

International Scientific Radio Union

U. R. S. I.

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INFORMATIVE PAPER

Historical Account of U.R.S.I.

CHAPTER IV. — RADIO ASTRONOMY

1. — *Origin*

Although some mention of the radio electric emission of solar and galactic origin had been made before the Second World War, it was only after 1946 that U.R.S.I. became interested in Radio Astronomy.

While reviewing the various activities of U.R.S.I., Sir Edward Appleton, in his presidential address at the opening session of the General Assembly in 1946 said :

« The extension of our knowledge of galactic radio noise and the recent extensive work on abnormal solar radio noise can be said to follow directly from the availability of apparatus and techniques originally developed for radar operation. These subjects, it seems to me, should be of interest to Commission III which, up to the present, has concerned itself largely with the radio noise originating in the terrestrial atmosphere which is experienced on longer waves ».

At this General Assembly three papers were presented on this new aspect of U.R.S.I. activities. The consideration and discussion of these documents led the General Assembly to adopt the creation of a Sub-Commission (IIIe) on Radio Noise of Extra Terrestrial Origin, the chairmanship of this Sub-Commission was entrusted to Sir Edward Appleton.

The number and importance of the papers presented at the General Assembly in 1948 led U.R.S.I. to create Commission V on Radio Noise of Extra Terrestrial Origin, which became in 1950 the Commission on Radio Astronomy.

2. — *Chairmen*

In 1950 the chairmanship of the Commission on Radio Astronomy was entrusted to Dr. D. F. Martyn who held it until 1954, at which

time he was succeeded by Dr. M. Laffineur. Since 1957 the Commission has functioned under the chairmanship of Prof. A. C. B. Lovell.

3. — *Activities*

In 1948 the Commission on Terrestrial Atmospheric, in which the Sub-Commission on Radio Noise of Extra Terrestrial Origin was functioning, decided to publish, in the form of a Special Report of U.R.S.I. (n° 1), a report presented by Sir Edward Appleton on Radio Noise of Solar and Galactic Origin.

It was in 1950, during the 9th General Assembly, after examination and discussion of about 40 reports and documents, that the Commission established its first programme of coordinated research in proposing to carry out continuous observations on the neighbouring frequencies of 200 to 300 Mc/s. The Commission became interested in setting up a world chain of radio solar observatories. It created for this purpose a Sub-Commission (*Va*) called the world chain of radio solar observations.

During this General Assembly, the Commission interested itself in the terminology and in units, either used or to be used in Radio Astronomy.

At this same Assembly, a National Committee proposed the creation of a joint Commission on Radio Astronomy between U.R.S.I. and U.A.I., and I.U.G.G. Taking into account the close ties existing between U.R.S.I. and I.A.U. and the lesser importance of radio astronomy for I.U.G.G., the proposal was not followed and U.R.S.I. continued through Commission V to promote the research in this new field of science.

This interest explained the importance of the reports presented by 17 National Committees at the General Assembly held in Sydney in 1952. These reports, which cannot be analysed here, gave a summary of the world development of radio astronomy under the impetus given by U.R.S.I.

During this Assembly at Sydney, the Sub-Commission *Va* was able to announce that 12 countries had participated in the world chain of radio solar observations. For the other part, the two other Sub-Commissions (*Vb* — Terminology and Units, and *Vc* — Radio Indices of solar activity, set up in response to a request of C.C.I.R.) established reports which served as a basis for further

research. It was also during this Assembly that it was decided to publish three special reports of U.R.S.I. on the discrete sources of extra terrestrial radio noise (N° 3), distribution on the radio electric brilliance on the solar disc (N° 4) and the interstellar hydrogen (N° 5).

The 15 reports presented by the Sub-Commissions and the National Committees at the General Assembly in 1954 (The Hague) showed the importance of the development of radio astronomy and explained the place that this discipline held inside of U.R.S.I., not only because of its own research, but also because of the connections it had with other Commissions of the Union ; with Commission III for the study of the influence of the solar noise and phenomena on the behaviour of the ionosphere, with Commission IV for the effects of these same phenomena on the origin and propagation of atmospherics, with Commission VI for the study of the realization of the equipments and apparatus used in radio astronomy.

This cooperation with other Commissions of U.R.S.I. confirmed itself during the General Assembly in 1957, during which 3 of the 7 scientific meetings held by the Commission were organized jointly with other Commissions. It seemed advisable to report that besides the current activities of radio astronomy, detection and tracking of the extra terrestrial sources, study of the observational methods and of instruments and equipment used, utilization of results, etc., the Commission interested itself equally in three particular topics. These are : the determination of units and terminology to be used in radio astronomy, the choice of a basic solar index and the allocation of frequencies reserved for the radio astronomical observations.

The study of units and of terminology was entrusted to a Sub-Commission appointed for this purpose, and whose activities were described in the reports presented at the time of the General Assemblies.

It was the same with the research on the basic solar index, a study undertaken at the request of C.C.I.R. The statement of research concerning this subject is too long to include here, but the details can be found in the *Information Bulletin of U.R.S.I.*, or in the Proceedings of the General Assemblies.

One of the most important questions for radio astronomy was

the allocation, by the International Telecommunications Union, of frequencies reserved for radio astronomy. Approaches concerned with this objective were started since 1952 in the line of cooperation between U.R.S.I. and C.C.I.R. ; at that time, no other scientific organization seemed interested in this question.

The development of such approaches as well as the assistance given by the other organizations made the object of various papers published in the *U.R.S.I. Information Bulletin*. Due to the coordinated efforts of various scientists interested directly or indirectly in radio astronomy, due to the efforts of numerous National Committees of U.R.S.I., and due to the cooperation of C.C.I.R. and of other scientific organizations, radio astronomers were able to obtain in 1959 a solution which, if not entirely to their satisfaction, will permit them to continue their research with more confidence.

4. — *Sub-Commissions*

The enumeration of the various Sub-Commissions, appointed in view of particular researches, will give a general picture on the orientation of the work of the Commission on Radio Astronomy.

