuits existing between the European Ursigram Centers, the United States, and Japan be improved so as to permit the regular daily exchange of data gathered by these Centers.

5. That the data thus exchanged be reduced to a daily telegram of about 30 groups of only 5 digits, in the following order of priority :

(*a*) Chromospheric eruptions and P.I.D.B.
(*b*) Data on solar noise (SOLER).
(*c*) Data on solar corona (CORON).
(*d*) Data on magnetism (MAGNE).

6. That other data and all the details be exchanged between the regional centers by correspondence.

7. That in the nearest possible future and in order to permit effective short-term predictions, the above-mentioned exchange of data between regional centers be effected in such a way that each of the centers communicates its data to the neighboring center located directly to the west at the end of the local day (e. g., about 1800 local time), it being understood that these

abridged data should take account of observations made in the pertinent region at least up to 1600 of the same local day.

8. That special common codes be elaborated by the three Centers in view of the International Geophysical Year.

9. That the transmission of the Ursigrams be every day rather than on working days only and that accordingly regional centers which do not function on this basis, should strive to adopt it, since this is essential to take care of the needs of the International Geophysical Year.

10. That, one of the increasingly important measures for the domain of research served by the Ursigrams being the surveillance of solar activity on radio frequencies, the work of Subcommittee V*a* be particularly appreciated as well as those of the Observatories (of America, Europe and Japan) which regularly and promptly furnish their results for the Ursigrams.

11. That the collaboration of the telecommunication services and other official organizations of the different nations and of the commercial communication companies, making possible the rapid and useful exchange of essential geophysical data, be appreciated, and that their cooperation in the development of radio science be duly noted with gratitude.

33.III.15. — On C.C.I.R. Recommendation 115 « Study of Absorption in the Ionosphere » (1)

This recommendation is strongly endorsed. It is recommended that the programme outlined should receive high priority during the International Geophysical Year, 1957-1958.

34.III.16. — On C.C.I.R. Resolution 12 « Usage and Meaning of M.U.F. » (2)

1. It is agreed that the term MUF should be applied only to an instantaneous state of a particular region of the ionosphere which is continually undergoing variation, and that the term

(1) *Inf. Bull.*, **86**, 33-34.
(2) *Inf. Bull.*, **86**, 31-33.

MEDIAN MUF should be introduced for cases such as prediction graphs where a median value for a given hour of the day is meant.

2. Attention will be drawn to the above through the *U.R.S.I. Information Bulletin* and by other appropriate means.

3. Further thought should be given to the appropriateness of the term Maximum Usable Frequency for the characteristic currently deduced from vertical soundings and to how serious a misnomer it may have become from the practical standpoint in the light of recent work on regular transmissions on frequencies above the MUF.

35.III.17. — On C.C.I.R. Resolution 14 « Investigation of Circularly Polarized Emitted Waves Propagated via the Ionosphere » (1)

U.R.S.I. advises that the effects of adjustable transmitted polarization upon *hf* ionospherically propagated waves, both at vertical incidence and at oblique incidence, are under study in Holland at the radio establishment of the Netherlands P.T.T., and in the U.S.A. at Dartmouth College. The results of these studies will be published in due time.

36.III.18. — On C.C.I.R. Study Programme 58 « Choice of a Basic Solar Index for Ionospheric Propagation » (2)

The U.R.S.I. will expedite work on this programme.

There are two kinds hf solar radiation that affect ionospheric propagation conditions : corpuscular radiation P and wave radiation W, both consisting of several components. As to P, the U.R.S.I. considers the scheme of geomagnetic three hour-range indices Kw (regional) and Kp (planetary) as satisfactory ; these indices, as well as daily amplitudes A and Ak, are available for a uniform series starting 1937. They are made available by the I.A.T.M.E. of U.G.G.I. and are contained in daily Ursigrams.

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(1) *Inf. Bull.*, **86**, 43-44.
(2) *Inf. Bull.*, **86**, 44-45.

As to W, it is proposed to use noon values (averages 10... 14 local time) for E, F1 and F2 critical frequencies for stations with long series of observations, and to transform them into daily indices. These noon values depend on the station, the season, W, P, and on lunar variables, age and distances from perigee. A long series of consistent daily values of W has already been derived from geomagnetic data (S*q*(H) at Huancayo) for the years 1922-1947, published by J. Bartels in *Terr. Magn.*, 51 (1946). The same method of transformation can, with slight modifications, be applied to the ionospheric data. These computations start with the determination and subsequent elimination of the lunar influence and progress by statistical correlation with Zurich sunspot numbers, R. Their result is a detailed description how to derive, from the noon-values mentioned, a solar index independent of R. The success of the analogous geomagnetic study was good enough; the corresponding ionospheric study appears even more promising since the ionospheric data will be less affected by the changes, from day to day, of the ionospheric wind system.

37.III.19. — On C.C.I.R. Study Programme 59 « Identification of Precursors Indicative of Short-Term Variations of Ionospheric Propagation Conditions » (1)

The U.R.S.I. recommends the immediate study of geophysical or solar phenomena suitable for facilitating short-term predictions of ionospheric propagation conditions, and requests the Ursigram Committee to inform the U.R.S.I. delegation to the C.C.I.R. of all reports and publications on this subject which might be submitted to the VIIIth C.C.I.R. Assembly.

38.III.20. — On C.C.I.R. Study Programme 60 « Basic Prediction Information for Ionospheric Propagation » (2)

From information available it is evident that progress is being made in several countries on some parts of the Study Programme,

(1) *Inf. Bull.*, **86**, 45-46.
(2) *Inf. Bull.*, **86**, 46-48.

in particular the world map predictions of Section 2 and the role of the E-layer in long and short path predictions mentioned in Section 3.

A detailed report on the progress in this work seems premature this long in advance of the next meeting of C.C.I.R.

