Bulletin N° 100 November-December 1956

International Scientific Radio Union

U. R. S. I.

CONTENTS

IN MEMORIAM

Marcel Bayard

It is with a deep regret that we inform our readers of the death of Marcel Bayard, Member of the French National Committee.

Marcel Bayard who was « Ingénieur Général des Télécommunications » and Professor at the « Ecole Nationale Supérieure des Télécommunications » devoted himself to theoretical studies on the propagation of electricity on conductors and on the theory of conductor networks ; some of his results drew the attention to him, particularly the relationship between the actual and the imaginary part of a complex network impedance.

XIIth GENERAL ASSEMBLY

Rules for Submission of Reports and Papers

The text printed in *Information Bulletin*, n° 95, has to be modified on page 3 as follows :

1.5 *Add at the end* :

« In order to facilitate the reproducing of documents which will be distributed, the manuscripts should be in *black* type. »

Page 4 :

2.3. *Read* « 1952 », *instead of* « 1954 ».

2.4. *Read as follows* :

« Due to the fact that current needs are well covered by « Science Abstracts » and the « Bulletin Signalétique » and also by reference lists published in radio periodicals, National Committees are invited not to draft their reports only with reference lists mentioning all the literature published on fields relevant to the various Commissions. »

NATIONAL COMMITTEES

India

PROGRESS REPORT, SEPTEMBER 1955-FEBRUARY 1956

published by the Radio Research Committee, Council of Scientific and Industrial Research

PREFACE

The Radio Research Committee of the C.S.I.R. is in some respect different from other research committees, since, in addition to the normal work pertaining to such committees, it functions as the National Committee in India for the International Scientific Radio Union (U.R.S.I.). It also works in collaboration with the Indian National Committee for the International Geophysical Year, and has recently established its own Research Centre at its secretariat.

During the period under review the committee has sponsored twenty research schemes of which one was new. The subjects covered by such schemes were mainly (1) Ionospheric propagation, (2) Atmospherics, (3) Microwaves and (4) Electronics Instrumentation Development Work.

In India there is now a network of seven regular ionospheric stations, to which Trivandrum (situated at the geomagnetic equator) will soon be added. Most of these receive either full or partial assistance from the committee. Measurements of ionospheric absorption have been made at Ahmedabad and Haringhata-Calcutta, and of drift at Ahmedabad, Banaras and Waltair. Scatter experiments have been undertaken at Banaras using high power transmission from A. I. R., Delhi, and the local pulse transmitter. Construction of high precision ionospheric height measuring equipment was continued in Calcutta (Mr. B. M. Barnejee).

In the subjects of atmospherics, wave forms of a large number of atmospherics were studied at Banaras and Poona over a wide frequency range in the low and very low frequency band. At Banaras the possibility of locating sources of atmospheric by a single station was explored.

In the field of microwaves, the main emphasis at present is on the study of absorption and dielectric properties at these frequencies. This work has been continued in Allahabad, Lucknow and Waltair, and initiated at Roorkee. In additions, microwave propagation has been undertaken at Bangalore.

On the instrumentations side, work on millimicrosecond pulse generators and pulsive tube characteristic meters was continued at the Madras Institute of Technology, and the construction of a 100 Watt R.C., type F.M. oscillator at the Bengal Engineering College, Howrah was completed. Work was also continued at the National Physical Laboratory on the manufacture of capacitors and the development of the manufacturing process.

At the committee's own research centre at the Secretariat, research was confined to problems of radio propagation. Since January, 1955, the Secretariat has been publishing the monthly bulletin on Ionospheric Data which now contains the hourly data of seven ionospheric stations, the actual radio propagation data over Bombay-London circuit and the solar and magnetic data obtained at Kodaikanal. Experimental study of ionospheric absorption and drift by radio astronomical techniques has been taken up, and solar terrestrial relationships for stations within the geomagnetic anomaly have been investigated. The possibility of strong vertical drift causing temporary breaking of the E-layer at times of strong magnetic disturbance is being quantitatively explored. A new method has been developed to study oxygen dissociation in the high atmosphere from the observational results on effective recombination coefficient for day and night conditions.

CONTENTS

A. — Research Scheme sponsored by the Committee

Commission I

1. Absorption of microwave in the 3 cm region—Mr. Krishnaji, *Allahabad University.*
2. Absorption and dielectric properties in the microwave-region — Prof. P. N. Sharma, *Lucknow University.*

3. Microwave technique and its applications — Dr. RANGADHAMA RAO, *Andhra University, Visshakhapatnam.*
4. Measurements of dielectric constants at microwave frequencies — Mr. P. V. INDIRESAN, *Roorkee University.*

Commission II

1. Investigations on microwave propagation — Prof. K. SREENIVASAN, *Indian Institute of Science.*

Commission III

1. Ionospheric Investigations — Prof. S. K. MITRA, *Institute of Radio-physics and Electronics.*
2. Recording and analysis of reflection of electromagnetic waves from the ionosphere at Ahmedabad — Dr. K. H. RAMANATHAN, *Physical Research Laboratory.*
3. Scattering of Radio Waves — Dr. S. S. BARNEJEE, *Banaras Hindu University.*
4. Lunar and solar tides in the ionosphere — Mr. B. M. BARNEJEE, *Institute of Nuclear Physics, Calcutta.*
5. Travelling wave disturbances in the ionosphere by spaced receiver method — Dr. B. RAMACHANDRA RAO, *Andhra University.*
6. Study of winds in the Ionosphere — Dr. S. R. KHASTGIR, *Banaras Hindu University.*
7. Study of wind drifts in the E and F layers of the Ionosphere — Mr. U. D. DESAI, *Physical Research Laboratory.*
8. Design and construction of ionospheric recorder — Prof. K. SREENIVASAN, *Indian Institute of Science.*
9. The physics of the lower Ionosphere — Dr. A. P. MITRA, Secretary, *Radio Research Committee.*

Commission IV

1. Study of nature of Atmospherics — Dr. S. R. KHASTGIR, *Banaras Hindu University.*
2. Nature and origin of atmospherics — Dr. M. W. CHIPLONKAR, *Poona University.*

Commission VI

1. Construction of 100 Watt R-C-type F. M. Oscillator — Prof. H. RAKSHIT, *Bengal Engineering College.*
2. Millimicrosecond pulse generator — Mr. P. V. V. S. SASTRY, *Madras Institute of Technology.*
3. Pulsive tube characteristics meter — Mr. P. V. V. S. SASTRY, *Madras Institute of Technology.*

Commission VII

1. Project on manufacture of Radio Components in the National Physical Laboratory.

B. — U.R.S.I. National Committee Activities

1. — *Associate Editor for U.R.S.I.*

Dr. A. P. Mitra was appointed as an Associate Editor on behalf of India for the U.R.S.I.

2. — *World wide Standard Frequency and Time Service*

The National Physical Laboratory of India will soon initiate a standard frequency and time service, similar to MSF, WWV, etc.

Proposed characteristics of the signal are given below :

1. *Primary standards is to be used*	Three « Essen ring » type crystal oscillator units, developed by British Post Office. The time signals obtained with this standard will be checked up with the astronomical time computed with an « Astrolab » transit telescope unit.
2. *Location of the station*	New Delhi, India.
3. *Proposed call sign*	ATA.
4. *Type of service*	Experimental.
5. *Carrier power*	300 Watts, to be increased to 2 kW later.
6. *Type of antenna*	Vertical dipole.
7. *Number of simultaneous transmissions*	One (Three after a few months).
Number of frequencies to be used	One (Three after a few months).
8. *Emissions-hours per day*	Two hours per day. Will be increased to 22 hours later.
Emissions-days per week	Seven.
9. *Standard frequency to be used as Carrier*	10 Mc/s (5 Mc/s and 15 Mc/s will be added later).
10. *Standard Modulation frequency*	1000 c/s.
11. *Duration of tone modulation in minutes*	Five for every fifteen minutes.
12. *Duration of time signal in the transmission cycle*	Continuous.
13. *Method of adjusting the time signals*	By steps of 50 milliseconds.

14. *Transmission cycle per hour*	1000 c/s modulation with carrier for 0-5 mts, 15-20 mts, 30-35 mts, 45-50 mts. Pure unmodulated RF for 5-14, 20-39, 35 44, 50-59 mts. Voice code announcements for one minute duration 14-15, 29-30, 44-45, 59-60 mts.
15 *Details of the seconds pulse signals (time signals)*	(*a*) The second pulse, emitted for the identification of time, will consist of a group of 5 cycles of 1000 c/s signal. (*b*) For the identification of the minutes the signal for the zero second will be lengthened to 45 milliseconds duration (5 groups of second pulses emitted as a batch). (*c*) The second pulse signal will be transmitted throughout the transmission cycle. (*d*) During the tone period, the second pulse will be transmitted, preceded and followed by short interruptions of the modulated transmission. During the unmodulated RF period, the pulse will be transmitted as a modulating wave.

C. — Ionospheric Programme for the International Geophysical Year of 1957-1958

Ionospheric measurements will be undertaken in one form or another, by twelve stations distributed over a wide range of geomagnetic latitudes (18°75′ N to 1°3′ S). Of these eleven (all excepting Kodaikanal) will receive full or partial assitance from the Committee.

Of particular importance will be the initiation of the ionospheric station at Trivandrum, which has magnetic latitude of O° and a geomagnetic latitude of 1°3′ S.

India's ionospheric programme is given below (see also Prog. Rep. September 1954-February 1955).

A. — *Vertical Incidence Ionospheric Observation*

Station	Geomagnetic Latitude	Status	Equipment
Delhi	18.75° N	O	Automatic
Ahmedabad	13.60° N	O	Automatic
Haringhata-Calcutta	12.1° N	O	Automatic
Bombay	9.5° N	O	Manual
Madras	3.10° N	O	Manual
Tiruchirapalli	1.3° N	O	Manual
Kodaikanal	0.6° N	O	Automatic
Trivandrum	1.3° N	P	Manual

B. — *Ionospheric drift Measurements*

Station	Status	Remarks
Ahmedabad	O	Spaced receiver method.
Waltair	O	Spaced receiver method-terrestrial.
Haringhata-Calcutta	P	Spaced receiver method-terrestrial.
Delhi (AIR)	P	Spaced receiver method-terrestrial.

C. — *Absorption Measurements*

Station	Status	Remarks
Delhi (AIR)	O	Pulse technique.
Delhi (RPU)	P	Cosmic noise method.
Ahmedabad	O	Pulse technique and cosmic noise method.
Haringhata-Calcutta	P	Pulse technique.
Madras (MIT)	P	Cosmic noise method.

D. — *Atmospheric and terrestrial radio noise*

Station	Status	Remarks
Delhi	O	Detection of storms and Sea's.
Calcutta	P	Detection of storms and Sea's.
Banaras	O	Waveform study.
Poona	O	Waveform study.

E. — *Scatter Experiments*

Station	Status	Remarks
Banaras	Oper ating	Becskatter.

PROGRAMME

The current programme of scientific work at the committee secretariat is as follows :

1, Coordination, analysis and publication of ionospheric data.
2. Preparation of forecasts of radio propagations conditions.
3. Measurement of ionospheric drift from scintillation of radio stars.
4. Measurement of ionospheric absorption using cosmic radio noise.
5. Propagation of Low frequency radio waves.
6. Physics in the upper atmosphere.
7. Solar and terrestrial relationships.

Papers

Oxygen dissociation in the upperatmosphere — a new method of study, A. P. Mitra.

The study of mutual impedance due to the neighbouring elements on the driving point impedances of a linear array, R. Parthasarathy.

The C. W. signal source as a calibrator for a high level source of radom noise, R. Parthasarathy.

Investigation of ionospheric drift using 60 Mc/s radiation from discrete extra terrestrial sources, R. Parthasarathy.

Ionospheric absorption by cosmic radio noise at 20.1 Mc/s, Miss K. A. Sarada.

Some aspects of the geomagnetic distorsion of the F2 region at equatorial latitudes, N. V. G. Sarma ,A. P. Mitra.

Breaking of the E layer at night, N. M. Rao, A. P. Mitra.

U. S. A.

COOPERATION WITH I.R.E.

We inform our readers of a paper « International Cooperation in Radio Research — U.R.S.I. and I.R.E. », by J. H. Dellinger, Honorary President of U.R.S.I. (*Proceedings of the I.R.E.*, vol. 44, nº 7, July, 1956).

After an introducing account of how the U.R.S.I. and I.R.E. began, almost simultaneously, in their respective fields of science and engineering, the paper describes how U.R.S.I. functions. The system of National Committees is described and in particular of the U.S.A. National Committee. Example of U.R.S.I. accomplishments are given. U.R.S.I.-C.C.I.R. relations and U.R.S.I.-I.R.E. relations are explained. Future prospects are discussed.

COMMISSIONS

Commission III
On Ionospheric Radio

LETTER TO OFFICIAL MEMBERS OF THE COMMISSION

26th September, 1956.

I am preparing the programme of topics to be discussed by Commission III during the Twelfth Assembly of U.R.S.I. next year, and would be glad to have suggestions from you regarding these.

As you know, it will not be possible to have papers read and discussed during the meetings of our Commission unless they fall within the scope of the topics specially selected for general discussion, so that it is very desirable that these be carefully chosen to embrace the most active fields of current research.

Subjects which are under tentative consideration are :

(*a*) Geomagnetic distortion in the E and F1 regions.

(*b*) Whistlers (possibly in conjunction with Commission IV, though it seems possible that a full session could devoted to this subject from the standpoint of its bearing on ionospheric structure and theory alone).

(*c*) Disturbance phenomena in the F2 region.

(*d*) Theory of the F2 region.

(*e*) Rocket measurements in the ionosphere.

This list is at present quite provisional and may be modified in the light of suggestions from Members of the Commission. I would be glad to hear from you as soon as possible, and in any case before November 12, if you have proposals to make, and will do all I can to draw up a programme that will permit adequate discussion of the topics of greatest current and potential interest.

Yours sincerely,

D. F. Martyn,

President Commission III
Radio Research Laboratories,
Camden, N.S.W. Australia.

CALCULATIONS OF THE SOLAR ZENITH ANGLE

I. L. THOMSEN, Carter Observatory, Wellington

This ancient astronomical calculation has assumed some interest since the recommendation that solar zenith angles appropriate to an ionospheric station should be calculated at hourly intervals from sunrise to sunset on the 15th day of each month.

The tantalising variations of the Equation of Time and the solar declination have been brought to the attention of those concerned, and an attempt has been made to find suitable average values, so that calculations can be made once and for all (1). It is admitted that such a procedure will not give results to an accuracy of 0.001 for the cosine of the zenith distance, but it is suggested that since timing of measurements such as vertical incidence critical frequencies should be accurate to within only one minute, such accuracy is not necessary.

The purpose of this note is to suggest that the calculations, using correct values, designed to reach the accuracy of 0.001 are not as burdensome as they may appear from previous writers. Firstly, attention is drawn to the Abridged Nautical Almanac, or its foreign equivalents, which now dispenses with the Equation of Time, by the use of the Greenwich Hour Angle. With this publication, a copy of « Standard Four-Figure Mathematical Tables » by Milne-Thompson and Comrie, and a desk calculating machine such as the Brunsviga 20, the requirements for a year should be obtainable in one day or even less, by one computer.

If the calculations are made for each Greenwich hour, then direct entries are available in the Almanac and no interpolation is required. The method, well known to any practising astronomer is best illustrated by an example. *All figures are in units of the fourth decimal place.* For Godley Head, near Christchurch, New Zealand we have the coordinates : Latitude + 33°34′ S ; Longitude = 172°48′ E ; Cos Φ = +7246 ; Sin Φ = −6892.

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(1) W. J. G. BENYON, G. M. BROWN. — *U.R.S.I. Information Bulletin*, **97**, May-June, 1956, p. 17.