Sub-Commission Va : World-wide survey of solar radio noise (1950-1957), *Chairman* : A. H. DE VOOGT.

Sub-Commission Vb. — Terminology and Units (1950-1954), *Chairman* : M. LAFFINEUR.

Sub-Commission Vc : Basic Solar Index (1952), *Chairman* : M. LAFFINEUR (1952), S. CHAPMAN (1954-1959).

Sub-Commission Vd : Standardization of equipments and measurements (1954), *Chairman* : C. L. SEEGER.

Sub-Commission Ve : Frequency allocation (1957), *Chairman* : J. W. FINDLAY.

Erratum

Information Bulletin n° 119 (January-February 1960), p. 5,
line 14 should read :

« the Committee on Scientific Space Radio Research are examples
of such... »

NATIONAL COMMITTEES

Finland

MEMBERSHIP

Chairman : Prof. J. TUOMINEN, Helsinki University, Siltavuorenpenger 20, Helsinki.

Vice-Chairman : Prof. J. PONJAHPALO, The State Institute for Technical Research, Albertinkatu 40, Helsinki.

Secretary : Dr. P. MATTILA, Finland Institute of Technology, Albertinkatu 40, Helsinki.

Commission I : Prof. L. SIMONS, Helsinki University, Siltavuorenpenger 20, Helsinki.

Commission II : Prof. V. VÄISÄLÄ, The Finnish Academy of Sciences and Letters, Mäntytie 5A, Helsinki.

Commission III : Dr. P. MATTILA, Finland Institute of Technology, Albertinkatu 40, Helsinki.

Commission IV : Dr. V. ROSSI, Meteorological Office, Ruoholahdenkatu 8, Helsinki.

Commission V : Prof. J. TUOMINEN, Helsinki, Siltavuorenpenger 20, Helsinki.

Commission VI : Prof. J. POHNJAPALO, The State Institute for Technical Research Albertinkatu 40, Helsinki.

Commission VII : Prof. H. BLOMBERG, Finland Institute of Technology, Albertinkatu, 40, Helsinki.

Yugoslavia
MEMBERSHIP

President : Dipl. Ing. Djordje KOVAČEVIĆ, Director of the Institute « Mihailo Pupin », Belgrade, P. O. Box 906.

Secretary : Dr. Ing. Dejan BAJIĆ, Chief of the Ionospheric Observatory of the Institute « Mihailo Pupin ».

Commission Chairmen :

- I. Dipl. Ing. Bogosav KOVAČEVIĆ, Institute « Mihailo Pupin », Belgrade.
 - II. Dipl. Ing. Zivan DABIĆ, Institute « Boris Kidrič », Vinca.
 - III. Dr. Ing. Dejan BAJIĆ, Institute « Mihailo Pupin », Belgrade.
 - IV. Prof. Dipl. Ing. Aleksandar DAMJANOVIĆ, Electrotechnical Faculty, Belgrade.
 - V. Dr. Ivan ATANASIJEVIĆ, Natural Science Faculty, Belgrade.
 - VI. Dipl. Ing. Radoslav HORVAT, Electrotechnical Faculty, Belgrade.
 - VII. Prof. Dr. Ing. Branko RAKOVIĆ, Electrotechnical Faculty, Belgrade.
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INFORMATION

Daily values of the E-layer index J_E

(*Bulletin n° 120*, pp. 10-15)

306 / The value of J_E given on page 15 for 30th October 1959 ought to be 228. The paper quoted in Reference 3 has now been published (*J. Atmos. Terr. Phys.* (1960) **18**, ~~181~~).

Equation 2 should be used with caution because Eyfrig has recently suggested that the variation of f_oE , and hence J_E , with geographical location does not depend on latitude alone, and that some other unidentified controlling factor is present (*Geofis. Pur. Appl.* (1960) **45**, 179). Latitude variations have also been studied by SHIMAZAKI (*J. Radio R. Lab* (1959) **6**, 109).

COMMISSIONS

Commission III. — New publications

FRANCE

Bulletin de Mesures Ionosphériques (B. M. I.)

The results of measurements obtained in the various French ionospheric stations, until the end of the period named International Geophysical Year, have been submitted to a centralized reduction before publication in the « *Bulletin d'Informations Ionosphériques et Géophysiques* » (monthly median values) and in its supplement (hourly values). This publication is under process.

For later measurements (from January 1959 onwards) the « Section de Prévisions Ionosphériques Nationale » (S.P.I.N.) of C.N.E.T. is entrusted with the reduction of results from its stations. The publication will be issued as the work is going on without waiting for the achievement of reduction of I.G.Y. Data. This is the aim of the « *Bulletin de Mesures Ionosphériques* » which will give both the monthly median values and the hourly values (in a single series of booklets without any supplement).

The S.P.I.N. is also entrusted with the reduction of results from the Kerguelen ionospheric station (after the I.G.Y.). These results refer generally to longer periods than those from other stations which means longer reduction delays. Special issues of this Bulletin will be devoted to those results.

ITALY

We want to inform our readers that the Istituto Geofisico e Geodetico of the University of Genova has issued a publication entitled « Genova — Monte-Capellino Observatory — Ionospheric Data ».

This book covers the periods of the I.G.Y. (1 July 1957 — 31 December 1958) and the I.G.C. (1 January 1959 — 31 December 1959).

SUB-COMMISSION IIIc

Letter from the Chairman to the Members of Sub-Commission IIIc of the U.R.S.I.

Dear Sir,

On the occasion of the next General Assembly of the U.R.S.I. the activity of the Sub-Commission IIIc will be discussed and some conclusions must be drawn. A report to Commission III is being prepared and will be submitted in a short time.

The Sub-Commission IIIc was created in 1952 on the occasion of the General Assembly at Sydney. The scope of the Sub-Commission was the organizing of a world wide system of measurements of the propagation time of radio signals, by utilizing the existing standard time transmissions, or special transmissions.

It has soon appeared the difficulty for realizing such an ambitious program. Thus, only some limited groups of experiments could be organized.