39.III.21. — On C.C.I.R. Study Programme 63 « Radio Propagation at Frequencies Below 1500 kc/s » (1)

U.R.S.I. endorses the proposals of C.C.I.R. In particular the attention of National Committees is drawn to the need for more experiments on very low frequencies. These experiments will require special transmissions from the high-power transmitters available.

It is recommended that a special study of very low frequency propagation be made during the International Geophysical Year and that organizations having suitable transmitters available arrange for them to transmit according to a programme to be arranged.

40.III.22. — On C.C.I.R. Study Programme 66 « Study of Fading » (2)

U.R.S.I. concurs with the recommendation of C.C.I.R.

The attention of National Committees is drawn particularly to the need for more work to determine :

(*a*) The factors which produce field strenght variations, especially at oblique incidence ;

(*b*) The way in which fading is correlated at nearby points and at nearby frequencies.

41.III.23. — On C.C.I.R. Study Programme 67 « Pulse Transmission Tests at Oblique Incidence » (3)

1. Suitable pulse transmissions on several fixed high-frequencies were made by the Netherlands P.T.T. in 1952 and were recorded

(1) *Inf. Bull.*, **86**, 49-50.
(2) *Inf. Bull.*, **86**, 50-52.
(3) *Inf. Bull.*, **86**, 52-53.

at eight points in Europe and the north coast of Africa, and four points in North and South America. The results have been catalogued and circulated to Working Group 6 J of Study Group VI of C.C.I.R.

2. Other oblique path, hf, pulse experiments have been reported as follows :

(*a*) Fixed-frequency direct transmission :

H. P. Gates. — Observations of long-distance pulse propagation, U. S. Navy Electronics Laboratory (San Diego, Calif.) Rpt 116, 5 Apr. 49.

J. A. Pierce. — The frequency dependence of ionospheric transmission speeds, Harvard Univ., *Cruft Lab. Tech. Memo.*, 5 May 49.

S. S. Baral, A. K. Saha. — Observations at Calcutta of pulses transmitted from Delhi, *Ind. Journ. Phys.*, vol. 26 (Nov. 52), pp. 521-538.

K. Miya, M. Ishikawa, T. Kobayashi. — Study of the propagation characteristics by the impulsive wave from San Francisco, *Proc. Semi-Ann. Meeting CRWO* (Japan) N° 3 (1951), p. 56. See abstract R11, *Rep. Iono. Res. Jap.*, vol. 6 (1952) N° 4, p. 221.

M. Strohfeldt, R. W. E. McNicol, G. de Gipps. — Ionospheric measurements at oblique incidence over eastern Australia, *Aust. Jour. Sci. Res.*, vol. 5A (Sept. 52), pp. 464-472.

(*b*) Sweep-frequency direct transmission :

Members of the Central Hiraiso, Yamagawa Radio Wave Observatories (Japan). — Sweep frequency pulse test of oblique incidence, *Proc. Semi-Ann. Meet. CRWO* (Japan), N° 4 (1952), p. 45. See abstract R2, *Rep. Iono. Res. Jap.*, vol. 7 (1953), N° 1, p. 41.

P. G. Sulzer, E. E. Ferguson. — Sweep-frequency oblique-incidence ionosphere measurements over a 1150 km path, *Proc. I.R.E.* (correspondence) vol. 40 (Sept. 52), p. 1124. Also : B. Wieder, P. G. Sulzer, J. W. Wright. — The NBS oblique path sweep frequency experiment, presented at U.R.S.I.-I.R.E. Meeting, Nat'l Bur. of Stds., Washington, 27-30 Apr. 53.

J. Dieminger. — Echo sounding of the ionosphere at oblique incidence, *Z. Angew. Phys.*, vol. 3 (Mars-Apr. 51) pp. 90-96. DSIR. abstract 674 of 1952. See later paper to appear in *Arch. Elek.* (Uebertragung), probably Oct. 54.

J. W. Cox. — Oblique incidence pulse transmission over a 2360 km path via the ionosphere, accepted for publication by *Wireless Engineer*.

(*c*) Fixed-frequency backscatter :

An automatic instantaneous indicator of skop distance and MUF, U. S. Nat'l Bur. Stds., Rpt I.R.P.L.-R9, 5 Feb. 45.

O. G. Villard, Jr, A. M. Peterson. — Scatter-sounding : A new technique in ionospheric research, *Science,* vol. 116 (29 Aug. 52), pp. 221-224.

L. C. EDWARDS. — COZI-Communication zone indicator, *Electronics*, vol. 26 (Aug. 53), pp. 152-155. D.S.I.R. abstract 3600 of 1953.

(*d*) Sweep-frequency backscatter :

R. SILBERSTEIN. — Sweep-frequency (3-25 Mc/s) backscatter, *Journ. Geophys. Res.* (correspondence), vol. 59 (Mar. 54), p. 138.

(*e*) For information on the ground and sea as a source of backscatter, see :

W. G. ABEL, L. C. EDWARDS. — The source of long-distance backscatter, *Proc. I.R.E.*, vol. 39 (Dec. 51), pp. 1538-1541.

K. MIYA, T. KOBAYASHI, N. WAKAI. — Field intensity of scattering wave in *hf* band, *Rep. Iono. Res. Japan*, vol. 5 (1951) N° 2, pp. 55-73.

A. T. WATERMAN. — On the strength of a backscattered signal, presented at U.R.S.I.-I.R.E. Meeting, Nat'l Bur. Stds., Washington, 3-6 May 54 (author from Stanford Univ., Stanford, Calif.).

W. C. HOFFMAN. — A theoretical model for *hf* backscatter from the sea surface via the ionosphere, *ibidem* (author from U. S. Navy Electronics Lab., San Diego, Calif.). Submittee to *Trans. I.R.E.* (AP) for publication.

