INTERNATIONAL RADIO CONSULTATIVE COMMITTEE

C.C.I.R.

DOCUMENTS OF THE

IXth PLENARY ASSEMBLY

LOS ANGELES 1959

VOLUME II

RESOLUTIONS, QUESTIONS AND STUDY PROGRAMMES

Published by the
INTERNATIONAL TELECOMMUNICATION UNION
GENEVA, 1959

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Corrigendum to Volume II - issued in April 1960

Volume II

p. 31 Res. 38 — Delete " * " from heading.

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TABLE OF CONTENTS OF VOLUMES I TO V

of the Documents of the IXth Plenary Assembly of the C.C.I.R.

(Los Angeles, 1959)

Note — *For ease of reference, the page numbering in the English and French editions has been made the same.*

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LAYOUT OF VOLUMES I, II AND III

Recommendations, Reports, Resolutions, Questions and Study Programmes of the C.C.I.R.

General

The Recommendations, Reports, Resolutions, Questions and Study Programmes of the C.C.I.R., the texts of which appear in Volumes I, II and III, are those which have been approved by the IXth Plenary Assembly of the C.C.I.R., together with those which, approved by the Vth, VIth, VIIth and VIIIth Plenary Assemblies, have been retained.

The Recommendations, Reports and Resolutions of a general nature are arranged in numerical order.

The Questions and Study Programmes are grouped together and arranged in the numerical order of the Study Groups. For each Study Group, the Questions are laid out in numerical order, each being followed by the Resolution(s) and Study Programme(s) to which they are related. Study Programmes which are not the result of a Question are indicated by a note.

Questions submitted to the C.C.I.T.T. form the subject of a separate chapter.

References to the texts, if any, forming the basis of Recommendations, Reports, Resolutions, Questions and Study Programmes are given below the title. On the right under this reference is shown the Plenary Assembly or Assemblies which have approved or subsequently modified the text.

Mention is made in a footnote, when the occasion arises, of the texts or text which have been replaced by the text in question; in the case of a Question, the Study Programmes are shown which arise from it; and in the case of Study Programmes, mention has been made where necessary of the Questions to which they refer.

To facilitate reference to a desired document, and to reduce the bulk of the bound edition, the previous Volume I has been divided into three.

Volume I Recommendations of the C.C.I.R.
Volume II Resolutions, Questions and Study Programmes of the C.C.I.R.
Volume III Reports of the C.C.I.R.

Further to facilitate the tracing of a desired document, the Recommendations and Reports of the C.C.I.R., while retaining their serial numbering, have been grouped into ten sections, designated by capital letters:

A. Transmission
B. Reception
C. Fixed services
D. Mobile services and space-systems
E. Sound broadcasting and television
F. Radio-relay systems
G. Propagation
H. Standard-frequencies and time signals
J. International monitoring
K. Vocabulary

Definitions of the Recommendations, Reports, Resolutions, Questions and Study Programmes of the C.C.I.R.

The following definitions of Recommendations, Resolutions and Questions are those which appear in Doc. No. 272 of Geneva (Drafting Committee). The definition given for Study Programmes is that which appears in Doc. No. 630 of London (Drafting Committee). The definition given for Reports is that which appears in Doc. No. 731 of London (U.S.A.) modified by the addition of the words " by a Study Group ".

Recommendation	Statement issued when the study of a Question, or part of a Question, has been concluded.
Report	Statement for information on the studies carried out by a Study Group on a given subject.
Resolution	Statement of an opinion of the C.C.I.R. on a non-technical subject.
Question	Statement of a technical problem which the C.C.I.R. is to consider.
Study Programme	Text describing the work to be done on a given technical problem forming the subject of a Question.

Origin of certain documents referred to in these volumes

The documents referred to in this volume as " Stockholm ", " Geneva ", " London ", " Warsaw " and " Los Angeles " are respectively the documents of the Vth, VIth, VIIth, VIIIth and IXth Plenary Assemblies of the C.C.I.R. held in Stockholm in 1948, Geneva in 1951, London in 1953, Warsaw in 1956 and Los Angeles in 1959.

The documents referred to in this volume as of " Mexico " and " Florence/Rapallo " are respectively those of the High-Frequency Broadcasting Conferences of Mexico City (1948/49) and of Florence/Rapallo (1950).

Other documents referred to in this volume are the documents of the meetings of certain Study Groups of the C.C.I.R. The following list of the meetings of these Study Groups is given for information:

Zurich (July 1949)	Study Group XI
Washington (March 1950)	Study Groups VI and X
London (May 1950)	Study Group XI
Geneva (July 1950)	Sub-Group Gerber of Study Group XI
The Hague (April 1952)	Study Groups I and III
Stockholm (May 1952)	Study Groups V, VI and XI
Geneva (August 1952)	Study Group X
Geneva (September 1952)	Study Group IX
Brussels (March-April 1955)	Study Groups I and XI
Paris (July 1957)	C.M.T.T. (C.C.I.R./C.C.I.T.T. Joint Committee for Television Transmissions)
Geneva (December 1957)	Sub-Group Lépéchinsky
Moscow (May-June 1958)	Study Group XI
Geneva (July-August 1958)	Study Groups I, II, III, IV, V, VI, VII and IX
Monte-Carlo (October 1958)	C.M.T.T.

Numbering of the Recommendations, Reports, Resolutions, Questions and Study Programmes of the C.C.I.R.

The Recommendations, Reports, Resolutions, Questions and Study Programmes of the C.C.I.R. are numbered consecutively in five series, each starting at No. 1.

The series of Recommendations, Questions and Resolutions were started at the Vth Plenary Assembly (Stockholm 1948).

The series of Reports and Study Programmes were started at the VIth Plenary Assembly (Geneva 1951).

Questions and Study Programmes remaining for study after the IXth Plenary Assembly (Los Angeles, 1956) carry in Roman figures after the serial number, the number of the Study Group to which they have been submitted.

The following table serves as a guide to the numbering of C.C.I.R. documents:

Plenary Assembly of C.C.I.R.	Recommendation No.	Report No.	Resolution No.	Question No.	Study Programme No.
Vth Stockholm (1948)	1 to 35	Nil	1 and 2	1 to 33 *	Nil
VIth Geneva (1951)	36 to 85 **	1 to 15	3 to 9	46 to 73	1 to 38
VIIth London (1953)	87 to 144	16 to 37	10 to 19	74 to 112 ***	39 to 78 ***
VIIIth Warsaw (1956)	145 to 227	38 to 95	20 to 38	123 to 164 ****	82 to 115 ****
IXth Los Angeles (1959) . . .	228 to 324	96 to 174	39 to 67	171 to 206	124 to 168

* Questions Nos. 34 to 45 were submitted to the C.C.I.R. between the Vth and VIth Plenary Assemblies.

** Recommendation No. 86 was issued after the meeting of Study Group No. X of the C.C.I.R. held in Geneva in 1952.

*** Questions Nos. 113 to 122 and Study Programmes Nos. 79 to 81 were submitted to the C.C.I.R. between the VIIth and VIIIth Plenary Assemblies.

**** Questions Nos. 165 to 170 and Study Programmes Nos. 116 to 123 were submitted to the C.C.I.R. between the VIIIth and IXth Plenary Assemblies.

Allocation of Reports, Resolutions, Questions and Study Programmes to the Study Groups of the C.C.I.R.

Fourteen sections are provided, one for each of the fourteen Study Groups of the C.C.I.R., and each section is preceded by a list giving the allocation of Reports, Resolutions, Questions and Study Programmes to that Study Group.

In each section, the Questions are arranged in order of subject, and are followed by the relevant Resolutions, and Study Programmes. Included in the list are also the Reports of the C.C.I.R. which are relevant to the Question under study. Resolutions which do not directly concern the work of a Study Group have been collected in a special section at the beginning of this Volume.

A fifteenth section has been provided in which are to be found those Questions and Study Programmes which have been referred to the C.C.I.T.T. or to the C.M.T.T. for joint study.

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NOTE BY THE DIRECTOR OF THE C.C.I.R.

DOCUMENTATION FOR C.C.I.R. MEETINGS

To secure economy, both in time and money, in the reproduction of documents for C.C.I.R. meetings, the Director draws particular attention to Resolution No. 35 which deals with the contents and the length of documents. It is reproduced on page 31 of this volume. Further, as requested by the Organization Committee of the C.C.I.R. in Warsaw, the Director offers the following additional suggestions concerning the preparation and presentation of documents.

1. *General :*

1.1 On each document the Study Group to which it belongs and the meeting to which it is to be presented should be clearly indicated;

1.2 only *one* Question, Study Programme, etc. should be dealt with in each document;

1.3 lengthy quotations should not be made from the text of existing documents where a simple reference to the number (or paragraph) would suffice;

1.4 when announcing the date of a C.C.I.R. meeting, the Director, in consultation with the Chairmen of the Study Groups concerned and taking into account Resolution No. 67, will state the latest date by which documents should be received;

1.5 in conformity with § 1 of C.C.I.R. Resolution No. 67 (page 44), when documents are sent to the Chairman of a Study Group three copies should be despatched simultaneously to the Director of the C.C.I.R. for translation and reproduction.

2. *Texts :*

Texts, not longer than about 2,500 words (5 pages), should be presented in one of the working languages of the Union, typewritten and on one side of the paper only.

Mathematical formulae should be included only when absolutely essential for clarification. Whenever possible the derivation of formulae should be avoided.

3. *Figures :*

In general any one document should not include more than three pages of figures. In the interest of economy, the use of photography and other half-tone reproductions should be avoided.

Since the documents of the C.C.I.R. are reproduced in several languages, no textual matter should appear on the figures, with the exception of standard abbreviations internationally accepted (e. g. " Fig. 1 ", " km ", etc.). Should an explanatory text be necessary, it must be given on a separate page.

If possible figures should be submitted on transparent paper to facilitate reproduction.

The overall dimensions of figures should not exceed 17×25 cm ($6\frac{1}{2} \times 10$ inches) so that they may be reproduced on paper of the standard size used by the C.C.I.R.

COMPLETE LIST OF RESOLUTIONS ADOPTED BY THE C.C.I.R.

COMPLETE LIST OF QUESTIONS FORMULATED BY THE C.C.I.R. *

* The numbers of the Questions still under study are followed by a Roman numeral indicating the Study Group to which they have been allocated.

COMPLETE LIST OF STUDY PROGRAMMES OF THE C.C.I.R. *

* The numbers of the Study Programmes still under study are followed by a Roman numeral indicating the Study Group to which they have been allocated.

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RESOLUTIONS

of a general nature or involving organizations other than the C. C. I. R.

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RESOLUTION No. 15 *

STANDARDIZATION OF FACSIMILE APPARATUS FOR USE ON COMBINED RADIO AND METALLIC CIRCUITS

(Study Group No. III)

The C.C.I.R., (London, 1953)

CONSIDERING

(a) that a Joint Study Group of the C.C.I.T. and C.C.I.R., under the direction of the C.C.I.T., has already been formed for the study of certain aspects of " Transmission of half-tone pictures over combined radio and metallic circuits ";

(b) that this Joint Study Group has not yet completed its work;

(c) that the C.C.I.R. takes considerable interest in C.C.I.T. Question No. 46 - Arnhem (i.e. Question No. VI.8 (amended) of the Geneva revision) concerning the characteristics of apparatus for the transmission by facsimile of:

— telegrams in the public telegraph service;
— business documents;
— documents of large size such as, for example, meteorological charts;

(d) that other questions concerning facsimile telegraphy which are of joint interest to the C.C.I.T.T. and the C.C.I.R. will probably arise;

UNANIMOUSLY RESOLVES

that the Joint Study Group of the C.C.I.T. and C.C.I.R.** should remain in being to study these matters.

RESOLUTION No. 17

USE OF THE 26 Mc/s BROADCASTING BAND

(Study Group No. X)

The C.C.I.R., (London, 1953)

CONSIDERING

(a) that it is important that long-distance broadcasting should use all channels available to it;

(b) that when the smoothed relative sunspot number reaches 70, long-distance broadcast transmissions can be carried out efficiently during daylight hours, over many routes, on frequencies within the 26 Mc/s broadcasting band;

(c) that hitherto these frequencies have been very little used;

(d) that such transmissions on these frequencies, whenever they are possible, are particularly advantageous because of the very low atmospheric noise intensity and the low absorption;

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* This Resolution, together with Recommendation No. 244 and Question No. 95 (III), completes the study of Question No. 58.

** At present — " Joint Study Group C.C.I.T.T.-C.C.I.R. for phototelegraphy (MP) ".

(e) that this band will not be fully used until receivers covering it are available;

UNANIMOUSLY RESOLVES

1. that administrations should bring to the notice of broadcasting organizations the advantages of the 26 Mc/s band for long-distance broadcasting when ionospheric conditions are favourable;
2. that, when broadcasting organizations have decided that they will make use of the 26 Mc/s band, they should make their intention known well in advance, in order to expedite the availability of suitable receivers.

RESOLUTION No. 19 *

IDENTIFICATION OF RADIO STATIONS

(Study Group No. VIII)

The C.C.I.R., (London, 1953)

CONSIDERING

(a) that the need for solution of the problems raised in Question No. 187 (VIII) and Study Programme No. 115 is rapidly becoming more acute, more widespread and increasing use is being made of the radio spectrum, as well as greater use of multi-channel and high-speed F1 systems, resulting in increased congestion in the radio-frequency spectrum, particularly below 27500 kc/s;

(b) that only slight progress has been made in the study of Question No. 17 and Study Programme No. 26;

(c) that representations have been made by the I.F.R.B. to the C.C.I.R. to expedite satisfactory solutions of the problem posed in C.C.I.R. Question No. 17 and Study Programme No. 26 to facilitate the work of monitoring stations and to further the programme adopted by the E.A.R.C., Geneva, 1951;

(d) that increased emphasis is desirable in finding prompt and satisfactory solutions to the question of " Identification of Radio Stations ", and particularly that means should be found to superimpose, or otherwise transmit the call sign, preceded, when appropriate, by a special signal ** on radio transmissions employing multi-channel and high-speed F1 systems:

RESOLVES

that in the meantime, and as a matter of urgency, administrations should take such measures as will ensure transmission of the call sign preceded, when appropriate, by a special signal**, in a manner readily receivable and understandable by monitoring stations, as frequently as practicable, having regard to the present urgent need to facilitate international monitoring and more particularly to the furtherance of present efforts by administrations, assisted by the I.F.R.B., to carry out the decisions of the E.A.R.C., in Geneva, 1951.

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* The Bielorussian S.S.R., the P.R. of Bulgaria, the P.R. of Hungary, the Ukrainian S.S.R., the P.R. of Roumania, and the U.S.S.R. reserved their opinions on this Resolution.

** See Recommendation No. 323.

RESOLUTION No. 24

RADIO TRANSMISSION CAUSED BY INHOMOGENEITIES IN THE TROPOSPHERE (COMMONLY TERMED " SCATTERING ")

(Study Group No. V)

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that experiments have already shown the possiblity of utilizing frequencies in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands for transmission by tropospheric scatter propagation to distances well beyond the horizon;

(b) that the utilization of such frequencies over such distances may tend to reduce the rate of expansion of services in other frequency bands;

UNANIMOUSLY RESOLVES

that the attention of administrations and of the I.F.R.B. should be drawn to the potentialities of the frequencies in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands for fixed services over distances well beyond the horizon by means of tropospheric scatter propagation and should be invited to keep in touch with developments in this field (see Study Programme No. 139 (V)).

RESOLUTION No. 31

ORGANIZATIONS QUALIFIED TO TAKE ACTION ON QUESTIONS OF SOUND RECORDING

(Study Group No. X)

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that differences of opinion may exist as to which of the organizations I.E.C., I.S.O. or C.C.I.R. is in the best position to take action in questions concerning recording;

(b) that unnecessary duplication of work and multiplicity of standards may result if the present situation is allowed to continue;

UNANIMOUSLY RESOLVES

1. that the C.C.I.R. should determine the acceptability of existing standards and should collaborate with other international organizations in formulating new standards when the existing ones are unsuitable for the international exchange of programmes;

2. that the Director of the C.C.I.R. should keep in close touch with the I.E.C. and the I.S.O. with a view to avoiding unnecessary duplication of work.

RESOLUTION No. 32

TRANSMISSION OF MONOCHROME AND COLOUR TELEVISION SIGNALS OVER LONG DISTANCES

(Question No. 121 (XI))

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that the scope of the studies under Question No. 121 (XI) is considerable, and that it is not yet possible to give a complete and definite answer to this Question;

(b) that it seems, however, as far as the transmission of monochrome television signals is concerned, that the knowledge acquired through studies and the experience will enable a partial and provisional answer to be given to the problems listed in Question No. 121 (XI);

(c) that this answer, even though partial and provisional, will give administrations essential indications for their design projects;

(d) that, however, experience has shown that only a particularly close collaboration between the C.C.I.R. and the C.C.I.T.T. will allow an effective recognition of this possibility and the drafting of an early and complete reply;

(e) that this very collaboration is now extremely desirable in view of the problems to be solved in connection with the transmission of signals of the various colour television systems submitted for study by the C.C.I.R.;

UNANIMOUSLY RESOLVES

1. that a joint C.C.I.R.-C.C.I.T.T. * Group be established to start work in the near future;

2. that this Joint Group be given the following terms of reference:

2.1 to examine the possibility of accepting for a hypothetical reference circuit of 2,500 km with two intermediate video junction points, and for all monochrome television systems, the specifications laid down in Report No. 84 **;

2.2 if this should be the case for all or some of the specifications proposed, to draft a Recommendation to this effect, which will be submitted for approval to the Plenary Assemblies of the C.C.I.R. and C.C.I.T.T.;

2.3 to study the measures to be envisaged in order that the specifications supposed necessary for the transmission of television signals over long-distance links (coaxial cables, radio relay links, waveguides, etc.), for any one of the colour-television systems being studied, be met;

3. that the Director of the C.C.I.R. be responsible for the convening, the organization and the secretariat of this Joint Group.

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* At present — " Joint Study Group C.C.I.R.-C.C.I.T.T. for television transmission (C.M.T.T.) ".

** This Report has been replaced by Recommendation No. 267.

RESOLUTION No. 35

REDUCTION OF PREPARATORY DOCUMENTATION

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that since 1948 the C.C.I.R. has continued to develop at an ever increasing rate, as indicated by the interest shown in its work;

(b) that one result of this growing interest has been a great increase in the preliminary documentation issued before plenary assemblies, to the extent of some 500 documents, totalling 3,500 pages, before the VIIIth Plenary Assembly in Warsaw;

(c) that it is desirable to reduce this large volume of documentation:
— to secure financial economy;
— to reduce the peak-load on the Secretariat;
— in the interest of the general efficiency of C.C.I.R. work;

UNANIMOUSLY RESOLVES

1. that documents submitted to the Chairman of the Study Groups should be as short as possible, and only in exceptional circumstances should be longer than *2,500 words,* with approximately *3 pages of figures,* making in all *8 pages per document ;*

2. that documents of purely theoretical interest, which do not have a direct bearing on Questions and Study Programmes, or reports containing detailed original material, should not be submitted to the C.C.I.R. Short abstracts only of such documents should be sent to the C.C.I.R. for translation and publication. Copies of these documents, in their original language, could be distributed directly by the administration concerned to those who express their desire to receive copies;

3. that documents should contain only the indispensable minimum of mathematical formulae or numerical and experimental data;

4. that the Director should issue reminders to administrations requesting them to refrain from asking for more copies of documents than are really necessary.

RESOLUTION No. 38 *

TECHNICAL ASSISTANCE

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) Resolution No. 346 adopted by the 11th session of the Administrative Council reproduced in part in Document No. 491 of Warsaw;

(b) the growing importance of Technical Assistance in the sphere of telecommunications;

(c) the desirability of more effective collaboration in Technical Assistance on the part of the C.C.I.s;

(d) that additional technical information which could be given by the I.T.U. to the Technical Assistance Administration (T.A.A.) may improve ways and means of granting technical assistance;

(e) the advisability of keeping the countries concerned rapidly and fully informed of all the work carried out under the auspices of the I.T.U.;

RESOLVES

1. that a temporary joint C.C.I.R.-C.C.I.T.T. Committee be established promptly to study the present ways and means employed in granting Technical Assistance and to prepare for the Administrative Council suggestions to improve them in respect of telecommunications. The detailed terms of reference of this Committee are given in the Annex;
2. that membership of the Committee proposed in § 1 should include the Director or the Vice-director of the C.C.I.R. and the Director of the C.C.I.T.T. together with two members of the C.C.I.R. and two members of the C.C.I.T.T. of countries which are not members of the Administrative Council of the I.T.U. ;
3. that the Director of the C.C.I.R. should bring this Resolution to the attention of the C.C.I.T.T., the Secretary General of the I.T.U. and the Administrative Council.

ANNEX

1. Thorough study of the existing Technical Assistance procedure on the basis of the documentation supplied by U.N.O. and the I.T.U. and the answers to a Questionnaire which should be sent to the members of the I.T.U.
2. To study methods of improving and accelerating this procedure.
3. The most advantageous method whereby countries requiring Technical Assistance could obtain such assistance in the following forms, which are given as an example:
   - 3.1 consultations regarding plans for the development of telecommunication systems;
   - 3.2 expert study of telecommunication projects in various spheres (broadcasting stations, television stations, radio relay links, etc.);
   - 3.3 expert assistance in the planning, construction, assembly, and in the final adjustment of equipment;
   - 3.4 exchange of specialists in the sphere of radio communication, sound broadcasting and television, so that the experience acquired may be shared;
   - 3.5 the sending of consultants and consulting engineers at the request of a country receiving Technical Assistance;
   - 3.6 assistance in the training of technical personnel of a country receiving Technical Assistance—in the country receiving such assistance—in the countries granting Technical Assistance at the request of the country receiving assistance.
4. Organization of a more extensive information service on the work carried out by the organs of the I.T.U.

RESOLUTION No. 40

INFLUENCE OF THE TROPOSPHERE ON FREQUENCIES USED FOR TELECOMMUNICATION WITH AND BETWEEN SPACE VEHICLES

(Study Group No. IV)

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that communication between the earth and space vehicles is now a practical possibility;

(b) that the troposphere influences the characteristics of the received signals and the apparent positions as observed by radio methods;

UNANIMOUSLY RESOLVES

that U.R.S.I. be asked the following Question:

1. what effect does the troposphere have on the propagation through it of radio waves of all frequencies. Particular attention should be paid to:
— the attenuation of the waves;
— any variations in the direction of propagation;

2. what frequencies of transmission from space vehicles will produce the most useful information on the troposphere as a supplement to that obtainable by other methods?

RESOLUTION Nº. 42

WHISTLER MODE PROPAGATION

(Study Programme No 141 (VI))

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

that the mode of propagation at very low frequencies, known as the whistler mode, has potentialities for radio communication and can cause interference;

UNANIMOUSLY RESOLVES

that the U.R.S.I. be asked the following Question:

how may the field strength be calculated for waves propagated by the whistler mode for the case of:

1. both transmitter and receiver on the earth's surface;

2. one terminal on the surface and the other in or above the ionosphere?

RESOLUTION No. 43

RADIO PROPAGATION AT FREQUENCIES BELOW 1,500 kc/s

(Study Programme No. 142 (VI))

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

the problems involved in Study Programme No. 142 (VI) requires the scientific cooperation of the U.R.S.I.;

UNANIMOUSLY RESOLVES

that the U.R.S.I. be asked the following Question:

1. what physical conditions in the lower ionosphere are responsible for the reflection of Medium, Low and Very Low frequencies with particular reference to the possibility that more than one reflection height may be simultaneously effective;

2. how do the diurnal and seasonal variations in sky wave field strength depend on:
   — geographical location with particular attention to transpolar paths and antipodal regions;
   — path orientation including the influence of the earth's magnetic field;
   — solar and geomagnetic indices with particular reference to the amplitude and phase consequences of SID's and polar blackouts;
   — orientation of the path with respect to the day-night line;

3. what mathematical treatment is applicable to the general conditions of long-distance propagation in which the ionization, the direction of the magnetic field, and ground conditions (including terrain) vary along the propagation path? This question is of particular practical importance at the present time in relation to variations of phase and amplitude at Low and Very Low frequencies.

RESOLUTION No. 44

CHOICE OF A BASIC INDEX FOR IONOSPHERIC PROPAGATION

(Study Programme No. 150 (VI))

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that the sun is generally accepted as the primary cause of many geophysical phenomena and in particular of the formation of the ionosphere and of most of its variations;

(b) that when suitable smoothed averages are used the Wolf sunspot numbers provide an index of solar activity which shows a fairly good correlation with similarly smoothed ionospheric propagation data, but that these numbers are nevertheless subjective and empirical since they are obtained from an arbitrary formula base on the number of spots and of groups of spots observed on the sun's disk;

(c) that determination of the Wolf numbers depends on visual observation of the sun which can be made only under favourable meteorological conditions;

(d) that it has recently been shown that the intensity of solar radiation in the VHF (metric) and UHF (decimetric) ranges is closely correlated with visible solar phenomena;

UNANIMOUSLY RESOLVES

that U.R.S.I. be asked the following Question:

1. what relationships exist between solar phenomena, other than sunspots expressed in Wolf numbers, which can be observed objectively, and ionospheric propagation conditions;

2. what is the relationship between the intensity of solar radiation at radio frequencies and ionospheric propagation conditions;

3. what is the possibility of establishing an index of solar activity, based upon optical or radio observations, which can be usefully employed as a basic index for ionospheric propagation;

4. what is the possibility of utilizing, perhaps temporarily, some observations of terrestrial phenomena, such as of a geomagnetic or of an ionospheric character, so as to provide a suitable index of solar influence on ionospheric phenomena, for use in connection with ionospheric propagation studies?

RESOLUTION No. 45

IDENTIFICATION OF PRECURSORS INDICATIVE OF SHORT-TERM VARIATIONS OF IONOSPHERIC PROPAGATION CONDITIONS

(Study Programme No. 93 (VI))

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that increased efficiency in many practical uses of ionospheric radio propagation would result if reliable identification of precursors of variations in propagation conditions could be made;

(b) that such identification is most important for ionospheric storms;

(c) that solar phenomena appear to be an important source of precursors;

UNANIMOUSLY RESOLVES

that the U.R.S.I. be asked the following Question:

what solar events or other phenomena may be used for reliable prediction of short-term variations in ionospheric radio propagation conditions, particularly ionospheric storms?

RESOLUTION No. 46

MEASUREMENT OF ATMOSPHERIC RADIO NOISE

(Study Programme No. 154 (VI))

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that information is required on the atmospheric radio noise received on the types of directional antenna in common use for radio communication;

(b) that such information might be obtainable by consideration of the mean power and other properties of the noise radiated from thunderstorm areas;

UNANIMOUSLY RESOLVES

that U.R.S.I. be asked the following Question:

1. how can the mean noise power radiated, at different frequencies in the range 10 kc/s to 30 Mc/s from areas of thunderstorm activity be deduced from:

— the characteristics of the noise radiated by individual lightning flashes;
— the geographical distribution and frequency of occurrence of lightning flashes in thunderstorm areas;

2. what information on these two topics is currently available in a suitable form for the estimation of radiated noise power?

Note. — The attention of the W.M.O. should be drawn to this Resolution.

RESOLUTION No. 47

EFFECTS OF THE IONOSPHERE ON RADIO WAVES USED FOR TELECOMMUNICATION WITH AND BETWEEN SPACE-VEHICLES BEYOND THE LOWER ATMOSPHERE

(Study Groups Nos. IV and VI)

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that communication between the earth and artificial earth satellites is now a practical reality;

(b) that, while VHF and UHF emissions are likely to be used for many such communication purposes, the ionosphere nevertheless will have some influence on the character of the received signals and on apparent positions as observed by radio methods;

(c) that the study of the effects of the ionosphere on such communications may be facilitated by comparison of HF signals with VHF and UHF signals since the ionospheric effects are larger on the lower frequencies;

(d) that, in particular, the ionosphere above the F2-layer peak, which cannot normally be studied with radio waves of terrestrial origin, will have some influence on such communications;

(e) that magneto-ionic double refraction in particular can cause changes in the state of polarization;

UNANIMOUSLY RESOLVES

that U.R.S.I. be asked the following Question:

1. what effect does the ionosphere have on the propagation through it of radio waves of all frequencies; particular attention should be paid to:
   — the attenuation of the waves,
   — any variations in the direction of propagation,
   — changes in the state of polarization;

2. what frequencies of transmission from artificial earth satellites will provide the most useful information on the ionosphere as a supplement to that obtainable by ionospheric sounding from terrestrial observatories?

RESOLUTION No. 52*

IONOSPHERIC-SCATTER AND METEOR-BURST PROPAGATION

(Study Programme No. 147 (VI))

The C.C.I.R., (Warsaw, 1956—Los Angeles, 1959)

CONSIDERING

(a) that experiments carried out in the arctic, temperate and tropical zones, on ionospheric scatter propagation in the lower part of the VHF band, prove the possibility of utilizing very high frequencies for long-distance (continental and intercontinental) fixed services;

(b) that regular layer propagation can also occur in the same frequency range for certain periods of time which increase in duration with solar activity;

(c) that problems connected with the occurrence of regular layer propagation may, in middle and low latitudes, make undesirable the use of these frequencies in years of high solar activity;

(d) that experiments carried out since 1951 have shown that the use of a single frequency is sufficient for the operation of some radio circuits of this type 24 hours a day, throughout the year, although in view of § *b* and *c* this may not be practicable in all latitudes throughout the solar cycle;

(e) that, in addition to the above, intermittent communication in the lower part of the VHF band by meteor-burst propagation has been demonstrated;

(f) that a particular frequency can probably be shared by several scatter and/or meteor-burst circuits suitably distributed over the world;

(g) that the utilization of very high frequencies for fixed services over long distances may tend to reduce the rate of expansion of services in the medium and HF bands;

(h) that the transfer of some of the long-distance fixed services from the MF and HF bands to the VHF bands could reduce congestion in the former bands;

(i) that the divergences between the regional frequency allocations above 27·5 Mc/s made in the Atlantic City Table of Frequency Allocations, as laid down in Article 5 of the Radio Regulations, give rise to difficulties in exploiting the possibilities of both ionospheric scatter and meteor-burst propagation for inter-regional communications and of frequency sharing as indicated in § *f*;

UNANIMOUSLY RESOLVES

to invite Administrations and the I.F.R.B.:

1. to consider the potentialities of very high frequencies for fixed services over long distances by means of ionospheric scatter and meteor-burst propagation, bearing in mind the related interference problems;

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* This Resolution replaces Resolution No. 28.

2. to include, in any studies of frequency utilization which they may carry out in preparation for the next Administrative Radio Conference, the study of the consequences of these potentialities;

3. to keep in touch with developments in connection with Study Programme No. 146 (VI) (in particular § 8) and Study Programme No. 147 (VI) (in particular § 7).

RESOLUTION No. 53

STANDARD FREQUENCY AND TIME SIGNALS TRANSMISSIONS IN BAND 4

(Question No. 142 (VII))

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that considerable experience has now been obtained on the operation of a standard-frequency and time-signal service on the frequency bands allocated in accordance with Recommendation No. 2 adopted by the Administrative Radio Conference (Atlantic City, 1947);

(b) that the accuracy obtainable in receiving the standard-frequency and time-signal service at great distances is not always sufficient for those users requiring the highest precision;

(c) that it has been shown that a higher order of accuracy of standard-frequency reception at great distances can be obtained from transmissions in Band 4;

(d) that it may be possible also to make narrow-band and higher precision transmissions of time signals in Band 4;

(e) that intolerable interference would be produced if several standard-frequency and time-signal stations operated simultaneously on the same frequency in Band 4, and service would need to be carefully coordinated with a limited number of stations;

UNANIMOUSLY RESOLVES

that the next Administrative Radio Conference be requested to provide for an international standard-frequency and time-signal service in Band 4, a suitable frequency being in the neighbourhood of 20 kc/s (15 to 25 kc/s) and the bandwidth required being about 100 c/s.

RESOLUTION No. 55

RADIO RELAY SYSTEMS FOR TELEVISION AND TELEPHONY.

Preferred frequency bands and centre frequencies for radio-relay links for international connections.

(Study Group No. IX)

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that line-of-sight and near line-of-sight radio-relay links have already been established by many countries for international connections and that such networks are expanding;

(b) that some countries may be considering the use of tropospheric-scatter links for international connections;

(c) that the C.C.I.R. has recommended preferred radio-frequency interconnection arrangements for radio-relay links of capacity from 60 to 1,800 telephone channels, or for television (Annex I);

(d) that, for radio-frequency interconnection of links in international networks, agreement is necessary on specific radio frequencies as well as on the arrangement of radio channels within a band;

(e) that specific radio frequencies can readily be defined in terms of the centre frequency of the radio-frequency interconnection arrangement;

(f) that, for technical reasons, only certain preferred values of the centre frequency are acceptable in a given frequency band;

(g) that there are various aspects of radio-wave propagation and equipment design that lead to the choice of particular frequency bands for certain capacities and types of radio-relay system;

(h) that radio-relay links used for international connections must meet similar high standards of performance to those recommended by the C.C.I.T.T. for metallic circuits;

(i) that it is essential to avoid interference to radio-relay links used for international connections, either from other radio-relay links or from other radio services (including harmonics), operated in the same or other countries;

UNANIMOUSLY RESOLVES

that the attention of the Administrative Radio Conference be drawn to:

1. the technical advantages of international agreement on preferred frequency bands within which international line-of-sight and tropospheric-scatter radio-relay links may be established using the radio-frequency channel arrangements recommended by the C.C.I.R.;

2. the technical advantages of preferred values for the centre frequencies of bands for line-of-sight and tropospheric-scatter systems being established by international agreement;

3. the risk of interference between line-of-sight and tropospheric-scatter links if these operate in the same frequency band and in the same geographical zone;

4. the need to avoid interference to radio-relay links used for international connections from other radio services or harmonics radiated by them.

ANNEX I

C.C.I.R. RECOMMENDATIONS FOR PREFERRED RADIO-FREQUENCY CHANNEL ARRANGEMENTS FOR RADIO-RELAY SYSTEMS USED FOR INTERNATIONAL CONNECTIONS (1), (6)

Recommendation No.	Maximum capacity of each radio carrier (Telephone channels or Television (TV))	Preferred " centre " frequency (2), (3) f_0 (Mc/s)	Width of radio-frequency band occupied (Mc/s)
283	60/120	1,808 2,000 2,203	200 200 200
284	60/120	7,558·5 (4)	300
278 and 279	300/1,800 or TV or equivalent	1,903 2,101 4,003·5 (5)	400 400 400 (6)
280	600/1,800 or TV or equivalent	6,175	500 500 500

(1) The Recommendations referred to above apply to line-of-sight and near line-of-sight radio-relay systems. In the case of tropospheric-scatter systems, it has not yet been possible to formulate preferred radio frequency channel arrangements but the attention of the Administrative Radio Conference is drawn to Recommendation No. 303 and to Report No. 136.