(1) GMT 1956 Sept.	(2) L.H.A. = h	(3)	(4) cos h	(5) A	(6) B	(7) cos χ
			+	−	+	
14d19h	278°57′	81°03′ E	1556	385	1126	741
20	293 57	66 03 E	4059	384	2936	2552
21	308 57	51 03 E	6286	382	4547	4165
22	323 58	36 02 E	8087	380	5851	5471
23	338 58	21 02 E	9334	378	6753	6375
15 00	353 58	06 02 E	9945	376	7195	6819
01	368 58	08 58 W	9878	374	7147	6773
02	383 58	23 58 W	9138	372	6611	6239
03	398 59	38 59 W	7773	370	5624	5254
04	413 59	53 59 W	5880	368	4255	3887
05	428 59	68 59 W	3586	366	2595	2229
06	443 59	83 59 W	1048	364	758	394

No figures other than those given need be written. The value of h is obtained by adding the longitude (for eastern longitudes) directly to the L.H.A. Sun as tabulated. In this case it has been done exactly to the nearest minute of arc, but it is probably accurate enough to work out eastern or western hour angles for a mid-day point and apply the constant change of 15° per hour, to obtain column (3). At the most only about 1′ change occurs at either end of the day. Column (4) comes direct from (3).

Column (5) $= \sin \Phi . \sin \delta = A$

Column (6) $= \cos \Phi . \cos \delta . \cos h = B$

Φ is constant, but δ changes during the day, and an equinox period was chosen since it is then that the change is greatest.

Column (7) is then derived directly from :

$$\cos \chi = A + B$$

A little experimentation will probably show that A and B need not even be written if a Brunsviga is used.

In this example, account was taken of the value of δ for each hour in forming A and B, but if it was assumed to be constant the work reduces considerably. Taking the near noon-value, the equation reduces to :

$$\cos \chi = 7235 \cos h - 376$$

Machine calculation will now give cos χ directly with the operator having to worry about only cos h. Such an operation must surely be as simple as the one proposed by Beynon and Brown, with the added advantage that it is exact and directly applicable to the particular day and year.

By this simplified means we have the following values :

G.M.T. 1956 Sept.	Approx. Value cos χ	Error in Third Place
14d19h	750	—0.9
20	2561	—0.9
21	4172	—0.7
22	5475	—0.4
23	6377	—0.2
15 00	6819	0.0
01	6771	+0.2
02	6235	+0.4
03	5248	+0.6
04	3878	+0.9
05	2218	+1.1
06	382	+1.2

This is near the maximum range of errors that must occur by this method, since at the solstices they should be zero.

The work in these examples has been carried to four places to ensure accuracy in rounding off to the third place ; but if the third place is not so very important the problem could be worked on a slide rule after finding cos h. It would seem a pity not to ensure third place accuracy despite the uncertainties of other factors which might quite well be found to be not as great in some cases as expected.

Relationships between G.M.T., L.M.T., and standard time are obvious, and variations of the method for times other than the exact G.M.T. hour present no difficulties.

Commission IV
On Radio Noise of Terrestrial Origin
LETTER TO OFFICIAL MEMBERS OF THE COMMISSION

16 November, 1956.

Dear Colleague,

XIIth General Assembly, Boulder, 1957, Commission IV

At the General Assembly of U.R.S.I. to be held next year in the U.S.A. I propose that we should concentrate our attention on a few well-defined topics. Papers on these topics would be invited and discussed in detail at the meeting. Other papers would, in general, be mentioned only by title.

As a tentative list of topics I propose the following :

(1) Report of working party on the wave-form of atmospherics (Chairman : J. A. Ratcliffe) (see Recommendation 3 of The Hague Meeting).

(2) Report of working party on the characteristics of terrestrial radio noise. (Chairman : A. W. Sullivan) (see Recommendation 4 of The Hague Meeting).

(3) The relation between lightning and radio noise.

(4) Whistlers (joint meeting with Commission III).

(5) The International Geophysical Year.

Will you please let me have any suggestions about this procedure as soon as possible, and in any case before *January 1st.* 1957.

Yours sincerely,

(*s*) J. A. Ratcliffe,
President of Commission VI
Cavendish Laboratory
Cambridge, England

WORKING PARTY ON ATMOSPHERIC WAVEFORMS
Letter sent to Members of the Working Party

9th November, 1956.

Dear Colleague,

By Recommendation nº 3 of Commission IV at the General Assembly at The Hague you were appointed a member of a working party having the following terms of reference.

« The members will exchange records of atmospheric waveforms and information about the methods by which these have been obtained, and each will analyse them by his own method. The results of these analyses will be compared. If agreement can be reached about the meaning of the results a summarising report will be written. »

In November, 1954, I wrote to you suggesting how the exchange of waveforms might be made (*Inf. Bull.*, **88**, 21-29). I have now heard that Dr. Wormell has circulated waveforms to the other members of the working party, and that Dr. Horner and Dr. Rivault have decided that they are unable to co-operate because they no longer record waveforms.

In preparation for the meeting next year in the U.S.A. I shall be glad to hear what progress you have been able to make in this work, and in particular to have your answer to the following questions :

(1) Will you be able to circulate some waveforms to other members of the party, and if so, when ?

(2) Will you be able to analyse the waveforms sent to you by Dr. Wormell and let him have your results for comparison with his own ?

(3) Are you able to do any other work to add to the report of the working party ?

I shall be glad to have your reply to this letter as soon as possible, and at the latest by December 1st, 1956.

Yours sincerely,

(*s*) J. A. Ratcliffe,
Chairman
Cavendish Laboratory
Cambridge.

Commission VI
On Radio Wave sand Circuits

LETTER FROM THE PRESIDENT

October 4, 1956.

To : Chairmen, Commission VI of National Committees.

Dear Colleagues,

We should now start to direct attention to preparing for the XIIth General Assembly and I wish to submit some suggestions and thoughts on procedures for your consideration. You will recall that at the meeting in The Hague we gave considerable thought to definite the purposes of the General Assembly as related particularly to Commission VI and to the nature of technical sessions which could serve those purposes most effectively (Ref. Reports of Subcommissions and Working Parties, Proc. XIth General Assembly, vol. X, pt. 6). We were in general agreement that we should promote discussion type of sessions and minimize the formal reading of papers. To implement the procedure I propose the following :

1. *Preparation and Distribution of Papers.* — In the main all papers to be considered by Commission VI at the General Assembly shall be in the hands of the Secretary-General, Col. Herbays, by May 1. I should appreciate it if you would provide me and the vice-chairman, Mr. J. Loeb, with copies of all papers submitted to the Secretary-General and if you provide the chairman of the three Subcommissions with copies of those papers that are pertinent to their respective Subcommissions. The chairmen of the Subcommissions and Mr. Loeb and myself are to constitute a committee for detailed programming of the technical sessions. The May 1 deadline will give us just enough time to study the material and exchange our ideas by correspondence. I shall also explore ways and means of making copies of the papers for distribution among you well in advance of the General Assembly.

We shall of course be ready to accept and place on the agenda of the technical sessions any highly significant new developments in our fields of interest which become available after May 1.

2. *National Committee Reports.* — The National Committee Reports can be effective instruments of motivating an exchange of information which would provide a basis for evaluating the current status of a given field and delineating problems for future research. In the past the National Committee Reports have been essentially bibliographical in nature. It will be most helpful if the National Committee Reports go somewhat farther making a critical review of the contributions to a given field and in expressing the views of the National Committee on what its members consider to be the yet outstanding problems in the field. In particular, the National Committee Reports might evaluate the bearing of the contributions

made by scientists of their countries on the subjects proposed for study by the XIth General Assembly.

3. *Special Reports.* — I feel that review papers covering the fields of our Subcommissions are especially valuable and pertinent to the program of the General Assembly. I will welcome any special reports and critical comments that members may wish to submit on the topics outlined under « Proposals for Future Work » (Proc. of the XIth General Assembly, vol. X, pt. 6). I should appreciate it if the National Committees would encourage their members to participate in the program by preparing such reports. We are of course looking forward to such developments as may have been made by the special study groups set up at the XIth General Assembly.

I hope that we shall be able to have one session at least devoted to topics of common interest to the three Subcommissions. The National Committee Reports, if they provide the critical survey to which I referred earlier, would be appropriate topics for discussion at this session. In the accompanying letter from Dr. Sinclair concerning the program of Subcommission VI-3 there are two topics of interest to the Commission as a whole, the discussion of which might be initiated in the unified session. These topics are :

(*a*) The transition from Maxwell's equations to the limiting cases of geometrical optics on the one hand and circuit theory on the other.

(*b*) The design of antennas for trans-horizon communication.

Topic (*b*) derives its interest from recent developments in scatter propagation. The problems involved with respect to antennas seem to fall in area of microwave optics and information theory.

In addition, I wish to call your attention to the problem of interest to Commission IV and Commission VI (Proc. of XIth General Assembly, vol. X, pt. 6 ; Tech. Resolution, n° 5). I shall appreciate your giving attention to this topic and your sending me any material you have that bears on the subject.

Details of the Subcommission programs are being handled by the Chairmen of the Subcommissions. Professor van der Pol and Professor Tellegen have communicated with their Subcommissions on their respective plans. Professor Sinclair wrote to Subcommission VI-3 members some time ago. I am enclosing a recent second communication from Professor Sinclair pursuant to his program.

I trust that you will send me in the near future your comments on the foregoing suggestions and express your views as to the form and structure of our program. I very much appreciate your cooperation and kind help.

Sincerely yours,

(*s*) Samuel SILVER,
Chairman, Commission VI.

SUB-COMMISSION VI-3
ON ELECTROMAGNETIC THEORY
Letter to all National Committee

September 12, 1956.

Dear Mr. Chairman,

At the sessions of Commission VI at the XIth General Assembly held at The Hague, 1954, it was decided that further studies should be made of the following topics in the field of Sub-Commission VI-3 :

1. Study of the theory of broad-band antennas including the transition region in their design.
2. Further study of the transitions from Maxwell's equations to the limiting cases of geometrical optics on the one hand and circuit theory on the other.
3. Further study of guided waves including surface waves and the transmission through anisotropic media.

To the list I should like to add, because of the current interest in the topic, the following :

4. The design of antennas for trans-horizon communication.

Would you please inform me about any work on the above topics being carried out in your country. Papers on the above subjects are desired for the session of Sub-Commission VI-3 at the XIIth General Assembly to be held at Boulder, Colorado, U.S.A., in 1957.

Yours truly,

(*s*) George SINCLAIR,
Chairman, Sub Commission VI 3.
Department of Electrical Engineering
University of Toronto
Toronto 5, Ontario, Canada

Commission VII
On Radio Electronics

General Assembly

LETTER TO OFFICIAL MEMBERS OF THE COMMISSION

September 19, 1956.

Dear Col. Herbays,

On November 23, 1955, I wrote to you about the problems of organizing Commission VII for the General Assembly of the International Scientific Radio Union that is to take place at Boulder Colorado, in August and September of 1957 ([1]). At that time, I set up a timetable to guide our activities and in this letter I am happy to report that the organization is proceeding on schedule; perhaps even a little ahead of schedule.

To the best of my ability, I have interpreted your wishes in the choice of the topics to be discussed and in the matter of invitations to the outstanding authorities whom you selected to lead your discussions. The following is a list of topics and of the discussion leaders who have now agreed to act for us :

Topic	*Discussion Leader*
1. The Physics of the Cathode	Dr. L. S. Nergaard, R.C.A. Laboratories, Princeton, New Jersey, U.S.A.
2. The Physics of Semi-Conducting Devices for Radio Application	Dr. W. Shockley, Beckman Instruments Limited, Mountain View, Cal. U.S.A.
3. The Source and Nature of Noise in Electron Beams	Dr. A. Blanc-Lapierre, Professor, University of Algiers.

([1]) *Inf. Bull.*, **95**, 17 20.

4. Oscillation Phenomena in Gas Discharges — Dr. P. W. Allis, Department of Physics, Massachusetts Institute of Technology, Cambridge, U.S.A.

You will recall that we had planned that each discussion leader would deliver a one-hour paper, not a review of the subject although there will be necessarily some review involved, but rather a discussion of the up-to-the-minute problems and perhaps the problems not yet met. The rest of each meeting is to be taken up by discussion ; no formal papers will be delivered. Each of the discussion leaders named in the list has agreed to supply me with a condensation of his paper by May 1st, and I shall send copies of this to you shortly after I receive it. Further, each discussion leader has agreed to supply me with a full-length version of his address ; this will be duplicated and copies will be made available to you after the meeting is over. I have not asked them yet, but it may be that the discussion leaders would be willing to summarize the discussion at the end of each meeting ; about this point I shall let you know later.

Since two-thirds of each meeting is to consist of discussion from the floor, the success or failure of the meetings really depends on the Official Members of Commission VII. *Would you*, each in your own country, collect the recent results of research that bears on these four topics and *would you* organize it for presentation at the meeting ? *Would you* attempt to influence your National Chairman to select delegates to the Assembly who would be competent to discuss these topics in the Commission VII meetings ? I recognize that a great deal of work will be involved in these activities, but I believe that there will result considerable profit for all of us if some care is taken in organizing the discussions this winter.

During the next month or two, four chairmen must be found, one for each of the four meetings. During the coming winter they will have much to do in connection with the stimulation and coordination of discussions. As soon as you can, *would you* let me know the names of the delegates who will represent your country at the meetings of Commission VII. I shall ask the chairmen of meetings to write directly to you in the first place, but the list of names will give both them and me a chance to estimate the course that the discussions may take.

I shall write to you as soon as there is more information about the meeting.

Sincerely yours,

(*sgd*) G. A. WOONTON,
President,
The Eaton Electronics,
Research Laboratory
McGill University
Montreal, Canada.

REPORT OF COMMISSION VII
OF THE JAPANESE NATIONAL COMMITTEE

Main recent activities in the field of Radio Electronics in Japan will be reported in the following, under four subjects which will be chosen as topics of discussion as the next General Assembly.

1. — ELECTRON EMISSION
(T. MUTO)

Works carried out in the field of the research on electron emission are almost concerned with prolongation of the life of the oxide coated cathode and some new dispenser cathodes.

The life of the oxide coated cathode is by affected many factors such as evolved gases from tube parts, kind of the sleeve composition of oxide and the working temperature. But for such poison gases, the life of the cathode mainly depends upon the evaporation itself and also upon the growth of the interface layer. This interface layer is the result of chemical reaction of Ba and impurities which are introduced in the sleeve as the activator. It happens that these impurities sometimes make the life of the cathode rather short. To redress these obstacles, many investigations were done and it was clearified that it is necessary for the anode to be cleaned throughoutly, especially deposited Ba O layer on the anode as well as evolved gases must be perfectly removed. On the other-hand however cathodes at lower temperature are more sensitive to gas poisoning, the cathode temperature is desirable to be low as possible as we can from a standpoint of the long life. So it was ascertained that perfect degassing as well as suitable equipoise of the anode loss and the cathode temperature become quite important.

To measure the cathode temperature precisely, the spectral emissivity of the cathode surface was investigated and the relation between the spectral emissivity and cathode surface was clearified in several cases. The anode effect to the cathode temperature was too studied.

One of new types of the long life oxide coated cathode was proposed. This is composed of a thick Ba O base layer as supply source of free Ba and a thin ordinary (Ba-Sr) O layer near the surface. This cathode has a life of several times longer than conventional ones.

For the measurement of the interface layer resistance a convenient apparatus has been realized. By this apparatus the interface layer resistance can be measured from the difference of values of mutual conductance at different frequencies, and many items were clearified such as the relation between the interface layer resistance and silicon contents in the sleeve as well as falling nature of the mutual conductance in life, etc.

On the relation between the electron emission, the conduction and the noise of the oxide coated cathode, it was reported that Richardson plot the conduction current showed two straight line regions. The temperature dependence of the conduction current and the density of the former was a few times larger than that of the latter. The noise current accompanying the conduction current showed sharp increase when the conduction current saturated. This is owing to the disappearance of the space charge in the pore. On the growth mechanism of Flicker noise, it was reported that this noise must be certainly grown up from the fluctuation of the pore conduction in the cathode surface.

For the purpose of applying new dispenser cathodes such as L-cathode, the impregnetated cathode and the molded cathode to microwave tubes, investigations were made about the relation between the operating and manufacturing conditions. First it was confirmed that there was no appreciable difference between the pulsed and the d.d. emission even though the anode voltage had become as high as 1000-2000 V. Next some studies and developments were done on the effect of gases and the manufacturing condition, especially the method of manufacture of porous tungsten, welding of tungsten with molybdenum sleeve, etc. Other new cathodes such as W-Balium Silicate cathode and WC-Balium Silicate cathode were also studied and proposed. Moreover the ionic impact and gas contaminations of L cathode also were investigated in each case of hot and cold state. It is thought these are all of great promise.