3. Additional work is being conducted by :

J. H. CHAPMAN (Canada ; Defence Research Board, Ottawa).
A. H. DE VOOGT (Netherlands ; P.T.T.).
W. DIEMINGER (W. Germany ; Max Planck Gesellschaft, Lindau).
M. G. MORGAN (U.S.A. ; Dartmouth College, Hanover, N. H.).
and others.

COMMISSION IV

42.IV.4. — On C.C.I.R. Recommendation 120 « Revision of Atmospheric Radio Noise Data » (1)

The recommendation to prepare revised charts is welcomed. Experiments are in progress in different countries to provide more information about the variations of atmospheric noise and efforts are being made to express the results in terms of rms voltage as suggested by C.C.I.R.

In view of the requirements of C.C.I.R., National Committees are requested to encourage measurements of atmospheric noise, with particular reference to variations with time, direction of arrival, and the influence of sunsport activity.

It is considered that either rms or average voltage is a suitable criterion of atmospheric noise, but results should be expressed

(1) *Inf. Bull.*, **86**, 53-56.

in a form which allows direct comparison to be made with the proposed C.C.I.R. curves of rms voltage; in particular the effect of bandwidth variations should be studied over the widest possible range.

43.IV.5. — On C.C.I.R. Question 79 « The Responses of Radio Receivers to Quasi-Impulsive Interference » (1)

The questions suggested for study commend themselves to U.R.S.I. and are similar to questions which are being actively investigated by workers of U.R.S.I. Commission IV in various countries. These studies are also relevant to Question 71 « Determination of Noise Level for Tropical Broadcasting ».

For the time being it is recommended to National Committees that :

1. The first-order probability distribution function of atmospheric noise (probability $P(E \geqslant E_0)$ that the instantaneous envelope of noise voltage E is equal to or exceeds given reference voltages E_0) be measured in as many places as possible, to determine whether the log-normal distribution is a valid approximation under all conditions.

2. If the log-normal distribution is found to be valid, the variations of the parameters defining the distribution be studied as a function of the pre-detection power bandwidth.

3. Efforts be made to obtain other information leading to the statistical description of the short-time variations of the noise envelope, such as, for example, the autocorrelation function.

4. The development of a mathematical model which describes atmospheric noise be encouraged.

5. The development of a laboratory noise source to simulate atmospheric noise been encocuraged.

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(1) *Inf. Bull.*, **86**, 56-57.

44.IV.6. — On C.C.I.R. Study Programme 65 « Measurement of Atmospheric Radio Noise » (1)

This Study Programme is similar to that being pursued by members of U.R.S.I. Commission IV in different countries.

A group is set up to examine the question « what are the most easily measured characteristics of terrestrial radio noise from which the interference to different types of communication system can be determined ? »

In particular this working group will :

(*a*) Prepare a report as soon as possible, which will specify what requirements should be met in the measurement of average and rms atmospheric noise levels;

(*b*) Prepare a report for the next General Assembly on the progress made in the studies detailed in the comments on C.C.I.R. Recommendation 120 and Question 79.

COMMISSION V

45.V.2. — On Recommendation 118 « Protection of Frequencies Used for Radio-Astronomical Measurements » (2)

The U.R.S.I. wishes to emphasize the importance of making adequate frequency allocations for radio astronomy. It is recommended that both the C.C.I.R. and the National Committees of U.R.S.I. should take every possible step to obtain the necessary reservations. It is envisaged that at least one frequency per octave will be required with a band width of between one and two percent. It is recommended that the National Committees should coordinate their frequency allocation programmes through the medium of Subcommission V*d*. The U.R.S.I. wishes to emphasize again the importance of reserving internationally a frequency band around the spectral line of neutral hydrogen. It is recommended that a frequency band extending from 1400 to 1425 Mc/s should be reserved for observations of this line.

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(1) *Inf. Bull.*, **86**, 58-59.
(2) *Inf. Bull.*, **86**, 59-60.

COMMISSION VI

46.VI.3. — On C.C.I.R. Recommendation 107 « Communication Theory » (1)

It is suggested that the American papers be reviewed by a member of the American delegation and other papers by a member of the Netherlands delegation. Cooperation could consist in sending a list of papers before the 1st of March each year to the respective delegate, together with a note on their place in the theory, and where possible en abstract. It is suggested that the American delegation publish the combined list, and the secretariat of C.C.I.R. publish the abstracts that have a more direct bearing on communication.

47.VI.4. — On C.C.I.R. Question 44 « Communication Theory »

In order to answer the points (*a*) and (*b*) of C.C.I.R. Question nº 44, also the following point should be studied.

(*c*) What is the relation between permissible delay and residual uncertainty, and how does this depend on bandwidth utilization ?

48.VI.5. — On C.C.I.R. Study Programme 47 « Communication Theory » (2)

The information emitted by a source, by the selection of a message from a set of possible messages is defined as the number of binary decisions, by which the said message is specified in an ideal code.

An ideal code is a specification of the set of messages by a minimum number of binary decisions, averaged over all messages and all time. The ideal coding may require unlimited delays.

In the case of a stationery source the information thus defined is found to be the sum of the product of the probability of a given

(1) *Inf. Bull.*, **86**, 60-61.
(2) *Inf. Bull.*, **86**, 61-63.

message being chosen, multiplied by the logarithm of the reciprocal of this probability and summed over all messages.

$$H = -\Sigma\, p_i \log p_i \text{ Bits/message}$$

The unit corresponds to the choice between two equally probable messages (Shannon).

As is evident from the foregoing definition, information is not a physical quantity which could be measured by a physical device. Three cases must be distinguished.

1. If the a priori probabilities are known, determining the information is not a matter of measurement but of computation.

2. If either the mechanism of this information generating process, or the structure of its mathematical model are known, and only some parameters of the process remain undetermined, then it is possible to obtain by experiments a statistical estimate of the information content. No important practical examples of this case are known.