(2) The " centre " frequency here means a frequency approximately in the middle of the band. For technical reasons the " centre " frequency is not precisely at the middle of the band.

(3) Other centre frequencies may be used by agreement between the Administrations concerned.

(4) Subsequent to the Plenary Assembly, it was brought to the notice of the Secretariat that this figure is in error. The correct value should be 7557·5 Mc/s.

(5) In the case of radio-relay systems used in Regions 2 and 3 and operating in the 4,000 Mc/s frequency band, an alternative radio-frequency channel arrangement may be used (see the Note in Rec. No. 278).

(6) The attention of the Administrative Radio Conference should be drawn also to Study Programme No. 160 (IX).

RESOLUTION No. 57

RADIO-RELAY SYSTEMS FOR TELEPHONY USING FREQUENCY DIVISION MULTIPLEX

Methods for the computation of intermodulation-noise due to non-linearity

(Question No. 115)

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that Question No. 115 asks that a study be carried out of methods of computation of intermodulation noise due to non-linearity in radio-relay systems;

(b) that, after study of this Question, some useful information and some valuable reference material has been collected in Report No. 129;

UNANIMOUSLY RESOLVES

1. that the attention of those Administrations who are interested in this Questions be drawn to Report No. 129;

2. that the study of Question No. 115 be terminated.

RESOLUTION No. 58

STANDARDS OF SOUND RECORDING FOR THE INTERNATIONAL EXCHANGE OF PROGRAMMES

(Recommendation No. 208)

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that for the international exchange of recorded sound broadcast programmes magnetic recording on tape tends to replace lateral-cut recording on disks;

(b) that the C.C.I.R. standards for transcription recording on disks have been published by the I.E.C. in Publication 98;

UNANIMOUSLY RESOLVES

1. that the Director of the C.C.I.R. shall inform the I.E.C. that C.C.I.R. Recommendation No. 208 has been cancelled;

2. that future amendments of the existing specifications for lateral-cut transcription recording on disks will be left to the I.E.C.

RESOLUTION No. 59

STANDARDS OF SOUND RECORDING FOR THE INTERNATIONAL EXCHANGE OF PROGRAMMES

(Study Group No. X)

The C.C.I.R., (London, 1953—Warsaw, 1956—Los Angeles, 1959)

UNANIMOUSLY RESOLVES

1. that the Director of the C.C.I.R. inform the I.E.C. that Recommendation No. 209 has been amended (see Recommendation No. 261);

2. that I.E.C. be invited to take account of these amendments.

RESOLUTION No. 63

ON I.T.U. TECHNICAL ASSISTANCE

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) Resolution No. 32 of the Plenipotentiary Conference of Buenos Aires, 1952, Resolution No. 384 of the Administrative Council and C.C.I.R. Resolution No. 64;

(b) such future action as the Plenipotentiary Conference of Geneva (1959) may take in connection with Technical Assistance;

UNANIMOUSLY RESOLVES

that the I.T.U. organs might take into account, amongst other things, the proposals of the joint C.C.I.R./C.C.I.T.T. Committee on Technical Assistance (C.M.A.T.).

RESOLUTION No. 64

I.T.U. TECHNICAL ASSISTANCE

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that Resolution No. 32 of the Plenipotentiary Conference at Buenos Aires (1952) instructs the C.C.I.'s to undertake joint studies with a view to recommending suitable means for linking to the world telephone network regional networks which are not yet connected thereto;

(b) that Resolution No. 384 of the Administrative Council invites the C.C.I.s to undertake measures to help in the development of telecommunications in Asia and the Far East;

(c) that the questions raised in Administrative Council Resolution Nos. 382, 383 and 384 regarding the participation of the C.C.I.R. in the Technical Assistance Programme of the United Nations involve the broad responsibilities of the I.T.U. as the specialized agency of the United Nations for telecommunications, as defined in Article 1 of the Agreement between the United Nations and the I.T.U.;

UNANIMOUSLY RESOLVES

1. that countries wishing to modernize and/or expand their telecommunications should participate more actively in the work of the I.T.U. by establishing close relations with the organs of the Union;

2. that the countries involved be given accelerated and sustained Technical Assistance as the most appropriate method of implementing the tasks entrusted to the C.C.I.s by the Plenipotentiary Conference and the Administrative Council;

3. that the Plenipotentiary Conference be invited:

3.1 to entrust to the organs of the Union the responsibility of co-ordinating the preparation and implementation of any programme related to the improvement of the telecommunications systems in any country or region of the world which requires technical assistance for that purpose;

3.2 to provide for the necessary additional budgetary and staff requirements to carry out this responsibility;

3.3 to lay down any appropriate means for implementing this proposal.

RESOLUTION No. 65

EX-GRATIA PAYMENT TO THE GENEVA STAFF AT THE IXth PLENARY ASSEMBLY OF THE C.C.I.R.

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that Administrative Council Decision D.223 states: " no compensation will be granted to officials doing overtime on mission ";

(b) that this Decision concerns only officials brought from Geneva to Los Angeles;

(c) that a new procedure (Resolution No. 36) was established at Warsaw to carry out the work of the C.C.I.R., and there was not adequate experience to enable a close estimate of the volume of work involved and the staff required for the IXth Plenary Assembly;

(d) that the actual volume of work at the IXth Plenary Assembly far exceeded the estimates on which the strength of the staff brought from Geneva was based;

(e) that it was not possible to consider the extension of the Plenary Assembly beyond 29th April 1959, to enable completion of its work with normal working hours, as the necessary accommodation was not available and as such an extension would have involved considerable additional expenditure;

(f) that the nature of the work required experience of the C.C.I.R., particularly in respect of the key personnel;

(g) that the staff as a whole and especially the key personnel was obliged to work unduly long hours;

UNANIMOUSLY RESOLVES

1. a sum of 6,252.00 Sw. frs. should be included in the accounts over and above the amount of the budget of the IXth Plenary Assembly, to be used as an ex-gratia payment to such staff members in grades *e* to *k*, including supernumerary staff assimilated to these grades, who have put in more than 45 hours per week integrated over the whole period of the Plenary Assembly in accordance with the details given in the Annex below;

2. that this Resolution, and in particular the circumstances which obliged the Assembly to take this action, should be brought to the attention of the 14th Session of the Administrative Council.

ANNEX

DETAILS OF EX-GRATIA PAYMENT

Function	Status *	Grade	Amount of ex-gratia payment (Sw. frs.)
1. Secretary to Director.	P	f	24.00
2. Secretary to Vice-Director.	P	f	72.00
3. Administrative Assistant.	P	f	480.00
4. Secretary	P	h	132.00
5. Assistant to Chief Docs.	T	g	56.00
6. Assistant to Chief Docs.	S		
7. Chief Document Control.	T	h	712.00
8. Chief of Pool.	P	h	536.00
9. Shorthand Typist.	P	g	196.00
10. Shorthand Typist.	S		48.00
11. Shorthand Typist.	S		112.00
12. Shorthand Typist.	P	f	204.00
13. Shorthand Typist.	P	h	252.00
14. Senior Typist English.	S		320.00
15. Senior Typist English.	S		296.00
16. Senior Typist French.	T	i	216.00
17. Senior Typist French.	T	i	248.00
18. Senior Typist Spanish.	S		200.00
19. Senior Typist Spanish.	S		180.00
20. Typist.	P	j	148.00
21. Typist.	P	g	200.00
22. Head of Doc. Reproduction Service.	T	j	896.00
23. Head of Doc. Distribution Service.	P	k	724.00
TOTAL			6,252.00

*P = Permanent; T = Temporary; S = Supernumerary.

RESOLUTION No. 66

TECHNICAL APPARATUS

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) section 6.3 of the report of the Finance Committee of the VIIIth Plenary Assembly of the C.C.I.R. approving the inclusion of a sum for technical apparatus in the C.C.I.R. annual budgets for 1957, 1958 and 1959;

(b) the section of the Director's Report to the IXth Plenary Assembly of the C.C.I.R. headed " C.C.I.R. Technical Apparatus ", in particular the paragraph in which he reports on the review he has made as a result of Section 6.3 as mentioned in *(a)* above;

(c) that at its 13th session in 1958 the Administrative Council of the I.T.U. expressed a wish to have the opinion of the IXth Plenary Assembly of the C.C.I.R. before providing a credit for technical apparatus in the ordinary budget of the C,C.I.R.;

Reaffirming that the C.C.I.R. should not establish a laboratory, but, on the other hand, *recognizing* the utility of maintaining the small amount of technical apparatus existing in the Secretariat;

UNANIMOUSLY RESOLVES

1. to include annually in the estimates of ordinary expenditure of the C.C.I.R. a sum of Sw. frs. 6,000 to provide for the upkeep of the existing technical apparatus and for its gradual replacement, and to request the Administrative Council to provide this sum in the annual budgets;

2. that the Director should arrange for this apparatus to be used by the technical staff of the C.C.I.R. Secretariat;

2.1 so as to keep them in touch as closely as possible with modern technical radio developments and propagation phenomena in particular;

2.2 so as to contribute, where possible, to C.C.I.R. studies on wave propagation.

RESOLUTION No. 67*

ORGANIZATION OF C.C.I.R. WORK

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) the importance of utilizing the period of the Plenary Assembly as efficiently as possible;

(b) the experience between the VIIIth and the IXth Plenary Assemblies, with particular reference to Interim Study Group Meetings;

(c) the need to keep Interim Study Group Meetings to a minimum consistent with effective and economical working;

(d) the desirability of continuing the efforts to spread the work load of the Members and of the Secretariat as equally as possible over the interval between Plenary Assemblies;

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* This Resolution replaces Resolutions Nos. 36 and 37.

UNANIMOUSLY RESOLVES

1. that every effort should be made by the Director of the C.C.I.R. and the Study Group Chairmen to improve the efficiency of the work by correspondence;

2. that to expedite the work of the Study Groups, the Study Group Chairmen may appoint interim Working Groups. These Working Groups may be organized most expeditiously during Study Group meetings and, when appropriate, the organization and terms of reference of Working Groups should be specified in a Study Programme;

3. that interim Study Group meetings should only be held when this is deemed essential and be kept as short as possible;

4. that the necessity for holding an interim Study Group meeting, and the exact dates of such a meeting, will be decided between the Director of the C.C.I.R. and the Chairman of the Study Group concerned, after the latter has consulted his members and his Administration, and obtained the agreement of the majority of the members of the Study Group;

5. that the work to be carried out during the interim meetings shall be confined to work which it has not been possible to deal with by correspondence;

6. that, to allow time for the results of interim Study Group meetings to be prepared for the Plenary Assembly, these meetings should preferably take place *not later than seven months* before the start of the Plenary Assembly;

7. that, to avoid a large number of new contributions being submitted after the interim Study Group meetings, these meetings should, in principle, take place *not earlier than ten months* before the start of the Plenary Assembly;

8. that the series of Interim Study Group meetings should include a suitable grouping of related Study Groups where this is desirable;

9. that the Chairmen of Study Groups should prepare *Interim Reports* outlining the work to be done at interim meetings, such Reports to reach the Director of the C.C.I.R. at least two months before the start of such meetings;

10. that all Study Groups should hold final meetings at the same place as, and immediately preceding, the Plenary Assembly;

11. that the duration of the final meetings of the Study Groups shall not exceed 14 calendar days, and of the final Study Groups and the Plenary Assembly shall not exceed a total of 25 calendar days;

12. that administrations be reminded that the documentation for Study Group meetings shall conform with Resolution No. 35;

13. that, in order that contributions (excluding the *Final Reports* of the Study Group Chairmen) may be prepared by the Secretariat and distributed in time to reach the participants one month in advance of the start of the respective meetings, such contributions shall be submitted to the Study Group Chairman (one copy) and to the Director of the C.C.I.R. (three copies) as follows:

13.1 for interim Study Group meetings—*four months* prior to the opening dates of such meetings,

13.2 for the Plenary Assembly—*six months* prior to the opening date;

14. that contributions submitted after the preparation of the Study Group Chairmen's Final Reports will be considered by the Study Groups in their final meetings during the Plenary Assembly *only* in the most exceptional cases and subject to the approval of the Plenary Assembly. Such contributions shall be in the form of proposals for action by the Plenary Assembly, or proposals for specific changes to draft documents forming part of the Study Group Chairmen's Final Reports. The Study Groups in their final meetings should, in principle, consider only comments by administrations and delegations relating to the Documents forming part of the Study Group Chairmen's Final Reports;

15. that contributions for the final Study Group meetings, submitted after the preparation of the Study Group Chairmen's Final Reports, shall only be accepted for consideration if approved by the first plenary meeting of the Plenary Assembly;

16. that documentation for the Plenary Assembly shall consist of:

16.1 the Final Report of the Chairman of each Study Group, which should cover all the work of the Study Group (including work carried out at any interim Study Group meeting or by correspondence); it should also include such draft Recommendations, Resolutions, Reports, etc., as may be desirable;

16.2 the Report of the Director to the Plenary Assembly;

16.3 the Findings of the Joint Study Groups;

16.4 documents bearing on the organization of the C.C.I.R.;

16.5 any late documents for consideration at the first plenary meeting of the Plenary Assembly (see § 14 and 15);

16.6 documents from other international organizations of interest to the C.C.I.R.

17. that Study Group Chairmen should send their Final Reports to the Director of the C.C.I.R. so that he receive them at least four months before the start of the Plenary Assembly.

RESOLUTIONS, QUESTIONS AND STUDY PROGRAMMES

(Classified by Study Groups)

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STUDY GROUP No. I

(Transmitters)

Terms of reference :

1. To make specific studies and proposals in connection with radio transmitters and generally to summarize and co-ordinate proposals for the rational and economical use of the radio spectrum.
2. To study a number of problems concerning telegraphy and telephony from the transmission point of view.
3. To study spurious radiation from medical, scientific and industrial installations.

Chairman : Colonel J. LOCHARD (France)
Vice-Chairman : Professor S. RYŹKO (P. R. of Poland)

* See Volume III, Section A.

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QUESTION No. 1 (I)*

REVISION OF ATLANTIC CITY RECOMMENDATION No. 4

The C.C.I.R., (Stockholm, 1948)

CONSIDERING

that to give maximum effectiveness to the studies requested by the International Radio Conference of Atlantic City (1947) in its Recommendation No. 4 to the C.C.I.R. it is expedient to rearrange this recommendation and incorporate the relevant Bucharest questions;

UNANIMOUSLY RESOLVES

A. that the text of Atlantic City Recommendation No. 4 can be rearranged and extended as follows:
in respect of the various classes of emission in use, determination of:
(a) the bandwidth strictly necessary to ensure a service of the appropriate quality, practical methods of measuring the bandwidth actually occupied by each emission;
(b) the level of radio-frequency harmonics radiated by the stations of the different services, the level to which it is practicable to reduce such harmonics,
the methods of achieving this result,
the corresponding methods of measurement;
(c) study of improved methods of obtaining frequency stability in transmitters;

B. that the above questions ** be studied simultaneously and with the same urgency;

C. that Questions Nos. 1, 4, 11, 14, 16 and 17 of the C.C.I.R. of Bucharest be removed from the list of questions to be studied by the C.C.I.R.

AND UNANIMOUSLY DECIDES

to carry on permanently the study of the above-mentioned questions and to publish its recommendations and possible revisions as soon as practicable.

STUDY PROGRAMME No. 40 (I) ***

METHODS OF MEASURING EMITTED SPECTRA IN ACTUAL TRAFFIC

The C.C.I.R., (London, 1953)

CONSIDERING

(a) that it is of the highest importance to be able to determine with accuracy the bandwidth occupied and the spectrum of emissions in actual traffic;

(b) that the documentary material at present available does not give a full idea of the value of the results obtained in actual traffic with the apparatus used for measuring the spectrum of a periodic signal;

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* Study Programmes Nos. 40 (I), 124 (I), 125 (I) and 126 (I) arise from this Question.

** Concern Questions Nos. 1 (I), 2, and 3 (III).

*** This Study Programme arises from Question No. 1 (I) (§ *a*).

UNANIMOUSLY DECIDES that the following study should be carried out:

1. for a given type of measuring equipment, comparison of the results obtained on periodic signals and on actual traffic signals of comparable characteristics and of the same telegraph speed;
2. comparison of the results obtained with different methods such as those described in Recommendation No. 229;
3. continuation of experimental and mathematical studies in an attempt to bring out the physical meaning of the results obtained in actual traffic, considering various forms of energy distribution within the spectrum, especially those resulting from the use of privacy systems;
4. examination of the results obtained when using the method 1.1 of Recommendation No. 229 in cases where the bandwidth of the filter is inadequate to provide sufficient discrimination against adjacent components;
5. determination of the degree of accuracy obtainable with different methods such as those described in Recommendation No. 229.

STUDY PROGRAMME No. 124 (I)*

SPURIOUS EMISSIONS

The C.C.I.R., (Geneva, 1951—Los Angeles, 1959)

CONSIDERING

(a) that for wave propagation at frequencies where ionospheric reflection plays an important part, the propagation of spurious emissions in any given direction may, due to the wide difference in frequencies, be different from that of the fundamental emission in the same direction; this effect is additional to that caused by the difference in antenna directivity for the fundamental and the spurious emissions;

(b) that the spurious emissions of a transmitter provided for one class of service may interfere with other classes of service in other parts of the frequency spectrum;

(c) that the relationship between the fundamental and harmonic field intensities and between the radiated powers and field intensities of harmonics and other spurious emissions measured at a distance from the transmitter differ markedly in the cases:

- — where both the fundamental and the spurious emission involve ionospheric propagation;
- — where only the spurious emission involves ionospheric propagation;
- — where only the fundamental emission involves ionospheric propagation;
- — where neither the fundamental nor the spurious emission involves ionospheric propagation;

(d) that in order to achieve or maintain a good standard of practice for transmitters with respect to the suppression of spurious emissions, it is essential to have readily applicable methods of specifying and testing equipments;

(e) that since many existing high power transmitters have a fundamental to harmonic power ratio of 70 db or greater, it is desirable to consider further:

- — the need for revised limits for harmonic power output for such cases;
- — reduction of harmonic radiation from conductors with non-linear characteristics located within the high intensity fundamental field of the transmitter which might act as subsidiary generators;

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* This Study Programme, which replaces Study Programme No. 2, arises from Question No. 1 (I) (§ *b*)

(f) that different relationships exist between the signal-to-noise ratios appropriate for the several services in the various frequency bands and the interference caused by spurious emissions. For example, in view of the susceptibility of television to interference, the particular spurious emissions falling within television channels* which are in use in the vicinity of the interfering station are of paramount importance. The attenuation of these particular spurious emissions may in some cases need to be substantially greater than limits which may be applicable for some other services. Other services may also have special requirements peculiar to their own needs;

UNANIMOUSLY DECIDES that the following studies shall be carried out:

1. Recommendation No. 232 should be re-evaluated, for which purpose the various Administrations should submit data on measurements of radiated power and field intensity of spurious emissions to enable a more definite evaluation to be made of the relationships between them. Such evaluation should take into account the signal-to-noise ratio aspects as related to the different services with regard to the interference problem;
2. to secure further data on measurements of the power of spurious emissions;
3. study of the elements of antenna and antenna feeder design useful in reducing spurious emissions;
4. study of the design of transmitters and their output coupling networks with the object of reducing spurious emissions;
5. determination of the special conditions which may apply to high power transmitters. In this connection, consideration should be given to radiation from conductors with non-linear characteristics which such transmitters may excite.

STUDY PROGRAMME No. 125 (I) **

FREQUENCY STABILISATION OF TRANSMITTERS

The C.C.I.R., (Geneva, 1951 — Los Angeles, 1959)

CONSIDERING

(a) that Question No. 1(I) (§*c*) refers to frequency stability, by which is meant constancy of frequency;

(b) that improvement in the utilization of the radio-frequency bands depends also on the accurate positioning of the mean frequency, that is, on the accuracy of the frequency-determining elements as distinct from their stability;

(c) that degrees of accuracy and stability in excess of those required by the Radio Regulations of Atlantic City are available, but that such provision may conflict with economic considerations and design considerations such as weight and volume;

(d) that advancements in technique are being made in obtaining high accuracy and stability, whilst still meeting economic and design requirements;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. determine values of frequency tolerance realizable for new transmitters for all classes of stations, consistent with economic and design requirements;

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* See the Atlantic City Frequency Allocation Table, Chap. 3, Art. 5 of the Radio Regulations.

** This Study Programme which replaces Study Programme No. 3 arises from Question No. 1 (I) (§ *c*).

2. study methods of obtaining improved frequency tolerance in new transmitters;

3. determine by statistical means the distribution of the frequency variations observed on transmitters currently in operation.

STUDY PROGRAMME No. 126 (I)*

SPECTRA AND BANDWIDTH OF EMISSIONS

(Question No. 1 (I) (§ *a*) — Recommendations Nos. 230 and 231)

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) Question No. 1 (I) (§ *a*);

(b) that Recommendation No. 145 which contains partial answers to Question No. 1 (I) (§ *a*) was based on theoretical considerations as well as on results of measurements made under conditions which do not always represent those of actual traffic;

(c) that it is therefore necessary to extend the theoretical and the experimental studies on the spectra appropriate to the various classes of emission;

(d) that in the Radio Regulations of Atlantic City the definition of the bandwidth occupied is such that measurements of the bandwidth occupied are difficult even at a short distance from the transmitter;

UNANIMOUSLY DECIDES that the following studies should be carried out:

continuation of the studies of bandwidths and spectra under actual traffic conditions in the different cases met with in practice and for all classes of emission in accordance with the following provisions:

1. the studies should be carried out simultaneously by theoretical and experimental methods and a detailed comparison should be made of the results obtained by both methods.
The experimental studies should make use of the methods of measurement set out in Recommendation No. 229 as well as methods of measurement in actual traffic, which might be developed along the lines of Study Programme No. 40 (I);

2. the studies should be carried out to determine to what extent the radiation outside the necessary bandwidth can be reduced for transmitters now in use, and whether a stricter limitation could be imposed on transmitters installed in the future, with a view to the eventual proposal to an Administrative Radio Conference of:
   — the limits to be imposed on the radiated spectrum of existing transmitters,
   — the limits to be imposed on the radiated spectrum of future transmitters;

3. the studies should be conducted along the following lines for the various classes of emission, and applied to different types of transmitters in service or under development:

3.1 *Class A1, A2 and F1 emissions.*
A sufficiently large number of measurements of spectra and of signal shape should be carried out with different types of transmitters at present in use.
The appropriate means for limiting the spectra of these transmitters as, well as of new transmitters to be constructed, should be studied, with the aim, on the one hand, of determining the requisite filters and, on the other hand, of achieving a sufficient linearity of the amplifying stages or the frequency modulators.

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* This Study Programme, which replaces Study Programme No. 82, arises from Question No. 1 (I).

The transmitters so improved should be put in service so that final conclusions on their behaviour may be established for various operating conditions.

These studies should in particular be made in the frequency range of 10 kc/s to 30,000 kc/s for the following classes of emissions:

Telegraphy A1 and A2 : Morse 8 bauds and 24 bauds,

Telegraphy A1, A2 and F1 : Teleprinter and other automatic telegraph equipment, 50 and 120 bauds;

3.2 *Class A3 emissions.*

measurements of radiation outside the necessary band should be made with transmitters of different types using this class of emission, and particularly with independent-sideband transmitters.

These measurements should be made with narrow bandwidth measuring apparatus such as is described in Recommendation No. 229 and the results should be compared with those obtained with wide-band apparatus, as mentioned in Recommendation No. 230, § 2.4.

It would be useful to obtain these measurements when the transmitter is modulated by an artificial voice or by white noise; these two modulations approximately reproducing the two practical cases where the transmitter is used without a privacy equipment or with a band-splitting privacy device.

Methods for still further reducing out-of-band radiation should be investigated.

These studies should in particular be made in the frequency range of 10 kc/s to 30,000 kc/s for the following classes of emissions:

Telephony, double sideband, full carrier A3 : Low grade, commercial, high fidelity (broadcasting),

Telephony, independent sidebands, reduced carrier, one to four channels: Commercial quality;

3.3 *Other classes of emission.*

Comparative studies should be undertaken for the other classes of international telecommunications, in particular for the classes of emission used in the HF (decametric) band such as:

— multiplex emissions of various types;

— class A4 and F4 emissions.

These studies should then be extended to the classes of emission used in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands;

4. other studies based on new principles should be undertaken as suggested in Report No. 96 with a view to their possible application to new equipments;

4.1 the reduction of out-of-band radiation could be obtained through the determination of the best statistical distribution of the signal amplitudes which would permit a sufficient filtering of the signal without undue distorsion, and the determination of the practical coding processes to produce such a statistical distribution;

4.2 to reduce the occupied bandwidth, the most favourable shape of a practical elementary signal should be sought theoretically and the practical shaping circuits to produce such a shape should be developed;

4.3 a delay of the signal, which is justified theoretically when a reduction of interference is to be obtained, will be introduced by the filtering and coding envisaged in the two preceding studies. The maximum acceptable delay should be determined for the various classes of emission and different services and taken into account in assessing the number of filtering cells to be used;

5. The studies of the concepts of necessary and occupied bandwidths should be continued, the definitions of which should facilitate bandwidth measurements while still permitting their theoretical determinations;

5.1 Some percentage of power different from the percentage of 99 %, which has proved useful for some classes of emission, should be sought for classes of emission of more recent use, such as frequency division multiplex with a large number of channels, especially those designed for microwave systems;

5.2 The level of the spectrum components lying near the occupied band limits should be studied both theoretically and experimentally for the different classes of emission, in order to facilitate evaluation of occupied bandwidth from level measurements of spectrum components (see Doc. No. 119, Los Angeles, 1959, submitted by the U.S.S.R.).

QUESTION No. 75 (I)*

LIMITATION OF UNWANTED RADIATION FROM INDUSTRIAL INSTALLATIONS

(Question No. 3 (III))

The C.C.I.R., (London, 1953)

CONSIDERING

(a) that Resolution No. 5 annexed to the International Telecommunication Convention, Buenos Aires, 1952, requires the study of the influence of intentional or parasitic oscillations on radio services, especially broadcasting and mobile services, with a view to the possible establishment of standards permitting a harmonious co-existence of radio services with industrial installations producing radio oscillations;

(b) that the harmonious co-existence of radio services with industrial installations producing radio oscillations involves close collaboration between organizations representing the manufacturers and users of these installations on the one hand, and the radio services on the other, for which the existing collaboration between the C.C.I.R. and the Special International Committee on Radio Interference (C.I.S.P.R.) provides;

(c) that the C.I.S.P.R. has already extensively studied and continues to study the permissible signal-to-interference ratios for sound and television broadcasting, but has not yet made equivalent studies for other radio services;

UNANIMOUSLY DECIDES that the following question should be studied:

1. study of the most appropriate means of determining the level of intentional or parasitic oscillations produced by industrial, scientific or medical apparatus;

2. determination of the level to which it should be practicable to reduce such oscillations.

Note. — In this study the C.C.I.R. should keep itself informed on the results of the studies of the C.I.S.P.R. on the same subject, in order to avoid duplication of work.

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* Study Programme No. 84 (I) arises from this Question. See also Question No. 84 (I).

STUDY PROGRAMME No. 169 (I) *

FREQUENCY TOLERANCE OF TRANSMITTERS

(Recommendation No. 1 of the Administrative Radio Conference, Geneva, 1959)

The Administrative Radio Conference, Geneva, 1959,

CONSIDERING

(a) that Appendix 3 of the Radio Regulations specifies the permissible frequency tolerances for transmitters;

(b) that the principal objective of this Appendix has been the reduction of frequency space required per channel by means of the tightening of frequency tolerances, and that in many cases considerable improvement in spectrum utilization can continue to be obtained by further tightening of frequency tolerances;

(c) that for some services, a reduction in frequency tolerance to the lowest value possible in the state of the technique would be useful in order to increase the signal to noise ratio, improve intelligibility and reduce errors;

(d) that in certain cases, a further reduction of frequency tolerance would not in practice increase the number of available channels;

(e) that in particular frequency bands, the frequency tolerances specified in Appendix 3 of these Radio Regulations may already approach the minimum useful value for certain categories of station when using existing techniques and methods of operation;

(f) that it will be of considerable assistance to administrations, in the future planning of services and provision of equipment, to know those frequency tolerances which can be considered to be the ultimate useful minimum value for stations when using existing techniques and methods of operation;

(g) that in certain cases, reduction of frequency tolerances is subject to economic limitations, which should be known and taken into account;

INVITES THE C.C.I.R.

1. to continue its study of frequency tolerances with a view to the reduction of the frequency space required for a given channel;

2. to consider whether or not in certain cases it is possible to predict ultimate values of tolerances, which it would not be necessary to make more stringent under currently known conditions of operation, and to state what these tolerance values might be;

3. to report upon the possibility of achieving such ultimate values of tolerances consistent with economic and design requirements and other practical considerations;

4. to indicate which, if any, of the tolerances specified in Appendix 3 of the Radio Regulations have already attained these ultimate values.

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* This Study Programme arises from Question No. 1 (I), § *c*.

STUDY PROGRAMME No. 84 (I)*

LIMITATION OF UNWANTED RADIATION FROM INDUSTRIAL INSTALLATIONS

I

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that for the measurement of unwanted radiation no standard measuring method can yet be recommended;

(b) that the effect of interference is dependent on the particular type of service and on the waveform of the unwanted radiation;

(c) that it is desirable to compare measurements made on various test sites and possibly using different methods;

(d) that the effect of interference depends on the transmission coefficient between the source of interference and the receiver affected;

(e) that the C.I.S.P.R. has already studied and continues to study extensively the measuring methods for determinating the level of interference from industrial, scientific and medical apparatus to sound and television broadcasting;

(f) that due regard should be given to the special requirements of radiocommunication services other than broadcasting;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. determination of which parameters of the interfering field should be measured. The polarization and the relation between the magnetic and electric field should be considered;
2. the effects of the relative positions of the industrial, scientific and medical equipment or groups of equipments and the measuring set, the number of measurements at different distances and the number of directions in which measurements should be made;
3. the effect of different open sites on the measured field;
4. the methods that can be used to measure the radiation from industrial, scientific and medical equipment which is situated indoors and the relationship between measurements made indoors and those made on outside sites;
5. the importance of interference due to the presence of radio-frequency voltages in the mains leads of the industrial, scientific and medical equipment and the methods of measurement;
6. the effect of the working conditions of the apparatus to be measured during the measurements;
7. the wave collectors to be used for measurements in the different frequency bands;
8. the characteristics of the equipment to be used for the measurements, particularly its bandwidth;
9. the way in which interference with various radio services depends upon the waveform of the disturbing field;
10. the statistical distribution and the representative values for the transmission coefficient between the interference sources and the receiving antenna in the service concerned.

Note. — In this study the C.C.I.R. should keep itself informed of the results of the studies of the C.I.S.P.R. on the same subject, in order to avoid duplication of work.

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* This Study Programme arises from Question No. 75 (I).

RESOLUTION No. 39*

MEASUREMENT AND LIMITATION OF UNWANTED RADIATIONS FROM INDUSTRIAL INSTALLATIONS

(Question No. 75 (I))

The C.C.I.R., (Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that the C.I.S.P.R. has already studied and continues to study extensively the methods of measurement for determining the level of interference from industrial, scientific and medical apparatus to sound and television broadcasting;

(b) that the C.C.I.R. is quite prepared to give favourable consideration to any methods and apparatus for measuring such radio interference, adopted by the C.I.S.P.R., provided that such methods and apparatus possess characteristics adequate for establishing the level of interference likely to affect radiocommunications;

(c) that the C.C.I.R. must retain its right to propose to the competent administrative authorities the levels which must not be exceeded by interference caused by such equipment in the immediate vicinity of radio receiving stations operating under conditions specified in the Radio Regulations;

UNANIMOUSLY RESOLVES

1. that the C.C.I.R. should consider whether it is practical to adopt the measuring methods and apparatus recommended by the C.I.S.P.R. for determining the level of interference produced by industrial, scientific and medical (i.s.m.) equipment;

2. that it would be of value if the C.I.S.P.R. would be so good as to make available to the C.C.I.R. all measurements obtained with the methods and equipment mentioned above of

2.1 the level of interference caused in different cases by industrial, scientific and medical equipment in current use;

2.2 for the same cases, how far it has been possible to reduce these levels, taking into account economic and design requirements;

3. that contributions from the C.I.S.P.R. to the C.C.I.R. in this field should be incorporated in documents for regular circulation within the Study Groups, through the Secretariat of the C.C.I.R., in the same way as proposals from Administrations;

4. that the C.I.S.P.R. should be informed of the desirability of continuing the study of methods of measurement in portions of the radio-frequency spectrum other than those used for broadcasting.

Note. — The attention of the C.I.S.P.R. should be drawn to C.C.I.R. Study Programme No. 84 (I).

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* This Resolution replaces Resolution No. 20.

QUESTION No. 84 (I)*

DETERMINATION OF THE MAXIMUM INTERFERENCE LEVELS TOLERABLE IN COMPLETE SYSTEMS

(Question No. 3 (III))

I

The C.C.I.R., (London, 1953)

CONSIDERING

(a) that Resolution No. 5 annexed to the International Telecommunication Convention, Buenos Aires, 1952, requires the study of the influence of intentional or parasitic oscillations on radio services, especially broadcasting and mobile services, with a view to the possible establishment of standards permitting a harmonious co-existence of radio services with industrial installations producing radio oscillations;

(b) that the harmonious co-existence of radio services with industrial installations producing radio oscillations involves close collaboration between organizations representing the manufacturers and users of these installations on the one hand, and the radio services on the other, for which the existing collaboration between the C.C.I.R. and the Special International Committee on Radio Interference (C.I.S.P.R.) provides;

(c) that the C.I.S.P.R. has already extensively studied and continues to study the permissible signal-to-interference ratios for sound and television broadcasting, but has not yet made equivalent studies for other radio services;

UNANIMOUSLY DECIDES that the following question should be studied:

determination of the maximum level of interference caused by radiations from industrial, scientific and medical equipment producing radio oscillations, that can be tolerated in various frequency ranges by the types of system employed by radio services especially, by the mobile services.

Note. — In this study the C.C.I.R. should keep itself informed on the results of the studies of the C.I.S.P.R. on the same subject, in order to avoid duplication of work.

* See also Question No. 75 (I).