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3. T. Imai. — Deterioration of Oxide Cathode by the evolution of Gas from Anode under Electron Bombardment. *Le Vide*, nº 55, p. 384, Jun. 1955.
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6. H. Kuroda. — The Effect of Evolved Gas from other Electrodes on the Emission of Oxide-Coated Cathode. *Al. Meet.* ([1]), April, 1955.
7. K. Takeya, T. Shirakawa, S. Takahashi. — The Effect of Positive Ion Bombardment on the Oxide Cathode. *Le Vide*, nºˢ 52-53, p. 116, Sept., 1954.
8. J. Nakai, S. Nakamura. — Surface Treatment of Core-metal used for Oxide-Coated Cathode. *J. Phys. Soc. Jap.*, vol. 10, p. 566, July, 1955.
9. Y. Nakamura, Y. Kato. — Production of a Smooth Surface of Oxide-Coated Cathode. *Al. Meet.*, Oct. 1954.
10. T. Yabumoto, S. Yoshida. — Flicker noise and Shot noise of Oxide-Coated Cathodes. *Meeting of the Inst. of E. Com. Eng. Japan*, Oct. 1955.
11. T. Muto, K. Amakasu, M. Takahashi. — On the Relation between Spectral Emissivity of Oxide-Coated Cathodes and Crystal Structures of Ba Sr CO^3, April 1955.
12. T. Okabe, E. Mori. — On the Resistance of the Interface layer of Oxide-Coated Cathodes. *Al. Meet.*, April 1955.
13. T. Hashimoto, M. Uchida. — Emission Characteristic of L Cathode. *Report of E.C.L. N.T.T.*, vol. 3, nº 4, p. 10, April 1955.

([1]) Abbreviation *Al. Meet.* : Allied great meeting of three institutes in the field of electrical engineering of Japan.

14. T. Hashimoto, M. Uchida. — Several Experiments on the Porous Tungsten Cathodes. *Al. Meet.*, Nov. 1954.

15. Y. Koike, T. Shibata. — Bariated Tungsten Emitter (W-Ba Silicate). *Al. Meet.*, Nov. 1954.

16. Y. Koike, T. Shibata. — Bariated Tungsten Emitter (WC-Ba Silicate). *Al. Meet.*, April 1955.

17. S. Fukagawa, H. Adachi. — On the Ionic Impact and Gas Contamination of L Cathode. *Le Vide*, nº 54, p. 273, Nov. 1954.

2. — Semiconductors

(K. Hatoyama)

The general feature of researches on semiconductors in Japan may be characterized by (1) more detailed studies of the mechanism of transistor action and (2) precise measurements of the bulk properties of germanium and other semiconductors, especially at low temperature and in high magnetic field.

(1) *Physics of transistors*

Kikuchi has studied the mechanism of current amplification in point contact transistors (1) and proposed to consider the effect of variation of β with I_e in the equation $\alpha = \alpha^* \beta \gamma$, where conventional notation is used. He also studied the pulse characteristics of reverse current in point contact rectifiers (2) and found the « step » phenomenon-sudden increase of current during a very short voltage pulse. He suggested that this step happens at the time when the density of holes exceeds a certain value n_h^o.

Esaki studied the oscillations which take place at the negative-resistance region of the reverse characteristics of point contact rectifiers (3), and found that high resistivity, short lifetime, and low injection rate are in favor of the occurrence of the oscillations.

Watanabe and Nishizawa studied the change in reverse characteristics of a point contact on Si, placed very close to a *p-n* junction. They observed an appreciable decrease in reverse current when a reverse bias voltage was applied to the junction. They attributed the effect to the minority carrier extraction.

Watanabe compared the electron avalanche in semiconductors with those in gaseous discharge, and estimated the effective pressure in semiconductors of the order of 10^{-4} mm Hg.

Iwase and others suggested (4) an improved method of measuring the lifetime of minority carriers in semiconductors which can also be applied to silicon.

(2) *Bulk properties of semiconductors*

The works by Fukuroi and others (5) on Ge, InSb and Te in high magnetic field and at low temperature should be mentioned. Anomalous effects in Hall and magnetoresistance phenomena were observed.

Sasaki observed the electromotive force induced when acoustical waves are sent through a germanium single crystal (6). The effect is rather complicated and cannot be compared with simple calculations by Parmenter.

Okazaki, Okada and others studied the properties of various intermetallic compounds (7), such as InBi, Bi^2Te^3, GeSe, SnTe HgSe, and CdTe.

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4. IWASE and others. — *Abst. Phys. Soc. Japan Mtg.*, Oct. 1955.
5. FUKUROI. — *Abst. Phys. Soc. Japan Mtg.*, Oct. 1955 ; KANAI. — *Journ. Phys. Soc. Japan*, 10, 1955, 165, 718 ; SASAKI, KANAI, unpublished.
6. SASAKI. — *Abst. Phys. Soc. Japan Mtg.*, Oct. 1955.
7. OKAZAKI, OKADA and others. — *Abst. Phys. Soc. Japan Mtg.*, April, Oct. 1955.

3. — MICROWE ELECTRONICS

(S. OKAMURA)

Microwave Triodes

Studies for the design and construction of a triode for 4000 Mc/s operation were carried out.

1. Y. NAKAMURA, T. MIWA, Y. HASEGAWA — International Congress of Microwaves Tubes at Paris, 1956.
2. Y. HASEGAWA. — *Annual Meeting of I.E.E. of Japan*, nº 655, April 1956.

Study on the input admittance of microwave triodes was continued, and a theory of the microwave-triode design was discussed.

3. N. Kato, T. Isobe, K. Imai. — *Annual Meeting of I.E.E. of Japan*, nº 704, April 1955.
4. T. Sekiguchi. — *Journal of the Faculty of Engineering*, University of Tokyo, vol. 24, nº 4, Nov. 1955.

Klystrons

Study on the electronic admittance of reflex klystrons was continued, and the effect of space charge was discussed. Cascade bunching in a three-cavity klystron was treated by the theory of space-charge wave.

5. E. Sugata, M. Terada, H. Hamada. — *Annual Meeting of I.E.E. of Japan*, nº 657, April 1956.
6. Y. Koike, S. Yamanaka, S. Ono. — *Annual Meeting of I.E.E. of Japan*, nº 656, April 1956.

A double beam-type klystrons-frequency-multiplier was developed.

7. S. Matsuo. — *Proc. I.R.E.*, vol. 44, p. 101, Jan. 1956.

A Osaka tube, which is a sort of the electron-oscillation tube and invented by K. Okabe, was developed for frequencies between 6000 and 10 000 Mc/s. Oscillation mechanism of this tube and the strophotron reported by Alvén was discussed.

8. S. Matsuo, K. Ebisuya. — *Annual Meeting of I.E.E. of Japan*, nº 659, April 1956.
9. M. Den, H. Nishikawa. — *Meeting of the Institute of Electrical Communication Engineers of Japan*, nº 134, Oct. 1955.

Travelling-Wave Tubes

Various types of new electron guns were studied for solid cylindrical beams, solid ribbon beams and hollow cylindrical beams.

10. Y. Nikaido, M. Kitaoka. — *Annual Meeting of I.E.E. of Japan* nº 646, April 1956.
11. K. Fujisawa, S. Kaneko, S. Inoue, T. Nonaka. — *Annual Meeting of I.E.E. of Japan*, nº 645, April 1956.
12. M. Nishimaki, Y. Asaba. — *Annual Meeting of I.E.E. of Japan*, nº 722, April 1955.
13. S. Uda, H. Sekimoto. — *Annual Meeting of I.E.E. of Japan*, nº 721, April 1955.

Theoretical study of an electron beam under periodic electric and magnetic fields was presented, and the possibility to improve the focusing action was described.

14. M. SUMI. — International Congress of Microwave Tubes at Paris, 1956.

A number of papers considered the theory of the operation and the design of the travelling-wave tubes. The improvement of efficiency, the suppression of oscillations and the impedance matching to waveguides were described.

15. J. KOYAMA. — *Electrical Communication Laboratories Technical Journal*, vol. 4, n° 1, Jan. 1955.
16. Y. MIZUKAGA. — *Annual Meeting of I.E.E. of Japan*, n° 650, April 1956.
17. J. HIRANO. — *Annual Meeting of I.E.E. of Japan*, n° 720, April 1955.
18. D. D. KOBAYASI, S. HAMADA. — *Meeting of the Institute of Electrical Communication Engineers of Japan*, n° 138, Oct. 1955.

A helix-type travelling-wave tube was built for the 24 000 Mc/s band.

19. T. MIWA, J. KOYAMA, M. MISHIMA, I. YANAOKA. — International Congress of Microwave Tubes at Paris, 1956.

The application of travelling-wave tubes to a three-fold reflex amplifier was proposed.

20. K. SAWAZAKI, T. HOMMA. — *Proc. I.R.E.*, vol. 44, n° 19, Jan. 1956.

A new-radio-link system using a travelling-wave tube as an amplifier and a local oscillator simultaneously was described.

21. M. MORITA, Y. KAITO. — *Tokyo Section Meeting of I.E.E. of Japan*, n° 499, Oct. 1954.

Magnetron

Existence of the strong back-heating in the preoscillating magnetron was found. The effect was attributed to the scattering of the electron in the dense space charge affected by the magnetic field.

22. Y. UASUOKA. — *J. of the Physical Society of Japan*, col. 10, n° 12, p. 1102, Dec. 1955.

A tunable frequency magnetron using an external cavity resonator, coupled directly to the anode and excited at TE_{01} mode, was studied for 7000 Mc/s band.

23. S. Okamura, H. Yanai, S. Tamiya. — *Annual Meeting of I.E.E. of Japan*, n° 656, April 1955.

Developments of pulsed magnetrons operating in the millimeter-wavelength band were reported.

24. M. Nishimaki, A. Oshimoto. — *Annual Meeting of I.E.E. of Japan*, n° 655, April 1955.
25. S. Aoi, S. Nakajima. — International Congress of Microwave Tubes at Paris, 1956.

4. — Gaseous Discharges

(Y. Asami and S. Kojima)

For a breakdown process, the streamer and Townsend mechanisms are generally accepted. The region of validity of these mechanisms was investigated from the measurement of formative time lag by Mori (1) and from the statistical study of electron avalanches by Kojima and Kato (2).

Honda and Naito (3) explained a silent electric discharge of an ozonizer by the streamer mechanism. Hasebe and Yamamoto (4) attempted an improvement of the breakdown criterion based on the streamer mechanism. Nagao (5) expressed an opinion on the development of electron avalanches in extremely large pl.

Honda (6) made some calculations on the breakdown potential of highly ionized gases and applied it to the re-ignition of TR-tubes. Takeda (7) studied on the afterglow of mercury vapour with the analogous method to the one by Biondi and Brown.

On high frequency discharges, Takeda (8) took into account the attachment action of electrons for the criterion of breakdown process. Mitani (9) studied the direct current associated with the microwave discharge in a coaxial cavity and explained it as a kind of double probes.

A discharge plasma often shows similar behaviour to a semiconductor. Hall effect in the plasma was found by Takayama, Suzuki and Yabumoto (10). Observed apparent Hall voltage was explained to consist of the electromotive force due to diffusion and the true Hall electromotive force.

Kojima, Takayama and Shimauchi (11) measured noises in a plasma in the frequency range between 1 Mc/s and 10 Mc/s.

Noises in arc discharges were studied by Takakura et al. (12).

They obtained the conclusion that the noise was caused by a plasma-ion oscillation. Noises due to corona discharges were observed by Shinohara et al. (13), on the Shin-Hokuriku main transmission line of 250 kV.

Some protections against radio interference were also attempted.

Probe methods were studied by several authors. Watanabe and Kobayashi (14) extended the Langmuir's probe theory to the region where collisions of electrons in the sheath around the probe could not be neglected. From the standpoint of this theory, they studied the breakdown process of ion-sheath.

Okuda and Yamamoto (15) discussed the disturbance of plasma due to the probe. Floating-double-probe method was developed by Yamamoto and Okuda (16) into a triple probe which was useful for the measurement of energy distribution in electrodeless discharges.

REFERENCE

1. T. Mori. — *J. Inst. E. E. Japan,* 75 (1955), 1165.
2. S. Kojima, K. Kato. — *J. Phys. Soc. Japan,* 11 (1956), 322.
3. K. Honda, Y. Naito. — *J. Phys. Soc. Japan,* 10 (1955), 1007.
4. T. Hasebe, K. Yamamoto. — *Phys. Rev.,* 99 (1955), 1331.
5. S. Nagao. — *J. Inst. E. E. Japan,* 75 (1955), 121.
6. K. Honda. — *Appl. Sci. Res.,* (Netherlands), 5 (1955), 47.
7. S. Takeda. — *Bull. Yokohama National Univ.,* 4 (1955), 51.
8. S. Takeda. — *J. Inst. E. E. Japan,* 75 (1955), 1469.
9. K. Mitani. — *J. Phys. Soc. Japan,* 10 (1955), 391.
10. K. Takayama, T. Suzuki, T. Yabumoto. — *Phys. Rev.,* 96 (1954), 531.
11. S. Kojima, K. Takayama, A. Shimauchi. — *J. Phys. Soc. Japan,* 9, (1954), 802.
12. T. Takakura, K. Baba, et al. — *J. Appl. Phys.,* 26 (1955), 185.
13. U. Shinohara, et al. — *J. Inst. E. E. Japan,* 75 (1955), 973.
14. Y. Watanabe, H. Kobayashi, K. Mitsui. — *Ibid.,* 1053.
15. T. Okuda, K. Yamamoto. — *J. Phys. Soc. Japan,* 11 (1956), 177.
16. K. Yamamoto, T. Okuda. — *J. Phys. Soc. Japan,* 11 (1956), 57.

IONOSPHERIC STATIONS

Manuel of Ionospheric Stations

We have published in *Information Bulletin*, n° 99 (p. 15) lists of stations on which information will be included in the Manual. We pursue this publication inviting our readers to inform us of any errors or omissions.

Stations carrying out backscatter observations

Adak

Banaras
Banff
Boulder

Fairbanks
Fort Monmouth
Fort Randolf

Gainesville

Hanover

Johannesburg

Knob Lake
Kootwijk

Lijcksele

Meanook

Narsarssuak
Natal

Okinawa

Pullman

St. Louis
San Francisco
Seattle
Sitka
Stockholm
Sydney

Thule
Tonanzintla

Stations carrying out radar meteor observations

Adelaide

Kazan

Manchester

Naknek

Odessa

Ottawa

Stalinabad

Stations carrying out radio auroral observations

Anchorage

Baker Lake
Barter Is.
Bellingham

Cold Bay

Discon Is.

Fairbanks
Fritz Peak
Front Royal

Invercargill
Ithaca

Kerguelen
Kootwijk

Macquarie Is.
Manchester
Mawson
Murmansk

Naknek

Odessa
Ottawa

Resolute Bay

St. Andrews
Saskatoon

Tromsoe

Vahsel Bay

Stations carrying out radio atmospherics measurements and observations

Accra
Aden
Akita
Aldergrove
Angmagssalik

Bagneux
Balboa
Banaras
Bangui
Bill
Bologna
Boulder
Brest
Bunia
Byrd Land

Calcutta
Camborne
Cambridge
Churchill
Colombo
Columbia
Cyprus

Darwin
Delhi
Dixon Is.
Dourbes
Dunstable
Durban

Elisabethville
Enköping

Falkland Is.
Fanning Is.
Flin Flon
Fort Amador
Front Royal

Godhavn

Halifax
Helsinki
Hemsby

Irvinestown
Ivato

Johannesburg

Kerguelen
Kiruna
Kumamoto

Léopoldville
Leuchars
Lund

Mabashi
Maui
Mayebashi

Mont Joly
Murmansk

Narsarssuak
Narssaq
Nederhorst den Berg

Oohira
Ottawa

Panska Ves
Poitiers
Poona

Port Stanley
Pruhonice

Rabat
Resolute Bay
Rio de Janeiro

Seagrove
Singapore
Slough

Tahiti
Tatsfield
Thule
Tortosa
Toyokawa
Trappes
Tromsoe
Tunis

Uppsala

Vahsel Bay
Vigna di Valle

Yakutsk

Stations carrying out observations and measurements on audio atmospherics (whistlers)

Anchorage

Battle Creek
Bermuda
Boulder
Brisbane

Cambridge

Dunedin

Fairbanks
Falkland Is.
Father Point

Gainesville
Godhavn

Hanover
Huancayo

Kerguelen
Key West

Knob Lake

Macquarie Is.