3. If neither the mechanism nor the structure is known it is impossible to obtain a statistical estimate of the information itself. Only an upper bound can be estimated in this case. All natural information sources such as speech, music, picture transmission, etc. fall into the category.

In the absence of all noise the maximum information receivable is equal to the information emitted, as above defined.

In the presence of noise information received, as above defined, has a meaning only in the case of infinite delay. For finite delays one can only determine the a posteriori probabilities of certain messages having been emitted. From this one can formally define a received information as the difference of informations computed on the a priori and on the a posteriori bases. This, however, no longer corresponds to a number of definite binary decisions, since in every case there exists the possibility of an error.

The precise computation of this quantity is not possible on the basis of the received messages alone, but requires some sort of direct or a priori knowledge of the transmitted messages.

As in cases 2 and 3 of the previous discussion, statistical estimates of the received information of upper bounds there of can be obtained from observations at the receiving end alone.

New Study Programme

The following document has been approved by C.C.I.R. and allocated to Study Group n⁰ V.

49.II.8. — Study Programme N° 79 (V)
« Tropospheric propagation across mountain ridges »

(Question n° 85 (V))

The C.C.I.R.

Considering :

(*a*) That Question n° 85 (V) para. 3 seeks information on, amongst other things, the influence on the time distribution of the values of path attenuation, caused by the type of terrain over which the signal passes.

(*b*) That it would be of interest to study a particular type of path crossing a high mountain ridge so situated that it is in optical range of both the transmitter and the receiver.

(*c*) That there is already some evidence that signals reaching the receiver over such a ridge may, under certain conditions, be stronger than they would be in the absence of the ridge, and that, at the same time, they may show a reduced range of fading.

Decides, that the following studies be carried out :

1. The time distribution of the values of path attenuation (as mentioned in Sections 2 and 3 of Question n° 85 (V) for a signal path as described in (*b*) above.

2. The manner in which the reduction in path attenuation depends upon the directional and other properties (e. g. height) of the transmitting and receiving antenna systems.

INTERNATIONAL GEOPHYSICAL YEAR

Aurora and airglow

Excerpt of the minutes of the Rome Meeting of C.S.A.G.I. (September 30-October 4 1954)

WORKING GROUP ON AURORA AND AIRGLOW

S. CHAPMAN (Correspondent)

Sub-Group on Aiglow :

F. E. ROACH (U.S.A.), Chairman.
N. C. GERSON (U.S.A.).
J. KAPLAN (U.S.A.).
H. A. MILLEY (U.S.A.).
T. NAGATA (Japan).
M. NICOLET (C.S.A.G.I.).
K. R. RAMANATHAN (India).

Sub-Group on aurora :

C. T. ELVEY (U.S.A.), Chairman.
J. BARTELS (Germany).
W. DIEMINGER (Germany).
L. HARANG (Norway).
N. HERLOFSON (Sweden).
J. KAPLAN (U.S.A.).
R. MONTALBETTI (Canada).
I. OZDOGAN (Turkey).
E. TRYGGVASON (Iceland).

Sub-Group on Rockets (Now Group XI of C.S.A.G.I.) :

H. E. NEWELL, Jr (U.S.A.), Chairman.
J. Debrach (Morocco).
N. C. GERSON (U.S.A.).
T. COLD (Great Britain).
R. MONTALBETTI (Canada).
M. NICOLET (C.S.A.G.I.).
K. R. RAMANATHAN (India).
S. F. SINGER (U.S.A.).
K. RAWER (Observer).

Summary of work carried out during de meeting

(*Exerpts*)

A. The phenomenon of the aurora is produced by the bombardment of the atmosphere by charged particles from the sun. The investigation of the aurora is an important part of geophysical research and bears on practical problems of radio-communications.

Extensive visual, photographic, photometric and radio observations are being planned to give a synoptic view of the auroras over the globe. To facilitate the processing of data and its publication, auroral centers for several geographical areas are planned as well as one to serve internationally.

The centers will receive the data from the observatories and field stations and prepare synoptic maps at 15 minute intervals throughout both the disturbed and quiet periods. The auroral centers, also, will place the data taken throughout the period of the International Geophysical Year on punched cards for analysis.

The results will be compared with the various theories of the mechanism of the production of auroras and attempts will be made to determine the solar source of the particles and to deduce information concerning the space between the sun and the earth.

B. It is proposed to make systematic photometrics observation of the night airglow at approximately 40 stations during the International Geophysical Year. Four major chains of stations are planned : (1) Europe-Africa ; (2) The Far East ; (3) India-Kashmir, and (4) the Americas. The first and fourth chains will cross the maximum northern auroral zone and will thus serve to give a latitude profile of the nightglow as well as the intensities of the aurora.

The American chain will be in partial operation by 1955 and it is planned to develop standardized methods for the reduction of the data, which can be further extended as the full chain of stations is developed during the International Geophysical Year.

Report

presented by S. CHAPMAN

(*Excepl*)

1. — *Introduction*

The C.S.A.G.I. has considered.

1. The report by S. Chapman, correspondent of the C.S.A.G.I. Group on Aurora and Airglow.

1. The national reports presented to the 2nd C.S.A.G.I. meeting,

3. The reports by the Working Groups on Auroras of the International Association of Terrestrial Magnetism and Electricity (I.A.T.M.E.) and of the International Geophysical Year Committee of the I.U.G.G.

4. The reports by the Working Groups on Airglow of the I.A.T.M.E. and I.U.G.G.-A.G.I. Committee and has established the principal rules for the coordination of auroras and airglow observations which are not yet coordinated.