QUESTION No. 207 (I)

CLASSIFICATION OF EMISSIONS

(Recommendation No. 8 of the Administrative Radio Conference, Geneva, 1959)

The Administrative Radio Conference, Geneva, 1959,

CONSIDERING

(a) that Article 2, Section I, of the Radio Regulations classifies emissions for the purpose of designation;

(b) that certain symbols are used for classes of emission which are not precisely specified;

(c) that it may be necessary to specify new classes of emissions in the future;

(d) that in the recording processes used by the International Frequency Registration Board and by certain administrations, particularly in mechanical recording processes, a simple and precise method of designation is required, using the smallest practicable number of symbols for each designation to provide all the essential information;

(e) that it may be useful to combine in a single series of symbols the information now classified as supplementary characteristics with that giving the type of modulation of the main carrier;

(f) that the present method of classifying emissions does not adequately provide for systems employing multiple modulation processes;

(g) that the increasing use of multi-channel telephone and telegraph systems makes it desirable to classify them in categories and to adopt a uniform designation for the channels of such systems;

(h) that pulse-modulation is not intrinsically a basic modulation process but is a form of signal stimulus which gives rise to amplitude,- frequency- or phase- modulation or a combination of these modulations;

(i) that the Board sometimes receives or requires from administrations additional significant information of a supplementary nature—e.g., carrier level and telegraph signal code information, which is not always provided for in the present system of designation;

(j) that the present system of designation does not enable all emissions to be specified precisely or completely;

(k) that the terms emission, radiation and transmission are not defined in the Radio Regulations and that they are liable to confusion not only when they are translated from one language to another but also when they are used in the same language;

RECOMMENDS THAT THE C.C.I.R.

1. consider, in conjunction with the Board, all emissions and characteristics requiring classification;

2. study, in conjunction with the Board, various methods of designating and classifying emissions, and develop a method which could be used over a long period and which would enable all the essential information to be provided;

3. report their conclusions on these matters, and make a Recommendation in time for a decision to be taken at the next Administrative Radio Conference;

4. define the terms emission, radiation and transmission so that they may be used consistently and without confusion and be readily translated from one working language to another. *

* In collaboration with Study Group No. XIV.

STUDY GROUP No. II

(Receivers)

Terms of reference :

1. Measurement of the characteristics of receivers and tabulation of typical values for the different classes of emission and the various services.

   Investigations of improvement that might be made in receivers in order to solve problems encountered in radio communication.

Chairman : Mr. P. DAVID (France)
Vice-Chairman : Mr. Y. PLACE (France)

* See Volume III, Section B.

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QUESTION No. 171 (II)*

CHOICE OF INTERMEDIATE FREQUENCY AND PROTECTION AGAINST UNDESIRED RESPONSE OF SUPERHETERODYNE RECEIVERS FOR THE MARITIME MOBILE SERVICE

II

The C.C.I.R., (London, 1953 — Los Angeles, 1959)

CONSIDERING

(a) superheterodyne receivers may respond to signals of frequency other than that to which the receiver is tuned;

(b) technical and economic reasons limit the selectivity of maritime mobile radio receivers, especially those of ships of low tonnage, and non-compulsarily fitted ships having radio-communication equipment;

(c) in order to reduce the possible interference, particularly on the intermediate frequency it may be of advantage to have a low number of preferred intermediate frequencies;

(d) that for receivers of good quality a considerable value of IF attenuation can be achieved, but for lower quality receivers, or receivers that are required to be broad-band in order to cover the distress band, such high values may not be practicable;

UNANIMOUSLY DECIDES that the following question should be studied:

1. how many intermediate frequencies and in what bands should these be in order to be able to design economically sufficiently good maritime mobile receivers having regard to all frequency bands of the service; **

2. is it possible to propose a few intermediate frequencies for maritime mobile receivers;

3. what values of intermediate frequency attenuation are achieved by maritime mobile radio receivers (if receivers use more than one intermediate frequency, the values of attenuation for each should be given) and how do they depend on the frequency to which the receiver is tuned;

4. what are the minimum values of intermediate frequency attenuation to provide a satisfactory service for maritime mobile receivers;

5. how severe is this type of interference and how often and in what places is it experienced with present equipment; ***

6. what other measures could be taken to avoid interference to maritime mobile receivers?

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* This Question replaces Question No. 78 as far as maritime mobile services are concerned.

** From the documents submitted at Geneva in 1958 commonly used values of intermediate frequency appear to be about 55, 110, 530 and 1,200 kc/s.

*** The study of this Question should be continued in liaison with the C.I.R.M. and the International Chamber of Shipping.

QUESTION No. 172 (II)*

SENSITIVITY AND NOISE FACTOR

The C.C.I.R., (Stockholm, 1948 — Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that with regard to the information contained in the tables of Recommendation No. 234 it is desirable to have available recent data on receiver sensitivity and noise factor;

(b) that in the case of radiotelegraphy receivers for automatic reception it is desirable to have data on the maximum usable sensitivity limited by:

— signal distortion or mutilation,
— character errors in the reproduced text;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what are representative values of sensitivity and noise factor for the various types of apparatus used for the reception of different classes of emission in the different services and for receivers other than those for automatic reception of radiotelegraphy; **

2. in the case of receivers for automatic reception of radiotelegraphy: what are the values of maximum usable sensitivity limited by:

— signal distortion or mutilation,
— character errors in the reproduced text? ***

QUESTION No. 173 (II)****

FREQUENCY STABILITY OF RECEIVERS

The C.C.I.R., (London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that in accordance with Question No. 124 and Recommendation No. 156 information has been collected on the frequency stability of some receivers and the means to improve it, and that this information has been summarized in Recommendation No. 236;

(b) that nevertheless the collection of information should be continued in order to collect more data on certain types of receiver, particularly FM broadcast and television receivers;

(c) that, in certain receivers, e.g., those in which the frequency-change oscillators are crystal controlled or those which incorporate automatic frequency control, the stability of the filters may be a deciding factor in determining the overall stability;

(d) that in some cases the figures given in the tables in the Annex to Recommendation No. 236 showthat there are wide variations in the frequency stability of receivers of the same type;

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* This Question replaces Question No. 123.

** See Recommendation No. 234 (Annexes IV and V).

*** See Recommendation No. 234 (§ 5 and Annex II § 9).

**** This Question replaces Question No. 124.

(e) that in practice the passband of a receiver often has to be increased beyond that essential for the service required in order to allow for the frequency instability of the receiver;

(f) that it is desirable to define acceptable values for frequency instability of receivers designed for different purposes;

(g) that there is insufficient information on the effect of frequency stability of the different influences measured separately, e.g., humidity, large temperature range, etc.;

UNANIMOUSLY DECIDES that the following question should be studied: II

1. what are the most effective provisions of Recommendation No. 236;
2. what methods are most effective in improving the stability of filters and what are representative values for the stability achieved, for instance, with crystal magnetostriction filters, complex filters with electrical variation, etc.;
3. what are the date on frequency instability under various operating conditions, more particularly as regards wide temperature variations and ordinary temperature, humidity and supply voltage variations;
4. what are the maximum acceptable values of the frequency instability of receivers designed for various purposes, taking into account typical frequency response curves for the receivers used?*

Note. — Administrations are requested to present the results in the form laid down in the text of the Annex to Recommendation No. 236.

QUESTION No. 174 (II)

ASSESSMENT OF RECEIVER STABILITY

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that methods of assessing the stability of receivers used for the various services should be improved;

(b) that a measurement of the drift of frequency-change oscillators does not always give an accurate indication of the drift of the receiver tuning;

(c) that drift is caused by filters and other elements, as well as by frequency-change oscillators (see Recommendation No. 236);

UNANIMOUSLY DECIDES that the following question should be studied:

1. what criteria can characterize correct tuning for the various types of service and for receivers of various grades, and how should the quantities chosen as criteria be measured;
2. how far should the overall instability of a receiver be defined by the variation in tuning with operating conditions (time, temperature, humidity, supply voltage, etc.)?

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* In accordance with information obtained in reply to Question No. 178 (II).

QUESTION No. 175 (II)*

USABLE SENSITIVITY OF RADIO RECEIVERS IN THE PRESENCE OF QUASI-IMPULSIVE INTERFERENCE

The C.C.I.R., (London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that many types of interference—e.g. from atmospheric phenomena, ignition systems and electrical equipment—cannot be considered as either random noise or as simple isolated impulses, but may be regarded as " quasi-impulsive " and intermediate between those two cases;

(b) that while the usable sensitivity of a receiver may be limited in some cases by the internal noise of the receiver (cf. noise-limited maximum usable sensitivity—Recommendation No. 234) in other cases and in most services 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 methods are available for describing certain types of noise and for calculating their effects upon the receiver for the case of telegraphic reception (see Report No. 99);

(d) that it is possible to develop pulse generators representing the effects of some types of quasi-impulsive interference, for example for facilitating theoretical 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. is it possible for administrations to determine practically, and in a satisfactory manner, the characteristic values of the interference as they have been defined in Report No. 99, and to calculate the susceptibility of telegraphic receivers subjected to such interference;

2. is it possible to extend these methods to other types of receivers, such as those used for telephony and television;

3. is it satisfactory to substitute a pulse generator (e.g. generating pulses of identical shape at a controllable average rate and with a controllable amplitude distribution) at the input of the receiver, for a source of interference, and does this simulate with good approximation the effect of quasi-impulsive interference;

4. what are the methods of measuring the most useful definitions of the response of receivers to quasi-impulsive interference, taking into account any non-linear effects 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?

Note 1. — The above question should again be brought to the attention of the U.R.S.I., and the C.I.S.P.R., by the Director of C.C.I.R., with a view to encouraging those organizations to expedite their work bearing on these studies, requesting these organizations to inform the C.C.I.R. of the results of this study.

Note 2. — It is considered that the information obtained as an answer to § 1, 2, 5, and 6 should be communicated as soon as possible to the C.I.S.P.R.

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* This Question replaces Question No. 125.

QUESTION No. 176 (II)*

SPURIOUS EMISSIONS FROM RECEIVERS EXCLUDING SOUND-BROADCAST AND TELEVISION

The C.C.I.R., (London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that many receivers, excluding special types such as high grade HF long distance communication receivers (see Report 102), produce spurious radiation which may harmfully interfere with different services;

(b) that the I.E.C. lays down measurement methods only for emissions from sound-broadcast and television receivers **;

(c) that the C.I.S.P.R. is, as a matter of priority, firstly establishing limits for the emissions from sound-broadcast and from television receivers which affect other similar receivers;

UNANIMOUSLY DECIDES that the following question should be studied:

1. to what extent is it necessary for the C.C.I.R. to establish methods of measurement and limits for undesired emissions from types of receivers other than sound-broadcast and television;

2. are the methods established by the I.E.C. for measuring emissions from broadcast and television receivers also suitable for measuring the emissions from other classes of receivers; if not, what methods should be used;

3. what are typical values for fields in the different bands and, possibly, for different types of services, that should not be exceeded by these undesired emissions;

4. what are the best techniques to reduce these fields?

QUESTION No. 177 (II) ***

DISTORTION IN FREQUENCY-MODULATION RECEIVERS DUE TO MULTIPATH PROPAGATION

The C.C.I.R., (Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that experience with VHF (metric) frequency-modulation broadcasting and other services has shown that secondary, delayed signals may be received in addition to the primary signal;

(b) that both the phase and the amplitude of the composite signal will thereby be affected;

(c) that not all receivers have directional antennae discriminating effectively against reception of the secondary, delayed signal;

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* This Question replaces Question No. 126.

** Publication 106 of the I.E.C.

*** This Question replaces Question No. 127.

(d) that efficient circuits (for example limiters associated with ratio detectors) in the receiver will reduce the effect of amplitude variations, without impairing the suppression of impulsive interference, but in some receivers these circuits may be missing, be inadequate or require critical tuning;

(e) that consequently the subjective effect of residual amplitude modulation of the composite signal may be much more serious than that associated only with phase distortion, particularly if the path difference between the primary and secondary signals is large, for example, 8 km or greater;

(f) that display method of measurements, as described in I.E.C. Publication No. 91 " Recommended Methods of Measurement on Receivers for Frequency-Modulation Broadcast Transmissions ", are insufficiently sensitive for C.C.I.R. purposes;

UNANIMOUSLY DECIDES that the following question should be studied:

1. are the methods described and the input signal levels recommended in Report No. 103 suitable for measuring amplitude modulation suppression in FM VHF receivers;
2. what values are obtained using the above methods;
3. what is the minimum amplitude-modulation suppression ratio necessary to eliminate as far as is practicable avoidable distortion of the received signal for typical values of path difference and amplitude ratio betwen direct and indirect signals?

QUESTION No. 178 (II)*

SELECTIVITY OF RECEIVERS

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that selectivity measurements so far produced have been limited primarily to receivers suitable for A1, A2 and A3 classes of emission, little information being available for other types of receiver (F1, F2, F3, F4, pulse-modulation, television, etc.);

(b) that such measurements as are available have been chiefly made by the single-signal method, little information being available on measurements made by the multiple-signal method;

(c) that, in determining the selectivity of the receiver, that is to say, its ability to separate the desired signal from undesired signals, there are cases where the determination of the usual selectivity curve (amplitude/frequency characteristic) is insufficient;

(d) that multiple-signal methods suitable for receivers for A1, A2, F1 and F3 signals have not been fully considered;

(e) that, if the amplitude/frequency characteristic is such that the attenuation slope in the vicinity of the edges of the passband is very high, the phase/frequency and group-delay/frequency characteristics within the passband may in consequence be non-linear and non-uniform respectively;

(f) that numerous instances where this is particularly true are those where the signal shape may be of importance (e.g., telegraphy, facsimile, pulse modulation, television);

(g) that certain factors, such as the non-linearity of various stages of the receivers, amplitude modulation suppression, the time constant of detectors, etc., play an important part in determining the multiple-signal selectivity of receivers;

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* This Question replaces Question No. 128.

UNANIMOUSLY DECIDES that the following question should be studied:

1. what are representative figures for the single-signal selectivity of types of receivers for classes of emission other than A1, A2 and A3;
2. what methods are suitable for measuring and expressing the multiple-signal selectivity of receivers for A1, A2, F1 and F3 signals*;
3. what are representative figures for multiple-signal selectivity of various types of receivers including those for class A1, A2, A3, F1 and F3 signals;
4. what are the design features in receivers affecting the multiple-signal selectivity and how should their parameters be chosen to minimize interference from unwanted signals;
5. for which types of receivers are the phase/frequency or group-delay/frequency characteristics important as information additional to the amplitude/frequency characteristics;
6. what are the appropriate methods of measuring the phase/frequency or group-delay/frequency characteristics**;
7. what are the representative figures of the phase/frequency or group-delay/frequency characteristics in cases such as are indicated in § *(e)*?

II

Note. — Contributions to the study of this question are contained in Doc. 31 (Japan) and 102, 105, 106, 108, 110 and 123 (U.S.S.R.) of Los Angeles, 1959.

STUDY PROGRAMME No. 127 (II)***

PROTECTION AGAINST KEYED INTERFERING SIGNALS

The C.C.I.R., (Geneva, 1951 — London, 1953 — Los Angeles, 1959)

CONSIDERING

(a) that the reduction of interference between adjacent channels is a very important problem, the solution of which should be sought with great care and by all possible means;

(b) that for keyed telegraph transmissions a partial solution has already been reached by considering separately:

— the transmitter, by reducing the extent and amplitude of the spectrum (Recommendation No. 230);

— the receiver, by increasing the selectivity in regular operation (reduction of bandwidth and increase of slope on each side of the passband) (Recommendation No. 235).

These measures are quite effective when applied simultaneously and have already led to important improvements, but do not fully solve the problem;

(c) that in practice, telegraphic emissions involve, outside the band necessarily occupied, components of levels in excess of that indicated in Recommendation No. 230; while, even with the rounding of the keyed signals at present in use, the spectrum often still encroaches on the necessary band of an adjacent channel, thus preventing full advantage being realized from the high selectivity possible in receivers;

(d) that on the other hand, the envelope of the components of the emitted spectrum and the selectivity curve of the receiver obtained in normal or non-keyed operation are not the only factors involved;

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* Some opinion on this point has been expressed in Doc. 109 (Los Angeles, 1959).

** Some measuring methods and apparatus for the measurement of the group-delay/frequency characteristics of receivers are given in Report No. 104.

*** This Study Programme replaces Study Programme No. 43. It does not refer to any Question under study.

(e) that for instance, Recommendation No. 230 indicates the limit-contour within which the amplitudes of the different components should be restricted; but that the amplitude and phase of each individual component can vary in accordance with the manner in which the restriction is achieved; the resulting distortion of the signal shape may also vary;

(f) that the selectivity curve of receivers is not perfectly rectangular but there is some irregularity in the passband response and a limited slope on the sides of the passband so that each component of the signal suffers some change in amplitude; furthermore, they suffer a phase change, usually of an indeterminate amount, which increases with increasing slope of the sides of the passband. In combining these components the resultant output signal differs in shape from the input signal; this may result in amplitude distortion effects. Further distortion may be caused by non-linearity in other parts of the receiver;

(g) that it is difficult to calculate the distortions mentioned in § *(e)* and *(f)* or the total distortion which results over the complete transmission system; in particular, if the total distortion is fixed, that is, if the quality of the transmission is predetermined, it may be that the division of distortion between receiver and transmitter could modify the interference produced in adjacent channels; in this case the division should be chosen so as to produce minimum interference. The theoretical optimum division might of course have to be modified in the light of technical difficulties or economic factors (relative costs of filter circuits at transmitter and receiver, etc.) and of propagation effects;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. the interference produced when the wanted and unwanted signals have such degrees of rounding as are implied in Recommendation No. 230;

2. investigation of the receiver characteristics which will, for the wanted signal, add the least possible distortion to that produced by the rounding of the dot at the transmitter, but at the same time provide the greatest possible protection against adjacent keying signals; the investigation should include also the transient effects in the receiver, which are influenced not only by the usual selectivity curve (amplitude/frequency characteristic), but also by the phase/frequency characteristic and by non-linearity;

3. investigation of the total permissible rounding of dots from the transmitter input to the output of the receiving apparatus on a system basis, in order to reduce interference to a minimum while retaining a maximum of intelligibility, with special attention to the best compromise on the fraction of the rounding to be assigned to the effects of the transmitter, of propagation and of the receiver respectively (see Note);

4. the investigation should be made with the wanted and the unwanted signals of A1, A2, F1 and F4 type in all possible combinations, and for various keying speeds and frequency shifts;

5. the extent of the interference when the lowest level of the wanted signal is such that the distortion or mutilation resulting from noise is negligible; the level of the unwanted signal which is recorded should be that which produces the degree of distortion or error rate used for sensitivity measurements in Recommendation No. 234 (Annex II, § 5), and should be measured using as parameters the frequency spacing and the strength of the wanted signal;

6. the extent of the interference when the wanted signal is A3 (telephony and sound broadcasting) and A3b (single side-band telephony).

Note. — Study Programme No. 43 contained in § 3 a programme of investigation into the division of the rounding of the signals between the transmitter and the receiver. Since this aspect of the question concerns the whole circuit, it was decided at Geneva in 1958 to confide it to the new mixed Working Group (I, II and III) established at that time.

In these conditions, Study Group II has ceased to discuss this point and is content to record the contributions in the following documents: No. 236 (Netherlands) of London, 1953, No. 2 (Netherlands), No. 9 (Belgium), No. 319 (Japan) and No. 174 (France) of Warsaw, 1956 and I/31 (United States of America) of Geneva, 1958.

It notes also that there is a connection between this subject and Report No. 96 and Study Programme No. 128 (III).

STUDY GROUP No. III

(Fixed Service Systems)

Terms of reference :

1. To study questions relating to complete systems for the fixed and allied services and terminal equipment associated therewith (excluding radio-relay systems). Systems using the so-called ionospheric-scatter mode of propagation, even when working on frequencies above 30 Mc/s, are included.
2. To study the practical application of communication theory.

Chairman : Dr. H.C.A. VAN DUUREN (Netherlands)
Vice-Chairman : Dr. S. NAMBA (Japan)

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* See Volume III, Section C.

* See Volume III, Section C.

QUESTION No. 3 (III)*

REVISION OF ATLANTIC CITY RECOMMENDATION No. 4

The C.C.I.R., (Stockholm, 1948)

CONSIDERING

that to give maximum effectiveness to the studies requested by the International Radio Conference of Atlantic City (1947) in its Recommendation No. 4 to the C.C.I.R., it is expedient to rearrange this Recommendation and incorporate the relevant Bucharest questions;

UNANIMOUSLY DECIDES:

A. that the text of Atlantic City Recommendation No. 4 can be rearranged and extended as follows: III

(a) consideration of the desirable conditions to be fulfilled by the complete systems employed by the different services in order to determine the reduired technical performance of the equipment (including the station terminal apparatus and the antennae) and of the measuring apparatus used, to ascertain whether the equipment satisfies the recommendations of the C.C.I.R.;

(b) consideration of the field-strength intensity necessary for the reception of different classes of emission in the different services;

(c) consideration of the effect of frequency stability of transmitters on the minimum practicable spacing between stations;

(d) consideration of the minimum practicable spacing between the frequencies of stations operating in adjacent channels for different classes of emission in the different services;

B. that the above questions** be studied simultaneously and with the same urgency;

C. that Questions Nos. 1, 4, 11, 14, 16 and 17 of the C.C.I.R. of Bucharest be removed from the list of questions to be studied by the C.C.I.R.;

AND UNANIMOUSLY DECIDES:

to carry on permanently the study of the above-mentioned questions and to publish its recommendations and possible revisions as soon as practicable.

STUDY PROGRAMME No. 128 (III) ***

FACTORS AFFECTING QUALITY OF PERFORMANCE OF COMPLETE SYSTEMS OF THE FIXED SERVICES

Signal-to-noise and signal-to-interference protection ratios for fading signals, bandwidth and adjacent channel spacing

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that Question No. 3 (III) establishes a permanent study of questions relating to the desired conditions of performance to be fulfilled by the fixed services;

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* Study Programme No. 128 (III) arises from this Question.

** Questions Nos. 1 (I), 2 and 3 (III).

*** This Study Programme, which replaces Study Programmes Nos. 44, 45, 49 and 50 and Questions Nos. 82, 129 and 131, arises from Question No. 3 (III).

(b) that the conditions for satisfactory performance of a system must take account of the need to receive signals propagated via the ionosphere which are subject to fading and multipath effects and are accompanied by radio noise and interference;

(c) that studies requiring signal-to-noise and signal-to-interference protection ratios are closely related, and that determination of necessary adjacent channel spacings requires, in addition, consideration of frequency stability and bandwidth of the systems;

(d) that there are a number of different techniques and systems in use in the radiotelegraph and radiotelephone services and, while it is essential to consider the most advanced state of the radio art, it is also necessary to give special study to conventional systems either affecting integration of land-line and radio services, or of concern to the I.F.R.B.;

UNANIMOUSLY DECIDES to carry out the following studies:

1. Classes of service:

The studies concern the following classes of service in regular use in the fixed services, but should also give due regard to new techniques and systems, including those under development, for application to the fixed services:

1.1 *Radiotelephony*

1.1.1 Types of emission: A3, A3a, A3b, F3*;

1.2 *Radiotelegraphy*

1.2.1 Types of emission: A1, A2, A9c, F1;

1.2.2 Telegraph speeds:

— A1, A2, hand speed 8 and 24 bauds, machine speed 50 and 120 bauds;
— A9c, multichannel VF telegraphy, 50 to 200 bauds per channel;
— F1, 50 to 600 bauds;

1.2.3 Codes:

— 5-unit start-stop;
— 5-unit synchronous;
— synchronous error-detecting and correcting systems using two-condition signalling codes other than the International Alphabet No. 2;
— other systems using more than two signalling conditions;

1.3 *Facsimile, phototelegraphy ; Hellschreiber*

1.3.1 Types of emission: A4, F4.

2. Minimum conditions required for satisfactory service:

2.1 Acceptable criteria and values for:

2.1.1 *intelligibility* over radiotelephone circuits**;

2.1.2 *error rate* for characters and elements over radiotelegraph circuits (*efficiency factor* for ARQ circuits);

2.1.3 *legibility* of copy over facsimile (phototelegraphy) and Hellschreiber circuits;

— what is the maximum duration and percentage of the time during which performance inferior to the standard values can be tolerated;

2.2 Performance of the system as a function of:

— signal-to-noise and signal-to-interference (co-channel) ratios;
— required signal-to-noise and signal-to-interference (co-channel) protection ratios for the acceptable standard values of intelligibility, error rate (efficiency factor on ARQ circuits), or legibility, for the various services***, considering:

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* F3 above 30 Mc/s only, with reference to ionospheric scatter applications.

** For the various grades — just usable, operator to operator (order wire);
— marginally commercial;
— good commercial.

*** For radiotelephone services, the signal-to-noise ratio required in the audio band must be specified, and from this the signal-to-noise ratio required in the radio-frequency band is established.

2.2.1 Signal fading, taking account not only of the amplitude distribution, but also of the autocorrelation function and the distribution of duration of the fades;

2.2.2 Diversity (space, frequency, or time) techniques:
— noise reducers,
— coding including the use of error-correcting; codes or ARQ*,
— use of more than two signalling conditions, and
— optimum modulation and detection techniques**;

2.2.3 Multipath effects;

2.2.4 Interference effects of radio noise of various types such as atmospheric, impulsive, or Gaussian noise, as described by the wave form and amplitude distribution of the instantaneous values of the noise,
— the resulting interference effects on actual reception, taking account of the method of detection, and of filtering prior to and following detection;

2.2.5 Interference effects of co-channel signals representing the various classes of emission, taking account of the spectral and statistical (fading) characteristics of the interfering signal; III

2.2.6 Monthly mean signal-to-noise ratios and signal-to-interference ratios required for circuits of various lengths and directions for the acceptable standard values of circuit performance (§ 2.1) to be met during the specified percentage of the time, taking into account,
— the distribution within an hour of the mean values of the short-term (fading) distributions of signals and noise,
— the distribution within a month or season for a given hour of the hourly mean values of the signal strengths and atmospheric noise levels (Report No. 65) ***;
this study is intended to lead to revisions or replacement of Recommendations Nos. 161, 164 and 240.

2.3 Minimum bandwidth required for satisfactory transmission and reception of the intelligence, in a complete system (this is not the question of " bandwidth necessarily occupied ", involving the capability of the transmitting system to avoid radiation outside the band needed for communication, which is included in Study Programme No. 126 (I)).

3. Determination of adjacent channel signal-to-interference protection ratios, and frequency separations between various classes of service, considering:

3.1 the use of effective receiving band-pass filters no wider than necessary for satisfactory reception (§ 2.3 above, and Recommendations Nos. 235, 237 and 238);

3.2 the bandwidth occupied by the interfering transmission (see Recommendation No. 231);

3.3 the frequency tolerance and stability of the desired and interfering signals;

3.4 the studies of § 2.2 above relating to co-channel signal-to-interference protection ratios.

Note. — The results of this study should be presented in the form indicated in the Annex. The results are intended to lead to revision of Recommendation No. 240.

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* It would be useful to compare the systems using the various telegraph codes, including those of § 1.2.3, in terms of undetected or uncorrected error rate for a given power and signalling speed, in words per minute, and operating under the same conditions. A 5-unit start-stop system may also be used as the reference system by regarding each mutilated character as on error only. It is provisionally suggested that the ratio of error rates should be expressed for two circuit conditions only, namely, when the system under test is subjected to an average of one undetected or uncorrected error per 1,000 characters, and per 10,000 characters.

** A special study is needed comparing the different systems used for voice-frequency telegraphy on radio circuits; this is dealt with in Study Programme No. 129 (III).

*** The monthly mean values of atmospheric noise for various time blocks, and information on the distribution of values within the month is given in Report No. 65; with regard to monthly mean values of signal strength, and distribution of hourly values within the month, until such time as C.C.I.R. adopts information on this subject, other standard references may be used, such as U.S. National Bureau of Standards Circular No. 462.

ANNEX

MINIMUM PROTECTION RATIOS AND FREQUENCY SEPARATION UNDER STABLE CONDITIONS

Wanted signal	Interfering signal																							
Type of Service	A1 100 bauds				F1 $2D = 400$ c/s				F4				A3a				A3				Broadcast			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
	db	kc/s			db	kc/s			db	kc/s			db	kc/s			db	kc/s			db	kc/s		
A1 — 24 bauds aural																								
A1 — 50 bauds (printer)																								
A1 — 120 bauds (recorder)																								
F1 — 50 bauds (printer)																								
F1 — 120 bauds (recorder)																								
F1 — 200 bauds (printer ARQ)																								
F4 phototelegraphy																								
A3a SSB																								
A3 DSB (commercial)																								

Note. — Column No. 1 gives in db the limiting values of signal-to-interference ratio when the occupied band of the interfering emission either falls entirely within the passband of the receiver, or covers it completely. Columns numbered 2, 3 and 4 indicate the frequency separation necessary between a wanted and an interfering signal when the latter is 0, 6 or 30 db higher than the wanted signal.

QUESTION No. 43 (III)*

VOICE-FREQUENCY TELEGRAPHY ON RADIO CIRCUITS

(Geneva, 1951)

The VIth Plenary Assembly of the C.C.I.T., Brussels (May, 1948),

SUBMITTED the following question for study by the C.C.I.R.:

what are the conditions which should be imposed on VF telegraph plant employing double-current technique used on modulated radio transmission channels?

Note. — To be studied in collaboration with the International Telegraph Consultative Committee (C.C.I.T.T. Study Group No. 9: Telegraph channels).

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STUDY PROGRAMME No. 129 (III) **

VOICE-FREQUENCY (CARRIER) TELEGRAPHY ON RADIO CIRCUITS

The C.C.I.R., (Geneva, 1951 — London, 1953 — Los Angeles, 1959)

CONSIDERING

(a) that different methods are now in use for voice-frequency telegraphy on radio circuits operating below 30 Mc/s subject to fading, noise and interference,

— either using equipment normally designed for land-line working and suitably adapted for radio;

— or using equipment especially designed for radio working (see for example Docs. 29 and 195 of Geneva, 1951; Docs. 5, 205 and 273 of London, 1953; and Doc. 422 of Warsaw, 1956, MADFAS system);

(b) that studies carried out so far show that it is impossible to compare transmission systems in which marking and spacing are obtained by the two-tone method and by the method of frequency-shift keying of a single voice-frequency oscillator without taking into account all the factors of the equipment (see more particularly Doc. 273 of London, 1953);

(c) that the study of Question No. 43 (III) is to be continued in conjunction with the C.C.I.T.T. to obtain, if possible, unification of at least some of the component elements of voice-frequency equipment used on wire and radio;

(d) that experience in reception of voice-frequency telegraphy over radio circuits has shown the importance of correct design of the limiters, the filters and the diversity combining circuits; and that, from these considerations and the special conditions mentioned in Report No. 19 for combined voice-frequency telegraphy channels employing diversity operation, it appears that frequency-modulated voice-frequency telegraphy equipments on radio circuits may differ substantially from voice-frequency land-line equipment; they may, therefore, have to be designed and constructed with their special purpose in mind;

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* Study Programme No. 129 (III) arises from this Question.

** This Study Programme, which replaces Study Programme No. 46, arises from Question No. 43 (III).

UNANIMOUSLY DECIDES that the following studies should be carried out:

comparisons of the different systems used to transmit and receive voice-frequency telegraphy on radio circuits subject to the effects of fading, noise and interference, with a view to standardizingtheir characteristics, taking into account the following techniques and factors:

— frequency-shift keying of one voice-frequency oscillator;
— transmitting mark and space by the two-tone method;
— other modulation systems, e.g. phase modulation;
— reception by discriminator or separate filters;
— influence of modulation index $= \frac{\text{frequency shift in c/s}}{\text{telegraph speed in bauds}}$

on the error rate, and channel spacing.

QUESTION No. 74 (III)*

ARRANGEMENT OF CHANNELS IN MULTI-CHANNEL TELEGRAPH SYSTEMS FOR LONG-RANGE RADIO CIRCUITS OPERATING ON FREQUENCIES BELOW ABOUT 30 Mc/s

The C.C.I.R., (London, 1953)

CONSIDERING

(a) that lack of uniformity in the arrangement and designation of the channels in multi-channel telegraph systems for long-range radio circuits operating on frequencies below about 30 Mc/s may give rise to certain difficulties when one transmitting station has to work with more than one receiving station;

(b) that many such systems are in use besides the multi-channel voice-frequency telegraph systems referred to in Question No. 43 (III);

UNANIMOUSLY DECIDES that the following question should be studied:

what is the best way of arranging and designating the channels in multi-channel telegraph systems for long-range radio circuits operating on frequencies below about 30 Mc/s?

QUESTION No. 81 (III)**

DIRECTIVITY OF ANTENNAE AT GREAT DISTANCES

The C.C.I.R., (Stockholm, 1948 — Geneva, 1951 — London, 1953)

DECIDES to study the following question:

experimental study, by administrations and various organizations, of the directivity of antennae realised at great distances (taking full advantage of existing transmissions) by any suitable method, for example, by use of mechanically or electrically steered antennae.

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* This Question replaces Question No. 46.

** Study Programmes 130 (III) and 131 (III) arise from this Question, which replaces Question No. 48.

STUDY PROGRAMME No. 130 (III)*

IMPROVEMENT OBTAINABLE FROM THE USE OF DIRECTIONAL ANTENNAE

The C.C.I.R., (London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that Study Programme No. 128 (III) requires knowledge of the improvement in the signal-to-interference ratio that can be obtained by the use of directional antennae on long-distance circuits;

(b) that the Annex to Recommendation No. 162 shows median value of discrimination in the form of gains in various arcs relative to the optimum gain for a half-wave dipole** at the same height and on the correct azimuth when the wanted and unwanted emissions are in the range 3000 - 10,000 km;

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(c) that it is also important to know the discrimination given by the antenna when the wanted station or the interfering station, or both are at much shorter range;

(d) that it appears practicable to obtain some reduction of interference by using a null method at the receiver;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. determination of the signal power gain in the main lobe provided by practical directional antennae used under actual propagation conditions, relative to a half-wave horizontal dipole** at the height of the centre of the directional antenna; the median value and cumulative distribution with time of the values of gain during short periods (as, for example, less than an hour) should be observed; observing periods should be suitably distributed and the data studied on a statistical basis so as to show dependence of results on time of day and season for normal propagation conditions, and the effect of especially critical propagation conditions such as encountered near time of sunrise and sunset, and at times of failure of the operating frequency near the MUF, and at times of ionospheric disturbances;

2. determination of the signal power gain in directions outside the main lobe and/or values of discrimination provided by the antenna between the wanted and interfering signals. The data should include the variations with time referred to in § 1 above, and should specify directions or the appropriate arcs shown in Fig. 1 of Recommendation No. 162;

3. the effects of the antenna height in increasing the number of hours of useful transmission and in the reduction of interference;

4. the usefulness of a null method of minimizing the interference. The data required to evaluate the usefulness might consist of:

4.1 Logs of commercial receiving stations showing outages due solely to interference and the relative azimuth bearing of interfering stations,

4.2 experimental data on the use of directional antenna systems and antennae with adjustable directions of null, under conditions where interference is experienced.