Nome

Ottawa

Poitiers
Port Lockroy

San Francisco
Seattle

Thule
Toyokawa

Unalaska

Washington
Weddell Sea
Wellington

Stations carrying out propagation experiments non included in the previous lists (oblique incidence, tides, etc.)

Baguio
Baker Lake

Cebu
Charlottesville

Churchill

Djibouti

Fort Randolph
Freiburg

Guantanamo

Hiraiso

Invercargill

Johannesburg

Kerguelen
Kiruna

Leidsendam
Lindau

Mayaguez

Okinawa
Ondrejov
Ottawa

Pointe Géologie
Pruhonice

Rabat
Resolute Bay

San Francisco

Tsumeb

Wellington
Winnipeg

ATMOSPHERICS STATIONS

Manual of Atmospherics Stations

2nd LIST

The first list published in *Bulletin*, nº 99, pp. 19-27, contained the following informations :

1. Geographical coordinates.
2. Geomagnetic coordinates.
3. Characteristics measured.
4. Type of apparatus.
5. Frequencies and bandwidths.
6. Other stations of the network.
7. Operating schedule.
8. Publication of results.
9. Responsible authority.
10. Date of report.

for the following stations :

Accra	Brest	Delhi
Aden	Brisbane	Dourbes
Angmassalik	Camborne	Dunedin
Bagneux	Chypre	Dunstable
Bangui	Colombo	Durban

In the following pages we are publishing information on :

Akita	Irvinestown	Leuchars
Churchill	Ivato	Maleashi
Falkland Is	Johannesburg	Mayebashi
Fanning Is	Kerguelen	Narssacq
Halifax	Kumamoto	Nederhorst den Berg
Hemsby	Léopoldville	Oohira

Akita

1. N 39°41′ E 140°06′.
2. 29.5° 205.4°.
3. Waveform and direction of atmospherics.
4. (*a*) Waveform recorder (portable);
   (*b*) Cathode-ray direction-finders (portable).
5. (*a*) 50 kc/s-300 kc/s.
   (*b*) 10 kc/s; bandwidth 300 c/s.
6. Toyokawa, Kumamoto.
7. For a week every season at:

0010-0013, 0910-0913, 1210-1213, 1510-1513, 2110-2113 JST
0020-0023, 0920-0923, 1220-1223, 1520-1523, 2120-2123 JST

8. Proceedings of the Research Institute of Atmospherics, Nagoya University.
9. Prof. A. Kimpara, The Research Institute of Atmospherics, Nagoya University, Ichida-cho, Toyokawa-shi, Aichi-ken, Japan.
10. July 1956.

Churchill, Manitoba

1. N 58°48′ W 94°06′.
2. +68.7° (1956) 322.9° (1956).
3. RMS amplitude averaged over 10 seconds converted to units of microvolts per metre for a 1.0 kc/s bandwidth.
4. Vertical whip antenna, preamplifier, fixed tuned radio frequency meter, receiver, squaring amplifier, average detector, logarithmic converter, recording milliameter.
5. 64 kc/s, bandwidth 1.5 kc/s.
6. Ottawa.
7. Continuous.
8. —
9. Defence Research Telecommunications Establishment, Defence Research Board, Shirley Bay, Ottawa, Ontario, Canada.
10. November 1956.

FALKLAND IS

1. S 51°42′ W 57°48′.

2. −40.4° 09.00°.

3. Field-strenght of slow-speed Morse signal giving 95 % intelligibility through the noise. Time of arrival and form of whistling atmospherics.

4. (*a*) Thomas equip. : vertical aerial (6 m), preampli. with 2-20 Mc/s filter, superhet. rec., signal gener., keying unit.

(*b*) L.F. equip. : vertical aerial (12 m), superhet. receiver (15-500 kc/s), electronically keyed signal gener.

On both equip., aural indication of level using headphones; manual operation.

(*c*) Whistler receiving equip. designed at Stanford Univ., U.S.A.

5. (*a*) 2.5, 5, 10, 15, 20 Mc/s, bandwidth 6 kc/s.

(*b*) 18, 30, 135, 220, 440 kc/s, bandwidth 300 c/s.

(*c*) 1-10 kc/s (wide band).

6. Whistler observ. in conjunction with a station in Bermuda, near the conjugate geomagn. point.

7. Every few hours at all frequencies subject to other commitments.

8.

9. D.S.I.R., Radio Research Station, Slough, Bucks., England.

10. March 1956.

FANNING IS

1. N 03°55′ W 159°23′.

2. +03.7′ 91.4° (W).

3. Field-strength of slow speed Morse signal giving 95 % intelligibility through the noise.

4. (*a*) Thomas equip. vertical aerial (6 m), preampli. with 2-20 Mc/s filter, superhet. receiver, signal generator, keying unit.

(*b*) L.F. equip. : vertical aerial (12 m), superhet. receiver (15-500 kc/s), electronically keyed signal generators.

On both equipments, aural indication of level using headphones; manual operation.

5. Equip. (*a*) : 2.5, 5, 10, 15, 20 Mc/s; bandwidth 6 kc/s.

Equip. (*b*) : 18, 30, 135, 220, 400 kc/s; bandwidth 300 c/s.

6. —

7. Hourly at HF from 1945-1951.

Similar programme will be carried out on both frequency bands.

8. 1945-1951 HF data in D.S.I.R. Special Report, nº 26, no further data yet available.

9. D.S.I.R. Radio Research Station, Slough, Bucks., England.

10. March 1956.

HALIFAX

1. N 44°36′ W 63°30′.

2. +56.0° E 7.1°.

3. Full recording of whistler waveform.

4. Vertical whip antenna, preamplifier, filters, main amplifier, clipper, magnetic tape recorder, timing and program control equipement.

5. 500 kc/s to 15 kc/s.

6. Ottawa, Saskatoon.

7. 2 minutes every hour, starting at 35 minutes past the hour.

8. —

9. Defence Research Telecommunications Establishment, Defence Research Board. Shirley Bay, Ottawa, Ontario, Canada.

10. November 1956.

HEMSBY

1. N 52°14′ E 1°41′.

2. 54.5° 86.1°.

3. Direction of arrival of atmospherics.

4. Twin channel cathode-ray direction finder, type RRO, Mark III.

5. 300 c/s bandwidth at 10 kc/s.

6. Dunstable (Plotting centre), Leuchars, Camborne, Irvinestown.

7. —10 to 00 min. at the following times :

April-Sept. : 0430, 0600 and hourly to 2100 U.T.

Oct.-March : 0600 hourly to 2100 U.T.

8. Circulated to Meteorological Organizations through Dunstable.

9. The Director, Meteorological Office M.O.12., Dunstable, Bedfordshire, England.

10. March 1956.

IRVINESTOWN

1. N 54°28 ½′ W 07°38′.

2. 58.5° 77.6°.

3. Direction of arrival of atmospherics.

4. Twin channel cathode ray direction-finder, type RRO, Mark III.

5. 300 c/s bandwidth at 10 kc/s.

6. Leuchars, Camborne, Hemsby, Dunstable (plotting centre).

7. —10 to 00 min. at the following times.
April-Sept. : 0430, 0600 and hourly to 2100 U.T.
Oct.-March : hourly from 0600 to 2100 U.T.

8. Circulated to Meteorological Organizations through Dunstable.

9. The Director, Meteorological Office M.O.12., Dunstable, Bedforshire, England.

10. April 1956.

IVATO (Madagascar)

1. S 18°55′ E 47°33′.

2.

3. Study of atmospherics propagation : recording of mean and quadratic field strength of atmospherics in microvolts/metre.

4. Recording receiver, photo-recorder.

5. 27 kc/s, bandwidth 1000 c/s, mean and quadratic field strength.
5 Mc/s, bandwidth 1000 c/s, mean field strength.

6. —

7. Continuous recording 00-24 hours.

8. Results communicated to L.N.R., Bagneux.

9. Laboratoire National de Radioélectricité, Département R.N., 196, rue de Paris, Bagneux (Seine), France.

10. Août 1956.

JOHANNESBURG

1. S 26°06′ E 27°55′.

2. —27° 90.9°.

3. Field-strength of slow-speed Morse signal giving 95 % intelligibility through the noise.

4. (*a*) Thomas equip. : vertical aerial (6 m), preamplif. with 2-20 Mc/s filter, superhet. receiver, signal generator, keying unit.

(*b*) L.F. equip. : vertical aerial (12 m), superhet. receiver (15-500 kc/s), electronically keyed signal generator.

On both equipments, aural indication of level using headphones, manual operation.

5. Equip. (*a*) : 2.5, 5, 10, 15, 20 Mc/s ; bandwidth 6 kc/s.

Equip. (*b*) : 18, 30, 135, 220, 400 kc/s ; bandwidth 300 c/s.

6. —

7. Measurements at 5 frequencies on both equipments, every hour at the hour, except 0000-0600 U.T.

8. Equip. (*a*) : Sept. 1949-Nov. 1951 : D.S.I.R., Special Report, n° 26 (Radio Research Board).

Nov. 1951 onwards : data available but unpublished.

9. D.S.I.R., Radio Research Station, Slough, Bucks, England.

10. March 1956.

KERGUELEN (Port aux Français)

1. S 49°21′ E 70°13′.

2. —57.2° (1956) 128.0° (1956).

3. Study on atmospherics propagation ; recording of mean level (maxwells/metre) of the mean and quadratic field strength (micro-volts/metre) ; Study of S.I.D. ; Study of whistling atmospherics ; Localisation of atmospherics centres.

4. Recording receivers, photo-recorder, magnetic tape recorder, narrow-beam direction-finder, cathodic-ray direction finder.

5. 27 kc/s, 5.3 kc/s.

6. Poitiers (whistling atmospherics) ; Bagneux (S.I.D. patrol).

7. Continuous recording, 0000-2400.

8. Results communicated to L.N.R., Bagneux.

9. Laboratoire National de Radioélectricité, Département R.N., 196, rue de Paris, Bagneux (Seine), France.

10. August 1956.

Kumamoto

1. N 32°56′ E 130°48′.

2. 22.5° 198.5°.

3. Waveform and direction of atmospherics.

4. (*a*) Waveform recorder (portable).
   (*b*) Cathode-ray direction-finders (portable).

5. (*a*) 50 kc/s-300 kc/s.
   (*b*) 10 kc/s ; bandwidth 300 c/s.

6. Toyokawa, Akita.

7. For a week every season at :
0010-0013, 0910-0913, 1210-1213, 1510-1513, 2110-2113 J.S.T.
0020-0023, 0920-0923, 1220-1223, 1520-1523, 2120-2123, J.S.T.

8. Proceedings of the Research Institute of Atmospherics, Nagoya University.

9. Prof. A. Kimpara, The Research Institute of Atmospherics, Nagoya University, Ichida-cho, Toyokawa-shi, Aichi-ken, Japan.

10. July 1956.

Léopoldville

1. S 04°22′ E 15°15′.

2. —03.2° (1956) 83.5° (1956).

3. (*a*) Direction of arrival of atmospherics.
   (*b*) Number of atmospherics per minute above a given level.
   (*c*) Maximum amplitude of received atmospherics.

4. (*a*) Lugeon radio-goniograph.
   (*b*) Lugeon atmoradiograph.
   (*c*) Lugeon radiomaximograph.

5. (*a*) 25 kc/s, bandwidth 10 kc/s.
   (*b*) and (*c*) 27 kc/s, bandwidth 3 kc/s.

6. —

7. Continuous operations.

8. —

9. Bureau de Géophysique, c/o Service Météorologique, Léopoldville, Belgian Congo.

10. July 1956.

LEUCHARS

1. N 56°23½′ W 02°52′.

2. 59.5° 84.2°.

3. Direction of arrival of atmospherics.

4. Twin channel cathode-ray direction-finder, type RRO, Mark III.

5. 300 c/s bandwidth at 10 kc/s.

6. Camborne, Hemsby, Irvinestown, Dunstable (Plotting centre).

7. —10 to 00 min. at the following times :

April to Sept. : 0430, 0600, hourly to 2100 U.T.

Oct. to March : 0600, hourly to 2100 U.T.

8. Circulated to Meteorological Organizations through Dunstable.

9. The Director, Meteorological Office, M.O. 12, Dunstable, Bedfordshire, England.

10. March 1956.

MABASHI

1. N 35°42′ E 139°40′.

2. 25.4° (1956) 205.5° (1956).

3. Strength of atmospheric noise in V.L.F. band.

4. Field intensity meter in V.L.F. band with following characteristics : gain : about 80 db ; time constant of detector : 80 sec ; recording speed : 2 cm/hour.

5. 2.5, 5 and 10 kc/s ; bandwith 200 c/s.

6. —

7. Continuous observations.

8. Special Report of the Meteorological Research Institute.

9. S. KITAGAWA, Meteorological Research Institute, Mabashi 4-499, Suginami-ku, Tokyo, Japan.

10. July 1956.

MAYEBASHI

1. N 36°24′ E 139°04′.

2. 26.0° 204.5°.

3. (*a*) Waveforms of atmospherics.
(*b*) Field-strength of atmospherics.
(*c*) Light intensity of lightning flashes.

4. (*a*) Waveform recorders.
(*b*) Field meter.
(*c*) Light intensity recorder of lightning flashes ; Boy's camera (low speed) ; chronophotograph for measuring light intensity of ligthning flashes ; high speed rotating camera (wide angle) for lightning flashes.

5. (*a*) 100 c/s-100 kc/s.

6. Toyokawa.

7. From the middle of July to the end of August, continuous operation during thunderstorms.

8. Proceedings of the Research Institute of Atmospherics, Nagoya University.

9. Prof. A. KIMPARA, The Research Institute of Atmospherics, Nagoya University, Ichida-cho, Toyokawa-shi, Aichi-ken, Japan.

10. July 1956.

NARSSAQ

1. N 60°54′ W 45°58′.

2. 71.0° 35.7°.

3. Atmospheric radio noise.

4. Noise measuring set according to Thomas with aerial amplifier as indicated by Horner.

5. 2.5, 5, 10, 15 and 20 Mc/s.

6. —

7. At intervals of one or two hours.

8. Through D.S.I.R., Radio Research Station, Slough.

9. Danish National Committee of U.R.S.I., c/o Prof. J. RYBNER, Royal Technology University, Oster Volgade 10 G., Copenhagen K, Denmark.

10. September 1956.

NEDERHORST DEN BERG

1. N 52°19′ E 05°05′.

2. 54.1° 89.4°.

3. Atmospherics flux.

4. Tuned crossed-loop aerial (SE and SW).

Tuned amplifier, detector and DC circuit, time constant circa 60 sec.

5. 25 kc/s ; bandwidth about 200 %.

7 kc/s.

6. —

7. 24 hours a day.

8. Monthly Bulletin (in cooperation with K.N.M.I. at De Bilt.)

9. Ir. A. H. DE VOOGT, Hoofdbestuur P.T.T., Kortenaerkade 11-12, Den Haag, Nederland.

10. August 1956.

OOHIRA

1. N 35°37′ E 140°30′.

2. 25.2° (1954) 204.9° (1945).

3. (*a*) Amplitude probability distribution and r.m.s. value of atmospheric noise in M.F. band.

(*b*) Probability distribution of absolute strength of atmospheric noise in H.F. band.

4. (*a*) Field-Intensity meter with amplitude probability distribution analyser by A. W. Sullivan's method. Gain about 120 db ; 6 m vertical rod antenna.

(*b*) Field-Intensity meter with amplitude probability distribution analyser in I.F. amplifier stage. Gain about 120 db ; noise figure, about 10 db, 2 m and 6 m vertical rod antenna ; time of observation 1 min.

5. (*a*) 525, 1605 kc/s, bandwidths 10 and 1 kc/s.

(*b*) 2.5, 5, 10 and 20 Mc/s; bandwidths 100 c/s, 500 c/s, 1 kc/s and 5 kc/s.

6. —

7. (*a*) Continuous observation.
(*b*) 5 observations on each frequency every two hours.

8. (*a*) N.H.K. Technical Journal.

9. (*a*) T. FUJITA, Technical Research Laboratory, Broadcasting Corporation of Japan, Kinuta-cho 361, Setagaya-ku, Tokyo, Japan.
(*b*) S. AMARI, Director, Radio Research Laboratories, Ministry of Postal Services, Kokubunji P.O., Kita-tama-gun, Tokyo, Japan.