A first series has been made from December 1954 to December 1956 on the radio-path from Torino to Rugby, by utilizing the standard time transmissions by I.B.F. and M.S.F., with the cooperation of the N.P.L. (Teddington), Royal Greenwich Observatory, and I.E.N. (Torino). A collaboration to the experiments was given by some other laboratories, i.e. of the Dutch P.T.T., the German P.T.B. and the Fernmeldetechnisches Zentralamt, the French L.N.R., the Commonwealth Observatory of Australia, and the Swedish Telecommunication Board. The experiments were suspended at the end of 1956, when it appeared that for collecting a better information on the propagation time stability, some improvements in the intrinsic stability of the I.B.F. time signal transmissions were desirable.

A contemporary tentative of organizing experiments on the longer and more interesting radio path between Torino and Washington, had no success due to some difficulty of receiving I.B.F. transmissions at Washington.

A second important series of experiments has been organized by Japanese people on the radio path Tokyo-Hawaii, by utilizing the standard time transmissions by JJY and WWVH. It has endured from July 1957 to September 1958.

Finally a short series of determinations has been organized

again by the I.F.N., N.P.L. and the Royal Greenwich Observatory between Torino and Rugby, on the occasion of the solar eclipse of October 2nd 1959, and with the collaboration of the German P.T.B. and the Fernmeldetechnisches Zentralamt. The analysis and the elaboration of the data is still in course. However, it has already appeared that the improved stability of the standard time signal transmissions, especially of I.B.F., in comparison with experiments made in 1955-56, permits now to collect more precise data on the variations of the propagation time.

The presence of the Sub-Commission IIIc has undoubtedly shown its utility in the first years of its activity, by promoting experiments and calling attention on the possibility of improving the precision of the comparison by suitable methods of observation. But the successive experience has proved the difficulty of a central organization of the experiments, so that for the moment they can preferably be settled on by individual initiative and agreement between a group of laboratories. Thus, although it is likely that further experiments will be organized in the future to obtaining a better knowledge of the propagation time of the signals, I think the Sub-Commission IIIc has done its duty and I propose it would be dissolved by the next General Assembly.

I should be very grateful, would you kindly let me know your opinion on that subject.

Very sincerely yours,

M. BOELLA,
Chairman of Sub-Commission IIIc
of the U.R.S.I.

May 20th, 1960.

Commission V

FREQUENCY ALLOCATIONS FOR RADIOASTRONOMY

by E. HERBAYS and R. COUTREZ

I. — For many years, U.R.S.I. endeavoured to obtain the protection of frequency bands used for radioastronomical observations. The Union was seconded in its efforts by I.A.U. and C.C.I.R.

This assistance was recognized by the General Assembly of 1957 in a Resolution adopted on proposal of Commission V and was drafted and follows :

« Commission V expresses its thanks to the I.A.U. and C.C.I.R. for considering Resolutions 4 and 5 adopted by Commission V at the XIth General Assembly in 1954. Once again it insists on the absolute necessity that those observatories engaged in Radioastronomy which are troubled by interference should receive the backing of the authorities in their own and neighbouring countries.»

Estimating that this Resolution had to be accompanied by facts and sustained by an action as extended as possible, Commission V proposed in a Resolution adopted by the General Assembly of 1957 to set up a new Sub-Commission *Ve* composed of Representatives of 15 National Committees, charged with preparing recommendations to be submitted through the appropriate authorities to I.T.U. at the Geneva Meeting in 1959.

On the other hand, the General Assembly of I.A.U. in Moscow (1958) adopted the following Resolution on a proposal of its Commission 40 :

« The I.A.U. supports the suggestion that U.R.S.I. should provide C.C.I.R. with the detailed requirements for frequency bands for radioastronomy. The I.A.U. asks C.C.I.R., with the cooperation of U.R.S.I., to treat this matter with the greatest urgency, and to take the necessary steps to obtain these frequency bands at the forthcoming International Conference on Frequency Allocations ».

Before approaching I.T.U., U.R.S.I. took steps so that its desiderata be considered and supported by C.C.I.R. The first step consisted of preparing for C.C.I.R. a report summarizing the whole history of frequency allocations for Radioastronomy, the needs of this science and the aid it gives to techniques in Radio-communications.

Dr. J. H. Dellinger, Chairman of the U.R.S.I. Committee for C.C.I.R. work accepted to represent U.R.S.I. at the Plenary Assembly of C.C.I.R. held in Los Angeles in 1959, and the National Committees were invited to ask their members attending this meeting to back Dr. Dellinger with their efforts. The activities of this delegation and the results reached were described in Dr. Dellinger's Report published in the *Information Bulletin*, N° 115. The Recommendation No. 309 formulated by C.C.I.R. in 1959

(replacing Recommendation No. 173) recognized the importance of such questions and it contained a list of frequency bands which must have international protection.

This action was supported by several Memoranda from radio-astronomy institutions in various countries, particularly those of Netherlands, Belgium and the United Kingdom. These documents called attention to the necessity of an adequate protection of frequency bands, and to the fact that, without such protection, the development of Radio-astronomy would be halted.

To answer a demand of I.T.U., the U.R.S.I. Board of Officers nominated Professor B. van der Pol as an Observer at the Geneva Conference of I.T.U. with the task of defending the interests of Radioastronomy. In order to reach a complete coordination of efforts, the Board agreed that Professor van der Pol should also represent I.A.U. Unfortunately, the health of Professor van der Pol forced him to interrupt his activities. Meanwhile, the problem of frequency allocations for Space research came into consideration and C.O.S.P.A.R. joined its efforts with U.R.S.I. and I.A.U. These three organizations conjugated their works and took steps to see that a radioastronomer representing their common interests be constantly present in Geneva. Successively, Professors J. H. Oort, H. C. van de Hulst, C. L. Seeger, R. Coutrez, W. J. G. Beyon, J. F. Denisse, J. W. Findlay undertook this delicate task. A permancy of U.R.S.I., I.A.U., C.O.S.P.A.R. observers was organized with the attendance of Prof. Seeger, van de Hulst and Denisse. Successively two radioastronomers (Prof. Coutrez and Ir. R. Gonze) were members of a governmental delegation, the former also as a U.R.S.I. representative.