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* This Study Programme, which replaces Study Programme No. 85, arises from Question No. 81 (III).

** The median values of the gain can also be expressed relative to the isotropic antenna.

STUDY PROGRAMME No. 131 (III)*

DIRECTIVITY OF ANTENNAE FOR FIXED SERVICES USING IONOSPHERIC SCATTER PROPAGATION

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that systems are at present in service using ionospheric scatter propagation at frequencies above 30 Mc/s and that extension of use of this mode of propagation may be expected in the international fixed services;

(b) that it is desirable to establish the preferred characteristics of such systems needed to facilitate their international connection, and that particularly it is important to have similar or matched directivity of the antennae at opposite terminals of the circuit;

(c) that antenna directivity, including the characteristics of radiation pattern, gain, beamwidth and direction of the main lobe or lobes, significantly affects transmission loss, and the possibility of occurrence of multipath propagation and interference to and from other services;

UNANIMOUSLY DECIDES that the following studies should be carried out:

studies of the desirable characteristics of the directivity of transmitting and receiving antennae for international fixed services using ionospheric scatter propagation above 30 Mc/s, including gain, beamwidth and direction of the main lobe or lobes and tolerances for the radiation pattern outside the main lobe, taking into account:

— dependence on propagation characteristics of the scattering medium including dependence on scattering angle, size and inhomogeneity of the scattering region;
— effects of meteoric ionization, and the techniques of beam slewing and beam splitting, and how these may depend on season and time of day;
— operating frequency;
— diversity;
— polarization;
— multipath propagation in relation to the modulation technique used;
— interference to and from other services.

QUESTION No. 94 (III)

FACSIMILE TRANSMISSION OF DOCUMENTARY MATTER OVER COMBINED RADIO AND METALLIC CIRCUITS

The C.C.I.R., (London, 1953)

CONSIDERING

(a) that increasing use is being made of facsimile telegraphy for the transmission of documentary matter;

(b) that it is desirable to standardize the characteristics of the facsimile apparatus employed for this purpose;

(c) that the C.C.I.T. has already undertaken the study of this matter (Question No. 46 - Arnhem refers);

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* This Study Programme arises from Question No. 81 (III).

UNANIMOUSLY DECIDES

that the following question should be studied by the Joint Study Group of the C.C.I.T. and the C.C.I.R. * in so far as radio transmission problems are concerned:

what should be the characteristics of apparatus for the transmission by facsimile of:

— telegrams in the public telegraph service;

— business documents;

— documents of large size such as meteorological charts?

QUESTION No. 95 (III)

TRANSMISSION OF HALF-TONE PICTURES OVER RADIO CIRCUITS

III

The C.C.I.R., (London, 1953)

CONSIDERING

that, in the transmission of half-tone pictures over radio circuits, direct frequency modulation of the radio carrier by the picture modulation frequencies would result in a greater signal-to-noise ratio than if the method of sub-carrier frequency modulation were used;

UNANIMOUSLY DECIDES that the following question should be studied:

what are the desirable characteristics for a system transmitting half-tone pictures over radio circuits, in which direct frequency modulation of the radio-frequency carrier is used?

QUESTION No. 130 (III)

TRANSMISSION OF METEOROLOGICAL CHARTS OVER RADIO CIRCUITS BY DIRECT FREQUENCY-MODULATION OF THE CARRIER

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that meteorological charts are being transmitted extensively over radio circuits by direct frequency-modulation of the carrier;

(b) that for high-frequency (decametric) transmissions a deviation of 800 c/s is widely used, while for low-frequency (kilometric) transmissions a deviation of 300 c/s is used;

UNANIMOUSLY DECIDES

that the following question should be studied by the Joint Study Group (MP) of the C.C.I.T.T. and the C.C.I.R. in so far as radio transmission problems are concerned:

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* At present — " Joint Study Group C.C.I.T.T.-C.C.I.R. for phototelegraphy (MP)".

1. what frequency deviations should be used in the different radio-frequency bands for the transmission of meteorological charts by direct frequency-modulation of the carrier;
2. should the higher or the lower limit of the carrier-frequency deviation correspond to documentary black?

QUESTION No. 132 (III)

RADIO RELAY SYSTEMS EMPLOYING IONOSPHERIC SCATTER PROPAGATION

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that experiments have already shown the possibility of utilizing frequencies above 27·5 Mc/s for transmission by ionospheric scatter propagation to distances well beyond the horizon;

(b) that systems using this mode of propagation are already in service;

(c) that it is desirable to determine the preferred characteristics of such systems needed to facilitate their international connection;

(d) that the frequency bands which might be used for such systems are already intensively used by other services;

UNANIMOUSLY DECIDES that the following question should be studied:

1. how do the propagation characteristics relevant to the exploitation of systems employing ionospheric scatter propagation vary with frequency;
2. to what extent are systems employing this mode of propagation liable to interfere with each other and with other services operating on the same or neighbouring frequencies;
3. what are the radio-frequency and baseband characteristics of such systems which it is essential to specify for the transmission of telephony or telegraphy in order to enable two systems to be interconnected, and what values should be specified?

QUESTION No. 133 (III) *

COMMUNICATION THEORY

The C.C.I.R., (Geneva, 1951 — Warsaw, 1956)

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 formulae suggest the use of pulse-code modulation;

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* Study Programme No. 86 (III) arises from this Question, which replaces Question No. 44.

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

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

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

UNANIMOUSLY RECOMMENDS the study of the following question:

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

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.

III

STUDY PROGRAMME No. 86 (III) *

COMMUNICATION THEORY

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956)

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 transmission time of a given quantity of information, or the transmitted 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 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, some at least 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 § *(a)*, can be made by generalising 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

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* This Study Programme, which replaces Study Programme No. 47, arises from Question No. 133 (III).

bandwidth occupied versus the amount of information transmitted in a given time for a given power *;

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

QUESTION No. 179 (III)

STANDARDIZED RADIOTELEPHONE SPEECH TEST RECORDINGS FOR THE FIXED SERVICE

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that standardization of test procedures is highly desirable in that it allows measurements to be compared readily;

(b) that radiotelephone systems cannot readily be evaluated by use of tones or combinations thereof because of the many parameters which are difficult to define and specify;

(c) that a characteristic modulation composed of normal speech information is necessary for making measurements as well as judging intelligibility on radio circuits;

UNANIMOUSLY DECIDES to study the following question:

1. what standard voice test signal would be applicable to measurements in the fixed radiotelephone services, taking into account speech characteristics related to language, age, sex, and emotional state of the speaker;

2. the desirability of including in a standard speech record, pulse signals, tones or other periodic modulation, to aid in evaluation of the telephone circuit;

3. the advisability of Administrations or the I.T.U. offering standard records for sale, including an appropriate statement of the measured characteristics of the test record, such as power distribution and frequency response.

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* 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.

QUESTION No. 180 (III)

USE OF INTERMITTENT COMMUNICATION IN RADIOTELEGRAPHY

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that the method of intermittent communication is coming into use particularly for circuits using meteoric ionization;

(b) that intermittent communication often enables the mean telegraph speed to be increased considerably, for a given quality of service, when the signals and interference at the receiver are random in character;

(c) that insufficient data are so far available concerning the fields in which it would be opportune to apply the principle of intermittent communication;

III

UNANIMOUSLY DECIDES that the following questions shall be studied:

1. Under what conditions is the use of intermittent communication advantageous in radiotelegraphy?
2. What advantages, as regards telegraph speed, can be expected from the use of intermittent communication under various conditions, as compared with the usual uninterrupted method?
3. What is the most rational course to be followed in the construction of equipment for the use of intermittent communication under various conditions?

QUESTION No. 181 (III) *

INFLUENCE ON LONG-DISTANCE HIGH-FREQUENCY COMMUNICATION USING FREQUENCY-SHIFT KEYING OF FREQUENCY DEVIATIONS ASSOCIATED WITH PASSAGE THROUGH THE IONOSPHERE

The C.C.I.R., (Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that Recommendation No. 246, § 3, recommends that, for frequency-shift systems working on two conditions only and operating between 3 Mc/s and 30 Mc/s, the values of frequency-shift should be 200, 400 and 500 c/s;

(b) that study of frequency deviations associated with passage through the ionosphere has shown that the resultant frequency variations may reach values of a few cycles per second, while instantaneous deviations may reach much higher values (see Documents of the VIth Plenary Assembly, Geneva, 1951, Vol. II, page 79, Doc. No. 213 (of Warsaw, 1959); Doc. No. 133 (Los Angeles, 1959) and Report No. 111).

UNANIMOUSLY DECIDES that the following question should be studied:

what minimum frequency-shift value is required for frequency-shift systems operating over long distances by high-frequency ionospheric propagation to take into account any possible influence of frequency deviations?

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* This Question replaces Question No. 139.

QUESTION No. 182 (III) *

FREQUENCY STABILITY REQUIRED FOR SINGLE SIDEBAND, INDEPENDENT SIDEBAND AND TELEGRAPH SYSTEMS TO MAKE THE USE OF AUTOMATIC FREQUENCY CONTROL SUPERFLUOUS

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that it is the practice with suppressed or reduced carrier SSB (single sideband) and ISB (independent sideband) telephone systems, and with many telegraph systems, to employ AFC (automatic frequency control) to adjust the receiver oscillator frequency in sympathy with frequency variations of the transmitted signal;

(b) that such AFC systems are complex and give rise to difficulty under poor propagation conditions;

(c) that the frequency stability which can now be achieved is much higher than that laid down in Recommendation No. 233, and is approaching a value which could provide sufficient inherent stability to enable AFC to be dispensed with;

(d) that frequency deviations caused by the passage through the ionosphere are not likely to influence significantly the operation of SSB, ISB and telegraph systems;

UNANIMOUSLY DECIDES that the following question be studied:

what frequency stabilities are necessary for SSB, ISB and telegraph operation in fixed HF systems, range 4,000–30,000 kc/s, to make AFC unnecessary, and how can these be achieved?

STUDY PROGRAMME No. 132 (III) **

TELEGRAPHIC DISTORTION, QUALITY INDEX, ERROR RATE, EFFICIENCY FACTOR

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that it is of the utmost importance to define and to determine the quality of a radiotelegraph communication;

(b) that the criterion of quality should conform to the definitions and measuring standards adopted by the C.C.I.T.T.;

(c) that interesting studies have been presented, but that it seems that it is still not possible to draw general conclusions;

(d) that it is important to make a large number of statistical measurements of distortion and error rate, to deduce from them " quality index " values and " efficiency factors " as defined below;

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* This Question replaces Question No. 167.

** This Study Programme does not refer to any Question under study.

UNANIMOUSLY DECIDES to carry out the following studies:

1. Application of the principles contained in the following C.C.I.T.T. definitions to radiotelegraph circuits:

1.1 *Quality index of a channel* (definition 33.22 of the List):
The probability of exceeding an assigned value of the degree of inherent distortion of a channel or of a section of a channel;

1.2 *Quality index of a telegraph apparatus* (definition 33.22 of the List):
— The probability of exceeding an assigned value of the degree of distortion of the modulation produced by a telegraph apparatus;
— Probability of the effective margin of a receiving apparatus being less than its nominal margin or less than a value assigned for that apparatus;

1.3 *Error rate of a radiotelegraph communication* (definition 33.19 of the List):
Ratio of the number of alphabetical signals of a message incorrectly received (after automatic translation when applicable) to the number of alphabetical signals of the message, the keying being correct;

III

1.4 *Efficiency factor in time* (of a telegraph communication with automatic repetition for the correction of errors (definition 33.23 of the List)):
The ratio of the time necessary to transmit a text automatically without repetition, at a specified modulation rate, to the time actually taken to receive the same text with a given error rate;

1.5 *Mutilation rate* (C.C.I.T.T. proposal):
(Error rate on mutations—not recommended),
(Error rate on elements — not recommended).
If a signal train entering a transducer has N transitions and if, on leaving this transducer, a device restores the incoming signal train so that the sequence and the sense of the transitions of the incoming signal train can be recognized, it is possible to count the number n_1 of transitions of the outgoing signal train which do not appear in the incoming signal train (shortage) and the number n_2 of transitions of the incoming signal train which do not appear in the outgoing signal train (extras); the mutilation rate is then the ratio $(n_1+n_2)/N$;

2.

2.1 Application of the C.C.I.T.T. standards for the measurement of *Error rate* for communications without correction of errors, or of the *Efficiency factor* for communications with automatic correction of errors;

2.2 These measurements should be affected in the following manner:
— duration of traffic observations for a measurement: 15 minutes;
— a count of the number of telegraph signals repeated in the course of these 15 minutes;
— a count of the number of errors during these 15 minutes (number of telegraph signals wrongly translated);
— a count of the number of telegraph signals received in the course of these 15 minutes;
— an indication should be given of the type of telegraph apparatus used and, when applicable, of the error-correcting system;
— an indication of the modulation rate;
— an indication of the maximum commercial speed, in words per minute, at that modulation rate;
— an indication of the average reception quality during the measurement (quality shown by means of one of the codes recommended by the C.C.I.R., SINPO or SINPFEMO code, or by a measurement of the average field during the observation);
— an indication of the date and time at which the observation was made;
— repetition of these 15 minutes measurement periods over one day on a given frequency during the hours when this frequency is normally used in order to take account of the influence of propagation conditions;

2.3 Measurements with the best technical accuracy are those made on the mutilation rate, but if the necessary apparatus is not available, error rate measurements would be very useful; Translation errors produced by a preceding error on the control of a function (such as inversion, line feed, synchronism, etc.) are not taken into account in the calculation of the error rate; in this case, the error on the control signal is counted only once;

2.4 As, in general, there seems to be no great call for a concept such as quality index, as far as radiotelegraph communication is concerned, the concept of error rate seems to have more point, especially if taken in conjunction with the idea of efficiency factors of a communication for which automatic repetition is used to correct error.

QUESTION No. 183 (III) *

FREQUENCY-SHIFT KEYING

The C.C.I.R., (Stockholm, 1948 — Los Angeles, 1959)

CONSIDERING

(a) that frequency-shift keying is employed in radiotelegraphy for the fixed services and it has also been extended to the mobile services;

(b) that it is desirable to standardize the main operating characteristics of systems employing frequency-shift keying;

(c) that various technical factors influence the choice of operating characteristics in such systems, in particular:

(ca) the overlap of marking and spacing signals due to multipath propagation (in this respect a small deviation is preferable);

(cb) the possible advantage of frequency diversity for reception (an advantage which increases with deviation);

(cc) economy of bandwidth and the consequent necessity for controlling the shape of the transmitted signals;

(cd) instability of frequency, which is one reason for the relatively large deviation employed in many existing equipments;

(ce) the choice of receiving systems, whether with separate filters or with frequency discriminator;

UNANIMOUSLY DECIDES that the following question be studied:

1. fixation of one or more standard values of deviation for fixed and mobile services in the various frequency bands, having regard to the various factors, in particular:
— the frequency spectrum resulting from the keying operation;
— the degree of frequency diversity desired;
— economy of bandwidth;
— instability of frequencies;

2. compilation of a standard terminology regarding the characteristics of systems employing frequency-shift keying.

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* Study Programmes Nos. 133 (III) and 134 (III) arise from this Question, which replaces Question No. 20.

STUDY PROGRAMME No. 133 (III) *

FREQUENCY-SHIFT KEYING

The C.C.I.R., (Geneva, 1951 — London, 1953 — Los Angeles, 1959)

CONSIDERING

(a) that frequency-shift keying is employed in radio telegraphy for the fixed services and has also been extended to mobile services;

(b) that it is desirable to standardize the main operating characteristics of systems employing frequency-shift keying;

UNANIMOUSLY DECIDES that the following study should be carried out:

III

1. the determination in each particular case of recommended values of frequency shift for emissions using frequencies between 2,000 and 27,000 kc/s;

2. the determination in each particular case of recommended values of frequency shift for emissions using frequencies below 2,000 kc/s.

STUDY PROGRAMME No. 134 (III) **

FOUR-FREQUENCY DIPLEX SYSTEMS

The C.C.I.R., (Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that there are in use in the fixed radiotelegraph services, operating between 2 Mc/s and 27 Mc/s, four-frequency diplex (or twinplex) systems in which each of four frequencies is used to transmit one of the four possible combinations of mark and space signals corresponding to two telegraph channels; it being understood that either or both of the two telegraph channels may be sub-channelled by time-division methods and that the use of such systems may be extended;

(b) that it is desirable to standardize the main characteristics of four-frequency diplex systems;

(c) that it may sometimes be necessary to employ the same radio transmitter to work with more than one receiving station;

(d) that various technical factors influence the choice of operating characteristics in such systems, in particular:
- — economy of bandwidth and the consequent need to control the shape of the transmitted signals;
- — a relatively wide spacing between adjacent frequencies may be necessary for high telegraph speeds;
- — the signal distortion due to propagation conditions;
- — the instability of the characteristics of certain receiver and transmitter elements such as oscillators, filters or discriminators;

UNANIMOUSLY DECIDES that the following study should be carried out:

the determination of the relation between the minimum frequency spacing and the telegraph speed over the range of telegraph speeds in practical use. This should be determined for both synchronous and non-synchronous operations.

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* This Study Programme which replaces Study Programme, No. 41, arises from Question No. 183 (III).

** This Study Programme which replaces Study Programme, No. 83, arises from Question No. 183 (III).

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STUDY GROUP No. IV *

(Space Systems)

Terms of reference :

To study technical questions regarding systems of telecommunication with and between locations in space.

Chairman : Professor I. RANZI (Italy)
Vice-Chairman : Dr. W. KLEIN (Switzerland)

Report No. 115 ** Factors affecting the selection of frequencies for telecommunication with and between space vehicles.

* No Questions or Study Programmes have as yet been allocated to this Study Group.
** See Volume III, Section D.

QUESTION No. 208 (IV)

RADIO EMISSIONS FROM ARTIFICIAL EARTH-SATELLITES AND OTHER SPACE VEHICLES

(Resolution No. 7 of the Administrative Radio Conference, Geneva, 1959)

The Administrative Radio Conference, Geneva, 1959,

CONSIDERING

(a) that it is desirable to study the question of identification for radio emissions from satellites and other space vehicles; *

(b) that it is desirable to study the question of providing for the cessation, at appropriate times, of radio emissions from satellites and other space vehicles;

INVITES

1. the C.C.I.R. to study the above-mentioned questions;

2. Members and Associate Members of the Union launching satellites and other space vehicles to give consideration to the above-mentioned problems and to present the results of their study to the C.C.I.R.

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* In collaboration with Study Group No. VIII (See Question No. 188 (VIII)).

STUDY GROUP No. V

(Propagation, including the effects of the earth and the troposphere)

Terms of reference :

To study the propagation of radio waves over the surface of the earth, taking into account changes in the electrical constants of the earth and irregularities of terrain, and including the effects of the troposphere.

Chairman : Dr. R.L. SMITH-ROSE, C.B.E. (United Kingdom)
Vice-Chairman : Dr. A. KALININ (U.S.S.R.)

* See Volume III, Section G.

* See Volume III, Section G.

QUESTION No. 135 (V)

DETERMINATION OF THE ELECTRICAL CHARACTERISTICS OF THE SURFACE OF THE EARTH

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that for calculations of radio propagation and particularly of propagation along the surface of the earth, it is of great importance that the equivalent values of ε (dielectric constant) and σ (conductivity) for the surface of the earth be known;

(b) that, although the question of the radio field in the vicinity of the earth's surface has been extensively studied from the theoretical point of view (in determining ε and σ knowledge of the field pattern would appear to play an important part), there is no sufficiently simple and reliable practical method in current use for determining these values;

(c) that Report No. 46, Question No. 184 (V) (§ 5) and Study Programme No. 135 (V) (§ 6) deal only with certain aspects of these problems;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what is the most practical method for radiocommunication services of determining equivalent values of ε (dielectric constant) and σ (conductivity) for the surface of the earth;

2. how can changes in these values be deduced from the corresponding changes in the field characteristics along the path;

3. what types of apparatus can be recommended for such measurements and what degree of accuracy can be expected;

4. how do the measured values depend on frequency;

5. what physical factors, for example vegetation and weather, affect the accuracy and the interpretation of the measurements and to what extent?

Note. — In connection with the above studies the following point should also be borne in mind, that in propagation over an inhomogenous earth the field characteristics may depend upon the distribution of ε and σ in both the horizontal and vertical directions in the ground; for example, in the neighbourhood of a boundary between two sections of markedly different ε and σ, the measurement of the field characteristics may lead to a negative equivalent conductivity.

V

QUESTION No. 137 (V) *

MEASUREMENT OF FIELD STRENGTH IN THE NEIGHBOURHOOD OF OBSTACLES

The C.C.I.R., (London, 1953 — Warsaw, 1956)

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;

* This Question replaces Question No. 86.

(b) that a knowledge of the value of the undisturbed field is of importance in 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.

QUESTION No. 138 (V)

MEASUREMENT OF FIELD STRENGTH FOR VHF (METRIC) AND UHF (DECIMETRIC) BROADCAST SERVICES, INCLUDING TELEVISION

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that at many receiving sites for VHF (metric) and UHF (decimetric) broadcast services there may be many obstacles, such as buildings and trees, which impair reception, and these sites may also be in shadow areas;

(b) that under these conditions field strengths vary widely from location to location and are difficult to measure and to predict in detail;

(c) that the available field strengths may also vary with time;

(d) that for these reasons available field strengths have been expressed on a statistical basis in terms of the percentage of time and of locations for which a specified grade of service is obtainable;

(e) that there are in use at present several methods of measuring the field strengths available, including
- — continuous mobile measurements with a low, non-directional antenna,
- — short periods of mobile measurements at regular intervals with the antenna elevated to about 10 meters,
- — single-location measurements with a similarly elevated antenna;

(f) that it is desirable to correlate the field strengths measured by the above and other methods with the field strengths wihch would have prevailed at the broadcast receiving locations in the absence of obstacles;

(g) that it is desirable to analyse and to present the measurements in such a manner that they may assist in predicting the available field strengths which may be expected under various conditions of terrain, including buildings and vegetation, at the receiving locations in the service area;

UNANIMOUSLY DECIDES that the following question should be studied:

what are the methods by which the field strengths available for VHF (metric) and UHF (decimetric) broadcast services may be measured, analysed and presented so that the quality of these services may be assessed or predicted under varying conditions?

QUESTION No. 184 (V) *

GROUND-WAVE PROPAGATION

The C.C.I.R., (Stockholm, 1948 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

the continuing importance of the effect of the characteristics of the earth on the propagation of waves used for all types of radio communication and radio location, including directional transmission and direction finding;

UNANIMOUSLY DECIDES that the following question be studied:

what should be taken into consideration to determine the ground-wave characteristics in a correct way to cover the entire radio-frequency spectrum now in practical use, giving particular attention to:

1. the effect of large natural and man-made obstacles in diffracting the waves in either the horizontal or the vertical plane;
2. the effect on transmission of inhomogeneities and small undulations of the ground;
3. the siting of aerials for frequencies above 30 Mc/s;
4. the relative effects obtained with horizontal and vertical polarization;
5. the variations in the phase of radio waves in transmission over the ground?

V

STUDY PROGRAMME No. 87 (V) **

EFFECTS OF STANDARD TROPOSPHERIC REFRACTION ON FREQUENCIES BELOW 10 Mc/s

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956)

CONSIDERING

(a) that the ground-wave propagation curves for frequencies below 10 Mc/s submitted with Recommendation No. 307, make no allowance for normal tropospheric refraction;

(b) that allowance is sometimes made for normal refraction by the assumption of an effective earth's radius of 4/3 times the actual value;

(c) that the effect of normal tropospheric refraction is likely to decrease with decreasing frequency;

(d) that some mathematical analyses relating to this subject have been completed and published ***;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. further measurements of ground-wave field strengths over a sufficiently long path of uniform conductivity, such as a sea path, to determine experimentally the modification of the ground-wave curves required to include the effects of tropospheric refraction at frequencies below 10 Mc/s;
2. interpretation of the mathematical analysis relating to ground-wave propagation to include the effects of tropospheric refraction on all frequencies below 10 Mc/s;
3. Investigation of the possible influence of tropospheric refraction on the phase of the ground wave.

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* Study Programmes Nos. 87 (V), 89 (V) and 135 (V) arise from this Question, which replaces Question No. 134.

** This Study Programme, which replaces Study Programme No. 51, arises from Question No. 184 (V).

*** See, for example, BREMMER H., *Terrestial Radio Waves, Theory of Propagation*, II, 145, Formula No. 31.

STUDY PROGRAMME No. 89 (V) *

GROUND-WAVE PROPAGATION OVER IRREGULAR TERRAIN

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956)

CONSIDERING

(a) that it is of great importance to pursue studies concerning propagation over irregular terrain;

(b) that the phenomenon known as obstacle gain is proving to be of great practical significance;

UNANIMOUSLY DECIDES that the following study should be carried out:

propagation of radio waves over irregular terrain, with consideration of the following aspects:

1. propagation over a specific path between fixed points, with particular reference to:
- — propagation along valleys between mountains,
- — propagation across valleys,
- — propagation in urban areas,
- — propagation over single obstacles of definite shape,
- — propagation across hills and mountains and observation of the phenomenon known as obstacle gain;

2. the possibility of obtaining increased field strength by achieving reduction of the strength of reflected rays reaching the receiving point;

3. propagation over a specific area surrounding a transmitter, using statistical methods, with particular reference to propagation over very irregular terrain;

4. the influence of irregular terrain on the best choice of site and the appropriate polarization of antennae for a desired type of service;

5. the experimental study of the phase variations with distance produced by irregularities of the terrain;

6. the further development of the mathematical analysis and its practical applications.

STUDY PROGRAMME No. 135 (V) **

GROUND-WAVE PROPAGATION OVER INHOMOGENEOUS EARTH

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that the problem of amplitude and phase variations in ground-wave propagation resulting from the non-uniformity of the electrical constants along the path is of great importance in connection with:

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* This Study Programme, which replaces Study Programme No. 54, arises from Question No. 184 (V).

** This Study Programme, which replaces Study Programme No. 88, arises from Question No. 184 (V).

— the determination of the service areas of radio transmitters,
— the use of medium and low frequencies for navigational aids,
— the study of coastal refraction;

(b) that, although the rigorous mathematical analysis has now been largely extended to include the effect of:
— several boundaries,
— curvature of the earth,
— propagation obliquely to a boundary,
— variations of the electrical constants of the ground in the vertical direction,
the general problem has not been formally solved;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. the obtaining of further experimental results for amplitude, phase and polarization of ground-waves over inhomogeneous earth under as wide a range of conditions as possible;

2. the interpretation of these results in terms of the methods referred to in Recommendation No. 308;

3. the further development of the mathematical analysis and its adaptation for engineering application to replace, if possible, the existing empirical methods;

4. the extension of the experimental and theoretical work to take account of changes in the electrical constants of the ground both in the horizontal and the vertical direction;

5. the possibility of using amplitude and phase measurements to detect and estimate changes in the electrical constants along a land path.

V

QUESTION No. 185 (V) *

PROPAGATION DATA REQUIRED FOR RADIO-RELAY SYSTEMS

The C.C.I.R., (London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that in the planning of a communication network it is necessary to define the over-all system performance achieved for given percentages of time;

(b) that designers of radio systems in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands require to know, from the point of view of sustained satisfactory operation, the tropospheric propagation characteristics and the resulting path attenuation that is exceeded for a low percentage of the time for each particular frequency band over the working range, which may extend from well within the optical range in line-of-sight systems to several times the optical range in tropospheric scatter systems;

(c) that the planning of systems requires a knowledge of the seasonal distribution curves of such propagation characteristics;

(d) that from the point of view of interference beyond the normal range it is necessary to know the value of path attenuation likely to be exceeded for a large percentage of time, at distances up to several times the working range;

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* Study Programme No. 136 (V) arises from this Question, which replaces Question No. 136.

(e) that the system bandwidth may be limited by multipath propagation effects;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what is the distribution with time of the values of path attenuation in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands, and particularly the values likely to be exceeded for 99·9 %, 99 %, 50 %, 1 %, 0·1 % and 0·01 % of each month of the year;
2. what is the cumulative distribution of the length of individual time intervals during which the path attenuations exceed each of the levels described in § 1 for a representative month of each season;
3. to what extent are these distributions dependent upon the length of path, the geographical region and the type of terrain over which the path passes, and for optical paths, the terrain clearance;
4. what limitations on the bandwidth of transmission are imposed by the propagation medium?

STUDY PROGRAMME No. 136 (V) *

INFLUENCE OF THE TROPOSPHERE ON PROPAGATION ACROSS MOUNTAIN RIDGES

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that Question No. 185 (V) seeks information on, amongst other things, the influence on the time distribution of the values of path attenuation, caused by the type of terrain over which the signal passes;

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

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

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. the time distribution of the values of path attenuation as mentioned in § 2 and 3 of Question No. 185 (V) for a signal path as described in *(b)* above;
2. the manner in which the reduction in path attenuation depends upon the directional and other properties (e.g. height) of the transmitting and receiving antenna systems.

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* This Study Programme, which replaces Study Programme No. 79, arises from Question No. 185 (V).

STUDY PROGRAMME No. 57 (V) *

INVESTIGATION OF MULTIPATH TRANSMISSION THROUGH THE TROPOSPHERE

The C.C.I.R., (London, 1953)

CONSIDERING

that in systems using frequencies above 30 Mc/s, radio waves may travel from a transmitter to a receiver along several paths;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. investigation of time and phase differences occurring in multipath transmissions;
2. determination of the percentage of time for which given time and phase differences occur respectively;
3. statistical analysis of the relative strengths of signals occurring in multipath transmissions;
4. investigation of the manner in which the quantities measured vary with frequency over bands of the order of those used in television and wide-band radio and television systems;
5. investigation of the manner in which the same quantities are affected by the use of space-diversity systems.

V

STUDY PROGRAMME No. 137 (V) **

TROPOSPHERIC PROPAGATION CURVES FOR DISTANCES WELL BEYOND THE HORIZON

The C.C.I.R., (Geneva, 1951 — London, 1953 — Los Angles, 1959)

CONSIDERING

(a) that the curves given in Recommendation No. 312 *** are restricted to the frequency range 40 to 600 Mc/s, and that no definite dependence on frequency has yet been established;

(b) that the corrections to the curves provided for different meteorological conditions have been established for some areas only and cannot necessarily be used in all parts of the world;

(c) that it is important to determine what variations from the curves may be caused by irregular terrain of all types;

(d) that the curves refer specifically to transmission over land, whilst long-distance tropospheric propagation over sea is also of interest;

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* This Study Programme does not refer to any Question under study.

** This Study Programme, which replaces Study Programme No. 55, does not refer to any Question under study.

*** It must be emphasized that the curves of Recommendation No. 312 are intended for use in the planning of broadcasting services for the solution of interference problems over an extended area; they should not be used for point-to-point communication links, for which systems the actual terrain profile may be determined and methods of field strength prediction of higher accuracy may be used.

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. continuous recording for distances well beyond the horizon, of transmissions in the frequency range 30 to 4000 Mc/s in as many parts of the world as possible over a period of at least two years, to determine how long-distance field strengths vary with frequency;
2. particular investigation of the problem of oversea paths;
3. statistical analysis of the results of such experiments along the lines adopted in the production of the curves given in Recommendation No. 312.
4. investigation of alternative methods of presentation of the data, if these appear to have advantages from the engineering point of view;
5. deduction from this analysis of the modification to those curves to allow for the different average meteorological conditions existing in different parts of the world;
6. statistical study of the variation of field strength at various distances from the transmitter;
7. study of the statistical distribution of the field as a function of location of the point of reception within a specified zone;
8. investigation over various transmission distances of the effect of changing the height of the transmitting aerial;
9. investigation over various transmission distances of the effect of using directive aerials both for transmission and reception.

RESOLUTION No. 23

TROPOSPHERIC-WAVE PROPAGATION CURVES

(Study Group No. V)

The C.C.I.R., (Warsaw, 1956)

UNANIMOUSLY CONSIDERING

(a) that the need exists for revision of the curves attached to Recommendation No. 111 *;

(b) that much data have become available since the publication of these curves;

(c) that there was insufficient time during the VIIIth Plenary Assembly at Warsaw, for the proper consideration of the data then available;

(d) that additional data are continually being made available particularly as regards the UHF (decimetric) band;

(e) that to prepare for the next regional conference on frequency assignments for broadcasting (sound and vision), this revision should be completed;

UNANIMOUSLY RESOLVES

1. that an international Working Group should be established to examine all available data and to prepare provisional new curves intended to replace the curves of Recommendation No. 111*;
2. that the Working Group be composed of members nominated by the Administrations of the United States, France, the Federal German Republic and the United Kingdom;

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* This Recommendation has been replaced by Recommendation No. 312.

3. that the co-ordination of the work of the Group should be undertaken in the United Kingdom by the Radio Research Organisation of the Department of Scientific and Industrial Research under the direction of the Chairman of Study Group No. V;

4. that as soon as the curves are available they should be communicated to the Director of the C.C.I.R. by the Chairman of Study Group No. V and submitted for approval to all administrations. If approved, they should be considered valid for provisional use pending consideration by the IXth Plenary Assembly *;

5. that as far as possible the work of the Group should be conducted by correspondence.

STUDY PROGRAMME No. 138 (V) **

TROPOSPHERIC-WAVE PROPAGATION

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

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 detailed 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. 312;

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 strength 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 No. 311;

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, § 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;

V

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* See Recommendation No. 312

** This Study Programme, which replaces Study Programme No. 90, does not refer to any Question under study.

5. world-wide climatology should be studied and as a first step in this important work, the national telecommunications services, in agreement with the meteorological services concerned, should calculate for each season the monthly mean value of the parameter N, as defined in § 2 of the Annex, for both day and night, at ground level and at a height of 1000 metres above the ground. They should also caclulate the parameter ΔN determined by the difference between these two values of N, with a view to establishing world-wide charts of constant values of ΔN and world-wide charts of constant values of N at the surface of the ground, N_s. Further, if N_o is taken as the value of N reduced to sea level, it may be found that N_o used as an intermediate step may lead to more accurate values of N_s being derived; the general validity of this procedure should be studied and the preparation of charts of constant values of N_o considered;

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.

Note 1. — National Administrations, the U.R.S.I. and other international organisations 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.