10. July 1956.

C. C. I. R.

Change in the Direction

The VIIIth Plenary Assembly of the C.C.I.R. has chosen Dr. Ernst R. Metzler as Director of the C.C.I.R., with effect from 1st January, 1957, in succession to Prof. Dr. Balth. van der Pol who is retiring.

At the time when Prof. Dr. Balth. van der Pol is leaving the C.C.I.R. it should be recalled that he has been one of the most ardent promoters of the collaboration between the U.R.S.I. and the C.C.I.R. In this field Prof. Dr. van der Pol has given one more proof, which is expected not to be the last, of his attachment to our Union of which since more than thirty years he is one of the strongest supporters.

Dr. Metzler was the head of theradio services in the General Directorate of the Swiss P.T.T. He was born in 1900 and in 1929 entered the service of the Administration, in which he has had a brillant career. Apart from the important part which Dr. Metzler has played in the development of radio — and especially of broadcasting — in his country, he has been actively engaged in the field of international telecommunication. He has attended numerous I.T.U. conferences and has made important cohtributions to the work of C.C.I.R., particularly as chairman of the first Study Group (Transmitters). He has also been an active worker, since 1930, on the technical committees of European broadcasting organizations. More recently, his eminence as expert in the technique of radio transmitting station led to his being chosen as technical assistance expert to accomplish missions in Lebanon, in Libya and in Saudi Arabia, under the auspices of the I.T.U.

Announcement from the U.R.S.I. Committee for C.C.I.R. work

In view of the great importance of the collaboration between the U.R.S.I. and the C.C.I.R., is is felt that all measures should be taken to increase the speed and the efficiency of the valuable help which the U.R.S.I. renders the C.C.I.R. We have therefore asked the U.R.S.I. Secretary General to publish the following C.C.I.R. documents as soon as possible. This early publication bringing the questions to the attention of 'the U.R.S.I. national delegations and the individual scientists will thus enable them to have more time to study the matter in question than just during the time available during the U.R.S.I. General Assembly. We hope that by this early publication the efficiency of the U.R.S.I. help to the C.C.I.R. might be considerably increased.

Thank you.

(*sgd*) Dr. J. H. Dellinger, *Chairman*;
Prof. Dr. Balth. van der Pol;
Dr. R. L. Smith Rose;
Mr. B. Decaux.

VIIIth Plenary Assembly du C.C.I.R.

LIST OF C.C.I.R. FINDINGS OF INTEREST TO THE U.R.S.I.

(*a*) Findings on which U.R.S.I. Collaboration is requested

Doc. n°	*C.C.I.R. Finding*	*Subject*	Pages
		Commission I	
859	Recommendation 179	Standard Frequency Transmissions and Time Signals.......	50
		Commission II	
773	Study Programme 90 (V)	Tropospheric Wave Propagation	53
		Commission III	
*	Recommendation 59	Exchange of Information for the Preparation of Short-Term Forecasts and the Transmission of Ionospheric Disturbance Warnings	55

(*b*) FINDINGS OF POSSIBLE INTEREST TO U.R.S.I., ON WHICH COLLABORATION IS NOT REQUESTED

(a) FINDINGS ON WHICH U.R.S.I. COLLABORATION IS REQUESTED

Commission I

Doc. 859.

RECOMMENDATION N° 179 (1)

Standard frequency transmissions and time signals

(Question n° 140 (VII))

(Geneva, 1951 ; London, 1953 ; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that the International Administrative Radio Conference, Atlantic City, 1947, allocated frequency band 2.5 Mc/s ± 5 kc/s (2.5 Mc/s ± 2 kc/s in Region 1), 5 Mc/s ± 5 kc/s, 10 Mc/s ± 5 kc/s 15 Mc/s ± 10 kc/s, 20 Mc/s ± 10 kc/s, and 25 Mc/s ± 10 kc/s,

(1) This Recommendation replaces Recommendation n° 122 (*U.R.S.I. Inf. Bull.*, **86**, 15 21, July Aug. 1954). Accepted with a reserve by the B.I.H. on the numerical value given in par. 10.

and requested the C.C.I.R. to study the question of establishing and operating a worldwide standard frequency and time service;

(*b*) that the operation of 10 standard frequency and time signal stations, 4 of which were put into operation since the VIIth Plenary Assembly (London, 1953), has allowed collection of considerable data on their performance;

(*c*) that the usefulness of the standard frequency trasmissions would be improved appreciably when the exclusive bands allocated for the service are cleared from stations other than standard frequency stations, since the present standard frequency service is still experiencing interference from other services operating in the standard frequency bands;

recommends :

1. that a standard frequency transmission should comprise a standard carrier frequency, modulated by time signals and, if desired, by one or more standard audio frequencies;

2. that the standard audio frequencies should be chosen preferably from 440, 600, or 1000 c/s.

3. that the time signals should consist of impulses repeated at intervals of one second and maintained within 50 milliseconds of Universal Time, UT2 ([1]).

4. that these impulses should consist preferably of n cycles of 200 n c/s tone; where *n* is an integral number limited by the bands allocated for standard frequency transmissions and time signals;

5. that the first impulse of each munute be prolonged ao as to be easily identified;

6. that preferably the time signals should be transmitted without any other modulation for periods of 60 seconds or more and a total of at least 10 minutes per hour;

7. that each standard frequency station have a silent period of at least 4 minutes per hour;

8. that the frequencies transmitted should be accurate within ± 2 parts in 10^8;

([1]) Provisional Uniform Universal Time nº 2 as adopted by the I.A.U., Dublin, 1955.

9. that the time intervals transmitted should be accurate within ± 2 parts in $10^8 \pm 1$ microsecond ;

10. that the requirements of paragraphs 8 and 9 may be realized by direct or indirect reference to an atomic or monecular frequency standard, e. g., that based on the Cesium Fm $(4.0) \longleftrightarrow (3.0)$ resonance at zero field (9, 192, 631, 830 $\pm$ 10 c/s) ;

11. that each Administration should promptly publish :

the provisional measured values of frequencies and time signals for each day at a specified time or for each group of 5 days at a specified time,

the date, time and magnitude of adjustements to the time signals,

the date, time and magnitude of adjustements to the frequency which exceed one part in 10^9 per day ;

12. that each Administration should send the following to the Director of the C.C.I.R. for collation and distribution :

the final measured values of frequencies and time signals for each calendar year, the values being given for each group of 5 days at a specified time.

the date, time and magnitude of adjustements to the time signals,

the date, time and magnitude of adjustements to the frequency which exceed one part in 10^9 per day ;

13. that each Administration should coordinate with the Chairman and Vice-Chairman of Study Group VII, any new standard frequency broadcasts or any changes in existing standard frequency broadcasts ;

14. that each Administration should send all pertinent new information on standard frequency broadcasting stations to the Chairman and Vice-Chairman of Study Group VII for forwarding to the ITU Journal, for publication in that Journal ;

15. that no new standard frequency station, operating in the standard frequency bands, shall be notified to the I.F.R.B. until experimental investigations and co-ordination have been completed in accordance with Recommendation nº 2 to the C.C.I.R. of the Radio Regulations ;

16. that any standard frequency station operating within the framework of this Recommendation and found to be causing

harmful interference within the service areas of other established stations should eliminate such interference ;

17. that Administration which have not already done so should clear the bands exclusively allocated for Standard Frequency Broadscats and Time Signals according to the clearance programme proposed by the I.F.R.B. as soon as possible ;

18. that co-operation with the B.I.H. and the U.R.S.I. should continue.

Commission II

Doc. 773.

Study programme no 90 (V) [1]

Tropospheric wave propagation

(Geneva, 1951 ; London, 1953 ; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that widespread developments have taken place in the practical application of radio waves at frequencies above 30 Mc/s ;

(*b*) that the propagation of such waves is known to be a function of the thermodynamic conditions prevalent in the troposphere and that numerous relevant measurements have been made ;

(*c*) that, nevertheless, the detailled structure of the field in time and space is still insufficiently known ;

(*d*) that the propagation studies required for the establishment of a radio circuit necessitate a statistical knowledge of the propagation medium, that is, of the atmosphere ;

(*e*) that the lack of appropriate measurements makes it impossible as yet to verify the various theories put forward in explanation of radio-wave propagation ;

(*f*) that progress in the investigation of such propagation has already led to Recommendation no 111 ;

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(1) This Study Programme replaces Study Programme no 56 (*U.R.S.I. Inf. Bull.*, **86**, 29-30, July-Aug. 1954). It does not refer to any Question under study.

unanimously decides that the following studies should be carried out :

1. Efforts should be made to establish the correlation between the variations in the radio field strenght and the thermodynamic parameters of the atmosphere ;

2. Study of rapid variations in the radio field strength in time and space with a view to defining the different types of propagation ; the establishment of a correlation between these types of propagation and the different meteorological conditions ; the presentation of the results obtained should be on the lines described in Recommendation n° 170 and the relevent annex ;

3. The variations in the refractive index of air with space and time, whatever their cause, should be investigated in detail ; in particular, to facilitate calculation of this index, accurate thermodynamic and radio measurements, the latter by means of a refractometer or a similar device, should be made whenever possible (see Annex, paragraph 1) ;

4. The improvements in the instruments for measuring the small and rapid variations of the refractive index of the atmosphere, with special reference to the refractometer and a sensitive hygrometer with a low time constant ;

5. World-wide radio climatology shall be studied, and as a first step in this important work, the national telecommunication services, in agreement with the meteorological services concerned shall calculate for each season the mean gradient of the refractive index of the air, both for day and night, between ground and a height of 1000 metres, with a view to establishing world-wide iso-gradient charts (see Annex, paragraph 2) ;

6. Administrations and private operating agencies should be encouraged to verify, by means of a large number of accurate measurements, the various theories put forward in explanation of propagation beyond the radio horizon.

Notes :

1. National Administrations, U.R.S.I. and other international organizations should be encouraged to pursue as a matter of great urgency the theoretical and experimental study of the propagation of radio waves through the troposphere.

2. The above Study Programme should be brought to the attention of the W.M.O. by the Director of the C.C.I.R., with particular reference to paragraphs 4 and 5.

ANNEX

1. The thermodynamic measurements intended for the calculation of the refractive index of the air and its gradient should if possible, be made with an accuracy of :
Distance between 2 consecutive points of measurement : 10 metres.
Temperature : $\pm 0.2^{\circ}$ C.
Humidity (mixing ratio) ± 0.1 g.

Continuous measurement equipment should be used for preference.

2. To facilitate the preparation of results, the refractive index gradient for air shall be calculated by the difference between N measured at 1000 meters and at ground level,

with $N = (n - 1)\, 10^6 = \frac{77.6}{T}\, (p + 4810\, \frac{e}{T})$.

n = refractive index of air,
T = absolute temperature in degrees Kelvin,
e = water vapour pressure in *mb*,
p = atmospheric pressure in *mb*.

It is desirable that a description of the apparatus used and the method of operation should be provided.

The calculation should cover a period of 5 years, i. e. 1951-1955.

The numerous data furnished by the national meteorological services during the International Geophysical Year shall be published separately in so far as they are likely to provide additional information as compared with those for other years.

It shall be assumed that the seasons can be represented by the months of February, May, August, November, and that the hours of measurement shall be 0200 and 1400 U. T.

Commission III

RECOMMENDATION n° 59

Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings.

See *U.R.S.I. Inf. Bull.*, **86**, 31-33, July-Aug., 1954.

Doc. 908.

REPORT N° 62 (1)

Investigation of circularly polarized emitted waves propagated via the ionosphere

(Resolution n° 14)

(Warsaw, 1956)

1. In accordance with Resolution n° 14 of London, the U.R.S.I. has informed the C.C.I.R.(Warsaw Doc. n° 89) that this subject is under active study in the Netherlands and the United States of America. Accordingly Resolution n° 14 has served its purpose and may be deleted.

2. A contribution from the Netherlands on the subject of the measurement of the polarization of radio waves reflected by the ionosphere has been received by the C.C.I.R. (Warsaw Doc. n° 256).

3. Further consideration of this subject by the C.C.I.R. should depend on the nature of the results of investigations now in progress by U.R.S.I.

Doc. 957.

RESOLUTION N° 26

Ionospheric sounding stations after the I.G.I.

(Warsaw, 1956)

The C.C.I.R.,

considering :

that at the termination of the International Geophysical Year a favorable opportunity will occur for the establishment of an improved worldwide network of permanent ionospheric sounding stations ;

unanimously resolves :

that the attention of U.R.S.I. should be drawn to the desirability of a recommendation concerning the continuation of certain of the more useful ionospheric sounding stations after the I.G.Y. for the purpose of making propagation forecasts.

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(1) This Report was unanimously adopted. It replaces Resolution n° 14 (*U.R.S.I. Inf. Bull.*, **86**, 43 44, July-Aug. 1954).

Doc. 975.

RESOLUTION Nº 27 (1)

Non-linear effects in the ionosphere

(Warsaw, 1956)

The C.C.I.R.,

unanimously resolves :

That the U.R.S.I. be invited to inform the C.C.I.R. of any results from experiments and theoretical studies still continuing on the subject of ionospheric cross-modulation which may have important practical applications.

STUDY PROGRAMME Nº 60 (VI)

Basic prediction information for ionospheric propagation

See *U.R.S.I.Inf. Bull.*, **86**, 46-48, July-Aug., 1954.

STUDY PROGRAMME Nº 63 (VI)

Radio propagation at frequencies below 1500 *kc/s*

See *U.R.S.I. Inf. Bull.*, **86**, 49-50, July-Aug., 1954.

STUDY PROGRAMME Nº 66 (VI)

Study of fading

See *U.R.S.I.*, *Inf. Bull.*, **86**, 49-50, July-Aug., 1954.

Doc. 679.

STUDY PROGRAMME Nº 92 (VI)

Choice of a basic index for ionospheric propagation

Modification (2) to Study Programme nº 58 (3)

The word « solar » should be delected in the title of Study Programme nº 58.

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(1) This Resolution replaces Study Programme nº 61 (*U.R.S.I. Inf. Bull.*, **86**, 48-49, July-Aug. 1954).

(2) Unanimously adopted.

(3) *U.R.S.I. Inf. Bull.*, **86**, 44-45, July-Aug. 1954.

Doc. 677.

Study Programme n° 93 (VI) [1]

Identification of precursors indicative of short-term variations of ionospheric propagation conditions

(London, 1953 ; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that it is desirable to have an index or indices suitable for short-term forecasts of ionospheric disturbances ;

(*b*) that long-term indices for ionospheric propagation may not be satisfactory for indicating short-term variations in the ionosphere ;

(*c*) that ionospheric propagation disturbances may result from either corpuscular or electromagnetic radiation from the sun ;

(*d*) that a correlation has been found [2] between short-term variations of ionospheric propagation conditions and certain indices of both magnetic phenomena and solar eruptions ;

unanimously decides that the following study should be carried out :

The possibility of selecting particular hinds of solar observations, or observations of other phenomena, which can be made objectively, and which may be usefully employed for short-term predictions of ionospheric propagation conditions.

Note : This Study Programme should be brought to the attention of the U.R.S.I. by the Director of the C.C.I.R., with a view to encouraging U.R.S.I. to expedite its work bearing on these studies. U.R.S.I. should be requested to inform the C.C.I.R. of the results of its study.

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(1) This Study Programme replaces Study Programme n° 59 (*U.R.S.I. Inf. Bull.*, **86**, 45-46, July-Aug. 1954). It does not refer to any Question under study.

(2) See Warsaw Doc. 78, 79, 123, 124 and 347.

Doc. 934.

STUDY PROGRAMME N° 97 (VI) (1)

Pulse trasmission tests at oblique incidence

(Geneva, 1951; London, 1953; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that the study of many problems in ionospheric propagation of direct concern to C.C.I.R. can be greatly aided by the use of fixed frequency pulse transmissions;

(*b*) that these problems include :

— the nature of fading,
— the assessment of ionospheric absorption,
— the investigation of transmission modes,
— the measurement of group delay times,
— the polarization and direction of arrival in azimuth and elevation of ionospherically reflected waves,
— the consequences of magnetic-ionic double refraction,
— the relation of the vertical incidence critical frequencies to the oblique incidence classical MUF,
— the causes of propagation above the classical MUF.