On the other hand, the Secretary General of U.R.S.I., in his letter of March 19, 1959 (see *U.R.S.I. Information Bulletin*, No. 114, p. 50) invited the official Members of Commission V to contact their governmental delegations at the I.T.U. Administrative Conference, in order to convince them of the importance of Radio-astronomy in Science. A remarkable lecture given by Prof. Oort, President of I.A.U., and attended by numerous delegates in Geneva, threw light on the great value of this branch. Moreover, Radio-astronomers present in Geneva undertook a sustained action to demonstrate the necessity of an adequate frequency protection for the future of a discipline which revealed itself as a powerful

tool for pure knowledge, as well as in its practical consequences for the development of techniques. The discussions in Geneva showed the interest of numerous delegations on this question.

We are very pleased to quote here the support given by M. G. Pedersen, who presided over the crucial Commission 4 of I.T.U., the action of delegations, especially those of the Netherlands, Belgium and the United Kingdom, and the remarkable contribution of some of their members.

II. PRINCIPAL RESULTS OF THE CONFERENCE. — The principal results of the I.T.U. Administrative Conference were (a) the Radio Regulations, which should be considered as a Chart between sovereign states, whose enforcement essentially depends on the action of the Administrations responsible for Radiocommunications in the various nations, (b) the Resolutions and Recommendations adopted by the Administrative Conference. The Radio Regulations contain many items of interest for Radio Astronomy and Space Communications. It will be noted, at first hand, that Radio Astronomy and Space Research are now considered by I.T.U. as *Services*, with the same rights as the other services (see Ch. I : Terms and definitions) Frequency allocations for Radioastronomy and Space Research are mentioned either in the Table (part. of Art. 5 of Radio Regulations) or in the footnotes : a large majority considers that an allocation in the table or in the footnotes are of the same value. Resolution 7 and Recommendation 35 refer to Space Research. We are giving hereafter the text of Recommendations 30 and 31 related to Radioastronomy.

The results of the Administrative Conference are described in three documents analysed here :

- (a) the Second and final Newsletter, drafted by Dr. C. L. Seeger and edited jointly by U.R.S.I., I.A.U. and C.O.S.P.A.R. ;
- (b) a Memorandum drafted by Dr. R. M. Emberson, Associated Universities Inc., New York ;
- (c) a Report drafted by the General Direction of Radio-communications, Belgian Administration of Telegraphs and Telephones.

We are limiting ourselves to frequency allocations for radio-

astronomy. The following comments made by Dr. Seeger in the second newsletter appeared to us as essential :

(1) It is the overwhelming opinion of all who attended the Geneva Conference that Radio Astronomy obtained much more concrete consideration than was hoped, and this, for four principal reasons :

- (a) the essentially unanimous, coordinated, reasonable and minimum demands of radioastronomers of a number of countries,
- (b) the presence of active observers and delegates, beginning with the preparatory efforts of Prof. van der Pol ;
- (c) the strong and steadfast support of the delegations of Netherlands, Belgium and United Kingdom ;
- (d) the successful efforts of some astronomers and others to modify the original policies of their delegation.

However, in spite of allocations in the Frequency Table, Radio Astronomy appears only half way, perhaps, of its objectives, either for nominal frequencies or for bandwidths. In certain cases, allocations remain regional ;

2) to maintain the present results and to obtain an effective protection against harmful interference, it appears of primary importance that radioastronomers continue to coordinate their demands among themselves, and to conjugate their efforts through U.R.S.I. and I.A.U. as in the past. It is unreasonable to expect that Radio Astronomy can approach the next I.T.U. conference without prior effort. Since power in I.T.U. resides in the strongest and the best organized national delegations, it is of absolute necessity that radio astronomers maintain intimate contact with their national Administrations. Generally speaking, those seeking a protection of an usage recognized by the Administrative Conference should principally refer to *their administrations*, who have been persuaded to protect radio astronomical observations.

(3) the chief occupants of the radio frequency spectrum are Broadcasting-Television, Military and Aeronautical authorities, and in the future, Space communications. Though they influence indirectly the policy of national administrations, the military needs are not discussed by I.T.U. In this respect, there is a gap and it is evident that an effective protection can not be realized unless conciliating the positions of all interested. It is recommended

that radio astronomers approach also their national military authorities.

(4) the attention of radio astronomers is called on the other conferences related to frequency allocations. For instance, the Meeting of the European Broadcast Union in 1960 will be of great importance for the eventual protection of a frequency band in the neighborhood of 600 Mc/s.

III. CONCLUSIONS. — The above considerations show that the coordinated action of C.C.I.R., U.R.S.I., I.A.U. and C.O.S.P.A.R. together with the efficient help of various national delegations and the generous efforts of a great number of participants to the I.T.U. Conference brought to light the importance of Radio Astronomy.

We are sure to be the interpreters of all radio astronomers in thanking all those which took part in that action.

However the problem is not yet entirely solved. We ask the radio astronomers to pursue their action in this field. Only a coordinated action can ensure that an efficient protection of frequencies for Radio Astronomy will be reached. For this reason we beg our readers to consider with great care the conclusions of the Second Newsletter which have been summarized in section II.

Table of allocation of frequency bands between 10 kc/s and 40 kc/s
(Geneva 1959)

We shall limit ourselves in mentioning that this table gives the frequency bands reserved for Radio Astronomy in the various regions dividing the world according the rules of I.T.U. We assume that the interested organizations will be able to consult this table at their respective governmental departments.

*Summary of I.T.U. Recommendations concerned
with frequency allocation
for radioastronomical observations*

In Recommendation n° 20, I.T.U. asks the Administration to take any practically possible measures to protect the standard frequency bands 2,5 , 5, 10, 15, 20 and 25 Mc/s against any interference, these bands may be used for radio astronomical observations

Recommendation n° 31 *recognizes* the Radio astronomical service and *recommends* that Administrations should :

- (a) pursue the consideration of the problem of frequency allocation to radio astronomy ;
- (b) consider the possibility of a definite allocation in the 37-41 Mc/s band ;
- (c) give the greatest possible protection of the 606-614 Mc/s band in establishing the allocation schemes ;
- (d) notify to the I.T.U. Secretary General the sites of radio astronomical observatories and the bands used, the Secretary General should notify such information to the I.T.U. Members and associated Members.