The high atmosphere emits light, observable at night and during twilight, of two distinct kinds. One of these, called the aurora polaris, is generally visible only in magnetic latitudes of about 60° and more, except during magnetic and ionospheric storms, when the aurora becomes visible in lower latitudes ; the aurora often has distinct forms, such as arcs, rays and draperies, which may move, and often change their shapes during intervals of minutes. The other type of high atmosphere luminosity, called the airglow, is emitted all over the world ; though it is sometimes patchy, it does not have the definite forms often shown by auroras, nor does it vary in intensity as rapidly or greatly as does the aurora. The airglow of the twilight sky is called the twilight airglow. The airglow and aurora occur also in the sunlit sky (daytime aurora and the day airglow) but are imperceptible, owing to the brightness of the sky, except at considerable heights in the atmosphere, above which the scattering of sunlight is weak compared even with the rather faint emission of the aurora and airglow.

Both these phenomena are complex. Their further investigation is an important part of fundamental aeronomic research, and bears on practical problems such as radio communication. A great effort will be made during the International Geophysical

Year to study these phenomena more systematically, accurately and completely than ever before.

Observations of the airglow will necessarily include the aurora when visible ; hence an airglow research program will contribute to the auroral investigation ; but apart from this, the two programs are rather distinct, and consequently are separately considered here.

Observations of the airglow will also include the zodiacal light when visible ; this light is mainly visible for an hour or more, after the end of evening twilight and before dawn, as a cone of light extending upward from the horizon along the ecliptic ; the light decreases with angular distance from the sun, both along the ecliptic and perpendicular to it.

Part. I. — The Auroral Program

2. — *Problem of Auroral observations*

2.1. *The auroral, subauroral and minauroral regions A, B, C.*

2.2. *Objective and Needs.* — The objective of the auroral program of observation is to record the occurrence, the changing form, the intensity, the color and the spectral composition of the luminosity and to determine the true location — height and geographical position — of the regions in the atmosphere whence the light is emitted. The body of facts thus described is called the *morphology* of the aurora. It includes the study of the development of the aurora, over all its extent, during individual occurrences of various kinds, from those most intense and widespread (auroral storms) down to minor occurrences during otherwise very quiet periods.

Limitations on this program are imposed by geography (fewer observations are made over the sea than on land, and fewer over sparsely than over more densely populated regions of similar magnetic latitude) : and by weather (clouds prevent or restrict auroral visibility from places below them) : and by season (in summer the nights are shorter and brighter than in winter, and in the highest latitudes there is no real night in summer) ; and by human acts or characteristics (in towns where bright lights pale the aurora, observation is difficult ; after midnight most people are asleep ; in regions where auroras seldom occur they have in the past occurred unexpectedly, and have passed with few and poor observations; and the aurora may be so complex and changing as to render a record and description difficult to make).

Some of these limitations can be overcome or reduced. Automatic cameras can record auroras throught the night. Airmen fly above the clouds and can see auroras hidden from ground observers when the sky is overcast. Radar beams, and short wave communication signals, can detect the presence of auroras independently of occular vision, and by day as well as by night. Astronomers, meteorologists and others on land and sea may be stimulated to improve the visual auroral watch. Special periods called « Alerts » will be announced throughout the world from a Prediction Center during the International Geophysical Year indicating intervals (of a few days at a time) when active spots on the sun render the occurrence of a widespread aurora more than usually likely; this will make it more worth while for well prepared (and well equipped) observers in regions where auroras occur seldom to keep watch for the aurora, with greater probability that their effort will be rewarded by observations of great value — and by the sight of a natural wonder of considerable beauty, interest and rarity.

If the solar activity develops during an Alert period so that the probability of an imminent great magnetic storm and widespread aurora si sufficiently heightened, a *Speical World Interval* should be declared by the Prediction Center, and notified throughout the world, calling for intensified auroral watch even in regions of low magnetic latitude — down to 10° or 15°.

These arrangements make it advisable for minauroral countries where auroras seldom occur, in magnetic latitudes less than 45° north and south, to organize an auroral watch, and to arrange that the observers are informed of the notification of Alerts and Special World Intervals. Pamphlets should be prepared giving an illustrated account of past great auroras that were seen over a large part of the globe; these pamphlets should be available to National Committees for the International Geophysical Year to arouse and maintain the interest of observers, and to indicate the nature of the phenomenon they are to observe. Instructions should be given as to the method of making and recording the observations, for observers with or without photographic or other equipment.

For subauroral countries, in magnetic latitudes between 45° and 60°, where auroras will be visible more frequently, more elaborate plans of observation are prepared, and still more so in the auroral regions of magnetic latitude greater than 60°.

The observations thus made, at many individual stations widespread over the globe will be used to improve and extend the existing isochasmic charts, showing the geographical distribution of the frequency of auroral visibility.

3. — *Types of observations*

The following are at present the chief of auroral observations :

(*a*) Visual, with or without filters and colorimeters.

(*b*) Photographic and photometric.

(*c*) Spectroscopic and spectrophotometric.

(*d*) Radio observations of echoes, radio star scintillation and absorption, and auroral noise.

(*e*) Rocket observations of auroral ionizing particles, auroral ionization and conductivity, and (in the geomagnetic program) of the ionospheric electric currents associated with auroras.

The studies of auroral frequency by Fritz, Vestine and others show that in the auroral zones auroras occur on almost every clear dark night ; well inside the polar caps enclosed by the auroral zones they occur only a few times every month, and outside the auroral zones the frequency of occurrence falls rapidly to values of perhaps one, or at most a few, auroras a year (even during sunspot maximum) in the minauroral belt between geomagnetic latitudes 45° N and 45° S. It is therefore necessary to have different schemes of observations for different regions of the earth during the International Geophysical Year.

The polar caps enclosed by the auroral zones are rather inaccessible, and have not been extensively studied in the past. There is some evidence, and some reason to expect, that auroras in these inner regions are associated with the earlier phases of auroral displays, and that a detailled study of events inside the auroral zones may give new information of value for auroral theory. During the International Geophysical Year there will be a number of temporary stations in these regions, and it is desirable to make full use of this unique opportunity to establish a network and keep a continuous auroral watch over as much as possible of the auroral regions above 60° geomagnetic latitude.