(*c*) that where high power is needed for such pulse transmissions use might be made of commercial trasmitters;

(*d*) that at least for short and medium distances where the individual modes can be separated much additional information can be obtained by using sweep-frequency pulse transmissions;

(*e*) that such transmissions involve difficult technical problems of synchronisation and display at the receiver;

unanimously decides that the following studies be carried out :

1. The characteristics of long distance ionospheric propagation by the use of fixed frequency and sweep frequency pulse trans-

(1) This Study Programme partially replaces Study Programme n° 67 (*U.R.S.I. Inf. Bull.*, **86**, 52 53, July Aug. 1954). It does not refer to any Question under study.

missions, using commercial transmitters if practicable where high power is needed on fixed frequencies.

2. The making of ionospheric vertical incidence soundings at points along the transmission path, in particular as near to the terminal points and the mid-point as possible.

3. The continued development of the techniques required in connection with the display used at the receiver and its synchronization with the transmitter.

Note : The above Study Programme should be brought to the attention of the U.R.S.I. by the Director of C.C.I.R. with a view to encouraging that organisation to expedite its work bearing on these studies, requesting the U.R.S.I. to inform the C.C.I.R. of the results of its study.

Doc. 954.

STUDY PROGRAMME N° 98 (VI) (1)

Back-scattering

(Geneva, 1951 ; London, 1953 ; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that back-scatter phenomena yield direct information at the trasmitting station of the performance of the frequency used ;

(*b*) that back-scatter phenomena reveal an increase of the MUF above the value calculated from vertical incidence tests and produce signals within the classical skip-distance ;

(*c*) that back-scatter measurements can partly replace oblique incidence pulse tests ; (Compare Study Programme n° 97 (VI)).

unanimously decides that the following studies should be carried out :

1. Discrimination between various back-scatter modes (Ground-scatter, E-scatter, etc.) ;

2. the use of back-scattering to supplement the information obtainable by oblique incidence pulse transmissions ;

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(1) This Study Programme partly replaces Study Programme n° 67 (*U.R.S.I. Inf. Bull.*, **86**, 52-53, July-Aug. 1954). It does not refer to any Question under study.

3. field-strength measurements to determine the back-scattering coefficient as a function of frequency, the nature of the scattering surface and the angle of incidence at the scattering surface ;

4. determination of the incident field at the scattering zone from the back-scattering coefficient as derived from the field-strength measurements made near the transmitting site ;

5. study by back-scattering of sporadic-E formation and movement ;

6. determination from back-scattering measurements of actual propagation conditions ;

7. determination of effective antenna diagrams at large distances by means of back-scattering.

Note : The above Study Programme should be brought to the notice of U.R.S.I. by the Director of the C.C.I.R. with a view to encouraging that organization to expedite its work bearing on these studies requesting the U.R.S.I. to inform the C.C.I.R. of the results of its studies.

Doc. 946.

STUDY PROGRAMME Nº 99 (VI) (1)

Estimation of sky-wave field strengths on frequencies above 1500 *kc/s*

(Geneva, 1951 ; London, 1953 ; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that the estimation of sky-wave field strengths on frequencies above 1500 kc/s is of great importance in the planning of high frequency long-distance radio-communications ;

(*b*) that the similar problem for short distances up to 800 km is of special importance in tropical broadcasting ;

(*c*) that such estimates depend upon a knowledge of ionospheric absorption ;

(*d*) that this absorption is a more complicated function of local

(1) This Programme replaces Recommendation nº 115 (*U.R.S.I. Inf. Bull.*, **86**, 33-34, July-Aug. 1954). It does not refer to any Question under study

time, season and geomagnetic latitude than is usually assumed in making field strength estimates;

(*e*) that in this connection the E layer often has a complicated structure and there is considerable night-time absorption in certain tropical regions;

(*f*) that the mechanism of long-distance ionospheric propagation is not yet fully understood;

unanimously decides that the following studies should be carried out :

1. the making of absorption measurements in as many parts of the world as possible with a view to improving the basic data embodied in methods for estimating sky-wave field strengths on frequencies above 1500 kc/s;

2. the improvement of such methods to take more account of the earth's magnetic field especially near the magnetic equator and in regions of abnormally high absorption;

3. the possibility of deciding on the method most adapted to the needs of tropical broadcasting and taking into account the special conditions existing in low geomagnetic latitudes;

4. the further examination of the theoretical basis of long-distance ionospheric propagation with regard to the possible modification of the methods of field strength estimation.

Note : All organizations participating in these studies should collaborate and exchange information among themselves and with the U.R.S.I.

Doc. 839.

Commission IV

STUDY PROGRAMME n° 96 (VI) (1)

Measurement of atmospheric radio noise

(Geneva, 1951; London, 1953; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that there is a continuing need for more information regarding atmospheric noise and its influence on radio systems, parti-

(1) This Study Programme replaces Study Programme n° 65 (*U.R.S.I. Inf. Bull.*, **86**, 58-59, July-Aug. 1956). It does not refer to any Question under study.

cularly to provide data for further revisions of the noise curves and charts which have been prepared for the C.C.I.R. ;

(*b*) that there is still no generally adopted objective method of measuring atmospheric noise ;

(*c*) that the aims of Study Programme nº 65 have only partly been achieved ;

unanimously decides that the following studies should be carried out :

1. the setting up of a worldwide network of stations for measuring atmospheric noise and for locating its sources ;

2. the establishment of a direct comparison between objective and subjective methods of noise measurement (including the Thomas method) for the various classes of emission so as to choose the most suitable methods of measurement for the future ;

3. extension of facilities (e. g. narrow-sector and cathode-ray direction finders) for locating thunderstorm centres and for the comparison of the results of observations at various frequencies within the spectrum of atmospherics ;

4. the experimental and theoretical determination of the characteristics of atmospherics noise, and in particular its statistical properties ;

5. the choice of a method of statistical presentation of atmospheric noise data that can be subsequently recommended ;

6. the investigation of the relative importance of atmospheric noise as compared with other types of noise as a limiting factor in radio communication.

Notes :

1. The studies mentioned in this programme should be carried out in close collaboration with the World Meteorological Organization.
2. the above Study Programme should also be brought to the attention of the U.R.S.I. by the Director of C.C.I.R. with a view to encouraging that organization to expedite its work bearing on these studies, requesting the U.R.S.I. to inform the C.C.I.R. of the results of its study.

Commission V

Doc. 805.

RECOMMENDATION N° 173 [1]

Protection of frequencies used for radio astronomical measurements

(London, 1953; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that protection from interference in radio astronomical measurements is required;

(*b*) that for the observation of known spectral lines certain bands at specific frequencies are of particular importance;

(*c*) that account should be taken of the Doppler shifts of the lines resulting from the motion of the sources which are in general receding from the observer;

(*d*) that for other types of radio astronomical observations a certain number of frequency bands are in use, the exact positions of which in the spectrum are not of critical importance;

(*e*) that a considerable degree of protection can be achieved by appropriate frequency assignments on a national rather than on an international basis;

(*f*) that, nevertheless, it may be impracticable to afford such protection in or near populous or industrial regions;

unanimously recommends :

1. that radio astronomers should be encouraged to choose sites as free as possible from interference;

2. that administrations should afford all practicable protection from interference to radio astronomical measurements in general, but give particular attention to the protection of observations of line emissions known or thought to occur in the following bands;

Line	Line frequency (Mc/s)	Band to be protected (Mc/s)
Deuterium	327.4	322- 329
Hydrogen	1420.4	1400-1675
OH	1667	1645-1675

[1] This Recommendation replaces Recommendation n° 118 (*U.R.S.I. Inf. Bull.*, **86**, 59-60, July-Aug. 1954).

3. that Administrations, in seeking to afford protection to particular radio astronomical observations, should attempt to limit harmonic radiations falling in the bands indicated above.

Notes :

1. Administrations might consider the dual advantage to radio-astronomy of reserving or otherwise protecting the second and third subharmonics (1/2 and 1/3) of the line-frequency bands which could then be used for other radio astronomical purposes.
2. The Director of the C.C.I.R. should communicate this Recommendation to U.R.S.I.

Commission VI

Doc. 834.

Report no 46 (1)

Temporal variations of ground-wave field strengths

(Study Programme no 52)

(Warsaw, 1956)

Contributions to this study which were submitted to the VIIIth Plenary Assembly, Warsaw 1956, are summarized below :

Doc. no 24 (Federal German Republic) deals with a series of measurements made to observe the temporal variations of the field strength of various medium frequency broadcast transmitters and to observe also the actual variations of the effective electrical constants of the soil. It was concluded that the observed field variations were not caused by variations in effective soil constants since, seasonally, a period of high field values (in winter) occurred at the same time as low values of the soil constants were observed and vice versa. Some preliminary correlation between the variations of the soil constants and the level of subterranean water, was however obtained.

Doc. no 140 (United Kingdom) confirms previous observations which showed high values of field strength in winter months and

(1) This Report was unanimously adopted. It replaces Report no 20 and completes the work in Study Programme no 52.

correspondingly low values during summer months. It is concluded that although changes of conductivity of the soil and absorbtion due to vegetation could both account for the effects observed, the latter is the more probable explanation.

Doc. nº 182 (France) refers also to measurements reported in Doc. nº 196 (France) which were made over a sea path. The field was found to remain constant within a range of 6 db and showed no seasonal trend.

Doc. nº 220 (F. P. R. of Yugoslavia) presents a discussion on the effect of temperature variations on the soil conductivity and the field strength.

Doc. nº 274 (Netherlands) makes two brief references to the temporal variation effect. It was observed (at VHF) that field strengths in winter were 1 to 2 db higher than in summer over medium distances and that the presence of leaves in summertime increased the absorbtion.

However, it is suggested, that a study of the phenomenon should be made by U.R.S.I. and its findings reported to the C.C.I.R.

Note : The above Report should be brought to the attention of the U.R.S.I. by the Director of the C.C.I.R. with a view to encouraging that organization to expedite its work bearing on these studies, requesting the U.R.S.I. to inform the C.C.I.R. of the results of its study.

Doc. 937.

Question nº 125 (II) (1)

The usable sensitivity of radio receivers in the presence of quasi-impulsive interference

(London, 1953; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that many types of interference — e. g. from atmospheric phenomena, ignition systems and electrical equipment — cannot

(1) This Question replaces Question nº 79.

be considered as either random noise or as simple isolated impulses but may be regarded as « quasi-impulsive ».

(*b*) that while the usable sensitivity of a receiver may be limited in some cases by the internal noise of the receiver (c. f. noise limited maximum usable sensitivity, Rec. nº 154), in other cases it may be limited by external quasi-impulsive interference and that it is desirable to have a standard method of measurement for this sensitivity ;

(*c*) that this type of maximum usable sensitivity should be determined as the maximum input signal (expressed as the E. M. F. of the unmodulated carrier) which must be applied in series with the specified source impedance to the input of the receiver in order to obtain, at the output, the signal level and the signal to quasi-impulsive interference ratio necessary for normal operation, when the normal degree of modulation is applied to the carrier, (this should be done for stated values of quasi-impulsive interference applied to the input) and that the maximum usable sensitivity as defined above should be described as « impulse-limited ».

(*d*) that means for expressing mathematically the essential characteristics of quasi-impulsive interference and the development of pulse generators representing the effects of quasi-impulsive interference may be desirable, e. g. for facilitating theorical as well as practical studies of the response of receivers to such interference ;

(*e*) that representative values for the response of receivers to quasi-impulsive interference are necessary for system planning purposes, and that data on the values of quasi-impulsive interference permissible in normal operation are required ;

unanimously decides that the following question should be studied :

1. In what radio services, other than sound broadcast and television, is the usable sensitivity of receivers limited by quasi-impulsive interference ?

2. It is possible to calculate approximately the response of receivers to quasi-impulsive interference from a simple mathematical model ? If so what parameters of quasi-impulsive interference are of the greatest importance for this calculation ?

3. Is it possible to substitute a pulse generator (e. g. generating a Poisson distribution of pulses of equal form at a controllable average rate and with a controllable amplitude distribution) at the input of the receiver, for a source of interference, and in this way to simulate with good approximation the effect of quasi-impulsive interference ?

4. What are the methods of measuring and the most useful definitions of the response of receivers to quasi-impulsive interference, taking into account any non-lineal effecte that may occur in practice ?

5. What is the amount of quasi-impulsive interference permissible in normal operation for a given signal level ?

6. What are representative figures for the impulse-limited sensitivity of receivers ?

Notes :

1. The above question should be brought to the attention of the U.R.S.I. by the Director of C.C.I.R. with a view to encouraging that organisation to expedite its work bearing on these studies, requesting the U.R.S.I. to inform the C.C.I.R. of the results of this study.
2. It is considered that the information obtained as an answer to questions 1, 5 and 6 should be communicated as soon as possible to the C.I.S.P.R.

Doc. 770.

Question nº 137 (V) [1]

Measurement of field strength in the neighbourhood of obstacles

(London, 1953 ; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that the electromagnetic field in the neighbourhood of obstacles may differ considerably from that which would be present in the absence of such obstacles ;

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[1] This Question replaces Question nº 86.

(*b*) that a knowledge of the value of the undisturbed field is of importance on theoretical and practical investigations ;

(*c*) that, however, at present there are no general methods for predicting the exact quantitative effect of obstacles on this undisturbed field ;

unanimously decides that the following question should be studied :

What general criteria must be satisfied so that the effect of obstacles may be neglected, these criteria being expressed in terms of the physical properties of the obstacle, the distance of these obstacles from the measuring point, the wavelength or any other relevant parameter ?

Note : The above Question should be brought to the attention of the U.R.S.I. by the Director of the C.C.I.R.

Doc. 888.

Study Programme n° 86 (III) (1)

Communication theory

(Question n° 133 (III))

(Geneva, 1951 ; London, 1953 ; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that in view of the increasing congestion of the radio spectrum and telecommunication circuits, it would be advantageous to discover technical methods of decreasing the bandwidth, the trasmission time of a given quantity of information, or the trasmitted power ;

(*b*) that present studies seek mainly to perfect established systems whereas recent theories seem to show that these systems occupy several times the bandwidths strictly necessary for the transmission of the required information at the required speed ;

(*c*) that even with existing systems, it is not possible to reduce the bandwidth to that strictly necessary because of unpredictable

(1) This Study Programme replaces Study Programme n° 47 (*U.R.S.I. Inf. Bull.*, **86**, 61-63, July-Aug. 1954).

noise, natural and man-made interference, and complex propagation conditions ; a margin of bandwidth is necessary to decrease distortion and the frequency of errors due to these phenomena ;

(*d*) that it is not certain that existing codes, at least some of which were not designed in the light of phenomena peculiar to radio propagation, are making the best use of the occupied bandwidth ;

(*e*) that a systematic study of methods such as referred to in para. *a*), can be made by generalizing the procedures in use for certain transmission systems or by applying the results of the general theory of communication to specific practical cases :

unanimously decides that the following studies should be carried out :

1. The review of the various codes in use and the study of new codes leading to an economy of bandwidth or transmission time for a given quantity of information preserving a given quality of transmission, taking into account the phenomena peculiar to radio propagation and the comparison of the various existing systems of modulation from the point of view of the bandwidth occupied versus the amount of information trasmitted in a given time for a given power (1).

2. The study in conjunction with U.R.S.I. of the methods of communication theory, that are best suited for practical application.

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(1) Relative to this study, it is useful to consider, in the case of radio telephony, the determination of the relation between intelligibility and the shape and width of the passband of the receiver for signal-to-noise ratios, consistent with :

— just usable quality, operator to operator,
— marginally commercial quality,
— good commercial quality,

taking into account that :

1. in many cases the noise power is distributed uniformly over the audio frequency spectrum, while speech power is distributed unevenly in the spectrum ;
2. when high noise levels are present in the communication system, and the signal to noise ratio is constant, the intelligibility might show a maximum as a function of the bandwidth and the distribution of the power corresponding to the frequencies it contains. This distribution of the power may vary with fading.

(b) FINDINGS OF POSSIBLE INTEREST TO U.R.S.I., ON WHICH COLLABORATION IS NOT REQUESTED

Commission III

Doc. 922.

REVISION OF REPORT N° 7

REPORT N° 54 (1)

Long distances propagation of waves of 30 to 300 Mc/s by way of ionization in the E and F regions of the ionosphere

(Question n° 7, Section 3)

(Geneva, 1951 ; Warsaw, 1956)

Add at the end of paragraph III-3 the following text :

In connection with transmission by regular layers, attention is drawn to the possibility of long-distance transmission on frequencies well above the classical MUF by the mechanism described in Doc. n° 122 (Czechoslavakia) of Warsaw, whereby the wave can remain for a considerable distance between an upper and lower level in a single ionospheric layer.