This recommendation *calls the attention* to :

- (a) the relevant provisos of the Radio communication Rules ;
- (b) the closed coordination with National Departments ;
- (c) the necessity of selecting for radio astronomical observatories, sites far away from disturbing centres.

Commission VI

SYMPOSIUM ON ELECTROMAGNETIC THEORY

We want to inform our readers that the Proceedings of the Symposium on Electromagnetic Theory organized on June 15-20, 1959, by U.R.S.I. Sub-Commission VI-3 and the I.R.E. Professional Group on Antennas and Propagation with the sponsorship of U.R.S.I. Commission VI, have been issued as a Special Supplement to the « I.R.E. Transactions on Antennas and Propagation ».

Copies of this special supplement can be purchased from the Institute of Radio Engineers, 1 East 79 St., New York. Price per copy : members of Professional Group on Antennas and Propagation \$ 8.00 ; members of the I.R.E. \$ 12.00 ; non members \$ 16.00.

INTERNATIONAL GEOPHYSICAL YEAR

Activities of World Warning Agency

Summary of A.G.I. Warning Decisions and Geomagnetic Disturbances for July 1, 1957, December 31, 1958

During the I.G.Y. 21 Special World Intervals (SWI) totaling 45 days were declared by the World Warning Agency. Sixteen of these SWI were followed by 18 geomagnetic disturbances as indicated by Fredericksburg, Virginia, magnetograms (see Table 1). During two of the SWI there were two separate storms. Only four SWI, seven days in all, were not followed by disturbance. One SWI of one-day duration was initiated after a geomagnetic storm had started.

In six of the eighteen months (July, November 1957, July, August, October and December 1958) Special World Intervals were declared prior to the onset of the most severe disturbance observed during the month. The most severe storm in September 1957 began during an already successful SWI. Another major disturbance was missed intentionally in September 1957 since several severe storms had been predicted earlier in that month. In three months (August 1957, March and June 1958) SWI preceded the second most severe disturbance of the month. In each of the following months, October and December 1957 and April 1958, only one minor storm was observed. No storms were recorded in January and November 1958.

There were 40 periods of Solar Alert during the I.G.Y. totaling 193 days (see Table 2). Thirty-five geomagnetic disturbances as indicated by Fredericksburg, Virginia, magnetograms occurred during 24 of these Alerts. No storms accompanied 16 of the Alert periods and 18 geomagnetic disturbances during the I.G.Y. were not covered by periods of Alert.

TABLE I
Special World Intervals

N°	Year	Started 00.01 T. U.	Ended 23.59 U. T.	Duration in Days	Geomagnetic Storm (Fredericksburg)	
1	1957	June 30	July 03	4	June 30, 04XX U. T. (115) July 02, 0857 U. T. (44)	
2		August 24	August 24	1	No storm	
3		29	30	2	August 29, 1910 U. T. (28) ⁽¹⁾	
4		September	02	September 04	3	September 02, 03.15 U. T. (106)
5			12	13	2	13, 00.48 U. T. (143)
6		October 22	October 23	2	No storm	
7		November 26	November 27	2	November 26, 14.55 U. T. (51)	
8	1958	March 05	March 05	1	March 05, 05XX (34)	
9		15	15	1	14, 12.12 U. T. (23)	
10		23	25	3	25, 15.40 U. T. (22)	
11		30	31	2	30, 08XX U. T. (27)	
12		June	06	June 08	3	June 06, 18XX U. T. (51)
13			20	22	3	21, 02XX U. T. (44)
14		July	08	July 09	2	July 08, 07.49 U. T. (183)
15			30	31	2	No storm
16		August	17	August 18	2	August 17, 06.23 U. T. (56)
17			24	24	1	24, 01.40 U. T. (45)
18		27	28	2	27, 02XX (32)	
19	October 23	October 25	3	October 24, 07.30 U. T. (55)		
20	November 26	November 27	2	No storm		
21	December 13	December 14	2	December 13, 00.02 U. T. (33)		

The A-index (Fredericksburg) for the most severe 24-hour period of the disturbance is given in parentheses after the date of the storm.

⁽¹⁾ Duration less than 24 hours.

TABLE 2
Periods of Solar Alert

Nº	Year	Started 16.00 U. T.	Ended 16.00 U. T.	Duration in Days	Geomagnetic Storm Began
1	1957	June 28	July 06	8	June 30, July 2, July 5
2		July 16	20	4	No storm
3		21	24	3	July 22
4		25	27	2	No storm
5		August 02	August 07	5	August 03, August 06
6		23	25	2	No storm
7		28	September 06	9	August 29, August 31, September 2, September 4
8		September 09	15	6	September 13
9		18	23	5	September 21
10		27	October 02	5	September 29
11		October 14	20	6	October 14
12		21	23	2	No storm
13		November 12	November 15	3	No storm
14		24	27	3	November 26
15		December 15	December 22	6	No storm
16		26	29	3	No storm
17	1958	January 08	January 10	2	No storm
18		27	29	2	No storm
19		February 09	February 13	4	February 11

TABLE 2
Periods of Solar Alert

Nº	Year	Started 16.00 U. T.	Ended 16.00 U. T.	Duration in Days	Geomagnetic Storm Began
20		26	28	2	No storm
21	March	02	March 07	5	March 05
22		14	16	2	March 14
23		20	April 01	12	March 25, March 30
24	April	07	10	3	No storm
25		30	May 05	5	No storm
26	June	03	June 08	5	June 06
27		19	23	4	June 21
28	July	05	July 14	9	July 08
29		20	22	2	July 21
30		24	August 04	11	July 27
31	August	11	15	4	No storm
32		16	25	9	August, 17, August 22, August 24
33		26	29	3	August 27
34	September	10	September 18	8	September 16
35	October	03	October 06	3	No storm
36		14	26	12	October 22, October 24
37	November	14	November 16	2	No storm
38		25	30	5	No storm
39	December	04	December 07	3	December 04
40		10	16	6	December 13, December 15
				193	

The Aug. 12, Nov. 6, Dec. 31, 1957, Feb. 16, Mar. 11, Apr. 17, May 13, 25, 28, 31, June 10, 14, 28, July 18, Sept. 3, 25, Oct. 27, and Dec. 17, 1958 storms were not covered by periods of Alert.