Note 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 § 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 two consecutive points of measurement: 10 metres,
   Temperature: $\pm$ 0·2° C,
   Humidity (mixing ratio): $\pm$ 0·1 g/kg,
   Continuous measurement equipment should be used for preference.

2. The parameter $N=(n-1).10^6$ is given by the formula:

   $N = (77{\cdot}6/T)\,(p + 4810\,e/T)$
   n = refractive index of the air,
   T = absolute temperature in degrees Kelvin,
   e = water-vapour pressure in mb,
   p = atmospheric pressure in mb.

   In all cases it is desirable that a description of the apparatus used should be provided. The calculations should, if possible, cover a period of at least five years, preferably covering the period 1951–1955 and 1956–1960.

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

   It should be assumed that the seasons can be represented by the months of February, May, August and November and the hours of measurement will, whenever possible, be at the even hours, local meridian time. Since the determination of ΔN is dependent upon data from radio-sonde ascents, the times at which these are made must necessarily be used, though every effort should be made to make these measurements as extensive as possible.

STUDY PROGRAMME No. 139 (V) *

RADIO TRANSMISSION UTILIZING INHOMOGENEITIES IN THE TROPOSPHERE (COMMONLY TERMED " SCATTERING ")

The C.C.I.R., (Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that, in various countries, recent experiments, characterized by the use of transmitting and receiving antennae directed towards the same part of the troposphere, have shown that radio signals in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands can be propagated consistently through the troposphere over unexpectedly great distances, and that, beyond the line of sight, fields are found to be much greater than the diffraction theory for a standard radio atmosphere would predict;

(b) that useful signals can be obtained in this manner at distances greater than was formerly expected;

(c) that tropospheric inhomogeneities play an important role in this phenomenon;

(d) that little is known about geographical and topographical influences;

V

UNANIMOUSLY DECIDES that the following studies should be carried out:

investigation of this new tropospheric propagation phenomenon, in its widest sense, with a view to the extension of knowledge of:

1. the characteristics of the signal, in particular signal strength, signal distortion (time delays, bandwidth), fading rates and fading range and their dependence on frequency, range and geographical situation;

2. the influence of meteorological conditions, including water vapour, rain and snow on signal strength;

3. the efficiency of antennae in relation to size and design;

4. the use of space, frequency and polarization diversity for transmission and reception;

5. the application of such diversity techniques for co-channel transmission and reception.

STUDY PROGRAMME No. 140 (V) **

PROPAGATION AT VHF AND UHF OVER DISTANCES UP TO 200 KILOMETRES

(Resolution No. 41)

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that Recommendation No. 312 refers mainly to field strengths well beyond the horizon;

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* This Study Programme, which replaces Study Programme No. 91, does not refer to any Question under study.

** This Study Programme does not refer to any Question under study.

(b) that in the planning of VHF and UHF services it is important to have a knowledge of field strength characteristics both within and beyond the horizon;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. investigations of the field strength dependence upon distance, terrain, time and frequency, of VHF and UHF transmissions over distances of up to 200 kilometres;
2. examination of the best means of presenting the data obtained from such investigations, and its relation to the work of Study Programme No. 137 (V).

RESOLUTION No. 41

PROPAGATION AT VHF AND UHF OVER DISTANCES UP TO 200 KILOMETRES

(Study Programme No. 140 (V))

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that a need exists for a complete description of field strength characteristics as a function of distance, terrain, time and frequency, particularly for services operating in the VHF and UHF bands;

(b) that the international Working Group established under Resolution No. 23 is providing an analysis of field strength data relating to transmission distances well beyond the horizon;

(c) that it is important that an additional analysis should be made of field strength data relating to all shorterdistances not covered by Resolution No. 23;

(d) that there already exists a considerable amount of data relating to such short distances;

UNANIMOUSLY RESOLVES

that the international Working Group established under Resolution No. 23 should extend its activities to include the analysis and presentation of the data referred to in § *d* above.

STUDY GROUP VI

(Ionospheric propagation)

Terms of reference :

To study all matters relating to the propagation of radio waves through the ionosphere in so far as they concern radio communication.

Chairman : Dr. D.K. BAILEY (U.S.A.)

Vice-Chairman : Dr. E.K. SMITH (U.S.A.)

VI

* See Volume III, Section G.

* See Volume III, Section G.

STUDY PROGRAMME No. 93 (VI) *

IDENTIFICATION OF PRECURSORS INDICATIVE OF SHORT-TERM VARIATIONS OF IONOSPHERIC PROPAGATION CONDITIONS

The C.C.I.R., (London, 1953 — Warsaw, 1956)

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 ** 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:

VI

the possibility of selecting particular kinds 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. — The above 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 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.

STUDY PROGRAMME No. 100 (VI) ***

PREDICTION OF SOLAR INDEX

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that the sun is the primary cause of many geophysical phenomena, in particular, of the formation of the ionosphere and of most of its variations;

(b) that the gradual waxing and waning of solar activity, with intervals of approximately eleven years between maxima, corresponds closely with many slowly varying geophysical activity indices;

(c) that the slowly varying component of solar and geophysical activity can be estimated from many solar activity indices based on optical and radio measurements and by geomagnetic and ionospheric sounding measurements;

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* This Study Programme which replaces Study Programme No. 59, does not refer to any Question under study.

** See Docs. Nos. 78, 79, 123, 124 and 347 (Warsaw, 1956).

*** This Study Programme, does not refer to any Question under study.

(d) that reliable prediction of such parameters is of the utmost importance to radio propagation work;

(e) that autocorrelation techniques have been studied in various countries;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. predictions by all published autocorrelation or quasi-autocorrelation methods should be compared with each other and with the results of subsequent observations for recent years; these comparisons should be continued on a current basis;
2. further attention should be given to the combination of autocorrelation and empirica methods which may yield more nearly optimum predictions.

STUDY PROGRAMME No. 141 (VI) *

STUDY OF THE WHISTLER MODE OF PROPAGATION

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that the mode of ionospheric propagation called the whistler mode permits relatively efficient propagation of waves between approximately 3 and 30 kc/s along paths approximately parallel to the earth's magnetic field which may extend far out into space beyond the region of maximum ionization density in the ionosphere;

(b) that such propagation may be useful as a means of providing communication, but more especially may be capable of producing harmful interference;

UNANIMOUSLY DECIDES that the following studies be carried out:

1. investigation of the potential usefulness of the whistler mode for radio communication;
2. investigation of the interference potentialities of signals propagated by the whistler mode.

STUDY PROGRAMME No. 142 (VI) **

RADIO PROPAGATION AT FREQUENCIES BELOW 1500 kc/s

The C.C.I.R., (Geneva, 1951 — London, 1953 — Los Angeles, 1959)

CONSIDERING

(a) that the C.C.I.R. is not yet in a position to supply to the administrations and to the I.F.R.B. direct and unequivocal answers on this subject;

(b) that the ground-wave propagation of low and very low frequencies is usually not of great importance at distances in excess of about 2,000 km, unless the ground wave can be separated from the sky wave, since the latter is usually stronger;

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* This Study Programme, which does not refer to any Question under study, has been brought to the notice of the U.R.S.I. by Resolution No. 42. See also Study Programme No. 142 (VI).

** This Study Programme, which does not refer to any Question under study, replaces Study Programme No. 63. It has been brought to the notice of the U.R.S.I. by Resolution No. 43. See also Study Programme No. 141 (VI).

(c) that the requirement for ground-wave propagation curves for low and very low frequencies over distances beyond 2,000 km has been met by the C.C.I.R. (see Recommendation No. 307, Figs. 6 to 10);

(d) that the mathematical analysis of this problem mentioned in the title has been largely confined to ideal cases that are not sufficiently representative of practical conditions, especially where long-distance propagation is concerned;

(e) that there has been a revival of interest in the propagation of low and very low frequencies over all distances and particularly at distances in excess of 2,000 km, not merely in connection with communications, but more especially in connection with certain radio navigation systems employing pulse, phase comparison, or direction-finding techniques, or combinations of such techniques;

(f) that some progress has recently been made in understanding the nature and behaviour of the lower part of the ionosphere which is responsible for the sky-wave propagation most usually observed at low and very low frequencies;

(g) that the C.C.I.R. long and medium wave night propagation curves adopted at Cairo in 1938 cannot be considered as completely satisfactory now, as they are believed to overestimate the field at the longer distances, do not extend to distances below about 400 km, and do not take sufficient account of such factors as variation with frequency, with magnetic latitude, with season and with solar activity;

(h) that curves are needed for day-time sky-wave propagation for frequencies up to about 300 kc/s for distances at which the sky wave predominates;

UNANIMOUSLY DECIDES that the following studies be carried out: VI

1. the continuation of measurements at vertical and oblique incidence at frequencies below 1500 kc/s by administrations and laboratories having suitable facilities;

2. the determination of the physical conditions in the lower ionosphere responsible for the reflection of low and very low frequencies, with particular reference to the possibility that reflection occur simultaneously at more than one height;

3. determination of the diurnal and seasonal variations in sky wave field strength as a function of
- — geographical location with particular attention to transpolar paths and antipodal regions;
- — path orientation including the influence of the earth's magnetic field;
- — solar and geomagnetic indices with particular reference to the amplitude and phase consequences of SID's and polar blackouts;
- — orientation of the path with respect to the day-night line;

4. the development of the mathematical analysis to make it apply more closely to the general conditions of long-distance propagation in which the ionization, the direction of the magnetic field, and ground conditions (including terrain) vary along the propagation path; for navigation systems at low and very low frequencies, it is important to be able to calculate the effects of variations of propagation conditions along the path upon the phase and amplitude of the wave;

5. the possibility of revising the C.C.I.R. night propagation curves (presented at Cairo by the C.C.I.R. 1938) in the light of present knowledge, in view of the need of the administrations and the I.F.R.B. to have available reliable curves, taking account of relevant factors such as those expressed in Question *(c)* of the Annex to Report No. 150.

6. the possibility of establishing curves of day-time sky wave propagation for low and very low frequencies up to about 300 kc/s for distances at which the sky wave is predominant.

STUDY PROGRAMME No. 143 (VI) *

PROPAGATION BY WAY OF SPORADIC E REGION AND OTHER ANOMALOUS IONIZATION IN THE E AND F LAYERS OF THE IONOSPHERE

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that Es propagation may play an important role in HF communications out to long distances and frequently also (up to distances of 2,300 km) in the lower VHF band;

(b) that sporadic E data from ionosondes, normally used for predictions, does not provide adequate statistics on the field strength of the received signal;

(c) that continuous wave recordings and pulse measurements at fixed frequencies of sporadic E and other abnormal modes provide the sort of field strength statistics required by communication engineers;

(d) that for such recordings in the lower VHF band, normal D-region absorption is a negligible factor in the received signal;

(e) that it is frequently very difficult to separate sporadic E from other anomalous ionization in the E and F regions;

(f) that the composite effect of anomalous propagation modes is of interest to communication engineers;

UNANIMOUSLY DECIDES that the following studies be carried out:

1. field strength measurements of signals propagated by sporadic E and other abnormal modes should be made in the upper part of the HF band and, more particularly, in the lower part of the VHF band in order to determine, on a statistical basis, the magnitude of the field strength due to these phenomena, and the distributions with distance, time of day, season and solar and magnetic cycles;
2. where possible, the effects of the different abnormal modes should be separated and their relative importance be determined;
3. the following should be specified when data are reported:
   - frequency and transmitter power;
   - antenna gain, beamwidth, height, and site configuration;
   - receiver input impedance and calibration technique;
   - transmission line losses;
4. appropriate angle of arrival measurements should be carried out;
5. in addition to E-region effects, the extent of anomalous F-regions effects be also explored including, for example, the Western Pacific anomaly **;
6. preparation of world-wide and regional charts of transmission loss (or received signal level relative to free-space) in a form useful to radiocommunications.

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* This Study Programme does not refer to any Question under study.

** See Report No. 149.

STUDY PROGRAMME No. 144 (VI) *

STUDY OF SKY-WAVE PROPAGATION ON FREQUENCIES BETWEEN APPROXIMATELY 1·5 AND 40 Mc/s FOR THE ESTIMATION OF FIELD STRENGTH

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that the problem of estimating received field strengths is very important from application, planning and scientific viewpoints;

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

(c) that understanding of long distance ionospheric propagation is far from complete;

(d) that many factors, e.g. the influence of the magnetic field of the earth, must be taken into account;

(e) that there are certain applications for which the present methods are insufficiently accurates:

(f) that theoretical and experimental investigations on a widespread basis are needed if progress in this subject is to be made;

VI

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. detailed theoretical investigations of long distance ionospheric propagation;

2. improvement of methods of field strength estimation taking into account the magnetic field of the earth and the direction of wave propagation;

3. the improvement of field strength estimation with reference to special conditions which exist in the auroral zone;

4. in these studies the results of the following investigations should be incorporated into the estimation of field strengths:

— Recommendation No. 317 — field strength measurements.
— Study Programme No. 143 (VI) — sporadic E propagation.
— Study Programme No. 145 (VI) — absorption.
— Study Programme No. 148 (VI) — fading.
— Study Programme No. 151 (VI) — pulse transmission tests.
— Study Programme No. 152 (VI) — back-scattering;

5. the statistical comparisons of calculated and measured field strength values, taking into account the basic parameters of the period of comparison.

Note. — In carrying out the above studies note should be taken of related studies in the U.R.S.I.

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* This Study Programme, which together with Study Programme No. 145 VI) replaces Study Programme No. 99, does not refer to any Question under study.

RESOLUTION No. 48 *

STUDY OF SKY-WAVE FIELD STRENGTHS ON FREQUENCIES BETWEEN THE APPROXIMATE LIMITS OF 1·5 AND 40 Mc/s

(Study Programme No. 144 (VI))

The C.C.I.R., (Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that the calculation of sky-wave field strength on frequencies in the range between about 1·5 and 40 Mc/s for radiocommunication circuits of different lengths is of great practical importance;

(b) that the method of calculation of field strength within this range of frequencies should be based on sufficiently reliable theoretical grounds connected with the physics of the ionosphere and the laws of radio-wave propagation in the ionized region;

(c) that the theoretical grounds and calculation formulae, concerning computation methods, should be given a detailed experimental check on different high frequencies for radiocommunication circuits of various lengths and directions. In this it is necessary to take into account the time of day, season and the phase of solar activity;

(d) that the work of different Administrations as well as of the I.F.R.B. should be based on a method which, while theoretically reliable, would give the best correpondence with measured values of field strength;

(e) that, in order to appreciate the relative merits of the various methods, it will be necessary to make many comparisons of experimental data and the results of the several methods of computation;

UNANIMOUSLY RESOLVES

1. the continuance of the Working Party set up by Recommendation No. 177, in which the following Administrations are represented:

France (Chairman),
United States of America,
Japan,
Federal German Republic,
Roumanian People's Republic,
Czechoslovakia,
U.S.S.R;

2. that the Working Party continue the work on comparison of the three suggested methods of calculation of field strength on frequencies above 1,500 kc/s, namely those based on:

— Circular No. 462 of the National Bureau of Standards (U.S.A.);
— Technical Report R.P.U. 9 (U.S.A.) **;
— Doc. No. 744 (U.S.S.R.) of Warsaw, 1956;

3. that in future other methods of calculation be considered if any such are submitted by the Administrations to the C.C.I.R.;

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* This Resolution replaces Recommendations Nos. 177 and 178.

** Doc. No. 285 of Warsaw, 1956, indicates that R.P.U. Technical Report No. 9 is available as Catalogue No. PB 103,045 at:
The Office of Technical Services,
Department of Commerce,
Washington 25, D.C. (U.S.A.)

4. that in view of the great amount of work involved in the comparison of the calculation methods with one another, and with experimental data, the Administrations, Members of the C.C.I.R., should render all possible assistance to the Working Group;

5. that the Administrations, Members of the C.C.I.R. should carry out a number of measurements of field strength and radiated power of transmitters with a view to a comparison of the calculations carried out by different methods with experimental data (Recommendation No. 317);

6. that, in order to make the measurements reliable and comparable, the Administrations participating in the above-mentioned investigations should follow the recommendations of the Working Group on this subject;

7. that, taking into account that the work on measurements of field strength will require much time, during which continuous coordination will be needed, the task of the Working Group should be continued by correspondence as well as by meetings and be coordinated by its Chairman, who will report from time to time to the Chairman of Study Group VI and to the Director of the C.C.I.R. on the progress made.

VI

STUDY PROGRAMME No. 145 (VI) *

SKY-WAVE ABSORPTION ON FREQUENCIES BETWEEN THE APPROXIMATE LIMITS OF 1·5 AND 40 Mc/s

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) the need for obtaining more information on the absorption of waves propagated via the ionosphere;

(b) that this absorption is a more complicated function of local time, season and geomagnetic latitude than is usually assumed;

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

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. measurements of absorption at both vertical and oblique incidence in as many parts of the world as is possible with a view to improving the basic data embodied in methods for estimating sky-wave field strengths on frequencies between about 1.5 Mc/s and 40 Mc/s. Attention is drawn to the special need for measurements in regions of high absorption. Wherever possible, measurements should be made on a number of frequencies in order to determine the frequency dependence of absorption. The use of pulse transmissions is recommended;

2. measurements of the temporal variation of the absorption of extra terrestrial noise especially at high latitudes;

3. measurements of field strength of signals received from artificial satellites.

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* This Study Programme, which together with Study Programme No. 144 (VI) replaces Study Programme No. 99, does not refer to any Question under study.

STUDY PROGRAMME No. 146 (VI) *

INTERMITTENT COMMUNICATION BY METEOR-BURST PROPAGATION

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that meteor-burst propagation has been demonstrated to be a useful means of intermittent communication in the lower part of the VHF band; the useful range of distances extends from a few hundred to somewhat beyond 2,000 kilometres;

(b) that available propagation data are not yet adequate for the design of efficient systems utilizing this mode of propagation;

(c) that, while communication systems utilizing this mode of propagation provide propagation data, the data thus obtained are not always capable of generalization;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. the delineation of the physical mechanisms involved;

2. the determination of which statistical parameters of the received signals are required for the proper design and operation of communication systems, for example, it would be of interest to determine the time-distribution and frequency dependence of the signal envelope;

3. the diurnal and seasonal variation of these signal parameters for a given system with:
— geographical location,
— path orientation,
— solar and geomagnetic activity,
— other factors;

4. the influence of the plane-wave gain, directivity and orientation of the antennae on the useful characteristics of the received signals;

5. characteristics of the received signals such as:
— multipath distortion,
— Doppler shifts;
which affect the choice of modulation techniques, with a view to establishing maximum useful information rates;

6. the directional characteristics of scattering from meteor trails in relation to:
— privacy of communication,
— interference with or by other communication systems;

7. the space and frequency diversity characteristics of the signals in relation to:
— useful information rates in closed-loop (two-way) systems,
— privacy of communication;

8. the problems arising from the occurrence of conventional Es reflection (and of F layer reflections at times of very high solar activity), with special reference to interference both to and from other transmissions on the same, adjacent or harmonic frequencies.

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* This Study Programme does not refer to any Question under study.

STUDY PROGRAMME No. 147 (VI) *

IONOSPHERIC-SCATTER PROPAGATION

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that propagation by means of scattering in the lower ionosphere is now an established feature of communication systems using frequencies in the lower part of the VHF (metric) band over distances from approximately 1,000 to 2,000 kilometres;

(b) that communication systems and experimental links employing this mode of propagation were originally confined to arctic and sub-arctic regions and were developed during a period of low solar activity, but that more recently their use has been extended to middle and low latitudes, and results are now available for a period of unprecedentedly high solar activity (1957-1958);

(c) that F-layer propagation of radio waves over distances in excess of 2,000 kilometres at frequencies well above the classical MUF has been observed;

(d) that, while much study has already been given to these subjects (see Report No. 158), many factors require further investigation;

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UNANIMOUSLY DECIDES that the following studies should be carried out:

1. the delineation of the physical mechanisms involved with reference to the design and operation of such communication systems;

2. the diurnal and seasonal variation of median received signal intensity for a given system with:
- — geographical location,
- — path orientation,
- — solar and geomagnetic activity,
- — probability of occurrence of Es ionization,
- — other factors (for example, meteorological);

3. the influence of the plane-wave gain, directivity, and orientation of the antennas on the received signal intensity;

4. the short-term variations of received-signal intensity in relation to the use of diversity methods;

5. the characteristics of the received signals, affecting the choice of modulation techniques, such as the Doppler-shifted components and multipath components, with a view to establishing the maximum useful information rates and bandwidths;

6. the multipath characteristics of the received signal in relation to:
- — antenna directivity,
- — antenna orientation,
- — path length,
- — ionospheric and ground characteristics;

7. the problems arising from the occurrence of conventional Es reflections (and of F layer reflections at times of very high solar activity), with special reference to interference both to and from other transmissions on the same, adjacent, or harmonic frequencies.

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* This Study Programme, which replaces Study Programme No. 95, does not refer to any Question under study.

STUDY PROGRAMME No. 148 (VI) *

STUDY OF FADING

The C.C.I.R., (London, 1953 — Los Angeles, 1959)

CONSIDERING

(a) that the practical requirements of radio communication necessitate not only information on the median received field strength of radio transmissions, but also:
- — data on the amplitude distribution and rapidity of field strength variations (with respect to the speed of transmission),
- — effects of equipment time constants,
- — selective fading,

and that this information is essential to Study Groups Nos. III, X and XII in assessing the allowances for fading;

(b) that field strength variation involves phenomena of focussing, of variation in direction of arrival, of interference by components of a single mode, between different modes, and between the various magneto-ionic components, as well as of variations of ionospheric absorption and of scattering phenomena;

(c) that variations of field strength may, as a first approximation, be divided into three types:
- — irregular short period variations, assumed in general to result from interference and focussing, with an apparent period of occasionally as much as several minutes and dependent to a certain degree on the frequency. These variations should be allowed for in the assessment of a *fading safety factor ;*
- — irregular variations of periodicity large compared with the case above. i.e., hourly, daily or from one day to another, which may be due to fluctuating absorption or to prolonged large scale focussing or which may result from variations of arrival angle and polarisation. Allowance for them should be made in the assessment of an *intensity fluctuation factor ;*
- — regular variations with time of day, season and solar activity, to which are added the variations of the two above types;

(d) that it is important to have as much information as possible concerning the effects of fading on time, space, frequency and polarisation diversity reception;

UNANIMOUSLY DECIDES that the following studies should be carried out for the various frequency bands used in radio communication by means of the ionosphere:

1. the space and time distributions (for example, Rayleigh, normal and log-normal) of short-period field strength variations ranging from less than 10^{-4} sec to as much as several minutes. Such results may also be measured as space and time correlations, and as power spectra;

2. the time distribution of the duration of fades for different levels of the field strength relative to the median;

3. the severity of day-to-day variations of hourly median field strengths, i.e., for time intervals of one hour;

4. the extent to which the above variations are dependent upon season, solar activity and geographical location;

5. the effects produced by field-strength variations on different receiving systems, such as time, space, frequency and polarization diversity systems;

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* This Study Programme, which replaces Study Programme No. 66, does not refer to any Question under study.

6. the mechanisms which produce field-strength variations;
7. the extent to which any of the above studies are affected under modulation conditions;
8. the effects of selective fading on very closely adjacent frequencies (e.g., approximately 20 kc/s and less).

Note. — The above studies should be undertaken both from a theoretical and experimental viewpoint. When appropriate, consideration should be given to the time constants and other characteristics of the measuring equipment.

RESOLUTION No. 49

STUDY OF FADING

(Study Programme No. 148 (VI))

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

that there is now available in Report No. 159 a large body of valuable information on the fading of signals propagated by the ionosphere;

UNANIMOUSLY RESOLVES

1. that an international working party be formed to prepare, by correspondence, a comprehensive but brief report on those aspects of fading phenomena which concern the work of the C.C.I.R.;
2. that the following interested Administrations be invited to participate in this working party:
   Federal German Republic (Chairman),
   U.S.A.,
   France,
   India,
   Japan,
   Sweden,
   U.S.S.R.;
3. that this working party should have a report ready in time for consideration at the next meeting of Study Group VI ;
4. that the report should consist of a brief summary of information available in the literature together with adequate references.

VI

STUDY PROGRAMME No. 149 (VI) *

BASIC PREDICTION INFORMATION FOR IONOSPHERIC PROPAGATION

The C.C.I.R., (London, 1953 — Los Angeles, 1959)

CONSIDERING

(a) that the production of basic predictions for ionospheric propagation involves problems which are not yet fully solved;

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* This Study Programme, which replaces Study Programme No. 60, does not refer to any Question under study.

(b) that, nevertheless, extensive practical use is made of basic prediction information by radio operating services and Administrations (see Report No. 161);

(c) that the application to specific operational problems, of basic prediction information, as supplied by various Administrations and centres, has revealed occasional large discrepancies between basic prediction information and operational results, even though the solar activity may have been correctly forecast; these may be attributed to such causes as:

— different interpretations placed upon the basic ionospheric observations;
— different methods of converting basic ionospheric observational material into predictions;
— over-simplification of the prediction material resulting from the continuing use of the three-zone method of allowing for longitude effects in the characteristics of the F2 layer;
— inadequate understanding and lack of research concerning the role played by the E, Es and F1 layers, for the actual modes of propagation and for the effects of ground and ionospheric scatter;
— the need for suitable interpolation methods in the preparation of basic world predictions, especially for regions from which no data are available;
— differences in the statistical significance of the ionospheric and operational data sampled, and in the methods of assessing the circuit performance of the various classes of service;

(d) that confusion exists because of the lack of clear distinction between classical and operational viewpoints (see Recommendation No. 318);

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. the suitability of present methods for predicting oblique-incidence classical MUF from vertical data for both short and long paths;

2. the relation of classical and operational MUF;

3. the extent to which basic prediction material could be improved by different methods of presentation and interpolation (e.g., by the use of U.T. charts or by automatic interpolation methods);

4. the role played by ionization in the layers of the E region in the determination of operational MUF for short and long paths both in summer and winter;

5. practical methods of introducing into prediction data, propagation modes and the related subject of angles of arrival and departure;

6. the commercial use afforded by power-dependent modes, and the relative dependence of operational MUF on type of service and information rate;

7. transmissions by propagation off the great-circle path;

8. a statistical examination in terms of season, solar cycle, location, etc., of the day-to-day variation in MUF so that practical methods may be devised whereby this factor can be introduced into monthly predictions.

STUDY PROGRAMME No. 150 (VI) *

CHOICE OF A BASIC INDEX FOR IONOSPHERIC PROPAGATION

The C.C.I.R., (London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that the sun is generally accepted as the primary cause of many geophysical phenomena, in particular of the formation of the ionosphere and of most of its variations;

(b) that when suitably smoothed averages are used, the Wolf sunspot numbers provide an index of solar activity which shows a fairly good correlation with similarly smoothed ionospheric propagation data, but that these numbers are nevertheless subjective and empirical since they are obtained from an arbitrary formula based on the number of spots and of groups of spots observed on the sun's disk;

(c) that determination of the Wolf numbers depends on visual observations of the sun which can only be made under favourable meteorological conditions;

(d) that it has recently been shown that the intensity of solar radiation in the VHF (metric) and UHF (decimetric) bands is closely correlated with visible solar phenomena;

UNANIMOUSLY DECIDES that the following studies should be carried out: VI

1. the relationship between solar phenomena, other than sunspots expressed in Wolf numbers which can be observed objectively, and ionospheric propagation conditions;
2. the relationship between the intensity of solar radiation at radio frequencies and ionospheric propagation conditions;
3. the possibility of establishing an index of solar activity, based upon optical or radio observations, which can be usefully employed as a basic index for ionospheric propagation;
4. the possibility of utilizing, perhaps temporarily, some observations of terrestrial phenomena, which may be geomagnetic or ionospheric in character, to provide a suitable index of solar influence on ionospheric phenomena, for use in connection with ionospheric propagation studies.

RESOLUTION No. 50

ORGANIZATION OF WORK ON THE CHOICE AND EVALUATION OF IONOSPHERIC INDICES

(Study Programme No. 150 (VI))

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

that the objectives of Study Programme No. 150 (VI) have not been attained and are not likely to be attained in the near future unless special efforts are made;

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* This Study Programme, which replaces Study Programme No. 92, does not refer to any Question under study.

UNANIMOUSLY RESOLVES

1. that a small continuing working party be formed with the object of reviewing the studies in pursuance of Study Programme No. 150 (VI), taking account of the practical aspects such as ease and accuracy of measurement, with the ultimate aim of making possible both long- and short-term predictions of the chosen index or indices for ionospheric propagation services, particularly:
   — to make a thorough study of all indices relevant to ionospheric propagation, existing and potentially possible;
   — to make comparisons among these indices, with the view that a choice can be made as to which among them have the best correlation with ionospheric propagation phenomena;
2. that the following Administrations known or thought to have an interest in this study be invited to participate in this working party:

   Canada,
   United States of America,
   France,
   Japan,
   Netherlands,
   P. R. of Poland,
   Federal German Republic,
   United Kingdom,
   Switzerland,
   U.S.S.R;
3. that the Chairman of Study Group VI appoint a chairman from among the representatives participating in this work;
4. that this working party be encouraged to coordinate its studies with those of the special group which has been established by the U.R.S.I. on this subject.

STUDY PROGRAMME No. 151 (VI) *

PULSE-TRANSMISSION TESTS AT OBLIQUE INCIDENCE

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

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

(b) that these problems include:
   — the investigation of modes of propagation;
   — the practical limiting distance of one-hop propagation when the Pedersen ray and practical antenna patterns are considered;
   — the propagation of waves to great distances without intermediate ground reflections;
   — the measurement of group delay times;
   — the relation of the vertical-incidence critical frequencies to the oblique-incidence, for both the classical and operational oblique-incidence MUF for all ionospheric layers involved;
   — the study of modes which suffer abnormal attenuation, for example, some types of Es reflections;
   — the causes of propagation at frequencies above the classical MUF;
   — the investigation of the reciprocity problem;

* This Study Programme, which replaces Study Programme No. 97, does not refer to any Question under study.

— the nature of fading and of focussing effects;
— the assessment of ionospheric absorption;
— the direction of arrival in azimuth and elevation and the polarization of ionospherically reflected waves;
— the consequences of magneto-ionic double refraction;

(c) that fixed-frequency tests have been successfully made, with both experimental and commercial transmitters;

(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 sweep-frequency transmissions involve difficult technical problems of synchronization and visual display at the receiver;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. the characteristics of long-distance ionospheric propagation by the use of oblique-incidence pulse transmissions, taking account of the amplitudes of the different modes and, wherever practicable, of their angles of arrival;

2. the making of ionospheric vertical-incidence soundings at appropriate points along the transmission path;

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

VI

STUDY PROGRAMME No. 152 (VI) *

BACK SCATTERING

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that back-scatter phenomena yield direct information at the transmitting station of the performance of the frequency used, of the modes of propagation, and of the effectiveness of various antennas for a given service;

(b) that, nevertheless, because of losses of energy (particularly from the scattering process but also from the varying path attenuation), the absence of echoes from a particular range, with present techniques and sensitivity, does not necessarily indicate that communication with a station at that range is impossible;

(c) that back-scatter phenomena confirm that the operational MUF may exceed the classical MUF;

(d) that, nevertheless, if the skip-distance is varying with azimuth, and the beam width is more than a few degrees, appreciable errors can be made in measurements of skip-distance;

(e) that there are indications that long-distance back-scatter, although coming predominantly from the ground, may be received from ionospheric regions, and that in consequence large errors in measurement may be produced;

(f) that the back-scatter plan position indicator (PPI) is especially suitable for studying the movement of Es clouds;

(g) that back-scatter phenomena can be of assistance in identifying the modes of propagation of pulse signals at oblique incidence;

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* This Study Programme, which replaces Study Programme No. 98, does not refer to any Question under study.

(h) that back-scatter studies have proved useful in investigating certains types of long-range propagation previously observed on communication circuits, whereby waves appear to travel to great distances without intermediate ground reflections;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. discrimination between the various back-scatter sources on the ground or in the E, F and auroral regions;
2. the use of back-scatter technique on both fixed and sweep frequencies to supplement the information obtained by oblique-incidence pulse transmissions;
3. field strength measurements to determine the back-scattering coefficient as a function of frequency, the nature of the scattering source and angle of incidence at the scattering source;
4. determination of the incident field at the scattering zone from the back-scatter coefficient as derived from the field strength measurements made near the transmitting site;
5. investigation by back-scatter technique of the formation and movement of localized areas of Es;
6. determination from back-scatter measurements of actual propagation conditions within the limited range resulting from considerable loss of energy due to the scattering process and to varying path attenuation;
7. determination of the relative effectiveness of antennas for application within the limited range referred to above;
8. investigation, by back-scatter measurements, of unusual types of propagation, for example:
   — the absence of echoes between the one-hop and two-hop focussing zones;
   — the persistence of long-range echoes (often after the fade-out of the single- and multi-hop echoes);
9. investigation, by back-scatter measurements, of focussing effects in the ionosphere.

STUDY PROGRAMME No. 153 (VI) *

MEASUREMENT OF MAN-MADE RADIO NOISE

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that man-made radio noise is frequently the limiting factor in the reception of radio signals over a wide frequency range, particularly during daylight hours, when atmospheric noise is low;

(b) that the dynamic characteristics as well as the geographical, time and frequency dependence of man-made radio noise are entirely different from those of atmospheric noise;

(c) that information on the relative importance of atmospheric and man-made radio noise is needed for future revisions of Report No. 65;

(d) that previous measurements of man-made noise have largely been concentrated on the individual sources, the principal objective being the reduction in noise rather than a determination of the composite effect throughout given areas;

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* This Study Programme does not refer to any Question under study.

UNANIMOUSLY DECIDES that the following studies be carried out:

1. the investigation of the level of composite man-made radio noise as a function of geographic location, frequency, and time of day;
2. the investigation of the statistical characteristics of composite man-made radio noise as a function of the above variables, during short time intervals as well as for day-to-day variation;
3. the determination of the correlation of man-made radio noise levels with population density, industrial activity, electric power consumption, and other factors;
4. the determination of the types of measurement most significant for the evaluation of the interference potential of man-made noise for different types of services, for example, peak, quasi-peak, r.m.s. voltage, average envelope voltage, average logarithm, and probability distribution of the amplitudes.