3.6. *Radio auroral studies.* — The progam of radio auroral studies will partly overlap with the general program of ionospheric research during disturbed conditions.

Radio echo sounding. — The following notes refer to the measurement of radio echoes from auroras; this will be one of the chief types of radio auroral research during the International Geophysical Year.

— Wavelength in the range 3 to 10 metres.
— Transmitter power of ten or more kilowatts.
— Pulse length and recurrence frequency are not critical.
— Aerial Systems : in general aerial beams should be narrow (less than, say, 20° in azimuth) and directed at low elevation.

Where possible the aerial should rotate continuously about a vertical axis with a period of, say, one half minute. Selected stations in the auroral region will use aerials moveable in elevation (e. g. Dr. Harang's group); this will be useful provided the beam in sufficiently narrow (less than 20°). If fixed aerials are used, they should in general be inclined to the magnetic meridian to facilitate the study of apparent auroral motions, although in and near the auroral zone it may be desirable to have some aerial directed along the meridian for observation of movements in latitude.

Recording : For continuous observations an intensity modulated display with a moving film, giving a range-time record, is suitable. The P.P.I. type of display may be employed, with narrow beam rotating aerials; at certain stations the echo structure and fading should be observed with the A-Scope type of display.

The equipment parameters should be accurately known, and should be determined in detail.

The radio echo work must be coordinated with the visual, photographic, spectroscopic and other observations in the vicinity. It is desirable to arrange that the same auroral structures are studied simultaneously by the various techniques. In this connection it should be noted that at moderate latitudes the radio echoes originate from structures situated several degrees nearer to the pole than the echo station. Radio echo sites should as far as possible be selected so that ionospheric and magnetic records are available from observers immediately below the auroral reflecting region.

The magnetograph records and (so far as possible) continuous ionosphere records, should be available for use in interpreting the radio echo data.

The following are among the other principal methods of auroral research by radio measurements :

(*a*) The observation of *scatter* of VHF (very high frequency) waves, using several frequencies simultaneously in the band 30-100 Mc/s ; the frequencies to be chosen in the near future by international agreement.

(*b*) *Scintillation* of radio stars when their radio waves reach the receiver after passing through an aurora : and consequent *absorption* of the waves.

(*c*) *Drift measurements* of ionospheric winds : in the E layer using waves in the 2 to 3 Mc/s, by the Mitra method, and in the F layer, using spaced aerial reception of waves from radio stars, and methods of reduction to be adopted after consultation between the radio workers undertaking such measurements.

3.9. *Atmospheric electric observations.* — Hitherto no evidence has been obtained to establish a connection between auroral phenomena and electric field changes near the ground. If the reports of audible sounds during auroras ever do represent objective reality, it is possible that the sounds are associated with electric field changes. In view of the great height of auroras above the ground, and the electrical conductivity of the intervening atmosphere (due mainly to ionization by cosmic rays), such electric field changes seem improbable. But the variability of auroral height and intensity is very great, and it may still be worth while to make provision for atmospheric electric recording during great auroral displays, at one or a few arctic stations.

4. — *Auroral observing stations*

4.1. *Auroral observatories.* — Stations manned by one or more full-time workers for auroral research, and at which special as well as the general observing programs are undertaken, will be called *auroral observatories.*

The following observatories are in operation :

1. Tromsö, Norway.
2. Oslo, Norway.
3. St-Andrews, Edinburgh, Scotland.
4. Ithaca, N.-Y., U.S.A.
5. Williams Bay, Wis., U.S.A.
6. Saskatoon, Sask., Canada.
7. Churchill, Canada.
8. College, Alaska, U.S.A.
9. South Island, New Zealand.

4.2. *Auroral stations.* — Places where a continuous auroral watch is to be kept during the International Geophysical Year will be called *auroral stations.* The stations should at least fulfil the minimum program for the region in question. The following stations are planned or in operation according to information available in September 1954 :

Cap Linné, Norway.
Kiruna, Sweden.
Sodankyla, Finland.
Resolute Bay, Canada.
Baker Lake, Canada.
Winnipeg, Canada.
Point Barrow, Alaska.
Kodiak, Alaska.
Cold Bay, Alaska.
Sitka, Alaska.
Nome, Alaska.
Anchorage, Alaska.
Northway, Alaska.
Fort Yukon, Alaska.
Shingleton, Michigan, U.S.A.
New Haven, Conn. U.S.A.

and 6 to 10 as yet unnamed stations along the northern row of states of U.S.A.

4.3. *Gaps in the geographical distribution.* — When these observatories and stations are marked on a map, several serious gaps in the geographical distribution become apparent.

The most serious deficiency would be an absence of auroral observers at Greenland.

With reference to the importance of observations well inside the auroral zone, as described earlier, the recommended stations are listed in the following order of priority :

1. Thule.
2. Nord at Denmarks Fjord.
3. Scoresbysund.
4. Godhavn.
5. Angmagssalik.
6. Julianehaab.
7. Upernavik.

The next gap is in the region round Iceland.

4.4. *Networks of organized amateur observers.* — The following networks of organized amateur observers are now established or planned.

1. British Isles (this network is already working, with the cooperation of air pilots and meteorological officers).
2. Northeastern U.S.A.
3. New Zealand.
4. Finland.
5. Iceland.

The C.S.A.G.I. strongly urged that national committees in other localities should organize networks of auroral observers, and seek the cooperation of astronomical, magnetic and ionospheric observatories, as well as of the meteorological services, and airlines in auroral observations during the International Geophysical Year.

At present the aurora is being observed from a number of permanent arctic stations, and many more stations are already now planned for the International Geophysical Year. During the International Geophysical Year it is important to group the temporary stations, and increase their number where necessary, so as to form an adequate network in the region around the north geomagnetic pole. The network should consist of chains of stations crossing the auroral zone at regular intervals.