TABLE 3

Major Geomagnetic Disturbances

Nº	Year	Storm Started		U. T.	Storm Severity Index		
					Hit	Miss	
1	1957	June	30	0528	150		
2		September	02	0314	135		
3				04	1300	(145) ⁽¹⁾	
4				13	0046	160	
5				21	1005		164 ⁽²⁾
6				29	0016		139 ⁽³⁾
7			November	26	1454	64	
8	1958	February	11	0125		199 ⁽³⁾	
9		March	11	2316		64	
10		May	31	1652		72	
11		June	06	18XX	77		
12				21	02XX	66	
13				28	0713		103
14		July	08	0749	200		
15		August	17	0623	82		
16				24	0140	85	
17				27	02XX	64	
18		Septembre	03	0842			131
19				25	0408		82
20		October	24	0730		89	

⁽¹⁾ This Sept. 04, 1957 storm began during the successful Sept. 02 SWI.

⁽²⁾ This Sept. 21, 1957 storm was not covered by an SWI since several major disturbances had been predicted successfully earlier in the month. It was during a period of Solar Alert.

⁽³⁾ The Sept. 29, 1957 and Feb. 11, 1958 storms were during periods of Solar Alert.

In Table 3 are listed the major geomagnetic disturbances of the I.G.Y. based on the Ap-index prepared by J. Bartels of the Committee on Characterization of Magnetic Disturbance, I.A.G.A., I.U.G.G. These indices tend to be somewhat higher than those of Fredericksburg used in the Tables 1 and 2. All disturbances with $AP \geq 60$ are listed. The storm severity index is the highest daily Ap observed during the storm but not necessarily the most disturbed 24 hour period. This index appears in the «Hit» column when it was preceded by a Special World Interval or in the «Miss» column when no SWI had been announced. It will be noted that 11 of the 20 disturbances were preceded by SWI; 5 of the 10 severest storms are included.

Ionosphere

The Boulder Laboratories of the NBS have issued (Technical Note n° 48) a « Report on the I.G.Y. oblique incidence sporadic E- and F-scatter program » by J. W. Finney and E. K. Smith, Jr.

INTERNATIONAL TELECOMMUNICATIONS UNION

The Administrative Radio Conference

(Reprint from the journal UIT, n° 4, April 1960)

Committee 4

(Frequency Allocation Committee)

With Mr. G. Pedersen (Denmark) in the Chair, and Mr. E. J. Stewart (Australia) and Mr. E. Oltuski Ozaki (Cuba) as Vice-Chairmen, Committee 4 had to examine all the problems relating to frequency allocation. In the course of its work, Committee 4 set up the following working groups as indicated on the following page.

Committee 4 held thirty-nine meetings between 21st of August and 12th of December, 1959, and discussed the following matters, among others :

FREQUENCY ALLOCATION TABLE

Obviously the main task of this Committee was the preparation of the new Frequency Allocation Table. The problem was complicated by the following facts :

the previous Table drawn up in 1947 at Atlantic City has been implemented progressively during the period 1951-1959 ;

the technical development of radio systems used in the various services had advanced considerably during the previous ten years ;

in view of this development, many Administrations had been led to put new installations into operation in frequency bands which did not always correspond to the Atlantic City Allocations.

Above 10 500 Mc/s, frequency assignments had been made to stations of various services either as an experiment or even for normal operation ;

new radio services such as the « Space » and « Earth-Space » and radio astronomy services had to be fitted into the new Table,

All these points gave rise to considerable discussion both in the Committee and in the Working Groups and Sub-Groups. Committee 4 finally drew up the new Table, the main points of which are :

Between 10 and 4000 kc/s, slightly modified but the general structure is unchanged,

Between 4 and 27.5 Mc/s, a large majority of delegations was in favor of the « status quo », and felt that in view of the costly efforts made by Members of the Union to bring this part of the Table into use, no substantial changes should be made. There are therefore few modifications in this part of the Table, and only on slight matters of detail.

Between 27.5 and 960 Mc/s, the problem was made more difficult by the introduction of new radio systems using ionospheric or tropospheric scatter propagation; the development of the mobile service and future requirements in the broadcasting service, including television, also had to be taken into consideration. As a result of an exchange of views this part of the Table was amended; there are, however, many footnotes indicating that, in some countries, allocations to services may differ from those given in the Table.

Between 960 and 10 500 Mc/s, there were no important changes; it should, however, be noted that frequency bands were allocated to the radio astronomy service, and to the « Space » and « Earth-Space » services for research purposes.

Finally, Committee 4 extended the Frequency Allocation Table to 40 000 Mc/s (40 Gc/s). Satisfactory agreement was reached on this part of the spectrum, on a world-wide basis, with some footnotes, however, concerning certain countries which were given special assignments.

The new Frequency Allocation Table, the finalizing of which was a very difficult task, can be considered accurately to reflect the present and future situation of radio services in the various countries. Although there are 248 footnotes, it is reasonable to suppose that Administrations will endeavour to operate their stations in

conformity with the Table. The next Administrative Radio Conference will study the results obtained, it being of importance that it be held not more than five years later in order to avoid the difficulties that arose in 1959 when modifying a Table drawn up twelve years before.