STUDY PROGRAMME No. 154 (VI) *

MEASUREMENT OF ATMOSPHERIC RADIO NOISE

VI

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that the atmopheric noise data in Report No. 65 are now available for provisional use;

(b) that this report relates mainly to the distribution of noise power over the world, as received on a short vertical grounded aerial;

(c) that other characteristics of the noise are known to be important in determining the interference to radio services;

(d) that further measurements are required for the revision of this Report and to extend its scope;

(e) that a knowledge of the distribution of lightning flashes and of the power radiated by them is valuable in estimating the intensity and properties of radio noise;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. the setting up of a world-wide network of stations for measuring noise power either directly or by deduction from other characteristics;
2. the measurement of characteristics of the noise described in statistical terms;
3. the measurement, at stations with suitable facilities, of atmospheric noise on types of directional aerials in common use for radio communication, and the correlation of the results with information on the distribution of thunderstorms;
4. the estimation of the density of lightning flashes in thunderstorm areas:
   - by the use of networks of counters designed to record local flashes;
   - by the use of direction finding networks designed to locate thunderstorms at a distance;
5. the study of the intensity and nature of the noise from individual lightning flashes;

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* This Study Programme, which does not refer to any Question under study, replaces Study Programme No. 96. It has been brought to the notice of the U.R.S.I. and the W.M.O. by Resolution No. 46.

6. the development of methods of presenting statistical data on the characteristics of noise, other than its mean power, for use in assessing the interference to radio services;

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

RESOLUTION No. 51 *

DESIGN AND USE OF LOCAL LIGHTNING FLASH COUNTERS

The C.C.I.R., (London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that agreement has been reached on the main design features of a local lightning flash counter;

(b) that further experimental work is required on some minor features of design;

(c) that there is a need for study of the best means for operating the counters and for using the resulting data for studies of atmospheric noise and the meteorological processes in which it originates;

(d) that there is a need to increase the number of counters in use;

UNANIMOUSLY RESOLVES

1. that the working party formed in accordance with Recommendation No. 121 be continued, to promote further work on the design, operation and optimum approximate geographical distribution of lightning flash counters, and to prepare a programme for the use of the data obtained from them. This working party should operate by correspondence under its Chairman, and should report to the Chairman of Study Group VI prior to the Xth Plenary Assembly;

2. that the W.M.O. be informed of the continued interest of the C.C.I.R. in the establishment of adequate networks of counters to record the incidence of lightning over both the land and sea areas of the world;

3. that administrations should collaborate with national meteorological organizations in work designed to assess the value of lightning flash counters to both radio and meteorological services.

Note. — A description of a suitable counter has been published in the W.M.O. Bulletin of Vol. 8, No. 1, January 1959, and copies of the paper are obtainable by request to the C.C.I.R. Secretariat, together with any supplements which may be prepared from time to time.

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* This Resolution replaces Recommendation No. 121 and Resolution No. 25.

STUDY GROUP No. VII

(Standard-frequencies and time signals)

Terms of reference :

Organization of a world-wide service of standard-frequency and time-signal transmissions. Improvement of measurement accuracy.

Chairman : Mr. B. DECAUX (France)
Vice-Chairman : Professor M. BOELLA (Italy)

* See Volume III, Section H.

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QUESTION No. 140 (VII) *

STANDARD-FREQUENCY TRANSMISSIONS AND TIME SIGNALS

The C.C.I.R., (Stockholm, 1948 — Geneva, 1951 — London, 1953 — Warsaw, 1956)

CONSIDERING

(a) that the Atlantic City Radio Conference called for the study of the establishment and operation of a world-wide standard-frequency and time-signal service;

(b) that a number of stations are now regularly transmitting standard frequencies and time signals in the bands allocated by the Atlantic City Conference;

(c) that some areas of the world are not yet adequately served;

(d) that the use of more stations than are technically necessary would diminish the utility of the service by producing harmful interference;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what measures can be recommended for increasing the effectiveness of the existing standard-frequency and time-signal service in the bands allocated by the Atlantic City Conference;

2. what measures can be recommended for the reduction of mutual interference between standard-frequency and time-signal stations operating on the same frequency and whose service areas overlap?

STUDY PROGRAMME No. 155 (VII) **

STANDARD-FREQUENCY TRANSMISSIONS AND TIME SIGNALS

VII

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that Question No. 140 (VII) and Recommendation No. 319 call for information on methods for improving the usefulness of the existing standard-frequency transmission and time-signal service;

(b) that standard-frequency stations are operated simultaneously on the same carrier frequency;

(c) that standard frequency transmissions are also used as a means of measuring radio propagation characteristics;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. an investigation of the possibilities of reducing mutual interference between transmissions in this service by:

1.1 shortening the programme of tone modulation and of announcements;

1.2 use of modulation which gives the required information and accuracy in minimum bandwidth;

1.3 staggering the transmissions in the allocated bands and using a convenient type of modulation; a suggested staggering of frequencies is as follows:

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* Study Programme No. 155 (VII) arises from this Question, which replaces Question No. 87.

** This Study Programme, which replaces Study Programme No. 101, arises from Question No. 140 (VII).

Sub-bands (kc/s)			
	4,996 – 5,000	5,000 – 5,004	
	9,996 – 10,000	10,000 – 10,004	
14,992 – 14,996	14,996 – 15,000	15,000 – 15,004	15,004 – 15,008
	19,996 – 20,000	20,000 – 20,004	20,004 – 20,008
24,992 – 24,996	24,996 – 25,000	25,000 – 25,004	25,004 – 25,008

Note. — In each sub-band, the carrier frequency should be on the lower side.

1.4 a convenient world-wide coordinated time-sharing of frequencies on which there is mutual interference depending on the staggering of frequencies;

2. an investigation, with the assistance of Study Group VI, into the desirability of staggering the frequencies for radio propagation studies;

3. collection of information on how standard-frequency broadcasts in bands 6 and 7 may be coordinated with broadcasts in other bands to give the best overall world-wide service.

QUESTION No. 142 (VII)

STANDARD-FREQUENCY TRANSMISSIONS AND TIME SIGNALS IN ADDITIONAL FREQUENCY BANDS

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that Question No. 140 (VII) refers only to the transmission of standard frequencies and time signals in the bands allocated by the Radio Regulations Atlantic City 1947, centred on the frequencies of 2·5, 5, 10, 15, 20, and 25 Mc/s;

(b) that in certain regions, particularly in industrial centres, it is not always possible to obtain an adequate ratio of the wanted signal to the noise level with the existing standard-frequency and time-signal transmission system;

(c) that it seems advisable to ensure distribution of standard frequencies and time signals on a local basis;

(d) that the bands allocated for standard-frequency transmissions and time signals are at times made inoperable by ionospheric storms, which may last for a day or more;

(e) that frequency comparisons to within 1 part in 10^9 against standard-frequency transmissions operating in the allocated bands usually require a measurement period of 1 to 10 days;

(f) that in communications, research, and industry there is an increasing need for high measurement accuracy in a shorter measurement time;

(g) that frequency comparisons to within 1 part in 10^9 against standard-frequency transmissions operating at 16 kc/s or 60 kc/s require a measurement period of about 10 minutes;

UNANIMOUSLY DECIDES that the following question should be studied:

what can be recommended for the distribution of standard frequencies and time signals above 30 Mc/s and below 100 kc/s?

QUESTION No. 186 (VII) *

STABILITY OF STANDARD-FREQUENCY TRANSMISSIONS AND TIME SIGNALS AS RECEIVED

The C.C.I.R., (Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that standard-frequency transmissions and time signals when received are less stable than at the source;

(b) that some phenomena occurring in the propagation of radio waves, e.g. the Doppler effect or multipath interference, reduce the accuracy with which the standard-frequency transmissions and time signals can be utilized;

(c) that errors which occur during porpagation depend on the nature and condition of the medium and are generally different in different regions of the radio spectrum;

(d) that special forms of time signals may improve the accuracy with which they can be received;

(e) that the accuracy with which time signals can be received may depend upon the design of the receiving equipment;

(f) that standard-frequency transmissions and time signals as received are insufficiently stable for some uses;

(g) that a statistical knowledge of the figure of accuracy to be expected would be very useful and would increase the utility of existing and future standard-frequency transmissions and time signals;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what are the causes of the reduction in the stability and accuracy of the standard-frequencies and time signals as received by the users;

2. what is the magnitude in statistical terms of the instability introduced by these causes;

3. what is the most suitable form of time signals and receiving equipments for obtaining the best results in the reception of:
— time signals as utilized by those requiring normal accuracy;
— time signals as utilized by users requiring the maximum possible accuracy?

VII

STUDY PROGRAMME No. 156 (VII) **

FREQUENCY SPECTRUM CONSERVATION FOR HIGH PRECISION TIME SIGNALS

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that higher precision in the radio distribution of time signals necessitates, using present techniques, the use of an increased bandwidth;

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* Study Programme No. 156 (VII) arises from this Question, which replaces Question No. 141.

** This Study Programme arises from Question No. 186 (VII).

(b) that newly developed techniques may nevertheless effect a considerable bandwidth economy;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. an investigation of the relationships between bandwidths required, and precisions obtainable at present for various carrier-to-noise ratios as may be encountered in practice;
2. an investigation of narrow band techniques to generate and broadcast high precision time markers;
3. an investigation of the characteristics of the radio paths involved that limit the accuracy of time signals as received, and how these radio path parameters affect the choice of an optimum method.

STUDY GROUP No. VIII

(International monitoring)

Terms of reference :

To study problems relating to the equipement, operation and methods of measurement used by monitoring stations established for checking the characteristics of radio-frequency emissions. Examples of such measurements are: frequency, field-strength, bandwidth, etc.

Chairman : Mr. J.D. CAMPBELL (Australia)
Vice-Chairman : Mr. G.S. TURNER (U.S.A.)

* See Volume III, Section J.

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QUESTION No. 143 (VIII) *

AUTOMATIC MONITORING OF OCCUPANCY OF THE RADIO-FREQUENCY SPECTRUM

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that the rapidly increasing demand for radio services continues to require the most efficient use of the radio-frequency spectrum;

(b) that the most efficient use of the spectrum can be made only when its occupancy is known;

(c) that automatic monitoring is recommended as a valuable aid to determining the occupancy of the spectrum; and the desirable characteristics of such equipment have been recommended (see Recommendation No. 182);

(d) that it is desirable to make further studies of equipment characteristics and to determine the means whereby the greatest benefit may be derived from automatic monitoring records;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what is the accuracy of automatic monitoring equipment in determining bandwith and field intensity;
2. what is the capability of automatic monitoring equipment in determining signal-to-noise ratios;
3. what are the best means of analysing and evaluating automatic monitoring records, both singly and collectively;
4. is it possible to analyse present records by automatic means and, if not, what modifications are necessary to enable this to be done?

QUESTION No. 145 (VIII)

FREQUENCY MEASUREMENTS AT MONITORING STATIONS

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that it is possible to reduce the ratio between the error of measurement at monitoring stations and the specified tolerance of an emission as stated in § *c* of Recommendation No. 322;

(b) that it is desirable to simplify frequency measurements;

(c) that it may be desirable to use a stable transfer oscillator and an electronic frequency counter in conjunction with a spectrum analyser for frequency measurements under conditions of fading, interference, carrier instability, suppressed carrier and interruption of the carrier by keying;

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* This Question replaces Question No. 88.

(d) that the accuracy of frequencies of emissions and frequency tolerances are being improved and that in particular the measurement of the frequencies of television emissions in offset operation requires a high degree of absolute accuracy;

(e) that in general the frequency range of amplitude modulated emissions under effective observation at fixed monitoring stations is approximately from 10 kc/s to 50 Mc/s;

(f) that the number of frequency-modulated emissions, especially in the frequency range above 50 Mc/s, is increasing;

(g) that it is believed that the accuracy of the secondary standards for frequency measurements is capable of being improved;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what is the ratio of the error of frequency measurement to the permissible tolerance of emissions that is necessary and desirable for frequency measurements at monitoring stations and particularly when the permissible tolerances are small, when statistical methods are used for evaluation purpose;

2. what is the accuracy of frequency measurements which can be accomplished at monitoring stations, especially under the conditions contained in § *c* ;

3. bearing in mind the high degree of accuracy required for the measurements of certain emissions (e.g. television emissions where offset carrier operation is used), what equipments and methods are preferred for frequency measurements at monitoring stations with regard to:
— frequency-modulated emissions,
— amplitude-modulated emissions;

4. what is the accuracy required for measurements of frequencies (Recommendation No. 322):

4.1 of frequency-modulated emissions of stations operating
— in the band 4000 kc/s–50 Mc/s,
— in the band 50 Mc/s–500 Mc/s,
— above 500 Mc/s;

4.2 of amplitude-modulated emissions
— of stations, except broadcasting stations, operating in the band 10 kc/s–4000 kc/s,
— of broadcasting stations operating in the band 10 kc/s–4000 kc/s,
— of stations, except television broadcasting stations, operating in the band 4000 kc/s–500 Mc/s,
— of stations, except television broadcasting stations, operating above 500 Mc/s,
— of television broadcasting stations operating in the band 30 Mc/s–3000 Mc/s ?

QUESTION No. 187 (VIII) *

IDENTIFICATION OF RADIO STATIONS

The C.C.I.R., (London, 1953 — Los Angeles, 1959)

CONSIDERING

(a) that, in order to carry out an efficient monitoring service of radio stations, it is necessary for these stations to be identified as regularly as possible during their transmissions;

(b) that in some types of radio systems the identification procedure used at present is satisfactory to operating agencies, regulating administrations and monitoring services, as in the case of single-channel low-speed telegraphy;

* This Question replaces Question No. 104. The Ukrainian S.S.R. and the U.S.S.R. reserved their opinions on this Question.

(c) that the Atlantic City Radio Regulations (Chap. V, Art. 13, Section V, § 10) set forth requirements for transmissions of radio call signs, and state that each radio station provided with a call sign from the international series must, unless the Atlantic City Radio Regulations provide otherwise, transmit this call sign during the course of their transmission as frequently as is practicable and reasonable;

(d) that certain types of radio stations are exempted from the necessity of having an international call sign, for example, stations which are easily identified by other means and whose signals of identification, or characteristics of emission, are published in international documents;

(e) that satisfactory methods for identifying some multi-channel types of transmission have been evolved (Recommendation No. 323 and Report No. 171) but are not as yet in general use;

(f) that some types of emissions, particularly complex emissions, and some types of radio systems, may require new identification methods;

(g) that the requirement of frequently transmitting an identifying signal by interrupting the traffic imposes difficulties on the operating agencies by reducing the operating time of a circuit, particularly where heavily loaded multi-channel or high-speed machine operation is employed;

DECIDES that the following question should be studied:

the possibility of ensuring the convenient identification of stations utilising multi-channel synchronized systems, high-speed machine systems, facsimile systems, or other special systems of transmission, in the most effective manner without the necessity of interrupting the transmission of such stations, or of increasing the transmissions of such stations, or of appreciably increasing the bandwidth of the emissions. The increased costs to the monitoring and transmitting stations which would be incurred by the recommended solutions should be borne in mind.

VIII

QUESTION No. 188 (VIII)

MONITORING AT FIXED MONITORING STATIONS OF RADIO TRANSMISSIONS FROM SPACE VEHICLES

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that the rapid advances in recent years in space technology, including the successful launching of earth satellites, portend greatly expanded activity in outer space, including the likely eventual establishments of " space platforms ";

(b) that radio will play a major part in these space activities as regards communication, navigation and data collection and transmission;

(c) that space platforms might find a variety of uses in the telecommunication field;

(d) that the accurate measurement at a fixed monitoring station of frequency, spectrum occupancy and certain other technical characteristics of emissions from transmitters on the space vehicles and platforms will tend to be more difficult than on fixed or relatively slow moving transmission sources on or near the earth;

UNANIMOUSLY DECIDES that the following question be studied:

1. to what extent will the techniques of measurement from fixed monitoring stations on the earth of transmission of vehicles in space differ from those for transmissions originating from or near the earth;
2. what are the requirements for specialized equipment or associated facilities for performing frequency, spectrum occupancy, and other measurements of transmissions from vehicles in space;
3. what practical means can be devised for the identification by monitoring stations of transmissions from specific space vehicles?

QUESTION No. 189 (VIII)

MEASUREMENT OF S-VALUES AT MONITORING STATIONS

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that the number of cases of radio interference tends to grow with the ever increasing number of stations and the wider bandwidths occupied by some types of emission;

(b) that a need exists for monitoring stations to obtain in an expeditious manner comparable values of signal strengths for the investigation and clearance of cases of interference between radio stations;

(c) that because of the increased sensitivity of modern receiving equipment very small RF input signals will generally suffice for acceptable reception quality;

(d) that the maximum usable sensitivity of receivers changes with frequency and receivers have different internal noise characteristics;

(e) that it seems advisable for the purpose of monitoring service to establish a definite correlation between fieldstrength and S-values of QSA scale, SINPO and SINPFEMO codes, since the values obtained aurally cannot conveniently be compared;

(f) that most receivers used in Monitoring Stations incorporate S-meters, the indication of which is related to the strength of the input signal;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what correlation could be established between field strength values and the S-values of the QSA scale and SINPO-, SINPFEMO-codes taking into account the types of emission in the frequency bands 4 to 9 as defined in Recommendation No. 324;
2. what are the desirable characteristics of the antennae used for establishing the correlation indicated in § 1 above;
3. what are the preferred methods of measurement at monitoring stations to determine the correlated S-values?

QUESTION No. 190 (VIII) *

IDENTIFICATION OF SOURCES OF INTERFERENCE TO RADIO RECEPTION

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that a list of all electrical and electronic equipment which might at time cause radio interference would include practically every device that uses electricity;

(b) that interference-causing radiations have individual characteristics which, when observed aurally or visually, sometimes enable an experienced monitoring observer to identify the type of equipment producing the radiations;

(c) that it would be helpful in solution of interference problems for both monitoring observers and radio station operators to compare interfering signals with a ready reference of all types of such signals which permit of cataloging individual signal characteristics;

(d) that individual characteristics mentioned in *(c)* might include, but not be limited to, frequency range, distance range, on-off cycles, times of day the equipment source most generally used, characteristic note or tone, degree of frequency stability, usual bandwidth, type of signal as viewed on oscilloscope or panoramic presentation, type of equipment source and cause of radiations;

UNANIMOUSLY DECIDES that the following study should be carried out:

the possibility and desirability of listing by written description, aural recording and pictorial presentation, as appropriate, the individual characteristics of all observed types of interfering radiations, from either radio stations or electrical and electronic sources, where such references would assist in identifying a particular interfering signal.

QUESTION No. 191 (VIII)

VISUAL MONITORING OF THE RADIO-FREQUENCY SPECTRUM

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that every useful means of monitoring observation and measurement should be employed at monitoring stations, including visual methods employing a radio-frequency spectroscope;

(b) that a panoramic view of a portion of the radio-frequency spectrum can be presented on a cathode ray tube by the employment of suitable sweep circuits in the radio receiver or in an associated panoramic adaptor;

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* Account to be taken of the work of the C.I.S.P.R., in connection with this subject.

(c) that the simultaneous presentation of broad ranges of the spectrum on one or more cathode ray tubes would provide for a rapid determination of spectrum occupancy, frequency, amplitude and harmonic content (if one or more octaves are presented) of individual signals, and broad-band coverage characteristics of signals, including interference;

(d) that, although panoramic adaptors have been employed to some extent in monitoring stations as an adjunct to aural monitoring, it appears that more information can be obtained visually by monitoring observers, particularly in broad-band visual presentation of the spectrum;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what are the preferred equipment and the preferred methods for visual monitoring of broad ranges of the radio-frequency spectrum with regard to:

1.1 receivers and associated frequency-sweep circuits;

1.2 cathode ray tubes (including practicable size);

1.3 antennae and associated broad-band amplifiers and impedance-matching circuits;

2. what radio frequency ranges can be presented simultaneously on one or more cathode ray tubes of a spectroscope, taking into consideration the frequency characteristics of the antennae, amplifiers and receivers in order to allow relative comparisons throughout the portion of the spectrum under visual observation;

3. what adaptation of circuitry of the equipment specified in 1 above would be required to increase temporarily the resolution of the spectroscope;

4. what are the desirable operating methods and techniques to obtain maximum benefit from visual monitoring with a radio-frequency spectroscope, either when used alone or when used as an adjunct to aural monitoring?

STUDY PROGRAMME No. 102 (VIII) *

FIELD-STRENGTH MEASUREMENTS AT MONITORING STATIONS

The C.C.I.R., (London, 1953 — Warsaw, 1956)

CONSIDERING

(a) that Recommendation No. 181: " Accuracy of field-strength measurements by monitoring stations " does not cover all aspects of the problem, and that it recommends that studies relating to methods and equipment for use at monitoring stations should be continued;

(b) that the importance of collecting comparable field-strength data for the purpose of making propagation studies is increasing;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. taking into account the previous work of the C.C.I.R. in this field, what are the preferred equipment and the preferred methods for measuring the field strength of emissions for propagation studies at monitoring stations;
among other factors the following should be studied:
— the methods for measuring the field strength,
— the measuring and recording equipment,
— the total frequency range,

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* This Study Programme, which replaces Study Programme No. 69, does not refer to any Question under study.

— the calibrating equipment,
— the methods for analysing the records,
— the most effective form of presentation and distribution of these data for the benefit of various bodies, for example the I.F.R.B. (see Recommendation No. 22);

2. what are the most useful programmes of propagation studies in the different frequency ranges that can be carried out at monitoring stations bearing in mind
— the needs of the I.F.R.B., study groups of the C.C.I.R. and other bodies,
— the various distances and the particular paths over which propagation data are required;

3. what are the equipment and methods to be preferred for measuring the field strength of emissions
— with interrupted carrier,
— with reduced carrier,
— with other types of signals, including television signals;

4. what are the equipment and methods to be preferred for measuring the field strength of emissions of the types given in § 3 in the presence of noise and interference;

5. to what extent the determination of the relative levels of the field strength of the fundamental and of the harmonic frequencies of an emission measured at a distance can give usable data about the relative levels measured at the transmitter itself?

STUDY PROGRAMME No. 103 (VIII) *

SPECTRUM MEASUREMENT BY MONITORING STATIONS

The C.C.I.R., (London, 1953 — Warsaw, 1956)

CONSIDERING

VIII

(a) that it is desirable that international monitoring stations should be able to measure the spectrum of emissions;

(b) that Recommendation No. 229 is concerned only with measurements of spectrum made near the transmitter;

(c) that, although the methods of measurement and equipment used at monitoring stations for spectrum measurement may be generally similar to those used near the transmitter, nevertheless, additional factors will need to be considered (e.g., the effects of fading, noise and interference on the received signal and the necessity for making measurements on traffic rather than on periodic signals);

(d) that the accuracy possible or necessary at monitoring stations may differ from that possible for measurements made near the transmitter;

UNANIMOUSLY DECIDES that the following studies should be carried out:

determination of the most suitable equipment and methods for the measurement of spectrum of emissions by monitoring stations, taking into account:

1. the work of the C.C.I.R. concerning measurements of spectrum made near the transmitter;

2. the necessity for monitoring stations to examine various classes of emission and to make measurements of a fading signal in the presence of noise and interference;

3. the possible or necessary accuracy of measurements by monitoring stations.

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* This Study Programme, which replaces Study Programme No. 70, does not refer to any Question under study.

Note. — In order to determine the possible accuracy of measurements at monitoring stations in comparison with the accuracy obtainable near the transmitter, it would be desirable to make comparisons of the spectra of various types of emission using identical equipments:

— at the transmitter itself,
— at a monitoring station distant from the transmitter, under favourable conditions as well as under various conditions of fading, noise and interference.

In order to assist monitoring stations to identify various classes of emissions, particularly more complex types of machine telegraphy, it would be useful to study the spectra of these emissions both for the purpose of identification and of classification of such emissions in the presence and absence of fading and interference.

Present studies have largely been confined to measurement of the spectra of emissions using frequencies below 30 Mc/s and with bandwidths not exceeding 25 kc/s. It would be useful to extend the studies to emissions above 30 Mc/s where bandwidths up to about 10 Mc/s are often employed. It is recognised that this may entail the development of new equipment.

It is known that the spectrum of an emission is closely related to the form of the envelope of the emission and it is believed that it may, in certain cases, be more useful to have information on the waveform than on the spectrum or the bandwidth, e.g. in the case of television emissions. It is suggested that preliminary consideration might be given to the subject of measurement of waveform characteristics at monitoring stations.

STUDY GROUP No. IX

(Radio-relay systems)

Terms of reference :

To study all aspects of radio-relay systems and equipment operating at frequencies above about 30 Mc/s, including systems using the so-called tropospheric-scatter mode of propagation.

Chairman : Mr. W.J. BRAY (U.K.)
Vice-Chairman : Mr. E. DIETRICH (Federal German Republic)

IX

* See Volume III, Section F.

* See Volume III, Section F.

RESOLUTION No. 54

RADIO-RELAY SYSTEMS FOR TELEVISION

Maintenance Procedures

(Study Group No. IX)

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that Recommendation No. 290 gives the maintenance methods for radio-relay systems for telephony;

(b) that methods different from those used for telephony may have to be used for the maintenance of television radio links;

(c) that a joint C.C.I.R./C.C.I.T.T. Committee (C.M.T.T.) has been established to study television transmission;

UNANIMOUSLY RESOLVES

that the maintenance procedure for television radio-relay systems, in so far as it concerns the overall transmission performance, should be referred to the C.M.T.T., it being understood that the testing methods adopted should be the subject of agreement with the C.C.I.R.

Note. — The attention of the C.M.T.T. is drawn to the difficulties which may be produced by applying to radio-relay systems test signals of high amplitude which can cause serious interference in adjacent radio channels.

QUESTION No. 192 (IX)*

RADIO-RELAY SYSTEMS FOR TELEPHONY USING FREQUENCY-DIVISION MULTIPLEX

The C.C.I.R., (London, 1953 — Los Angeles, 1959)

IX

CONSIDERING

(a) that a variety of types of multi-channel radio-relay systems operating at frequencies above about 30 Mc/s use frequency-division multiplex;

(b) that in certain cases it is desirable to be able to interconnect systems of different types particularly on international circuits;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what are the radio or intermediate-frequency characteristics of frequency-division multiplex radio-relay systems operating at frequencies above about 30 Mc/s which it is essential to specify in order to enable two such systems to be interconnected;

2. what specifications should be drawn up for such characteristics and should be recommended as standards for radio-relay systems carrying frequency-division multiplex for use on international circuits and operating at frequencies above about 30 Mc/s?

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* Study Programme No. 157 (IX) arises from this Question, which replaces Question No. 93.

STUDY PROGRAMME No. 157 (IX)*

RADIO-RELAY SYSTEMS FOR TELEVISION AND TELEPHONY

Systems of capacity greater than 1,800 telephone channels or the equivalent

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that there may be economic and operational advantages in the use of radio-relay systems with a capacity of substantially more than 1,800 telephone channels or equivalent, on a single radio carrier;

(b) that very large capacity radio-relay systems may also be required in the future for the transmission of higher-definition television;

(c) that additional information is needed to establish the practical limits of capacity of such very large capacity systems;

UNANIMOUSLY DECIDES that the following studies be carried out:

1. the determination of optimum values for the system characteristics (including the baseband, intermediate frequency and radio frequency characteristics) to enable the maximum capacity in each radio carrier to be achieved;

2. the limitation on the maximum practicable capacity of the system due to the effects of multipath propagation.

QUESTION No. 193 (IX)**

RADIO-RELAY SYSTEMS FOR TELEVISION AND TELEPHONY***

Hypothetical reference circuits and circuit noise

The C.C.I.R., (London, 1953 — Los Angeles, 1959)

CONSIDERING

that the noise permissible in a radio-relay system may be expected to depend to some extent on the length of the system, and that it may, therefore, be desirable for design purposes to specify hypothetical reference circuits for radio-relay systems analogous to those specified by the C.C.I.T.T. for cable systems;

UNANIMOUSLY DECIDES that the following question should be studied:

the determination of:

— hypothetical reference circuits for the design of radio-relay systems,
— the elements appropriate to such circuits,
— the division of the permissible noise power amongst the various elements.

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* This Study Programme arises from Question No. 192 (IX).

** Study Programme No. 158 (IX) arises from this Question, which replaces Question No. 97.

*** This Question also includes tropospheric-scatter systems.

STUDY PROGRAMME No. 158 (IX) *

RADIO-RELAY SYSTEMS FOR TELEVISION AND TELEPHONY

Noise tolerable during very short periods of time

The C.C.I.R., (Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that, for radio-relay links, it is necessary to clarify how high noise levels occurring for short periods of time should be taken into consideration;

(b) that consideration must be given not only to the percentage of time during which high noise levels occur but also to the duration of each burst of noise;

(c) that account should be taken of the fact that in radio-relay systems high noise often occurs at night when the traffic is particularly light;

(d) that examples of the distribution of noise with time in radio-relay systems are given in Recommendation No. 287 and Reports Nos. 130 and 132 which also contain examples of the values of noise power likely to be experienced for short periods of time;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. in what way should the maximum value of noise be specified when considering transmission on radio-relay systems;

2. what should be the time constant of the noise measuring apparatus;

3. should a limit be set to the number of high noise bursts, of a duration exceeding a given value, occurring in a given time;

4. in considering this problem should account be taken of the fact that the traffic loading is greater during the day than during the night;

5. in what way can the maximum tolerable noise power for a part of a radio link be deduced from the maximum value of noise power tolerable for the complete radio link ?

RESOLUTION No. 56

IX

RADIO-RELAY SYSTEMS FOR TELEPHONY

C.C.I.T.T./C.C.I.R. Joint Working Party on circuit noise

(Questions Nos. 193 (IX) and 196 (IX))

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that a working party has been established by the C.C.I.T.T., with participation of C.C.I.R. representatives, to study circuit noise;

(b) that certain aspects of the questions under consideration by the C.C.I.R. might usefully be studied by this working party, that is to say:

— permissible noise power for the transmission of VF telegraphy or data (part of Question No. 193 (IX) and Report No. 132);

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* This Study Programme, which replaces Study Programme No. 105, arises from Question No. 193 (IX).

— permissible noise power for radio-relay systems using tropospheric-scatter propagation (part of Questions Nos. 193 (IX) and 196 (IX) and Report No. 135);

UNANIMOUSLY RESOLVES

1. that the working party on circuit noise established by the C.C.I.T.T. with participation of C.C.I.R. representatives be constituted as a C.C.I.T.T./C.C.I.R. Joint Working Party;
2. that this Joint Working Party be responsible for the studies indicated in *(b)* above;
3. that the Director of the C.C.I.T.T. be invited to be responsible for the convening, organization and secretariat of this Joint Working Party.

QUESTION No. 194 (IX) *

RADIO-RELAY SYSTEMS FOR TELEVISION

Preferred characteristics for the transmission of monochrome television

The C.C.I.R., (Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that the study of preferred characteristics for radio-relay systems for multi-channel telephony is being pursued;

(b) that requirements for the transmission of monochrome television over long distances are given in Recommendation No. 267;

(c) that Recommendation No. 267 does not, however, include a consideration of the characteristics (other than at baseband frequencies) of radio-relay systems designed for the transmission of television;

(d) that it is preferable for the major intermediate-frequency and radio-frequency characteristics of international radio-relay systems to conform as far as possible with those for multi-channel telephony;

UNANIMOUSLY DECIDES that the following question should be studied:

what are the preferred characteristics of international radio-relay systems for television where they differ from those for telephony?

STUDY PROGRAMME No. 159 (IX) **

RADIO-RELAY SYSTEMS FOR TELEVISION AND TELEPHONY

Preferred characteristics for the transmission of more than one sound channel

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that Recommendation No. 272 gives values for the preferred characteristics of a frequency-modulated sub-carrier for the transmission of a single sound channel on a radio-frequency carrier transmitting also a television signal;

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* Study Programme No. 159 (IX) arises from this Question, which replaces Question No. 146.

** This Study Programme arises from Question No. 194 (IX).

(b) that in certain circumstances up to six sound channels may be required over the same route as a television transmission;

(c) that radio-relay systems with a capacity of 600 or 960 telephone channels may be used to transmit a television signal *or* several sound channels on each radio-frequency carrier;

(d) that radio-relay systems with a capacity of 1,800 telephone channels or equivalent may be used to transmit a television signal *and* several sound channels on each radio-frequency carrier;

(e) that the sound channels provided by this means should meet the requirements of the C.C.I.T.T. for music circuits;

UNANIMOUSLY DECIDES that the following studies should be carried out:

the determination of the preferred characteristics for the provision of up to six sound channels in the following cases:

1. when the radio-frequency carrier transmitting the sound channels is used *alternatively* for television (radio-relay systems with a capacity of 600 or 960 telephone channels);
2. when the radio-frequency carrier transmitting the sound channels is used *simultaneously* for television (radio-relay systems with a capacity of 1,800 telephone channels or equivalent).

QUESTION No. 195 (IX)*

RADIO-RELAY SYSTEMS FOR TELEVISION AND TELEPHONY

Service channels

The C.C.I.R., (Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that service channels are necessary for the maintenance of radio-relay systems;

(b) that it would be desirable to define the steps to be taken for the establishment of such service channels and for facilitating their international interconnection;

UNANIMOUSLY DECIDES that the following question should be studied:

1. in what form and by what means should the service channels required for the maintenance of radio-relay systems be established;
2. what are the characteristics, if any, to be specified with a view to permitting international interconnection of such service channels;
3. what are the preferred values of such characteristics?

IX

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* Study Programme No. 160 (IX) derives from this Question, which replaces Question No. 147.

STUDY PROGRAMME No. 160 (IX)*

RADIO-RELAY SYSTEMS FOR TELEVISION AND TELEPHONY

Preferred Characteristics for Auxiliary Radio-Relay Systems for the Provision of Service Channels

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that an auxiliary radio-relay system for the provision of service channels for the maintenance, supervision and control of radio-relay links may be required;

(b) that this auxiliary system may be arranged by combining it with the main system, as is shown in Recommendation No. 296;

(c) that, on the other hand, it may be preferred to use an auxiliary radio-relay system quite independent of the main radio-relay system;

(d) that the frequency band concerned and the exact frequency allocation plan must be chosen carefully in order to avoid interference with the main system;

(e) that for this auxiliary radio-relay system the utmost reliability is essential, because of the operational importance of the supervisory circuits;

(f) that some factors effecting the bandwidth that is required for these circuits are discussed in the Annex;

(g) that Recommendation No. 295 states the number and the function of the service channels that are required;

(h) that economy in the use of the spectrum is important;

UNANIMOUSLY DECIDES that the following study should be carried out:

determination of the characteristics (baseband, type of modulation and radio frequency arrangement) of a high reliability auxiliary radio-relay system.

ANNEX

In considering *(e)* above it is pointed out that a high degree of reliability is required for service channels; consequently a standby auxiliary radio-frequency channel on each route is probably essential. These standby auxiliary channels could be provided on the same frequency as the main auxiliary channel or on a different frequency.

If the same frequency as the main auxiliary channel is used, the standby channel can be brought into circuit at any station by means of switches operated automatically by monitoring circuits on the equipment. The use of separate frequencies requires no monitoring circuits or switches and might therefore simplify the equipment and improve its reliability.