Doc. 678.

REPORT N° 57 (2)

Choice of a basic index for ionospheric propagation

(Study Programme n° 58 (VI))

(London, 1953 ; Warsaw, 1956)

1. *What are the desirable characteristics of a solar index which render it most applicable to ionospheric propagation* ?

A satisfactory index based on solar measurements must be related simply to some index of ionospheric ionisation from which seasonal and diurnal cyclic effect have been removed. It is also desirable that the correlation coefficient between corresponding pairs of the solar and ionospheric indices should be high, although

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(1) This Report was unanimously adopted. It replaces Report n° 7 (*U.R.S.I. Inf. Bull.*, **86**, 35-39, July-Aug. 1954).

(2) This Report was unanimously adopted. It replaces Report n° 25.

this is difficult to achieve on a daily or three hourly basis owing to the varying time lag between the solar and related ionospheric disturbances.

In addition, it is desirable that the solar index should permit short term forecast of changes in propagation conditions to be made.

The index should preferably refer to a property of the sun, such as radiation flux, which has direct physical relationship to the ionosphere.

The index should be measurable objectively.

As far as short term variations are concerned, it should be borne in mind that some of the short preiod variations in ionospheric conditions are the result of complicated dynamical phenomena taking place in the upper atmosphere. A solar index, therefore, which can only reflect conditions taking place in the sun itself cannot portray quantitatively variations of ionospheric conditions over periods shorter than the minimum over which these dynamical effects are averaged out.

2. *What solar phenomena which can be observed in sufficiently objective manner, will provide a more useful index of activity for application to ionospheric propagation than relative sunspot numbers ?*

Solar phenomena which are useful as indices of activity for application to ionospheric propagation, may be divided into two groups :

(*a*) Solar phenomena which can be observed by optical methods ;

(*b*) Solar phenomena which can be observed on radio frequencies.

For group (*a*) the total area of hydrogen or calcium flocculi or the total intensities of Hα or other emission lines can be measured objectively. The total area of hydrogen or calcium flocculi appear to be slightly better correlated with ionsopheric conditions than the sunspot number. On the other hand, such spectroscopic observations require better conditions of visibility than sunspot observations. This limits to some extent the availability of uo-to-date data.

The total intensity of emissions lines has not yet provided a useful index.

As far as is known at present, none of the solar phenomena mentioned above can be used as an index of short term variations of ionospheric propagation conditions.

As far as group (*b*) is concerned, an index of solar activity based on radio frequency observations, although it has been the object of several important researches, cannot be considered as perfectly defined at present. However, it has been shown recently that the intensity of solar radiation on 3000 Mc/s is a linear function closely linked with the area of spots visible on the sun and that a close correlation exists between the intensity of solar radiation on metric waves and the appearance of groups of active sunspots.

3. *What ionospheric characteristics which can be determined in a sufficiently objective manner, whenever observed, may be usefully employed as a basic index for ionospheric propagation* ?

No agreement has yet been reached as to what ionospheric characteristic might be most usefully employed as a basic index for ionospheric propagation. There is hope, however, that even where it is not possible to construct an index based on an exact knowledge of the mechanism of formation of the ionospheric layers, it may still be possible to derive an index based on empirical relations.

Until further knowledge is available one of the following might be considered for use as an ionospheric index :

(*a*) Region character figure of the E and F1 layer respectively :

$$A_E = \frac{(fo\text{E})^4}{\cos\chi} \text{ is proportional to } \frac{I_E}{\alpha E}$$

$$A_{F1} = \frac{(fo\text{F1})^4}{\cos\chi} \text{ is proportional to } \frac{I_{F1}}{\alpha F1}$$

where :

A = region character figure

fo = critical frequency

χ = zenith angle of the sun

I = intrinsic intensity of ionising radiation

α = effective recombination coefficient of E and F1 layer respectively.

The regular E and F1 layers are observable only in the daylight hours and are not sufficiently sensitive to disturbances to yield character figure of great significance.

(*b*) Smoothed values of the critical frequency of F2 layer.

Changes in *fo*F2 cannot be simply related to cosχ as for *fo*E and *fo*F1. For various reasons it is desirable to use noon values of *fo*F2, or the mean of a group of hours centred on noon, and to average out daily fluctuations by computing the monthly mean. Having eliminated daily changes in this way, the removal of seasonal changes may be achieved by several methods :

b.1. The simplest procedure is to compute the 12-month running mean of the monthly values. This not only removes the annual cycle but also smoothes out any short-period changes in the true monthly value of the index, and this may not always be desirable. A further disadvantage of 12-month running means is that the most recent available value at any time always refers to a date six months earlier.

b.2. An index depending only on individual months can be derived by a method due to Allen (1) (2) who first deduced for a given observatory the monthly mean values of noon *fo*F2 for zero sunspot number. The index for any actual month is then obtained by dividing the mean for *fo*F2 for that month by the value for the corresponding month for zero sunspot number. The agreement between indices of this kind calculated for a series of observatories was found to be good. There are, however, certain complementary features in the behaviour of the indices in the northerm and southern hemispheres. Consequently it would be advisable to combine the indices from a suitably selected group of observatories to form a reliable index completely free from any seasonal effects. Also, in view of the anomalous behaviour of *fo*F2 at Huancayo, discussed by Ratcliffe (3), care would be necessary when using data from equatorial observations for constructing an index intended to reflect the general level of solar activity.

b.3. When an observatory has been in operation for a complete solar cycle or longer, it is possible to deduce the relation between a monthly mean *fo*F2 and some solar index such as sunspot number.

Once this relation has been determined, it can then be used in reverse to convert an observed value of *fo*F2 into an ionospheric sunspot number or, more correctly, an ionospheric index.

As to the choice of the ionospheric layer on which to base an index, two factors are relevant : the sensitivity of the critical frequency to change in solar activity, and the magnitude of irregular fluctuations in the critical frequency. Expressions given by Allen (2) allow the sensitivities of the three principal layers to be compared, Table 1 gives values $\frac{100}{f}\frac{df}{dR}$ where f = critical frequency, and R = sunspot number for each layer.

TABLE I

Sensitivity of critical frequency (f) to change of sunspot number (R)

Layer	R	
	0	100
E	0.24	0.12
F1	0.31	0.14
F2	1.0	0.33

In the F2 layer critical frequencies are two or three times more sensitive than those of the E and F1 layers to change in sunspot number and, therefore, the solar activity. This advantage must be balanced against the greater irregularity of *fo*F2 particularly during disturbed conditions ; nevertheless, it seems likely that in spite of this defect, the F2 layer would provide a better index than either of the others.

A three-hourly I-index based on F2 critical frequencies and virtual heights has been evolved and found useful (4). Daily, monthly or annual indices can be formed from such an index and these could be developed for use in other latitudes with varying conversion tables. A world index [1] could then be obtained from results of a wide spread network of observatories.

It is also concluded (5) that monthly mean values of an index (I_{F2}) based on the characteristics of the F2 region of the ionosphere can be constructed. It is possible that this index will provide a more accurate index of solar activity, as measured by the response of the ionosphere, than that obtained from the monthly mean values of sunspot number (R). The month-to-month continuity of the index I_{F2} is high, and this fact would simplify its extrapolation for ionospheric forecasting purposes.

A further reason for choosing the F2 layer would be that long distance communications depend mainly on the F2 layer ; an index based on this layer rather than the E layer would therefore be the most likely to be capable of accurately defining ionospheric conditions on long communication circuits.

4. *Conclusion.*

It appears to be premature to make a final decision on this matter. For long term forecasts (month, year or cycle) in the future, the index R will continue to be used as the simplest and most homogeneous index characteristic of the ionosphere. In the meantime, the possibilities should be explored of using an index such as I_{F2}, which appears to have some advantages for the future. It seems desirable that all the work described in Study Programme nº 92 (VI) should be continued.

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2. Allen, C. W. — *Terr. Mag.*, 53, 433, 1948.
3. Ratcliffe, J. — *J. Geophys.*, 56, 463, 1951.
4. *N. Z. Journal Science and Technology*, Section B, vol. 33, March 1952.
5. Minnis, C. M. — *Atmos. Terr. Phys.*, 1955, vol. 7, pp. 310-321.

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[1] The U.R.S.I. (1952) meeting at Sydney suggested that this index could be refined further by eliminating lunar variation but it is doubtful if this would improve the quality of the Index sufficiently to warrant the extra work involved. Use of true heights instead of virtual heights is another point to be considered but again too much time would be consumed in first calculating the true heights.

Doc. 676.

Report n° 58 (1)

Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings

(Recommendation n° 59) (2)

(London, 1953; Warsaw, 1956)

For many years past scientific information of direct interest to those concerned with ionospheric forecasts and disturbances has been broadcast by certain countries in programmes known as Ursigrams arranged by the International Scientific Radio Union.

These programmes provide a means of exchange of summary information needed within 48 hours for the preparation of short-term forecasts and for similar urgent purposes. The exchanges are accomplished through regional networks connecting observatories, laboratories, and communications agencies with a regional centre. Regional centres in turn exchange 30 groups of summary data about once a day. The summaries include information on solar flares, sudden ionosphere disturbances, solar corona, solar radio noise, sunspots, ionospheric and magnetic activity, as well as forecasts. More detailed information is, in some instances, exchanged by weekly airletter.

1. The regional centres from which details, codes, schedules, etc., may be obtained are :

(*a*) United States of America :

Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado.

North Atlantic Radio Warning Service, Box 178, Fort Belvoir, Virginia,

North Pacific Radio Warning Service, Box 1119, Anchorage, Alaska.

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(1) This Report was unanimously adopted. It replaces Report n° 26 (*U.R.S.I. Inf. Bull.*, **86**, 39-42, July-Aug. 1954).

(2) P. 55.

(*b*) France :

Département Propagation du Centre National D'Etude des Télécommunications, 196, rue de Paris, Bagneux (Seine), France. TELEX address : Gentelabo Paris.

(*c*) Japon :

Radio Research Laboratories, Ministry of Postal Services, Kokubunji, Tokyo.

(*d*) New Zealand :

Carter Observatory, Wellington.

(*e*) Netherlands :

P. T. T. Receiving Station, Nederhorst-den-Berg.

(*f*) Federal German Republic :

Fernmeldetechnisches Zentralamt, Darmstadt.

(*g*) Scientific Research Institute of Terrestrial Magnetism, Ionospheric and Radio Wave Propagation, Ministry of Communications, Moscow, U. S. S. R.

2. The French station at Pontoise daily carries out broadcasts of Ursigrams by radio.

The type and source of the information broadcast by Pontoise are as follows :

CHROM : (Solar chromosphere) Austria, Fed. German Republic, France, Japon, Netherlands, Sweden ;

CORON : (Solar corona) Austria, Fed. German Republic, France ;

SOLER : (Solar radio noise) France, Japan, Netherlands ;

CORAY : (Cosmic rays) Fed. German Republic ;

ESFRE : (Critical frequency E*s*) and FODEU (*fo*F2) Fed. German Republic, France, Morocco, Netherlands ;

MAGNE : (Terrestrial magnetism) Fed. German Republic, France, Japan, United States ;

PERTU : (Ionospheric disturbances) Fed. German Republic, France, Morocco, Netherlands ;

PROPA : (Quality of propagation) Fed. German Republic.

The Ursigrams codes, times of transmission and frequencies used, can by obtained from the Secretariat of the U.R.S.I., 42, rue des Minimes, Brussels, Belgium.

Commission VI

Doc. 887.

RECOMMENDATION N° 115 [1]

Communication theory

(Question n° 44)

(London, 1953 ; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that the study of both the practical and theorical aspects of communication theory is of interest to I.T.U. ;

(*b*) that the bibliography on this subject and the documentation on the characteristics of various transmission systems in practical use, published by the Secretariat of the C.C.I.R. are useful for this study ;

(*c*) that the U.R.S.I. is willing to take part in the preparation of this bibliography, in particular through the help of its Netherlands Committee ;

unanimously recommends :

1. that other Administrations should co-operate in the preparation of the bibliography by sending to the Netherlands Administration a yearly list of papers on communication theory, published in their country, where possible with an abstract ;

2. that the Secretariat of the C.C.I.R. should continue the publication and dissemination of periodic supplements to the bibliography and to the documentation mentioned in paragraph *b*).

Doc. 895.

RECOMMENDATION N° 166

Unit of quantity of information

(Warsaw, 1956)

The C.C.I.R.,

unanimously recommends :

the following definition of the unit of quantity of information ; « the unit of quantity of information corresponds to a « message

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[1] This Recommendation replaces Recommendation n° 107 (*U.R.S.I. Inf. Bull.*, **86**, 60-61, July-Aug. 1954).

unit » consisting of a random choice between two equally probable signals »(Xth General Assembly of U.R.S.I., Sydney, 1952).

This unit may be designated by the word « bit ».

Note : The U.R.S.I. (The Hague, 1954) has drawn attention to the fact that the quantity of information in a message cannot be measured by a simple instrument. In most cases only a statistical estimate of an upper limit for the received quantity of information can be computed.

It is doubful whether the construction of a computer for this purpose would serve a useful end, since such statistical estimates can also be made indirectly.

Doc. 886.

QUESTION Nº 133 (III) (1)

Communication theory

(Geneva, 1951 ; Warsaw, 1956)

The C.C.I.R.,

considering :

(*a*) that for the transmission of a given volume of information through a given telecommunication channel with a given power, either in a given time using a minimum bandwidth, or with a given bandwidth in a minimum time, the theoretical formular suggest the use of pulse code modulation ;

(*b*) that the theorical coding method for improving on this involves a long delay ;

(*c*) that the theorical coding methods usually do not take into account the presence of a return channel, which in practice had led to efficient transmission systems with a low error rate ;

(*d*) that U.R.S.I. in Doc. nº 14 (Warsaw) has suggested further study ;

unanimously recommends the study of the following question :

1. the relation between permissible delay and residual uncertainly and its dependence on bandwidth utilization ;

---

(1) This Question replaces Question nº 44. The Study Programme nº 86 (III), p. 69 refers to this Question.

2. the improvement practicably possible in existing systems with regard to the transmission of information, in particular for those systems where a « go » and a « return » channel are available.

Documents received

Derivations and adjustement of standard frequencies and time-signals of station ZUO of the Union Observatory of Johannesburg (April-June, 1956).

Derivations and adjustements of standards frequencies and time-signals of stations WWV, Washington D. C., and WWVH Maui T. H., of the National Bureau of standards (January-March, 1956).

Bibliography on Communication Theory. Supplement nº 3.

INTERNATIONAL GEOPHYSICAL YEAR

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

APPENDICES TO THE FIRST REPORT OF THE SPECIAL SUB-COMMITTEE ON WORLD-WIDE IONOSPHERIC SOUNDINGS

The Report has been published in Bulletin n° 99, pp. 48-90.

Appendix I

Suggestions for Research at Stations

A considerable variety of phenomena occur on ionograms which, due to their transient or unusual character, fail to be reported in the tabulated numerical values. The station observers are in a unique position to pursue special experiments to resolve these problems. An indication of certain problems adaptable to individual field station study is given below.

1. — Sunrise Effects

The sunrise formation of the E, F1 and F2 layers has received very little investigation in the past, due to the scarcity of rapid sequence data during this period. In particular, the time and frequency variations of the pre-sunrise minimum of *fo*F2 are worthy of detailed study. Thus a simple and useful experiment is to make frequent recordings during the sunrise period and analyze them in detail.

2. — Sporadic E

In the past, tabulated E*s* data has proved to be of little value, probably because of the lack of proper classification system for E*s* types, and also because some of the data — especially *h'*E*s* — has been insufficiently accurate. While the recommendations for E*s* characteristics given in the body of this report will assist considerably in the study of E*s* on a world or regional basis, valuable work may be done at the station using the original records. Especially important during this trail period for the E*s* types are the following questions :

(*a*) Which of the proposed types are of frequent occurence at the station ?

(*b*) Are other distinct types, important to the station, omitted from the proposed list ?

(*c*) Are the proposed types distinct, and if so, by precisely what criteria ?

(*d*) Do transitions from one type to another occur ?

Among the many other E*s* problems well adapted to ind ividua station study may be mentioned the following :

(*a*) Is any particular type of E*s* concurrent with severe local thunderstorm activity ?

(*b*) If magnetograms are obtained locally, are the occurrences of certain types of E*s* related to distinctive magnetic field changes ?