The main chains according to present plans are in the following localities :

(*a*) Spitzbergen-Scandinavia.

(*b*) Greenland-Iceland-British Isles.

(*c*) Resolute Bay-Canada-U.S.A.

(*d*) Alaska.

In the southern hemisphere the auroral network is expected to include all the International Geophysical Year stations in Antarctic and adjacent islands.

Auroral height measurements will be made in Alaska, Canada and Sweden.

Radio measurements of winds in the auroral ionosphere will be made in Alaska and Canada.

Radar measures of auroral echoes of short-wave radio beams will be made in England, Canada, U.S.A. including Alaska, Australia and perhaps Sweden and New Zealand. It is hoped that the French antarctic expedition to Terre Adélie within the southern auroral zone will include such measurements in its work. It is hoped that radio echo meteor workers will be prepared to use their equipment for this purpose at least on special occasions when alerted ; this includes workers at Stanford, U.S.A. ; South Australia ; and New Zealand. Dual frequency measurements may be made at some stations, in Alaska, Canada, England and Norway.

As an additional means of giving *early warnings of auroras* the C.S.A.G.I. recommends that the occurrence of auroral radio echoes in the daytime be notified to one of the central agencies for the World Alert program, and also should be notified directly to the chains of stations to the westward. A suitable code should be drawn up for this purpose.

Observations of the scintillation and absorption of the radio waves received from radio stars will be made in Alaska, England, Norway, U.S.A. and Australia ; C.S.A.G.I. recommends that simultaneous radio echo and radio star measurements be made, at least at College (Alaska) ; Jodrell Bank (England) and Ithaca (U.S.A.).

Radio noise from auroras will be watched for by Alaskan and Canadian stations, and at present it seems unnecessary to recommend others to do likewise.

Very high frequency (V.H.F.) scatter will be observed in Alaska, Australia, Canada, England, Norway, Sweden, and U.S.A.

5. — *Establishment of Area Centers and a World Auroral Center*

For proper synoptic and statistical studies it is essential that the detailed procedures of observation be identical over large areas. Experience from the earlier polar years shows that this is difficult to achieve without a central agency for correlating the plans of the various observers. Also the task of constructing and publishing synoptic and statistical charts is most readily carried out by one, or a few, international agencies.

The C.S.A.G.I. recommends that auroral centers be established in convenient geographical areas for the processing of data, and for forwarding data to a World Auroral Center for the preparation and publication of world-wide synoptic maps of auroral displays and the analysis of statistical data. Suggested areas and auroral centers are :

1. Alaska (possibly including Yukon Territory of Canada) College, Alaska.
2. Western Canada and Western U.S.A., Saskatoon, Canada.
3. Eastern Canada and Eastern U.S.A., Ithaca, N.-Y.
4. Western Europe, Africa and Middle East, Edinburgh.
5. U.R.S.S.
6. South Asia.
7. East Asia.
8. Australia, Melbourne.
9. New Zealand.
10. South America.
11. Antarctica, each expedition.

It is suggested that Dr. E. H. Vestine and the Carnegie Institution of Washington be approached to serve as the World Auroral Center.

The persons responsible for area centers are invited to consider the details of the observational procedure along the general lines discussed in the present report, and in the near future communicate their conclusions to all persons or institutions responsible for auroral observations during the International Geophysical Year.

BIBLIOGRAPHY

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I. The observational data.

II. Physical conditions of the interstellar gas.

III. Shock waves and collision problems.

IV. Turbulence and magnetic fields in a compressible gas.

V. Formation of cosmic clouds and galaxies.

VI. Accretion problems.

VII. Gas and dust in interstellar medium.

VIII. Conclusions.

— *The Studies of the International Radio Consultative Committee. C.C.I.R.* by Dott. Ing. Federico Nicotera, Head of Radio Department of the Ministry of P.T.T. (Ediozoni Moderne, Roma).

After a Preface by Prof Luigo Sacco, this book contains the following sections :

I. Formations of the International Radio Consultative Committee and its Meetings.

II. The C.C.I.R. Studies, general outline.

III. Propagation studies :

1. Ground wave propagation.
2. Tropospheric propagation.
3. Ionospheric propagation.

IV. Presentation of antennae radiation data.

V. Problems concerning radio circuits and radio spectrum conservation :

1. Communication Theory.
2. Radio transmitters.
3. Radio receivers.

VI. Radiotelegraphy and radiotelephony.

VII. Broadcasting.

VIII. Multi-channel and wide-band radio relay systems operating on frequencies above about 30 Mc/s.

IX. Miscellaneous Subjects.

I.T.U. — *List of Broadcasting Stations* (13th edition) and list of broadcasting stations the frequencies of which appear in the Supplementary Information to the Radio Frequency Record; General Secretariat of the International Telecommunication Union, Geneva, 1954.

International Electrotechnic Commission. — Second edition of the International Electrotechnic Vocabulary. Group 12 : Magnetic transductors; Central Office of the I.E.C., 39, route de Malagnou, Geneva, Switzerland, S.F. 3.75 plus postage.

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Excerpt from the Contents :

On Radio Measurement at Jabalpur during the Solar Eclipse of June 30th, 1954, A. K. GHOSE, K. M. ROY, S. K. GUPTA, S. M. DAS GUPTA, V. V. SARWATE and G. K. MITHAL.

Power density diagrams of short-wave aerial arrays, S. SAMPATH.

Field strength near the skip distance, by H. POEVERLIN, Propagation Lab., Electronics Res. Directorate, Air Force Cambridge Res. Center, Cambridge, Mass., U.S.A.

Copies of this 13 page paper are available at the U. S. Department of Commerce, Office of Technical Services, Washington 25, D.C.