It sometimes occurs that a number of systems, each requiring supervisory circuits, converge at a point (including any connections with a local maintenance centre). On each route at such interconnection points, if the standby channel operates on a separate frequency, two pairs of frequencies in each direction of transmission will be required for the auxiliary relay system. The same frequency can often be used simultaneously for two transmitters or two receivers in opposite directions, but this cannot be done at frequencies below about 1,000 Mc/s.

The necessary spacing between adjacent frequency allocations at any station depends on the frequency stability of the equipment as well as on the modulation characteristics used. These factors should be considered in relation to all the frequency bands which might be used for this purpose ranging from about 8,500 Mc/s down to 1,000 Mc/s or even lower.

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* This Study Programme arises from Question No. 195 (IX).

QUESTION No. 196 (IX) *

RADIO-RELAY SYSTEMS EMPLOYING TROPOSPHERIC-SCATTER PROPAGATION

The C.C.I.R., (Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that experiments have already shown the possibility of utilizing frequencies in the UHF (decimetric) and SHF (centimetric) bands for transmission by tropospheric-scatter propagation to distances well beyond the horizon;

(b) that systems using this mode of propagation are already in service and other systems will be used in the future;

(c) that it is desirable to determine the preferred characteristics of such systems needed to facilitate their international interconnection;

(d) that some of the frequency bands that might be used for such systems are already used by other services;

UNANIMOUSLY DECIDES that the following question should be studied:

1. how do the variations with frequency and time of tropospheric-scatter propagation affect the design of radio-relay systems;

2. to what extent are systems employing this mode of propagation and operating on the same or on neighbouring frequencies liable to interfere with each other and with other services;

3. what are the radio-frequency, intermediate-frequency and baseband characteristics of such systems which it is essential to specify for the transmission of frequency-division multiplex telephony, television or telegraphy in order to enable two systems to be interconnected, and what values should be specified?

IX

STUDY PROGRAMME No. 122 (IX) **

RADIO-RELAY SYSTEMS EMPLOYING TROPOSPHERIC-SCATTER PROPAGATION

Radio frequency channel arrangements

The C.C.I.R., *(Approved at Geneva, 1958)*

CONSIDERING

(a) that radio-relay systems using tropospheric-scatter propagation are already in service and that systems of this type may come into more extensive use in the future;

(b) that such systems may use very high power (10 kW or even more, fed into high gain antennae);

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* Study Programme No. 122 (IX) arises from this Question, which replaces Question No. 148.

** This Study Programme arises from Question No. 196 (IX).

(c) that tropospheric-scatter systems are capable of causing interference over wide areas and long distances, to systems of the same or of different type operating on the same or closely adjacent frequencies; and that such interference could frequently extend over national boundaries;

(d) that tropospheric-scatter systems may be particularly susceptible to interference from systems of the same or of different type, because of the low field strengths available at the receiving terminal;

(e) that distances between adjacent stations may vary widely, e.g. between about 100 and 400 km;

(f) that overshoot problems are likely to be more severe than with line-of-sight systems;

(g) that interference may be caused in directions other than that of the main beam;

(h) that most tropospheric-scatter systems are expected to provide not more than about 120 telephone channels; that many smaller systems may provide only 12 or 24 channels, but certain systems may transmit wideband information such as television;

(i) that the transmitting power used may differ considerably according to the distance to be covered, the number of channels to be transmitted, etc.;

(j) that at present frequency modulation of the radio-frequency carrier is most generally used, but that other types of modulation, e.g. single sideband, may be introduced for some systems;

(k) that simultaneous transmission on two frequencies, to assist in the provision of quadruple diversity reception or for other reasons, while strongly deprecated in areas where the radio-frequency spectrum is likely to become congested, may be used in other areas;

(l) that the requirements for radio-frequency channel arrangements for tropospheric-scatter systems would seem from the above considerations to differ substantially from those for line-of-sight radio-relay systems or for other services;

DECIDES that the following studies should be carried out:

1. on what basis should radio-frequency channel arrangements for tropospheric-scatter systems be established;

2. what basic arrangements should be proposed?

Note :

This study should include consideration of the following points:

1. The extent to which radio frequency channel arrangements must be considered in relation to a large geographical area rather than only to individual routes.
2. The especially difficult problem of avoiding interference to and from other systems.
3. The need to accommodate systems of differing channel capacity, power, type of modulation and type of service.
4. The transmitted bandwidths appropriate to such systems.
5. The appropriate frequency spacing or spacings between go and return channels on a given section of route.
6. The appropriate frequency spacing between two or more parallel channels along the same section of route.
7. The appropriate frequency spacing between systems installed in the same station for use on different routes.

8. The distances at which frequencies can be re-used without undesirable interference effects, both in the direction of the main beam and in other directions.

9. Whether the problem of radio-frequency channel arrangements might be substantially eased if intermediate frequencies (or the first intermediate frequency if a double-frequency change receiver is used), differing from those given in Recommendation No. 273, were to be used.

QUESTION No. 197 (IX)*

RADIO-RELAY SYSTEMS FOR TELEVISION AND TELEPHONY

Transmission interruptions

(Question No. 10 of Study Group 3 of the C.C.I.T.T. to be studied by the C.C.I.R. in cooperation with Study Group 4 of the C.C.I.T.T.)

What is the duration of interruptions to transmission to be expected on radio links when switching from normal to standby equipment? (See Recommendation No. 305 of the C.C.I.R.)

Note. — It is necessary to distinguish the duration of breaks in transmission corresponding to the three following causes:

— failure of normal equipment,
— fading in radio-propagation indicated by the presence of excessive noise at a switching point of a radio link,
— change-over of the normal and standby equipment for maintenance of the radio link.

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* This Question, which replaces Question No. 165, also includes tropospheric-scatter systems.

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STUDY GROUP No. X

(Broadcasting)

Terms of reference :

To study the technical aspects of transmission and reception in the sound broadcasting service (except for tropical broadcasting), including standards of sound recording and sound reproduction to facilitate the international exchange of programmes; to study also the technical aspects of video recording in liaison with Study Group XI.

Chairman : Mr. A. Prose WALKER (U.S.A.)
Vice-Chairman : Dr. H. RINDFLEISCH (Federal German Republic)

X

* See Volume III, Section E.

* See Volume III, Section E.

QUESTION No. 23 (X)*

HIGH-FREQUENCY BROADCASTING

Directional Antenna Systems

(Stockholm, 1948)

For the following Question it will be appropriate to organize the compilation of statistical measured results from antennae of different types in various parts of the world, in respect of the signal laid down by the main beam and subsidiary lobes, and the amount of scattering in unwanted directions.

The C.C.I.R.

UNANIMOUSLY DECIDES that the following question should be studied:

what are the methods by which the formation of strong subsidiary lobes can be avoided, particularly when the directional antenna systems are fed asymmetrically to produce a slew of the main beam?

ANNEX

The characteristics of directional antenna systems used in broadcasting have been very completely studied from theoretical aspects, and a number of experimental investigations have been undertaken by various bodies on the actual measured performance **.

With a suitable designed antenna the power radiated in unwanted directions can be reduced to a small proportion of the power radiated in the wanted direction. An aerial system with a reflector having an aperture of two wavelengths should have a radiation at 25° off the main beam reduced 16 db below the main radiation field. At 40° off the main beam the radiation should be reduced to 35 db below the main radiation path. Tests have been made as to the actual reception at distant points at places which are off the main radiation beam. These show, however, that the field at such reception points is often in excess of the expected field predicted from the power radiated in the given direction.

These abnormal signal strengths presumably result from a field which is a combination of a direct radiation in the given direction, and indirect radiation due to scattering of the main beam on reflection. Measurements of this phenomenon would clearly take a very considerable time and could only be properly evaluated on a statistical basis. It appears possible that the limitation to frequency sharing may be the scattering of the main beam of radiation. X

It will, however, always be of utility to reduce the power radiated in unwanted directions and particularly in the subsidiary lobes of an antenna system.

Further study of this question is recommended, and in particular it is recommended that attention be given to the development of methods of avoiding the production of subsidiary radiation lobes when a directional antenna is asymmetrically fed in order to produce a slew of the main lobe of radiation.

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* Study Programme No. 106 (X) arises from this Question. The reasons which justify this Question are given in the Annex.

** H. PAGE, The Measured Performance of Horizontal Dipole Transmitting Arrays, *J.I.E.E.*, 92, Part III, No. 18, June 1945.
E. K. DANDEMAN, *Radio Engineering*, Chapman & Hall, page 674.
L. W. HAYES and B. N. MACLARTY, The Empire Service Broadcasting Station at Daventry, *J.I.E.E.*, **85**, No. 513, September 1939.
N. WELLS, Aerial Characteristics, *J.I.E.E.*, **89**, Part III, No. 6, June 1942.
J. E. HACKE Jr. and A. H. WAYNICK, *Restricted Range Sky Wave Transmission*, Elec. Eng. Dept., Pennsylvania State College, P.A., U.S.A.

STUDY PROGRAMME No. 106 (X)*

HIGH-FREQUENCY BROADCASTING

Directional Antenna Systems

(Recommendation No. 80)

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) the development in the use of highly directional antenna systems in H.F. (decametric) broadcasting;

(b) the need to share frequencies wherever possible to allow the most efficient use of the broadcasting bands;

UNANIMOUSLY DECIDES to carry out the following study:

the extent to which the theoretical protection can be obtained in practice when using the usual types of directional broadcasting transmitting antennae.

Note :

1. It is suggested that actual field-strength measurements should be obtained to verify the nominal gain in the main beam and the validity of Recommendation No. 80.
2. Tests should be arranged in such a way as to eliminate to the greatest possible extent the effects of changing ionospheric conditions.

QUESTION No. 39 (X)

HIGH-FREQUENCY BROADCASTING

Conditions for satisfactory reception

(Geneva, 1951)

The International High Frequency Broadcasting Conference, Mexico City,

CONSIDERING

that it has not been possible to make a complete study of a number of questions mentioned io the *Report of the Committee on Technical Principles and Standards* (Doc. No. 635 of Mexico);

DRAWS THE ATTENTION of the C.C.I.R. to the technical data contained therein and REQUESTS the C.C.I.R. to undertake the further study of the following question:

the technical and practical questions, such as the desirable modulation bandwidth, fading, and the various forms of distortion, related to the subjective aspects of quality of reception; in making this study, particular attention should be given to the question of the corrections that should be made to take account of long and short term fading in determining:

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* This Study Programme arises from Question No. 23 (X).

— the average level of the signal necessary to ensure satisfactory reception in the presence of noise or other interference having a fixed level;
— the average level of the signal necessary to ensure satisfactory reception in the presence of atmospheric noise;
— the ratio required between the average levels of wanted and unwanted signals.

QUESTION No. 66 (X)

TELEVISION RECORDING

The C.C.I.R., (Geneva, 1951)

CONSIDERING

the desirability of perfecting methods for recording television signals for subsequent reproduction;

UNANIMOUSLY DECIDES that the following question shall be studied:

what are the desirable characteristics of equipment for recording television signals and the corresponding sound?

Note. — It is recommended that the line-broadening (spot-wobble) technique should be investigated with a view to minimizing the line structure when recording on film.

QUESTION No. 150 (X)*

FREQUENCY-MODULATION SOUND BROADCASTING IN THE VHF (METRIC) BAND

X

The C.C.I.R., (London, 1953 — Warsaw, 1956)

UNANIMOUSLY DECIDES that the following question should be studied:

1. what protection ratio is required for frequency-modulation sound broadcasting in the VHF (metric) band; **

2. what advantages can be obtained from the off-setting of co-channel stations and what off-setting should be used for two or for three transmitters;

3. what is the resulting interference effect when two or more unwanted signals are present?

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* This Question replaces Question No. 99.
** See Report No. 77.

QUESTION No. 151 (X)*

MEASUREMENT OF PROGRAMME LEVEL IN SOUND BROADCASTING

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that difficulties have arisen in the exchange of programmes;

(b) that certain information has been submitted which indicates the desirability of further study;**

UNANIMOUSLY DECIDES that the following question should be studied:

by what methods and by means of what equipment should the programme level be controlled in connection with recording, reproduction and transmission over lines or radio links?

STUDY PROGRAMME No. 109 (X) ***

MEASUREMENT OF PROGRAMME LEVEL IN SOUND BROADCASTING

The C.C.I.R., (Warsaw, 1956)

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. an investigation into the errors in the indicated programme level, as measured in relation to the true peak value, arising from the use of existing equipment;
2. an investigation of improved methods of operation, new designs of equipment or modifications to existing equipment in order to minimise these errors.

STUDY PROGRAMME No. 161 (X) ****

STANDARDS OF SOUND RECORDING FOR THE INTERNATIONAL EXCHANGE OF PROGRAMMES

The C.C.I.R., (Geneva, 1951 — London, 1953 — Los Angeles, 1959)

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. an investigation of the possibility of adopting for the international exchange of sound programmes on magnetic tape a speed of 3·75 in/s, (9.525 cm/s), and the determination of the standards to be used, especially the reproducing characteristics;
2. investigation of methods for measuring wow and flutter for magnetic tape recording and reproducing, and of the values of those which may be allowed.

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* Study Programme No. 109 (X) arises from this Question.

** See Doc. No. 214 (Warsaw).

*** This Study Programme arises from Question No. 151 (X).

**** This Study Programme replaces Study Programme No. 74. It does not refer to any Question under study.

3. Further investigation of methods of absolute measurement of the characteristics of the signal recorded on a magnetic tape in order to define and measure, over as wide a range of wavelengths on the tape as possible, the absolute level of a recorded signal independently of the particular magnetic properties of each type of tape;

4. Further investigation of the technique of sound recording to extend and improve the recommendations already made and to reduce the tolerances.

STUDY PROGRAMME No. 162 (X)*

MEASUREMENT OF AUDIO NOISE FOR BROADCASTING AND IN SOUND RECORDING SYSTEMS

(Report No. 33)

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

that no methods exist for measuring noise in the audio channels of broadcasting systems and in sound recording systems, which provide satisfactory agreement with subjective assessments;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. what type of measuring set (mean, r.m.s. or peak) should be used for the measurement of noise;

2. what characteristics should be recommended for these measuring sets?

Note. — Study of § 1 and 2 should be made with reference to the measurement of noise with and without programme modulation (modulation noise in magnetic recording).

QUESTION No. 198 (X)**

SIMULTANEOUS TRANSMISSION OF TWO SOUND CHANNELS IN TELEVISION

The C.C.I.R., (Los Angeles, 1959)

X

CONSIDERING

(a) that it is often desirable for the purpose of international programme exchange to transmit two sound channels simultaneously in television;

(b) that such a transmission may also be useful in areas where several languages are spoken;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what systems, which should not involve any significant increase in the bandwidth of the television channel nor diminish the quality of the picture, can be used for the transmission, from a single transmitter, of two sound channels in television;

2. what modifications would have to be made to existing receivers to allow the choice of reception of either of the sound channels;

3. to what extent could these systems be used for stereophonic sound transmissions in television?

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* This Study Programme does not refer to any Question under study.

** Refer to Doc. XI/49 (France) of Moscow, 1958 and Doc. No. 144 (U.S.S.R.) of Los Angeles, 1959,

QUESTION No. 199 (X)*

STEREOPHONIC BROADCASTING

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that stereophonic recording of sound on both disc and magnetic tape is already becoming well established in the industry and such discs and tapes are already on sale to the public in some countries;

(b) that experimental transmissions of stereophonic sound programmes have already been made by broadcasting stations in a number of countries;

(c) that, if such transmissions become general without international coordination, serious problems of interference to existing broadcasting services could arise;

(d) that by the adoption of suitable techniques on an international scale such interference problems could be avoided and spectrum occupancy reduced;

(e) that it is desirable to achieve international standardization of transmission parameters so as to make possible the standardization of some parts of receivers for stereophonic broadcasting;

UNANIMOUSLY DECIDES that the following question should be studied:

1. by what methods can satisfactory stereophonic sound be broadcast to ensure maximum economy in frequency usage;

2. what systems can ensure compatibility** together with no significant loss of coverage or increase in mutual interference with existing services;

3. what parameters should be standardized?

STUDY PROGRAMME No 163 (X)***

STEREOPHONIC BROADCASTING STANDARDS FOR COMPATIBLE SYSTEMS IN SOUND AND TELEVISION BROADCASTING

The C.C.I.R., (Los Angeles, 1959)

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. investigate the systems for compatible stereophonic broadcasting indicating:

1.1 the general principles of each system;

1.2 the detailed specification of each system;

1.3 the overall theoretical evaluation of the performance of each system;

2. study the systems with particular regard to their feasibility and applicability to existing broadcast transmitters;

3. study the systems with regard to:

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* Study Programme No. 163 (X) arises from this Question, which replaces Question No. 170.

** " Compatible " in the sense that when a stereophonic programme is being broadcast, an ordinary receiver may continue to receive a satisfactorily balanced, non-stereophonic programme.

*** This Study Programme arises from Question No. 199 (X).

3.1 performance of existing non-stereophonic receivers when tuned to the stereophonic transmission;

3.2 performance of stereophonic receivers when tuned to the stereophonic signal;

3.3 performance of stereophonic receivers when tuned to non-stereophonic signals;

3.4 possibility of adapting existing non-stereophonic receivers for stereophonic reception;

4. investigate the systems with particular regard to:

4.1 coverage,

4.2 interference effects;

4.3 bandwidth involved and other matters concerned with channel utilization;

5. carry out field tests of those systems that appear most satisfactory;

6. study and report on the required technical characteristics of studio-transmitter links and related stereophonic transmission facilities;

7. study the subjective aspects of stereophonic sound.

QUESTION No. 200 (X)

STEREOPHONIC RECORDING FOR BROADCASTING

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that studies are being carried out in order to determine the best systems of stereophonic sound broadcasting;

(b) that audio-frequency stereophonic recordings are necessary for these new broadcasting systems;

(c) that the recommendations of the International Electrotechnical Commission should be examined in this respect to see if they are acceptable;

UNANIMOUSLY DECIDES that the following question be studied:

1. what stereophonic sound-recording methods can be used by broadcasting authorities;

2. what standard should be established to allow for the international exchange of these recordings ?

X

QUESTION No. 201 (X)

LONG- AND MEDIUM-WAVE SOUND BROADCASTING
Bandwidth of Emissions

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that adjacent channel transmitters in the long- and medium-wave bands very often give rise to harmful interference, especially in the secondary service area;

(b) that the selectivity of most of the existing long- and medium-wave receivers does not permit reception of the full radiated bandwidth;

UNANIMOUSLY DECIDES that the following question should be studied:

What would be the optimum value of radiated bandwidth of long- and medium-wave transmitters under the existing conditions taking into account
— spacing between carriers,
— distances between adjacent channel transmitters,
— typical receiver stability,
in order to give the best possible quality of reception in the secondary service area?

QUESTION No. 202 (X)*

MEDIUM-WAVE BROADCASTING

Quality of reception in the secondary service area

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

that there is insufficient information about the subjective aspects of the quality of reception in the secondary service area of medium-wave transmitters;

UNANIMOUSLY DECIDES that the following question should be studied:

1. by what methods should the quality of reception be assessed in the secondary service area;
2. under what conditions would such a service be considered satisfactory?

STUDY PROGRAMME No. 164 (X)**

MEDIUM-WAVE BROADCASTING

Quality of reception in the secondary service area

The C.C.I.R., (Los Angeles, 1959)

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. an investigation of methods of assessing the quality of reception under the conditions existing in the secondary service area;
2. an investigation of the influence of different factors affecting the quality of reception, such as geographical location of the transmitter, distance from the transmitter, carrier frequency, seasonal variation;
3. an investigation of the correlation between the quality of reception and the magnitude and fluctuation of the signal.

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* Study Programme No 164 (X) arises from this Question.

** This Study Programme arises from Question No. 202 (X).

QUESTION No. 203 (X) *

HIGH-FREQUENCY BROADCASTING
Effects of different spacings between carrier frequencies

The C.C.I.R., (Warsaw, 1956 — Los Angeles, 1959)

UNANIMOUSLY DECIDES that the following question should be studied:

What ratios of median wanted to unwanted signal field-strengths will give satisfactory reception ** when two transmitters, transmitting different programmes, use frequencies at spacings from 0 to 10 kc/s?

Details of test conditions should be submitted with the results obtained.

QUESTION No. 204 (X)

HIGH-FREQUENCY BROADCASTING
The effect of propagation path length and direction on protection ratios

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that experiments carried out on radio-telegraph circuits have shown that protection ratios can depend on path length (Doc. 129 of Los Angeles, 1959);

(b) that broadcasting protection ratios are also likely to be affected by path length;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what are the methods of determining the effect of path length on protection ratios in HF broadcasting;

2. how and to what extent do the length and direction of the path affect protection ratios in HF broadcasting?

X

QUESTION No. 205 (X) ***

COMPATIBLE SINGLE-SIDEBAND (C.S.S.B.) TRANSMISSION FOR AMPLITUDE-MODULATION SOUND BROADCAST SERVICES

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that compatible (unsuppressed carrier) single sideband transmissions (see Note) are now in limited experimental use by broadcast stations in certain countries;

(b) that the use of such a system of transmission could improve reception;

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* This Question replaces Question No. 149.

** Satisfactory reception is defined here as a condition when the interference from the unwanted signal is deemed tolerable. It should be assessed subjectively.

*** Study Programme No. 165 (X) arises from this Question.

(c) that further information is required regarding such systems;

UNANIMOUSLY DECIDES that the following question should be studied:

1. by what methods can compatible single sideband transmissions be accomplished;
2. what parameters should be standardized in order to derive the maximum possible advantages from such transmissions?

Note. — A single-side band transmission is considered to be compatible if it can be received on the existing conventional double-side band receivers without any modifications whatsoever and with satisfactory quality of reception.

STUDY PROGRAMME No. 165 (X)*

COMPATIBLE SINGLE-SIDEBAND (C.S.S.B.) TRANSMISSION FOR AMPLITUDE-MODULATION SOUND BROADCAST SERVICES

The C.C.I.R., (Los Angeles, 1959)

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. in what manner and to what extent can interference be reduced by the use of C.S.S.B. (see Note);
2. what is the effect of the use of such a system on reception in the zone where both the sky wave and ground wave signals are present to result in distortion;
3. what is the effect of C.S.S.B. on the audio fidelity and attainable permissible audio bandwidth;
4. what is the effect of C.S.S.B. on the transmitter coverage;
5. are there any other features of C.S.S.B. which could improve reception?

Note. — A single-sideband transmission is considered to be compatible if it can be received on the existing conventional double-side band receivers without any modifications whatsoever and with satisfactory quality of reception.

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* This Study Programme arises from Question No. 205 (X).

STUDY GROUP No. XI

(Television)

Terms of reference :

Technical aspects of television.

Chairman : Mr. E. ESPING (Sweden)
Vice-Chairman : Mr. G. HANSEN (Belgium)

XI

* See Volume III, Section E.

** Question No. 121 (XI) has been allocated to the C.M.T.T.

*** Study Programme No. 116 (XI) has been allocated to the C.M.T.T.

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QUESTION No. 118 (XI)*

COLOUR TELEVISION STANDARDS

The C.C.I.R., *(Approved at Brussels, 1955)*

CONSIDERING

(a) that Question No. 64 does not cover all aspects of the problems arising in the standardisation of colour television;

(b) that, in Europe at least, the situation in Bands I and III differs from that in Bands IV and V, and that, in deciding on colour systems for Bands I and III, individual administrations may find it convenient to use systems compatible with their monochrome systems already working in these bands;

(c) that, as Bands IV and V have not yet been exploited in many countries, it is desirable and theoretically possible for these countries to achieve a common standard for these bands;

(d) that in choosing a colour system for Bands IV and V administrations may well be influenced by any colour systems which they may have adopted for Bands I and III, and that this possibility complicates the choice of common standards;

DECIDES that the following question should be studied:

what standards can be recommended for colour television for public broadcasting? Account should be taken of such points as:

— satisfactory picture (colour and monochrome) and sound quality;
— economical use of bandwidth;
— reliable receivers of reasonable cost;
— operation of studio, transmitting and relaying equipment;
— susceptibility to interference;
— compatibilities;**
— frequency planning;
— international exchange of programmes;
— scope for development;
— the differences between Bands I and III as compared with Bands IV and V.

STUDY PROGRAMME No. 80 (XI)***

STANDARDS FOR VIDEO COLOUR TELEVISION SIGNALS ****

The C.C.I.R., *(Approved at Brussels, 1955)*

DECIDES that the following studies should be carried out:

1. the preferred colorimetric parameters for representing the television picture;
2. the scanning standards that can be recommended, e.g. sequential (field, line, dot), simultaneous or mixed;

XI

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* Study Programmes Nos. 80 (XI), 81 (XI), 110 (XI) and 117 (XI) arise from this Question, which replaces Question No. 64 and Study Programme No. 37.

** A compatible colour television system is one that produces acceptable monochrome versions of the colour pictures on existing monochrome receivers. A reverse compatible colour television system is one that produces acceptable monochrome pictures on colour receivers from existing monochrome transmissions: in either case bandwidths of the colour and monochrome systems may be the same or different.

*** This Study Programme arises from Question No. 118 (XI).

**** The answers to Question No. 153 (XI) with studies and experience of colour television systems should be taken into account.

3. comparison of the various methods of coding and decoding the colour picture information;
4. the minimum acceptable bandwidths for the signal components corresponding to these parameters.

STUDY PROGRAMME No. 81 (XI) *

STANDARDS FOR RADIATED COLOUR TELEVISION SIGNALS

The C.C.I.R., *(Approved at Brussels, 1955)*

DECIDES that the following study should be carried out:

comparison of different colour television systems in terms of the criteria listed in the text of Question No. 118 (XI). These comparisons should pay particular attention to colour television systems which are either in operation, or which are, or have been, the subject of experiment.

STUDY PROGRAMME No. 110 (XI) *

DISTORTION OF TELEVISION SIGNALS DUE TO THE USE OF VESTIGIAL-SIDEBAND TRANSMISSION

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that vestigial-sideband transmission of television signals is accepted practice in broadcasting;

(b) that this method of transmission results in overall distortion which is a combination of:
— quadrature distortion inherent in the method,
— distortion caused by non-uniformity of group-delay in transmitter circuits,
— distortion caused by non-uniformity of group-delay in receiver circuits;

(c) that the importance of the individual contributions listed in *(b)*, in respect of the overall degradation of the received picture, has not been established;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. the quantitative assessment of the respective distortions introduced in a television system using vestigial-sideband transmission, due to:
— quadrature error,
— group-delay error at the transmitter,
— group-delay error at the receiver;
2. suitable methods to be adopted for measuring and correcting such distortions;
3. the extent to which such corrections should be introduced at the transmitter.

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* This Study Programme arises from Question No. 118 (XI).

STUDY PROGRAMME No. 117 (XI)*

CONSTITUTION OF A SYSTEM OF STEREOSCOPIC TELEVISION

The C.C.I.R., *(Approved at Moscow, 1958)*

CONSIDERING

(a) the possible future development of stereoscopic television broadcasting;

(b) the great utility this form of television may have;

DECIDES that the following studies should be carried out:

1. *Stereoscopic monochrome television*

1.1 investigation into the development of methods of providing stereoscopic television not requiring the use of spectacles;

1.2 study of the possibility of decreasing the bandwidth of stereoscopic television broadcasting, e.g., by transmitting one picture of the stereoscopic couple with the full standardized bandwidth and the other with a reduced bandwidth on a sub-carrier within the first frequency spectrum;

1.3 study of the influence of noise on stereoscopic television pictures and determination of the permissible signal-to-noise ratio;

1.4 investigation of the design of receivers with direct reproduction of stereoscopic pictures, e.g., by taking the structure of receiving tube displays as a basis for the lay-out of the phosphorescent elements;

2. *Stereoscopic colour television*

2.1 the carrying out of tests to assess the quality of colour reproduction with binocular mixing of its components in respect of the stability of picture detail (" field-clash ");

2.2 study of the possibility of decreasing the frequency band for stereoscopic colour television, e.g., by transmitting the green field of the stereoscopic couple with the full standardized band, the red and blue fields being transmitted by means of a sub-carrier within the first frequency spectrum;

2.3 research into the design of receivers for the direct reproduction of stereoscopic colour television.

QUESTION No. 119 (XI)**

RATIO OF THE WANTED TO THE UNWANTED SIGNAL IN TELEVISION

The C.C.I.R., *(Approved at Brussels, 1955)*

CONSIDERING

(a) that the satisfactory operation of a television service renders it necessary to specify the maximum field-strength of interfering or unwanted signals which can be tolerated without unduly affecting the reception of television programmes;

* This Study Programme arises from Question No. 118 (XI).

** Study Programmes Nos. 123 (XI) and 166 (XI) arise from this Question which replaces Question No. 67.

(b) that the frequency bands allotted for television broadcasting services are so limited that it is essential for more than one transmitting station to operate in the same channel;

(c) that, on the frequencies used for television, radio waves in certain cases travel to distances far in excess of the normal service area;

(d) that the varying propagation of such waves, under different conditions, is the major factor in determining the geographical distances separating television transmitting stations to avoid mutual interference;

DECIDES that the following question should be studied:

the determination of the minimum admissible ratio of wanted to unwanted signal, when two television transmitters are operating:
— in the same channel,
— in adjacent channels,
— with dissimilar but partially overlapping bandwidths.

Note. — The reply to the question should give the protection ratios required when the transmitters are both radiating monochrome signals, both radiating colour signals, and when the one is radiating a monochrome and the other a colour signal; and it should take into account all the different signal standards that may be used and should also indicate percentage of time during which protection is desired and the proportion of the programme time for which the stated degree of interference must be avoided. Separate answers may be required for various grades of service.

STUDY PROGRAMME No. 123 (XI)*

RATIO OF THE WANTED TO THE UNWANTED SIGNAL IN MONOCHROME TELEVISION

Use of frequency-offset for sound when the wanted signal is frequency-modulated

The C.C.I.R., *(Approved at Moscow, 1958)*

CONSIDERING

(a) that, when assigning frequencies to television transmitters *for sound,* it is desirable to make the fullest use of the advantage derived from frequency-offset;

(b) that precision frequency-offset of the vision carriers makes it possible in some cases to obtain protection ratios (for just tolerable interference) of 20 db and that it is desirable for the protection ratios for the sound not to exceed this value;

(c) that recent tests tend to show that the protection ratio of 20 db mentioned in Report No. 82 for just tolerable interference in the case of wanted and unwanted frequency-modulated signals may be too small;

(d) that recent tests have shown that in this case an offset of about 20 kc/s may be advantageous;

(e) that Report No. 82 does not consider the case of a wanted frequency-modulated signal and an unwanted amplitude-modulated signal;

DECIDES that the following studies should be carried out:
determination of the protection ratio for the sound/signal (for just tolerable interference)

1. when the wanted and unwanted signals are frequency-modulated
— with a frequency difference below 300 c/s;
— with a frequency difference of about 10 kc/s;
— with a frequency difference of about 20 kc/s;

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* This Study Programme arises from Question No. 119 (XI).

2. when the wanted signal is frequency-modulated and the unwanted signal amplitude-modulated
   — with a frequency difference below 300 c/s;
   — with a frequency difference of about 20 kc/s.

STUDY PROGRAMME No. 166 (XI)*

RATIO OF THE WANTED TO THE UNWANTED SIGNAL IN TELEVISION

Use of the offset method when there are great differences between the carrier frequencies of the interfering stations

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that the offset method,** when there is partial overlapping of the interfering channels, may make it possible to reduce the protection ratios and thus facilitate the planning of television networks over territories where different television standards are used;

(b) that the advantages to be expected from the offset method depend on the stability of the line frequency of the picture received and the type of modulation of the unwanted signal;

(c) that the effect of the interference on the quality of a monochrome picture may take the form of contrast distortion and irregular line synchronisation;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. conditions and frequency bands in which the use of the offset method is advantageous;
2. methods to be applied in order to render the offset method advantageous when there are great differences in the carrier frequencies of the interfering transmitters;
3. influence of the sidebands of the wanted and unwanted signals when the offset method is used;
4. influence of the line synchronisation system in the receiver on the reception quality, when the offset method is used.

ANNEX

One useful method of carrying out these studies is given below:

Measurements are made with an interfering sinusoidal frequency varying from 5 kc/s to 10 Mc/s. The level of these frequencies is adjusted to give the same subjective interference as a reference signal of half the line frequency with a peak-to-peak amplitude of 17 db, 20 db and 23 db below the peak-to-peak value of the luminance signal (excluding sync. pulses), which correspond to ratio of 27 db, 30 db and 33 db respectively for the radio frequency carriers.

The frequency of the interfering sinusoidal signal should be adjusted for:

1. non-offset working;
2. offset working.

The measurement should be made with video frequencies and with radio frequency carriers. In the latter case the wanted signal should correpond to input levels at the receiver of both 1 millivolt and 0·1 millivolt.

Uniform viewing conditions are very necessary, in making these subjective tests, Doc. No. 76 of Brussels, 1955, should be consulted for guidance.

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* This Study Programme, which replaces Study Programme No. 118, arises from Question No. 119 (XI).

** See Report No. 82, § 4.

QUESTION No. 120 (XI)

EXCHANGE OF TELEVISION PROGRAMMES

The C.C.I.R., *(Approved at Brussels, 1955)*

CONSIDERING

(a) that it is desirable to exchange television programmes between countries;

(b) that a variety of television standards is in use;

DECIDES that the following question should be studied:

what methods can be used to enable television programmes to be exchanged between countries:

1. when the nominal field frequencies are the same, but the numbers of lines are different, or *vice versa;*

2. when the nominal field frequencies as well as the numbers of lines are different;

3. when the nominal field frequencies are the same and the numbers of lines are the same, but the synchronising signals are different in form?

Note. — Programme exchanges between different monochrome systems, between different colour systems, and between monochrome and colour systems should be considered.

QUESTION No. 121 (XI)*

TRANSMISSION OF MONOCHROME AND COLOUR TELEVISION SIGNALS OVER LONG DISTANCES (C.M.T.T.)

The C.C.I.R., *(Approved at Brussels, 1955)*

CONSIDERING

(a) that all the information required by the C.C.I.R. and the C.C.I.T.T. relating to the requirements for the transmission of monochrome television signals over long distances is not yet available;

(b) that it is necessary to study without delay the problems that may arise in the future concerning the transmission of colour television signals, whatever form these signals may take;

(c) that the choice of a standard colour television system must certainly take into account the possibility of transmitting the signals over existing links as well as the requirements that may be imposed on future circuits;

(d) that the adoption of a hypothetical reference circuit of 2,500 km length for the presentation of the results of studies, as proposed by the C.C.I.T.T. for cable circuits, is acceptable and useful;

DECIDES that the following question should be studied:

for the transmission of monochrome or colour television signals over a hypothetical reference circuit (2,500 km):

1. what are the characteristics of the signal and of the circuit that must be considered, what are their recommended values and what tolerances must be imposed in order to ensure satisfactory transmission;

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* Study Programmes Nos. 36 (XI) and 119 (XI) arise from this Question.