FOOTNOTES TO THE FREQUENCY ALLOCATION TABLE
AND CLASSES OF SERVICES

From the first meetings of Committee 4, a large number of delegations, as well as representatives of the International Frequency Registration Board, voiced the opinion that the footnotes to the Atlantic City Frequency Allocation Table could give rise to varying interpretations since the wording was not standardized. In some cases it was difficult to assess the relative status accorded to the different services. To solve this difficulty Committee 4 asked Working Group 4F, with Mr. Gejer (Sweden) in the Chair, to define the status of the various services and to separate the allocations into different categories. The work of this Group enabled the services with allocations in the Table or in footnotes to be divided into three main classes :

primary service,
permitted service,
secondary service

Also, the footnotes to the Table indicate whether the allocations concerned replace those given in the Table or are in addition to them.

FREQUENCY BANDS ALLOCATED EXCLUSIVELY
TO THE HIGH FREQUENCY BROADCASTING SERVICE

A certain number of frequency bands were exclusively allocated to the HF Broadcasting Service in the Atlantic City Table.

Because of congestion in these bands and the multiplicity of out of band broadcasting stations, a number of delegations asked for them to be widened.

Other delegations, however, disagreed with this proposal on the grounds that, since such widening would be to the disadvantage of other radio services, it would be wise to make absolutely certain that the change was necessary. For this reason, Committee 4

asked for the opinion of Committee 5, which was studying a new procedure for the improved use by the HF broadcasting service of the bands allocated to it. As this procedure has been drawn up and approved by Committee 5, it became pointless to propose the widening of the bands until the new procedure has been implemented. Accordingly, Committee 4, decided, on the recommendation of Committee 5, that there should be no change in the high frequency broadcasting exclusive bands.

Committee 5
(Frequency Registration Procedure
and International Frequency List)

Under the chairmanship of Dr. M. Joachim (Czechoslovakia) and the vice-chairmanship of Mr. M. A. Vieira (Portugal), Committee 5 had to study the problems arising from :
frequency assignment notification procedure ;
the International Frequency List.

The study of the frequency assignment notification procedure was entrusted to Working Group 5A with Mr. G. Searle (New Zealand) in the Chair, while Working Group 5 B, presided by Mr. J. A. Autelli (Argentine Republic) dealt with the International Frequency List.

FREQUENCY ASSIGNMENT NOTIFICATION PROCEDURE

The elaboration of a clear-cut frequency assignment notification procedure was a highly complicated task since conditions varied from service to service and from frequency band to frequency band. Working Group 5A had thus to work extremely hard.

It may be useful to recall the background of the matter. The Extraordinary Administrative Radio Conference (Geneva, 1951) noted that the Provisional Frequency Board (P.F.B.) was unable to prepare an International Frequency List, especially for the Fixed and Mobile Services. It therefore adopted a number of provisions which were applied by Administrations, with the help of the I.F.R.B., between 1952 and 1959.

During that time, it became evident that the rational use of the frequency spectrum required a serious study of each frequency assignment and that attention should be given to any changes in one or several characteristics of an existing assignment (bandwidth, power, antenna, directivity, etc.).

Working Group 5A had therefore to base its work on :

- the procedure given in Article 11 of the Atlantic City Radio Regulations ;
- the provisions of the Extraordinary Administrative Radio Conference (E.A.R.C.) Agreement (Geneva, 1951) ;
- the results obtained from 1952 to 1959 ;
- the difficulties encountered in preparing a high frequency broadcasting plan.
- the proposals submitted by a number of delegations for a new frequency assignment notification procedure and an improved use of the high frequency broadcasting bands.

After three months of discussion, Working Group 5A submitted for approval to Committee 5 :

- the new procedure for notification of frequencies and their registration in the Master International Frequency Register (Article 9 of the new Regulations) ;
- the procedure for the exclusive broadcasting bands between 5 950 and 26 100 kc/s (Article 10 of the new Regulations) ;
- appendices 1 and 2, giving directives for establishing Notices ;
- resolution No. 1 relation to the establishment of the Master International Frequency Register ;
- resolution No. 2 relation to the application from 1 March 1960 to 30 April 1961 (date upon which the new Regulations come into force) of the procedure specified in Article 10 of the Regulations.

INTERNATIONAL FREQUENCY LIST

The preparation of the International Frequency List gave rise to many problems at the Conference, because of the adoption, since the Atlantic City Conference, of a number of frequency assignment and frequency allotment plans. The development of radio services, the use of new techniques, and the case of new or developing countries required thorough study of the List. It was however clear to most delegations that the Conference could not undertake a complete revision, and would have to confine itself to adjustments likely to meet the requirements submitted. The work was split up among various subworking groups, the

terms of reference of which were limited to a specific region, service or part of the spectrum.

The main adjustments effected by the group concern :

the maritime mobile radiotelephone service. It was possible to provide an additional two-way channel in each band, and some channels were created for single sideband systems ;

The maritime mobile aeronautical service, the allotment plans for which were drawn up in 1949 and slightly altered pending a review of the whole problem by a future aeronautical conference, taking into account the increased speed of aircraft, in the future.

Conclusion

Thus after four months of hard work, the Administrative Radio Conference came to a successful conclusion. In the beginning it was permissible to wonder whether serious difficulties might not endanger its results ; the problems facing the Conference were considerable, especially with regard to future radiocommunications. Happily, however, the cooperation of all delegations was remarkable and so was their desire to reach solutions acceptable to all.

The Final Acts of the Administrative Radio Conference are composed of :

the Radio Regulations ;

the Additional Radio Regulations ;

the Additional Protocol,

the Resolutions and Recommendations adopted by the Conference.

Recommendation n° 4 of the Administrative Radio Conference

Attention of Members of Commissions II, III and IV should be drawn to Recommendation n° 4 adopted by the Administrative Radio Conference of Geneva, 1959.