INTERNATIONAL SCIENTIFIC AND TECHNICAL CONFERENCES

Date	Subject	Organizer	Locations
1955 June 6-18	International Organization for Standardization, General Assembly and Congress.	I.S.O. General Secretariat, 39, route de Malagnou, Geneva, Switzerland.	Stockholm, Sweden
June 13-17	Annual Symposium on molecular structure and spectroscopy.	Prof. H. H. Nielsen, Department of Physics, Ohio State University, Columbus 10.	Columbus, Ohio
June 20-25	International Symposium on Electrotechnique Wave Theory, sponsored by Commission VI of U.R.S.I.	Dr. J. W. Crispin, Jr., Willow Run Research Center, Univ. of Michigan, Ypsilanti, Michigan.	Ann Arbor, Michigan, U.S.A.
June 27-July 9	International Electrotechnical Commission, Meeting.	Mr. L. Ruppert, Administrative Secretary of I.E.C., 39, route de Malagnou, Geneva, Switzerland.	England
August 8-13	I.C.S.U. General Assembly, Meeting of the Executive Boards.	Dr. R. Fraser, Administrative Secretary of I.C.S.U., Tavistock Square, London.	Oslo, Norway
August 17-24	Australian and New Zealand Association for the Advancement of Science, 31st Meeting.	Prof. J. R. A. McMillan, Honorary Secretary of Association, 157, Gloucester Street, Sydney.	Melbourne, Australia

August 22-24	I.C.S.I. Mixed Commission on the Ionosphere, Symposium on Eclipses.	Dr. W. G. J. Beynon, Secretary of the Commission University College of Swansea, Department of Physics, Singleton Park, Swansea, Great Britain,	London, England
August 25-27	I.A.U. Symposium on Radio-Astronomy (by invitation).	Prof. P. Th. Oosterhoff, General Secretary of I.A.U., Leiden Observatory, Leiden, Netherlands.	Manchester, England
August 28-Sept. 5	I.A.U. 9th General Assembly.	Idem.	Dublin, Ireland
August 31-Sept. 7	British Association for the Advancement of Science-Annual Meeting.	The Secretary Baas, Burlington House, London, W-1.	Bristol, England
September 8-10	U.R.S.I. Special Commission for the A.G.I., Meeting.	E. Herbays, Secretary General of U.R.S.I., 42, Rue des Minimes, Brussels.	Brussels, Belgium
Idem 8-14	C.S.A.G.I. 3rd Plenary Meeting.	M. Nicolet, Secretary General of C.S.A.G.I., 3, Avenue Circulaire, Uccle, Brussels.	Idem
September 10-15	I.U.P.A.P. International Congress on Cosmic Radiation.	Prof. P. Fleury, Secretary General of I.U.P.A.P., 3, Boulevard Pasteur, Paris.	Mexico, D.F., Mexico

Date	Subject	Organizer	Locations
September 26-28	I.U.T.A.M. Symposium on Solid State and Plasticity.	Prof. F. H. van den Dungen, Secretary of I.U.T.A.M., 41, Avenue de l'Arbalète, Boitsfort Brussels, Belgium.	Madrid, Spain
Undecided	I.U.T.A.M. 2nd Symposium on Non-Linear Vibrations.	Idem.	Undecided
September 12-17	3rd International Symposium on Communication Theory.	Dr. Colin Cherry, Department of Electrical Engineering, Imperial College of Science and Technology, City and Guilds College, Exhibition Road, London S. W. 7.	London, England
1956			
August 8	I.G.U. 18 th International Geographical Congress.	Dr. G. H. T. Kimble, Secretary-Treasurer of I.G.U., c/o 20th Century Fund, 330 W. 42nd Street, New-York 36.	Rio de Janeiro, Brazil

August 28-Sept. 2	I.U.T.A.M. 9th International Congress of Pure and Applied Mecanics.	Prof. F. H. van den Dungen, Secretary of I.U.T.A.M., 41, Avenue de l'Arbalète, Boitsfort Brussels, Belgium.	Brussels, Belgium
September 3-10	I.U.H.S. 8th International Congress on History of Science.	Prof. V. Ronchi, Director, Istituto Nazionale di Ottica, Via San Leonardo, Florence.	Milano and Florence, Italy
September 5-7	I.U.T.A.M. Symposium on Fluid Mecanics.	Idem.	Göttingen, Germany
Undecided	C.C.I.R. 8th Plenary Assembly.	Palais Wilson, Geneva, Switzerland.	Warsaw, Poland
Idem	I.U.A.P.P. Symposium on Electron Transport in Metals.	Prof. P. Fleury, Secretary General I.U.P.A.P., 3, Boulevard Pasteur, Paris 15e.	Ottawa, Canada
1957 July 1-December 1958	International Geophysical Year World wide coordinated investigations in the following geophysical fields : solar activities, longitude and latitude, meteorology, ionosphere physcis, aurora and airglow, cosmic rays, geomagnetism, etc.	M. Nicolet, Secretary General of C.S.A.G.I., Institut Royal Météorologique, 3, Avenue Circulaire, Uccle, 1, Brussels, Belgium.	

Date	Subject	Organizer	Locations
August 22-Sept. 5	U.R.S.I., XIIth General Assembly.	E. H. Herbays, Secretary General of U.R.S.I., 42, Rue des Minimes, Brussels, Belgium.	Boulder, Colorado, U.S.A.
August 14-16	I.C.S.U. Mixed Commission on the Ionosphere, 5th Meeting.	Idem. or, Dr. W. G. J. Beynon, Secretary of the Commission, University of Swansea, Department of Physics, Singleton Park, Swansea, Great Britain.	New-York
Undecided	International Telecommunications Union, Plenipotentiary Conference.	Palais Wilson, Geneva,	Geneva, Switzerland
Idem	I.U.T.A.M. 3rd Congress on Gas Dynamics of Interstellar Clouds.	Prof. F. H. van den Dungen, Secretary of I.U.T.A.M., 41, Avenue de l'Arbalète, Boitsfort Brussels, Belgium.	Undecided