(*c*) By the use of M type echoes and expanded height sweep soundings, can meaningful values of E*s* thickness be deduced ?

(*d*) What is the effect of receiver gain (and, if possible, transmitter power) on *f*E*s* ?, *fb*E*s* ?

(*e*) What types of E*s* are associated with visible aurora ?

3. — Echo Amplitude and Absorption Studies

A powerful tool in the hands of the station operator is the use of the ionosonde's receiver gain to study certain types of echo. While useful inferences may often be made using uncalibrated gain controls, the value of experiments will increase materially if the results can be expressed in at least relative gain levels.

(*a*) Simple, routine noon or hourly measurements of absorption are of tremendous value if long continuous series of observations are obtained.

(*b*) Practically no experimental work on *deviative* absorption has yet been done : thus an ionosonde receiver calibrated throughout the frequency range could produce unique data on the variations of echo amplitude along the *h'f* curve.

(*c*) Measurements similar to (*b*) above, but permitting comparisons between 0 and X components (and Z, when observed) would be of equally great value.

(*d*) Absorption studies from rapid sequence soundings immediately following large solar flares are potentially capable of providing valuable information on abnormal ionization in the D region. The unique difficulty of such measurements (and the reason why they are best made by the station observers) is that the flares are of infrequent occurrence and are impossible to anticipate.

(*e*) The effect of extremes of receiver gain on the frequency range of spread echo — especially of the equatorial night time type — would be very interesting.

(*f*) Amplitude measurements taken of F2 echoes known to be oblique (especially on otherwise quiet night time soundings) are useful in the study of unusual curvature of the layer.

4. — Studies of Importance to Magneto-ionic Theory

Although most of the emphasis in ionospheric research is directed to the acquisition of knowledge about the ionosphere, it must be remembered that these regions of the atmosphere provide a unique laboratory for the study of the propagation of radio waves. In many instances the ionogram contains information not routinely scaled, which is of great interest from this point of view.

(*a*) The separation of O, X and Z critical frequencies of a layer: relatively large variations occur in O-X separations which are not ascribable to variations in the earth's magnetic field. These are explained as due to lateral deviation of the O and X components in opposite directions to points where horizontal irregularities cause variations in the expected critical frequencies. This same phenomenon accounts for differences in shape of the O and X traces from the same layer. The mere reporting of such instances is of great interest.

(*b*) The presence of unusual « critical frequencies » in the vicinity of the gyro-frequency on a few ionograms was at one time taken as proof that a correction to the equations of magneto-ionic theory was needed (Lorentz polarization term). The use of the correction has since been discouraged on other grounds, but an explanation of the early soundings has never been made. Thus the observation of penetration frequencies in the vicinity of the gyro-frequency would be of considerable interest.

(*c*) The occurrence at moderate and high latitudes of the third magneto-ionic component (Z trace) has important implications in magneto-ionic theory. In particular, the amplitude and virtual height variations of the F region Z echo in the vicinity of *fo*E are of special interest.

5. — Special Methods of Data Presentation

Since a considerable proportion of ionospheric research has in the past been done with median or other average values, a wide field of research is open to those in a position to deal with the actual observations. Often very interesting results are obtained when the values are simply graphed in new or different ways.

(*a*) A recent endorsement of this point of view is found in the new graphical technique of recording ionospheric data — the *f*-plot. The possibilities of this method are yet largely unexplored, but it is known that the *f*-plot is an excellent means of studying the dynamics of the ionosphere which are manifest in relatively small variations in frequency characteristics (e. g. *f*-min and *fo*F2).

(*b*) Contours of constant frequency or virtual height drawn on monthly (day by hour) tabulation sheets permit the easy determination of periods of unusual ionosphere behavior which then may be associated with periods of high solar or magnetic activity.

(*c*) Special graphs of frequency and height characteristics vs. solar position data (e. g. cos χ) are useful in the delineation of solar activity. Such tables of hourly values of cos χ will be available to I.G.Y stations for just such work.

Appendix II

Suggestions for punched card formats

An example of one scheme by which punched cards are used for the tabulation, checking, and statistical work on ionospheric data is found in the punched card format presently used by the C.R.P.L. group. The French group uses essentially the same method. The description below refers to the card of figure 1.

1. A standard card form may be used for all types of geophysical data. For example, ionospheric data in the form of hourly measurements or hourly median values are put in the same general form. Data pertaining to geomagnetism, solar observations, airglow, etc. may be similarly treated.

2. The body of the card contains a *number field*, consisting of 80 columns of the ten digits from 0 to 9. All *key* information (e. g. time, date, station, characteristic, etc.) as well as the data itself is punched within this array of numbers. The card equipment, of course, senses the *position* of a punched hole in the card.

3. The first thirteen columns of the card contain the following identifying information :

(*a*) *Type* (of card) :

Column 1 identifies type of number recorded — e. g. hourly measurement or median value.

Column 2 identifies (for ionospheric data) the hours of data contained on the card (06-18, 00-11, 12-23).

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5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5

6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6

7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7

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Table I. — *Code of characteristics for Measurements used by NBS Boulder Laboratories*

Ionosphere	2nd digit / 1st digit	Frequencies			Para-meters	Heights					
		fo 0	*fx* 1	others 2	M 3	*h'*min 4	*hp* 5	others 6	7	8	9
Layer F2	0	*fo*E2 00	*fx*F2 01		(M3000) F2 03	*h'*F2 04	*hp*F2 05				
F1	1	*fo*F1 10	*fx*F1 11		(M3000) F1 13	*h'*F1 14					
E	2	*fo*E 20				*h'*E 24					
E*s*	3	*f*E*s* 30		*fb*E*s* 32		*h'*E*s* 34					
others	4	*fo*E*s* 40		*f*-min 42		*h'*F 44					
Solar data	5										
Geomagnetic data	6										
Airglow	7										
	8										
	9										

(*b*) *Station* :

A three digit station code for all stations supplying data is designed. The stations are grouped by geographical location. This information is punched in *columns* 3, 4, 5.

(*c*) *Date* :

Column 6, 7 identifies year (e. g. 56 implies 1956).

Column 8, 9 identifies month (e. g. 09 implies September).

Column 10, 11 identifies day (e. g. 29 implies 29th of month).

(*d*) *Characteristic* :

A two digit unified code for all geophysical data has been designed. See Table 1. The ionospheric characteristic is the punched in *columns* 12, 13.

4. Hourly measurements : In the present scheme, the ionospheric data for one characteristic for 12 (or 13) hourly observations are punched on a single card. Five columns are devoted to each hourly value as follows :

Column 14, 15, 16 (for example) : the value of the characteristic (three digits).

Column 17 : qualifying symbol.

Column 18 : descriptive symbol.

Note : Three *rows* of spaces are available at the top of the card. One of these spaces and a space in the descriptive or qualifying symbol columns are used together to signify one of the alphabetic characters.

C.S.A.G.I.

I.G.Y. NEWS

The C.S.A.G.I. Coordinator is issuing a new publication « I.G.Y. News » ; hereunder some abstracts of the first issue of this publication.

Special Committee for the International Geophysical Year (C.S.A.G.I.)

Provided by the Secretary General, 25 October 1956

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C.C.I.R.	Professor B. VAN DER POL	January 1956
	Mr. J. VAN DER MARK	January 1956

(1) May 1952 : « Polar Year Committee » with N. E. NORLUND and J. M. STAGG.

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Provided by the Secretary General 25 *October*, 1956

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Fourth Meeting of C.S.A.G.I. and Second of A.C.I.G.Y., Barcelona

(Abstract)

Briefs details in advance of the full report are given here for the benefit of National Committees unable to be represented and to draw attention to matters of importance or particular interest to National Committees.

The Conference worked throughout the week commencing Monday 10th September as follows : Monday — C.S.A.G.I. ; Tuesday — Formal opening and Satellite Symposium ; Wednesday

a. m. C.S.A.G.I./A.C.I.G.Y. when Working Groups were formed, p. m. meetings of A.C.I.G.Y., C.S.A.G.I. and Working Groups which were continued over Thursday; Friday — Excursion to Montserrat; Saturday — Final A.C.I.G.Y. and C.S.A.G.I. meetings followed by Plenary Session ending at 1330; Sunday — Excursion to the Observatory at Tortosa. The Resolutions framed covered those made at the preceding Regional Conferences.

The Bureau, Finance and Publications Committees had met during the previous week.

Twenty-nine National Committees were represented of fifty-one countries then participating. W.M.O. and Unesco were represented.

A considerable amount of time was spent on financial and organisational matters the result in brief being that National Committes would be asked by letter from the General Secretary for comparatively small financial contributions to cover a C.S.A.G.I. budget deficit and at the same time be invited to make proposals on the future organisation for the direction of the ever increasing program. Other Resolutions and decisions which may be mentioned here are :

The I.G.Y World Data Centre organisation was carried a step further and the Coordinator authorised to communicate with Unions and National Committees and with Reporters for a specification of the data to be stored. It is expected that there will be a series of Centres by Disciplines and in association with Unions situated in Europe and also two Centres in U. S. A. and U. S. S. R. All will work on an international basis with full interchange of data.

A final Calendar of World Days and World Meteorological Intervals was agreed and will be promulgated by the General Secretary.

The Alert Warning Organisation was finalised except for minor detail. There will be trial weeks from 10th-16th both days inclusive of January, February, March, April and May 1957.

A satellite program with details to follow later was announced by the U. S. S. R. delegation. U. S. S. R. and U. S. A. are to use uniform tracking procedures which will facilitate the assistance that would be welcomed from other countries. This assistance may be in the simplified radio tracking or in the optical tracking programs. In the former case Universities and amateurs should make offers through their National Committees to the U. S. National Committee. In the latter case professional and non professional astronomers are both invited to help. Those with instruments available for such a purpose should write direct to Dr. Fred L. Whipple, Smithsonian Astrophysical Observatory, 60 Garden Street, Cambridge, Massachusetts, U. S. A. The first U. S. A. satellite is planned to have an orbit between Lats. 40° N and 40° S.

The program for the publication of the Manuals was so arranged that adequate supplies of Manuals would be ready for the Antarctic expeditions in the coming season.

I.G.Y. Volume I will contain details of I.G.Y. Stations up to date at 31st October 1956. Later additions will be promulgated in this News Section.

National Aurora Reporters were needed in all countries including those in equatorial regions and it is hoped that all NC's will respond to the Secretary General's Circular Letter 18 of 13th August 1956.

Amateur radio assistance to the I.G.Y. program was discussed. NC's will be asked to approach their Administrations to permit such cooperation within the needs of science and invite the cooperation of Radio Amateur organisations in their countries. C.S.A.G.I. initiated action on the international level by forwarding a resolution to the International Radio Consultative Committee (C.C.I.R.) which was meeting concurrently at Warsaw and has relations with Governments on Radio matters.

A film on last season's Antarctic activity shown by the U. S. S. R. delegation aroused much interest as did colour pictures shown by the Australian delegation. Previously at the 3rd Antarctic Conference in Paris a full length U. S. A. film and a shorter British one had been shown. A Resolution was accepted that copies of present and future films on I.G.Y. scientific activities in Antarctica should be deposited in C.S.A.G.I. Secretariat with a view to their eventual consolidation into a standard length film.

Logistic Capabilities of Antarctic Stations

The Adjoint Secretary for the Antarctic contributes :

During the 1st C.S.A.G.I. Antarctic Conference held in Paris, July 1955, the Working Group for Mutual Logistic Support was formed under the chairmanship of Admiral George Dufek to resolve problems related to (*a*) mutual logistic support and (*b*) emergency procedures. The Antarctic Conference decided that the Working Group should publish a list of the Antarctic bases including :

(*a*) The facilities to be established.
(*b*) The description of the capabilities of each base.
(*c*) The radius of effective support or assistance.

The material collected by the Chairman of the Working Group was reviewed at the 3rd Antarctic Conference, Paris, July 30-August 3, 1956 and has been published on October 8, 1956 in the form of a mimeographed document of 55 pages « Logistic Capabilities of Antarctic Stations ». It contains the data for the Antarctic Stations of the following nations : Argentina, Australia, Chile, France, Japan, New Zealand, Norway, U. S. S. R., U. K., U. S. A.

Copies may be obtained from the U. S. National Committee.

This document makes a significant contribution to the efficiency and safet y of all Antarctic operations during the I.G.Y.

Belgian Expedition to the Antarctic

The Secretary of the Belgian National Committee for the International Geophysical Year has provided the information that there will be a Belgian expedition to Antarctica. It is expected to maintain a station from January to December 1958. When further details are available they will be included in this News.

The leader of the expedition will be Cdt. Gaston de Gerlache son of the Chief of the Belgica expedition which in 1898 was the first to spend a winter in Antarctica.

I.G.Y. Manuals

The General Editor reports on 2nd November :

« The following Manuals have now been published in a temporary edition :

Seismology.
Longitude and Latitude.
Geomagnetism Vol. 1.
Antarctic Radio Communications.

Of the three Ionosphere Manuals, Volume 1 on vertical soundings has been distributed in a duplicated edition to those immediately concerned through the working group on the Ionosphere. This volume will be included in the definitive printed edition of the Manuals to be published later.

Volumes II and III dealing with absorption and drift measurements are expected to be published within the next few days.

The typing of Geomagnetism Vol. II, of Aurora and Airglow is in hand and these two Manuals should be published within the next few weeks. »

DOCUMENTS RECEIVED

Participation of the Republic of the Pnilippines

(Abstract)

V. — IONOSPHERE

At Baguio (N 16°25′ ; E 120°36′) ionospheric observations will be made, every fifteen minutes, of vertical incidence reflections with a C-2 automatic ionosphere recorder of U. S. National Bureau of Standards type.

Proposed Pakistan Programme

(Abstract)

V. — IONOSPHERE

The main features of this programme are :

(i) Ionograms of vertical incidence sounding.

(ii) Study of whistlers (if possible).

Station :

Quetta N 30°11′ E 66°57′.

(*a*) Vertical incidence sounding daily (NPL ionospheric recorder).

(*b*) Study of whistlers.

Egypt

Abstracts of the Programme

All correspondence concerning the I.G.Y. activities are to be sent to : Mr. M. F. TAHA, Secretary of the National Committee for Geodesy and Geophysics c/o Meteorological Department, Koubri El Koubba, Cairo, Egypt.

I. — World Days

Special attention will be given to observations during Regular World Days (RWD), Special World Intervals (SWI) and World Meteorological Intervals (WMI).

The Meteorological Department will undertake the reception of the Alerts for the Special World Intervals (SWI) during the I.G.Y. (57/1958), and will be distributed to the participating institutions in Egypt.

V. — Ionosphere

At Helwan Astronomical Observatory ionospheric observations will be made for recording ionic density and height of ionospheric layers.

The ionospheric recorder which is to be used covers frequencies from 0.7-25 Mc/s with a peak output 1.2 kW.

I.G.Y. World Warning Agency

North Atlantic Radio Warning Service, Box 178, Fort Belvoir, Va.

Letter to I.G.Y. World Day Centres

November 16, 1956.

Attached is the record of practice declarations of Alerts and SWI from July 20 to November 14, 1956 (1). We also list the advice received from other centers and the remarks recorded at the time by the NARWS forecaster making the practice decision.

Advice has been reaching us fairly systematically from Nera, Boulder and Anchorage. It is to be hoped that other centers will see to it that their opinions reach the I.G.Y. World Warning Agency, so that the declarations can be made in accordance with the C.S.A.G.I. plans. For instance it would be most useful to have Paris and Darmstadt advice separately on the interchange messages ; note that when all agree the advice can be designated

(1) The appendix is not published in the Bulletin.

EU for European, as provided by the code distributed on August 28.

We will plan to distribute the practice declarations in this form from time to time as a supplement to the distribution to centers on the daily interchange messages.

Comments are invited.

(Note that the cable address AGIWARN has been registered for the I.G.Y. World Warning Agency, NARWS, Fort Belvoir, Va.)

BIBLIOGRAPHY

International Electrotechnical Commission :

Publication 80. — 1st Edition : Specification for fixed paper capacitors for direct current. Price : Sw. Fr. 8, plus postage.

Publication 50 (16). — 2nd Edition of the International Electrotechnical Vocabulary Group 16 : Protective relays. Price : Sw. Fr. 6, plus postage.

On sale at the Central Office of I.E.C., 1, rue de Varembé, Geneva, Switzerland.