RECOMMENDATION N° 4
to the C.C.I.R., relating to studies of radio propagation
and radio noise

The Administrative Radio Conference, Geneva, 1959.

considering :

- (a) that the efficient utilization of radio frequencies depends upon the use of the most reliable technical data and standards, especially in those parts of the radio frequency spectrum which are most congested ;
- (b) that the satisfaction of new frequency requirements and the development of radio services can be facilitated by improvements, where these are necessary, in the technical standards at present used by the I.F.R.B. ;
- (c) that, in accordance with Appendix A, administrations will endeavour to promote further studies on radio propagation and radio noise through the medium of the C.C.I.R. ;
- (d) that the C.C.I.R. has adopted a programme of studies covering many of these problems ;

invites the C.C.I.R. :

1. to continue the studies of radio propagation and radio noise and to take measures for the co-ordination of the results of these studies carried out in different countries ;
 2. to give particular attention to those studies which will assist in the further refinement of the technical standards used by the I.F.R.B. ;
 3. to report regularly on these matters, even if the studies have not been completed ;
 4. to continue regular consultation with other organizations undertaking studies of propagation such as the International Scientific Radio Union, in order to attain the maximum possible degree of co-ordination.
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C. C. I. R.

The Collaboration of C.C.I.R. and U.R.S.I.

(Reprint from the Journal UIT)

In the opening address of the IXth Plenary Assembly of the C.C.I.R. in Los Angeles in April 1959, Dr. Metzler, director of this organization, reviewed the action of the C.C.I.R.

We thought it would be interesting to reproduce an extract from this statement :

« Without going into details of the development of the C.C.I.R. since its foundation, it is nevertheless permissible to mention that its functions, within the framework of the International Telecommunication Union, do not cease to grow in importance.

I am very happy, in this connection, to note the presence, in this auditorium, of Dr. Dellinger who, if I am not mistaken, is the only amongst us all who participated in that decisive conference of 1927, and who, since the very birth of our organization, has always taken such an active part in its work. I take this opportunity of paying tribute to this eminent pioneer of the C.C.I.R. and of the U.R.S.I. and to thank him on behalf of the Committee.

Let us also pay homage to all those collaborators in the work of the C.C.I.R. who are no longer with us today, but who, by their personal support of our organization have contributed to the scientific and technical development of international radiocommunications.

If our role within the I.T.U. is consultative by definition, the C.C.I.R. nevertheless assumes great responsibility in the development of radio throughout the world. We are very conscious of this key-role which implies, on the one hand, a close contact with scientific progress and, on the other, imposes a realistic view of the technical possibilities and the needs of the users of radio in every sense, who are represented here at this Plenary Assembly by their respective international organizations. From the scientific viewpoint, we can congratulate ourselves on the help we receive from the International Scientific Radio Union, for example,

often due to the direct personal contacts existing between the C.C.I.R. and that body.

« We are living in a scientific age ». That sentence, uttered some time ago by one of the great leaders of the American electronics and radio industry, is very characteristic of our present era. The interrelation uniting the various branches of contemporary science makes close cooperation and reciprocal aid more and more necessary. The C.C.I.R. in its own interests, cannot get away from this law, which is the basis of the progress of our knowledge.

As an example, I have just cited the U.R.S.I., which is today requesting the help of the C.C.I.R., that we may, at the time of the International Radio Conference, back their efforts to facilitate the development of a relatively new branch of the science- that of Radio Astronomy. This branch originated with the discoveries of the American engineer, Karl G. Jansky in 1932. Today it covers a vast field of research, frequently in direct relation with the technical problems raised by radiocommunications.

I have already mentioned the role of the C.C.I.R. within the framework of the I.T.U. The importance of the work of this IXth Plenary Assembly is no doubt accentuated by the fact that, next summer, the International Radio Conference opens in Geneva. The recommendations which our Plenary Assembly may draw up will not be without a certain influence on the new technical international radio regulations. One of the thorniest tasks of international radio conferences is that of frequency allocation. For the moment, the physical space available to practical solutions of the problem is still limited by the surface of the earth and by the ionized layers of the upper atmosphere.

It is indeed true that the moon can send us radio signals back and thus serve, under certain conditions, as a sort of passive relay station between two earth stations. But other even more promising perspectives are now being offered to us. These perspectives allow us to envisage a revolution in frequency allocation for long distance circuits. I am speaking about the sputniks and the explorers, placed in suitable orbits, and acting as extraterrestrial radio relays, whether active or passive.

New problems will one day be put to the I.T.U. in the radio field and the C.C.I.R. will be called upon to collaborate in finding their solution. Thus, upon the initiative of the International

Astronautical Federation, and in particular that of its active President, Mr. Andrew Haley who is with us here today, the C.C.I.R. has undertaken to study certain questions of wave propagation which reach the very core of the problem of circuits between here and outer space.

It is quite obvious that the need for international cooperation is more than ever necessary in this new field, if we only think of the possibilities of interference. »

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International Electrotechnical Commission

Publication 34-2. Second edition. — Recommendations on determination of efficiency of rotating electrical machinery (excluding machines for traction vehicles).

Publication 52. Second edition. — Recommendations for voltage measurement by means of sphere-gaps (one sphere earthed).

These publications are on sale at the Central Office of the I. E. C. at the price of Sw. Fr. 8.— per copy, plus postage, for Publication 34-2, Sw. Fr. 8.— per copy, plus postage, for Publication 52.

International Telecommunications Union

We have pleasure in informing you that the 20th edition of the *Alphabetical List of Call Signs* has just been published.

In conforming with No 460 of the Radio Regulations, this List gives the call signs of call stations mentioned in Lists I to VII ⁽¹⁾ which are provided with an international call sign, with the exception of amateur or experimental stations. The list is preceded by 1) a table showing the allocation of call signs by country, 2) an annex table showing the form of call signs assigned by each Administration to its amateur and experimental stations, and 3) an alphabetical list of the characteristic signals of radiobeacons whose particulars appear in the List of Radiolocation Stations.

The covers and explanatory notes appear in English, Chinese, Spanish, French and Russian.

The price per copy of this document (available at the General Secretariat of I.T.U., Palais Wilson, Geneva, Switzerland) which comprises 1144 pages, is 20.— Swiss francs : this includes carriage by ordinary post and the price of supplements issued prior to the next edition.

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- (1) Lists I : Radio Frequency Record ;
II : List of Fixed Stations ;
III : List of Broadcasting Stations ;
IV : List of Coast and Ship Stations ;
V : List of Aeronautical and Aircraft Stations ;
VI : List of Radiolocation Stations ;
VII : List of Special Service Stations ;