2. how do these characteristics and their values and tolerances differ as between the requirements for the transmission of monochrome signals and of colour signals;

3. what methods of measurement and what test signals can be recommended for checking the characteristics?

STUDY PROGRAMME No. 36 (XI) *

CONVERSION OF A TELEVISION SIGNAL FROM ONE STANDARD TO ANOTHER

The C.C.I.R., (Geneva, 1951)

UNANIMOUSLY DECIDES that the following studies shall be carried out:

methods of converting a television signal from one standard to another:
— when the field frequency is identical in the two standards, but the number of lines differs;
— when both the field frequency and the number of lines are different in the two standards.

STUDY PROGRAMME No. 119 (XI) **

REDUCTION OF THE CHANNEL CAPACITY REQUIRED FOR A TELEVISION SIGNAL

The C.C.I.R., *(Approved at Moscow, 1958)*

CONSIDERING

(a) that the large channel capacity required for the transmission of television signals introduces problems which are both technical and economic;

(b) that the need for large channel capacity limits severely the maximum distance over which television signals can be transmitted by radio;

(c) that all present day methods of transmitting and receiving television signals are wasteful in that they require a channel capacity greatly exceeding that which is necessary to transmit the essential information contained in a television picure and which can be utilized by the human eye;

DECIDES that the following studies should be carried out:

1. the methods which can be used to reduce the required channel capacity for a television signal without reducing perceptibly the quality of the reproduced picture;

2. the way in which removal of redundancy (signal compression) can best be exploited to reduce the bandwidth required for transmission;

3. the possibility of transmitting a signal from point to point by converting it into another (intermediate) signal which has been processed to have a bandwidth smaller than that of the original signal in keeping with a reduction of channel capacity;

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* This Study Programme arises from Question No. 121 (XI).

** This Study Programme, which replaces Study Programme No. 35, arises from Question No. 121 (XI).

4. the best method of exploiting signal compression to increase the range over which television signals can be transmitted, taking into account that for a fixed rate of information it is in general possible to exchange bandwidth and signal-noise ratio;

5. the ways in which knowledge of the characteristics of the human eye can be used to reduce to a minimum the amount of information which it is required to transmit in order to reproduce a satisfactory television picture.

QUESTION No. 152 (XI) *

ASSESSMENT OF THE QUALITY OF TELEVISION PICTURES

The C.C.I.R., (Geneva, 1951 — Warsaw, 1956)

CONSIDERING

(a) that appreciable discrepancies may exist between different experts' assessments of the quality of the pictures given by the television systems now in use or proposed;

(b) that these discrepancies are to be attributed to the fact that it is usually impossible to obtain simultaneous viewing of the pictures under comparison, to possible variations in quality between apparatus nominally using the same system and to alterations that may occur with time in the characteristics of the equipment used;

(c) that consequently it would be eminently desirable to have some standard method of gauging or even measuring television picture quality which would permit objective comparison of the results obtained in different places and would serve as a guide to the efficient and uniform working of the equipment in service;

UNANIMOUSLY DECIDES that the following question shall be studied:

what standardized methods and means of test, independent of the television standards which may be employed, can be used to measure accurately, and whenever possible, objectively, the deterioration introduced into monochrome and colour pictures by television, taking into account the system, the equipment and the transmission processes?

QUESTION No. 153 (XI) **

RESOLVING POWER AND DIFFERENTIAL SENSITIVITY OF THE HUMAN EYE

The C.C.I.R., (Geneva, 1951 — Warsaw, 1956)

CONSIDERING

(a) that those responsible for a regular television service must have an exact knowledge of the physiological properties of the human eye, the demands of which they are endeavouring to satisfy;

(b) that, among these properties, the most important are the resolving power by means of wihch regular fields and fine details are perceived, the differential sensitivity to brilliance and the differential sensitivity to a change in the shade of the same colour;

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* This Question replaces Question No. 65.

** This Question replaces Question No. 68.

(c) that accurate and sufficient data on the resolving power of the human eye is available for still pictures but insufficient data is available for the case of animated pictures;

(d) that the results of the numerous physiological studies already undertaken on this subject cannot, a priori, be assumed to be equally valid for the observation of television pictures, because of the special nature of such pictures;

UNANIMOUSLY DECIDES that the following question shall be studied:

1. what is the resolving power of the human eye, expressed in minutes of angle, for values of contrast, luminance, colour and distance, normally encountered when observing animated pictures;
2. what is the differential sensitivity of the human eye to:
   — a change of luminance,
   — a change of shade in the same colour,
   for values of contrast, luminance, colour and distance, normally encountered when observing television pictures?

QUESTION No. 166 (XI) *

SINGLE VALUE OF SIGNAL-TO-NOISE RATIO FOR DIFFERENT TELEVISION SYSTEMS

The C.C.I.R., *(Approved at Moscow, 1958)*

CONSIDERING

(a) that it is desirable to devise a method for the objective assessment of the signal-to-noise ratio valid for all television systems, with the object of recommending a single value for the tolerable signal-to-random noise ratio in television and especially for the international exchange of programmes;

(b) that the relation between the peak value of the signal and the RMS or quasi-peak noise does not necessarily indicate the visibility of the noise on the pictures received;

(c) that the method of assessing the signal-to-noise ratio by means of a weighting network producing a mean objective curve of the weighting of the various frequency components leads to a more objective assessment of the ratio;

DECIDES that the following question should be studied;

1. is it possible to recommend an objective mean curve for the weighting of the noise components as a function of frequency and also to recommend a weighting network to produce this curve giving a figure for the signal-to-noise ratio indicating the visibility of the noise on the pictures;
2. is there any other measurement method producing the same result that could be recommended;
3. is it possible, using the method or methods thus recommended, to adopt a single figure for the tolerable signal-to-random noise ratio in television especially for the international exchange of programmes?

XI

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* Study Programme No. 116 (XI) arises from this Question, which replaces Question No. 117.

STUDY PROGRAMME No. 116 (XI) *

SINGLE VALUE OF THE SIGNAL-TO-NOISE RATIO FOR DIFFERENT TELEVISION SYSTEMS

(C.M.T.T.)

The C.C.I.R., *(Approved at Moscow, 1958)*

CONSIDERING

(a) that a method of measuring the signal-to-noise ratio capable of giving a figure showing the visibility of noise on the pictures received has already been indicated and appears in the documents of the C.C.I.R., C.C.I.T.T. and C.M.T.T.;

(b) that this method implies the adoption of a weighting curve for the various noise components as a function of frequency;

(c) that this method also requires the adoption of a weighting network to transform noise in such a way that the measured signal-to-noise ratio shall give a valid indication of the visibility of the noise;

(d) that the various television systems, because of differing standards, have different requirements including different frequency bands;

DECIDES that the following studies should be carried out:

1. what should be the weighting curve for the various noise components as a function of frequency if the measured value is to be representative of the visibility of noise on the pictures received;
2. what weighting network can be recommended to produce this weighting curve;
3. what should be the characteristics of the equipment** associated with the weighting network in measuring the signal-to-noise ratio;
4. is it possible to obtain a single measuring apparatus by means of interchangeable subsidiary components meeting the different requirements of the various television systems;
5. what general conditions and parameters should be standardized in the experimental determination of the form of the weighting curve and what uniform method of expressing the results should be used;
6. in the case of colour television, what should be the forms of the weighting curves for the red, green and blue colours on the screen?

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* This Study Programme arises from Question No. 166 (XI).

** One of the possible devices for measuring signal-to-noise ratio is described in Doc. XI/25 (U.S.S.R.) of Moscow, 1958

STUDY GROUP No. XII

(Tropical Broadcasting)

Terms of reference :

To study standards required for good quality service in the tropical zone, and for tropical broadcasting systems; interference in the shared bands; power requirements for acceptable service; design of suitable antennae for short-distance tropical broadcasting; optimum conditions for the utilization of frequency bands used for broadcasting in the tropical zone; other associated questions.

Chairman : Dr. M.B. SARWATE (India)
Vice-Chairman : Mr. A.C. RAMCHAMDANI, M.Sc. (Tech.) (India)

* See Volume III, Section E.

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QUESTION No. 102 (XII) *

INTERFERENCE IN THE BANDS SHARED WITH BROADCASTING **

The C.C.I.R., (Stockholm, 1948 — Geneva, 1951 — London, 1953)

CONSIDERING

Recommendation No. 8 of the International Radio Conference (Atlantic City, 1947) and the studies pursued at the Vth, VIth and VIIth Plenary Assemblies of the C.C.I.R.;

DECIDES that the following question should be studied:

what is the minimum permissible protection ratio for broadcasting signals, when measured at the output of a receiver fitted with a filter having an audio-frequency cut-off of 5 kc/s and to what minimum value of the wanted field should this ratio be maintained?***

ANNEX

1. The permissible frequency tolerances for broadcasting stations would permit variations in frequency of broadcasting stations up to about 250 c/s until 1953 and up to about 150 c/s after that date. The corresponding tolerances for fixed stations would allow maximum frequency changes of about 500 c/s and 150 c/s respectively. The tolerances permitted to mobile stations would be initially about 2,500 c/s and later about 1,000 c/s. These tolerances are very large in relation to the possible spacing between broadcast carrier frequencies in the shared bands and, for a consideration of the problem, it is therefore necessary to assume a frequency spacing between such broadcast carriers.

2. If it is assumed that the stations of other services will be located only on frequencies centrally located between the broadcast carriers, and if it is further assumed that the broadcast carrier frequencies will be separated by not more than 10 kc/s, then the maximum frequency spacing between a fixed or mobile station and a broadcasting station would be 5 kc/s. From this consideration it will be seen that the permissible tolerances represent a very large proportion of the spectrum space between a broadcasting carrier and a sharing service carrier and that the possible heterodyne frequency will be such that a receiver giving adequate broadcasting reception would not eliminate it. At the present time, it would seem very difficult greatly to increase the stability of mobile transmitters and it is therefore suggested that a case exists for recommending to administrations in tropical zones that the minimum number of mobile stations should be assigned in the shared bands. For fixed stations it would seem that, since by 1953 fixed stations in these bands will have to maintain the same frequency tolerances as broadcasting stations, as specified in App. 3 to the Atlantic City Radio Regulations, it would be advisable to request administrations to expedite improvement in the frequency stability of fixed stations in bands shared with broadcasting and that the minimum number of fixed stations in tropical zones might be assigned in these shared bands, unless they do meet the requirements laid down for frequency tolerance for broadcasting stations.

* Study Programmes Nos. 112 (XII), 114 (XII) and 167 (XII) arise from this Question which replaces Question No. 4.

** The reasons justifiying this Question will be found in the Annex.

*** Practical consideration of the frequency separation of adjacent channels requires the use of an audio-frequency cut-off of 5 kc/s in the measurement, in preference to 6•4 kc/s, appropriate corrections being applied, if considered necessary, to correspond to an audio-frequency cut-off of 6•4 kc/s.

3. If it is not possible to eliminate mobile stations entirely from the shared bands in the tropical zones, then it might be recommended that every effort should be made to eliminate the use of mobile stations using A3 type of transmission in these bands. As, in other services, fully adequate telephony quality is maintained with a reduced audio-frequency bandwidth, it might be recommended that the audio bandwidth transmitted by mobile stations when operating in the tropical zones should be limited to 3,000 c/s.

4. In Stockholm Doc. No. 110, it is recommended that power limitations should be placed on broadcasting stations operating in these bands. It is generally admitted that the field strength required for an adequate telegraph service is of the order of 10% of the field strength required for an adequate signal on a broadcasting service. There would seem, therefore, to be a logical case to put a restriction on the power to be used by other services in the shared bands. All voice transmission in this band might possibly be carried out on power limits not exceeding those laid down for broadcasting stations in Stockholm Doc. No. 110.

5. A recommendation might be made in accordance with Art. 13, § 3 of the Atlantic City Radio Regulations that the use of directive antennae be followed in all possible cases in order to reduce mutual interference between services.

6. As is pointed out in Stockholm Doc. No. 21, page 5, the permissible interference level for ordinary telephony with noise reducers is +32 db and for ordinary telephony without noise reducers is +42 db. For broadcasting use, higher signal-to-noise ratios are suggested. It is felt, however, that it would be a matter of considerable difficulty under tropical conditions to obtain a signal-to-noise ratio greater than 40 db with respect to the local noise. Such a level has been taken as a reasonable maximum in Stockholm Doc. No. 110. It is considered, therefore, that it is not justifiable to specify limits of interference more stringent than that imposed by a protection ratio of 40 db between the wanted signal and the interference. It might be suggested, therefore, that an undesired signal should be defined as causing interference to a broadcasting service only when its effective level in the output of an ordinary receiver, having an audio passband of 6·4 kc/s, is less than 40 db below the desired signal level within the defined service area of the broadcasting station.

7. To minimise the effect of interference, a recommendation might be made that spurious radiation, key-clicks, sideband spread and other forms of interference-producing radiation should be kept to a minimum in all transmitters used in tropical zones on the shared bands.

8. While it is considered that, under normal conditions, a modulation band of 6,400 c/s is desirable in the interests of quality, it is recognised that, in the tropical zones, the levels of atmospheric noise in the tropical broadcasting bands and the possibilities of interference due to the difficulty of accommodating all stations in these bands are such that a modulation band of 5,000 c/s may have to be accepted.

STUDY PROGRAMME No. 112 (XII) *

SHORT-DISTANCE HIGH-FREQUENCY BROADCASTING IN THE TROPICAL ZONE (TROPICAL BROADCASTING) **

(Question No. 27 — Recommendation No. 215)

The C.C.I.R., (Geneva, 1951 — Warsaw, 1956)

CONSIDERING

(a) that there is little data on the determination of the power required for a given grade of tropical broadcasting service;

(b) that it would be helpful in the planning of new tropical broadcasting services to have more reliable data;

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* This Study Programme, which replaces Study Programme No. 38, arises from Question No. 102 (XII).

** As this service is defined in the considerations of Question No. 27 reproduced in the Annex.

(c) that more reliable data would be helpful in the organization of services in the bands shared with tropical broadcasting (See Art. 9, No. 244 of the Radio Regulations, 1947);

UNANIMOUSLY DECIDES that the following studies shall be carried out:

1. the experimental determination of the signal-to-noise ratio and the signal-to-interference ratio that should be adopted as representative of an acceptable tropical broadcasting service. The observations should be made with aerials and receivers that are representative of those normally used for tropical broadcasting reception. The reports on this study should indicate as fully as possible the conditions of measurement, the characteristics of the equipment and the methods used, so that the results may be correlated with those of other observers. In particular, the bandwidth of the receiver employed should be given;

2. a practical examination of whether the provisional power limits in Recommendation No. 215 are satisfactory or whether they should be changed to give an acceptable tropical broadcasting service. The reports on this study should include all the relevant factors concerned and, in particular, information on the following points:

— the area and the day, month and year for which observations are made;
— the distance from the transmitter to the point of observation;
— the carrier power of the transmitter and its depth of modulation;
— the details of the transmitting and receiving aerials;
— the characteristics of the receiver used.

Information on the signal-to-noise ratio and the signal-to-interference ratio (if possible in a statistical form) would also be helpful (see also § 1 above). Any conditions peculiar to the area concerned and which have an important bearing on the transmitted power required should also be stated;

3. the study of natural noise in the tropical zone, which should be continued, with particular reference to broadcasting conditions. The aim should be to provide noise data (in a statistical form if possible) which could be used in problems concerning the field strength or radiated power required to produce a given grade of broadcasting service. The method of measurement used should be clearly defined, particularly as concerns the bandwidth of the measuring equipment. Particular attention should be paid to those frequency bands allocated to broadcasting below 16 Mc/s which could be used for broadcasting in the tropical zone and to the normal broadcast listening hours (approximately 0600 to 2400 local time);

4. the study of the field strength produced by tropical broadcast transmitters.
Reports should, if possible, be evaluated on a statistical basis, and should give, in particular, the following information:

— method of measurement employed;
— methods of analysis;
— location of the transmitter;
— distance from the transmitter at which measurements are made;
— radiated carrier power;
— polar diagram of the transmitting aerial (or equivalent data);
— period during which measurements are made;
— radio frequency used.

It might be convenient to carry out this study in conjunction with those outlined in § 1 and 2 above. If it is possible to make measurements of the field strength produced outside the service area of the tropical broadcasting station, the resulting information would also be helpful in determining the degree of interference produced to other services which share frequency bands with tropical broadcasting.

ANNEX

Considerations of Question No. 27 (Maximum power for short-distance high-frequency broadcasting in the tropical zones):

The C.C.I.R.,

CONSIDERING

(a) *that a short-distance high-frequency broadcasting service is an indirect-ray service in which the incident ray meets the reflecting layer at a considerable angle to the horizontal and there is no appreciable skip distance between the transmitter and the service area ;*

(b) *that the outer limit of a short-distance service is considered here as being 800 km ;*

. . . . . .

STUDY PROGRAMME No. 114 (XII) *

INTERFERENCE IN THE FREQUENCY BANDS USED FOR TROPICAL BROADCASTING

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that the limited data available on the measured field-strength of tropical broadcasting transmitters operating in the bands 2,300 kc/s to 5,060 kc/s, and in the high-frequency broadcasting bands above 5,060 kc/s normally used for tropical broadcasting, is insufficient to arrive at the minimum signal to be protected, as required in Question No. 102 (XII);

(b) that the method of propagation affecting the field-strength values is not clearly known;

UNANIMOUSLY DECIDES that the following studies should be carried out:

1. extensive field-strength data should be collected on tropical broadcast transmissions in the bands 2,300 kc/s to 5,060 kc/s and in the high-frequency broadcasting bands above 5,060 kc/s normally used for tropical broadcasting, at distances of:
   — about 50 km;
   — 200 to 300 km;
   — 400 to 600 km;
   — 800 to 1,200 km and, if possible, at appreciably greater distances from the transmitters;
2. measurements as in § 1 above shall be carried out simultaneously with experimental observation of signal-to-noise ratios.

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* This Study Programme arises from Question No. 102 (XII).

STUDY PROGRAMME No. 167 (XII) *

INTERFERENCE IN THE BANDS SHARED WITH BROADCASTING

(Recommendation No. 216)

The C.C.I.R., (London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that Recommendation No. 216 does not provide a final answer to § 6, Question 102 (XII) and recommends a further study to determine finally a value for the minimum permissible protection ratio for broadcasting services operating in the tropical zone in the shared bands;

(b) that sufficient new data are not yet available in order to answer § 6, Question No. 102 (XII);

UNANIMOUSLY DECIDES that the following study should be carried out:

1. experimental determination of the minimum protection ratio to be provided for a broadcasting station operating in the shared bands in the tropical zone against interference from telegraphy (A1 and A2) and telephony (A3) emissions when:

— the interference is caused by one of these three types of emission;

— the interference is caused by two or more types of emission at the same time;

1.1 this study should be carried out taking into account transmitter frequency variations (up to and including those equal to the sum of the permissible frequency tolerances) of the tropical broadcasting services and other services sharing the bands as laid down in the current Radio Regulations;

1.2 measurements should be carried out at the output of a receiver fitted with a simple filter ** having an audio-frequency cut-off of 5 kc/s;

1.3 measurements should also be carried out for cut-off frequencies of 6, 7, 8 and 9 kc/s;

1.4 measurements should be carried out for carrier frequencies separated by 0, 1, 2, ... 10 kc/s;

1.5 the results should be expressed in terms of percentage of listener satisfaction, as well as of percentage of time during which the satisfaction is achieved;

2. experimental determination of the minimum field strength to which a protection ratio as defined in § 1 above should relate (taking into account the nature, intensity and distribution of noise levels in different parts of the tropical zone).

QUESTION No. 154 (XII) ***

BEST METHOD FOR CALCULATING THE FIELD STRENGTH PRODUCED BY A TROPICAL BROADCASTING TRANSMITTER ****

(Question No. 27)

The C.C.I.R., (Geneva, 1951 — Warsaw, 1956)

XII

CONSIDERING

(a) the importance of being able to calculate the power required to produce a given field strength under given conditions for tropical broadcasting;

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* This Study Programme, which replaces Study Programme No. 113, arises from Question No. 102 (XII).

** The characteristics of the filter employed should be given.

*** This Question replaces Question No. 69. See Report No. 128.

**** As this service is defined in the considerations of Question No. 27 reproduced in the Annex to Study Programme No. 112 (XII), page 184.

(b) that reliable methods of calculation would assist the planning of new tropical broadcasting services and the allotment of frequencies to services in the tropical zone;

(c) that, little basic data exists concerning ionospheric absorptionf or the tropical zone, and its dependence upon the time of day, the season and the sunspot cycle;

(d) that the relation between ionospheric absorption at oblique incidence and that at vertical incidence is not yet fully understood;

(e) that there is no internationally agreed method of examining the nature of the multiple reflections and of calculating the resultant field strength occurring at the intermediate distances involved in tropical broadcasting;

DECIDES that the following question shall be studied:

1. what is the best method that may be used for calculating the field strength produced at the earth's surface by the indirect ray, at various distances between 0 and 800 km and between 800 and about 4,000 km, by a transmitter situated in the " tropical zone " (as defined in App. 16 of the Radio Regulations, 1947) radiating a power of 1 kW from a half-wavelength dipole situated $\frac{1}{4}$ and $\frac{7}{16}$ of a wavelength above ground respectively, and operating in any of the frequency bands used for tropical broadcasting (i.e. the " shared bands " listed in Art. 9, No. 244, and the general broadcasting bands below 15,450 kc/s listed in the Table of Frequency Allocations, Art 5, Radio Regulations, 1947), at any season, and for sunspot numbers of about 5, 60 and 125, respectively, during normal listening hours (approximately 0600 to 2400 local time);

2. what is the probable error in the proposed method of calculation;

3. what basic data should be used in the proposed method of calculation;

4. what is the probable statistical distribution of the fading of the signal?

QUESTION No. 155 (XII) *

DETERMINATION OF NOISE LEVEL FOR TROPICAL BROADCASTING **

(Question No. 27)

The C.C.I.R., (Geneva, 1951 — Warsaw, 1956)

CONSIDERING

(a) that the determination of the transmitter power required depends upon the value of the signal-to-noise ratio regarded as being the minimum for an acceptable broadcasting service in the tropical zone and it is necessary to have as precise a knowledge as possible of atmospheric noise levels in this zone;

(b) that present knowledge of the atmospheric noise levels in the tropical zone and for tropical broadcasting frequencies has no agreed scientific significance and is insufficient for practical use;

(c) that the methods at present in use for the measurement of atmospheric noise are of a subjective nature, and are likely to be misinterpreted if applied to broadcasting;

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* This Question replaces Question No. 71.

** As this service is defined in the considerations of Question No. 27 reproduced in the Annex to Study Programme No. 112 (XII). (See page 184).

(d) that it therefore seems desirable to develop an objective method of measuring atmospheric noise levels for possible application to broadcasting, in particular to tropical broadcasting, and to relate such a method to the subjective effect on the listener;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what parameters, characterising atmospheric noise, would determine the response of a broadcast receiver to atmospheric noise and the effect of such noise on the grade of reception;

2. subsequent to the question in § 1, what characteristics of noise can be measured directly, what range of values should be covered by the measuring apparatus and how are these values related to the above-mentioned parameters;

3. what is the best method of atmospheric noise measurement for the specific conditions of tropical broadcasting, with particular regard to type of service, geographical zones, frequencies used and propagation conditions;

3.1 can a suitable objective method of noise measurement be developed in the near future;

3.2 can the subjective method, at present in use, be modified to obtain, as soon as possible, an approximate result for the type of service concerned;

3.3 is it possible, and under what conditions, to correlate the results obtained by a subjective method of noise measurement and those which may be expected from the application of an objective method;

4. how should the recommended measuring apparatus be designed for the specific conditions imposed by tropical climates and how should it be used to obtain results which can be correlated for the various parts of the tropical zone?

QUESTION No. 156 (XII) *

DESIGN OF TRANSMITTING ANTENNAE FOR TROPICAL BROADCASTING

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956)

CONSIDERING

(a) that the average radius of a tropical broadcasting service area is about 800 km;

(b) the necessity for further study of the design of transmitting antennae for tropical broadcasting for the purpose of concentrating the energy transmitted by reflection from the ionosphere as much as possible into the desired service area;

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(c) that the use of efficient antennae for transmission would permit the use of transmitters of lower power;

(d) the importance of reducing interference to a minimum between services which share frequency bands as provided by Nos. 244 and 253 of the Radio Regulations (Atlantic City, 1947);

(e) the provisions of No. 374 of the Radio Regulations (Atlantic City, 1947);

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* This Question replaces Question No. 103. See also Reports Nos. 86 and 87.

UNANIMOUSLY DECIDES that the following question should be studied:

1. what factors determine the best position of the transmitting antennae, with respect to the area to be served, in order to concentrate the energy received by reflection from the ionosphere within the desired service area and to reduce to a minimum the amount of energy received outside the broadcast service area;
2. what practical improvements, confirmed by measurement, can be made in the design of transmitting antennae for tropical broadcasting, in order to concentrate the energy received by reflection from the ionosphere within the desired service area and to reduce to a minimum the energy received outside the broadcast service area; in particular, what steps can be taken to reduce low-angle radiation to a minimum?

QUESTION No. 157 (XII)

FADING ALLOWANCES FOR TROPICAL BROADCASTING

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that Recommendation No. 164 and Study Programme No. 128 (III) treat the allowances for protection of fading signals for broadcasting in general only;

(b) that tropical broadcasting has special characteristics which are different from those of high-frequency broadcasting for long distances;

(c) that the nature, type and intensity of fading of broadcasting emissions under tropical conditions of propagation are peculiar and require further study;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what are the different types and characteristics of fading encountered in tropical zones;
2. what is the annoyance value to reception from the point of view of listener satisfaction;
3. what allowances should be provided for planning tropical broadcasting services?

STUDY PROGRAMME No. 170 (XII) *

SPECIFICATIONS FOR LOW-COST SOUND BROADCASTING RECEIVERS

(Recommendation No. 7 of the Administrative Radio Conference, Geneva, 1959)

The Administrative Radio Conference, Geneva, 1959.

CONSIDERING

(a) that the advantages of broadcasting should be made more easily available to the populations of the countries where at present the density of receivers is particularly low due to economic, geographic or technical reasons;

(b) that to this end, it is desirable that efficient broadcasting receivers should be available at prices low enough to secure their wide distribution in these countries;

(c) that general agreement on the preformance of suitable broadcasting receivers would prove most useful to radio receiver manufacturers by assisting them to produce suitable receivers having an agreed adequate standard performance at the lowest possible cost;

INVITES THE C.C.I.R.

1. to draw up performance specifications for one or more types of sound broadcasting receivers suitable for production in large quantities at the lowest possible cost, the receivers to meet the requirements of listeners in the countries mentioned in § *(a)* above. These specifications should cover receivers for amplitude modulated transmissions in the low, medium, and/or high frequency bands (bands 5, 6 and/or 7) as well as those for frequency modulated transmissions in the VHF band (band 8) according to the needs of the countries;

2. to avoid duplication of effort, and to complete the work in as short a time as possible, collaboration should be maintained with other international bodies working in this field;

AND REQUESTS THE SECRETARY-GENERAL

to communicate the result of this study, together with suggestions as to the action to be taken, to the Director-General of UNESCO.

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* This Study Programme also concerns Study Group No. II, the Chairman of which should be kept informed of the results obtained by Study Group No. XII as they become available.

STUDY GROUP No. XIII

(Mobile Services)

Terms of reference :

To study technical questions regarding the aeronautical, maritime, land mobile and radio location and navigation services, and miscellaneous operating questions of concern to several services.

Chairman : Mr. G.H.M. GLEADLE (U.K.)
Vice-Chairman : Mr. J. SØBERG (Norway)

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* See Volume III, Section D.

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RESOLUTION No. 33 *

PUBLICATION OF SERVICE CODES IN USE IN THE INTERNATIONAL TELEGRAPH SERVICE

(Study Group No. XIII)

The C.C.I.R., (London, 1953 — Warsaw, 1956)

CONSIDERING

(a) that the C.C.I.T. during its VIIth Plenary Assembly adopted the following question:

" the study, in collaboration with the C.C.I.R., of the possibility of assembling in a separate volume, to be published by the General Secretariat of the Union, the various codes regarded as useful in the international telegraph service (line and radio) for universal use that by service ";

(b) that the C.C.I.T. has requested the C.C.I.R. to collaborate in the study of that question;

(c) that it is of importance to assemble all service codes useful in the telegraph service (such as those contained in App. I of the International Telegraph Regulations, Q-code, etc.);

UNANIMOUSLY RESOLVES

1. that the C.C.I.R. should co-operate with the C.C.I.T.T. in assembling the volume mentioned under § *a* above, on the understanding that the C.C.I.T.T. assumes the supervision and responsibility for this work;

2. that the assembling in one volume of the various codes at present in use will be a first step towards a more unified system of service codes;

3. that administrations should consider whether there is an operational need for the unification of codes.

QUESTION No. 158 (XIII) **

MARINE IDENTIFICATION DEVICES

The C.C.I.R., (London, 1953 — Warsaw, 1956)

CONSIDERING

(a) that the use of marine radar identification devices might reduce marine casualties and make the movement of vessels safer in narrow congested waters;

(b) that the conditions of use of inter-ship radar identification and shore-based radar identification would be different;

(c) that as far as is practicable, however, it would be advantageous for the same type of ship-borne equipment to be used for both inter-ship identification and identification to a shore-based radar installation;

(d) that administrations have been advised in Recommendation No. 222 to take steps to formulate any international navigational requirements that should be met by devices for inter-ship radar identification;

(e) that work has already been carried out on this problem and is described in Doc. Nos. 53 and 71 of Warsaw and is summarized in Report No. 92;

* This Resolution replaces Resolution No. 18.

** This Question replaces Question No. 105.

UNANIMOUSLY DECIDES that the following question should be studied:

what devices can be recommended for international adoption for:
— identification of a ship on the radar of another ship;
— identification of a ship on the radar of a station on shore?

RESOLUTION No. 61

MARINE IDENTIFICATION DEVICES
(Question No. 158 (XIII))

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that studies carried out in response to Question No. 158 (XIII) and Recommendation No. 222 have served to draw attention to various marine identification devices;

(b) that the responsible shipping and administrative authorities have not advised the C.C.I.R. of any operational requirements for such devices;

(c) that the studies have shown a number of ways by which marine identification can be achieved without additional devices;

UNANIMOUSLY RESOLVES

that the study of marine identification devices be terminated.

QUESTION No. 160 (XIII)*

SELECTIVE CALLING DEVICES FOR USE IN THE INTERNATIONAL VHF (METRIC) MARITIME MOBILE RADIOTELEPHONE SERVICE

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) Recommendation No. 254 in answer to Question No. 107 concerning VHF (metric) equipments in the maritime mobile service;

(b) that there may be advantages in the use of selective calling devices in the operation of the international VHF (metric) maritime mobile service;

(c) that a selective calling device should provide for a sufficiently large number of individual non-conflicting signalling combinations;

(d) that the frequency bandwidth required for signalling should not exceed that required for the transmission of speech;

(e) that the signalling equipment should operate reliably under poor transmission conditions, that is, when it is just possible to understand speech at the normal modulation;

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* Study Programme No. 168 (XIII) arises from this Question.

(f) that the signal sending and receiving units should be capable of operating with the radio transmitting and receiving equipments commonly available on ships;

(g) that the transmission of a complete call number should be accomplished in a few seconds;

(h) that the equipment should be low in cost and capable of operation under shipboard conditions for long periods without excessive maintenance;

UNANIMOUSLY DECIDES that the following question should be studied:

1. is there a need for an international selective calling system in the VHF (metric) maritime mobile service, and to what extent, and for what purposes can selective calling be used with advantage;
2. what are the operational requirements that should be met by any selective calling system that could be used for the purposes recommended in answer to § 1 of this Question;
3. what are the essential technical characteristics of selective calling devices on which international agreement is required;
4. what selective calling systems are there which fulfil the operational and technical requirements in answer to § 2 and 3;
5. is it desirable to limit selective calling at any given coast station to vessels regularly using that coast station;
6. should it be possible to adjust the code of a ship to any particular code at will, bearing in mind the additional equipment complexity which might result;
7. is it useful to prefix the call by a long dash, or other special signal, in order to attract the attention of vessels not fitted with a selective calling device?

STUDY PROGRAMME No 168 (XIII)*

SELECTIVE CALLING DEVICES FOR USE IN THE INTERNATIONAL VHF (METRIC) MARITIME MOBILE RADIOTELEPHONE SERVICE

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that Recommendation No. 257 does not give a full reply to Question No. 160;

(b) that the essential technical characteristics of a selective calling system to be agreed upon need further study;

(c) that it is desirable to standardize the main operating and technical characteristics;

UNANIMOUSLY DECIDES that the following study should be carried out:

1. trials of the selective calling systems described in Docs. XIII/10, XIII/18, XIII/26 and 189 of Los Angeles, 1959, with a view to coming to a decision on the type of system that should be adopted internationally;
2. consideration of the number of individual code combinations required and the principles to be adopted in their allocation. In this connection attention is drawn to Doc. XIII/19 of Los Angeles, 1959;
3. determination of technical characteristics of the selective calling signal, in particular:

3.1 tone frequency or frequencies;

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* This Study Programme arises from Question No. 160 (XIII).

3.2 radio-frequency deviation;
3.3 composition and duration of signals;
3.4 transmission sequences;
3.5 tolerances on the above parameters;
3.6 any other parameters requiring international standardization;

4. degree of immunity of the systems from false operation and degree of their response to desired signals.

QUESTION No. 161 (XIII)

SPURIOUS EMISSIONS FROM FREQUENCY-MODULATED VHF (METRIC) MARITIME MOBILE EQUIPMENT

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that efficient operation of a VHF (metric) maritime mobile communication system could be limited by possible interference caused by spurious emissions falling within the band of frequencies used by the maritime mobile services;

(b) that it has been possible at present to recommend only provisional limits, based on equipment now in service, to such emissions;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what is the nature of such spurious emissions;

2. what are the tolerable limits for such spurious emissions from the point of view of interference?

QUESTION No. 163 (XIII)

CHARACTERISTICS OF EQUIPMENTS AND PRINCIPLES GOVERNING THE ALLOCATION OF CHANNELS IN THE VHF (METRIC) AND UHF (DECIMETRIC) LAND MOBILE SERVICES

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

(a) that an interchange of information on the requirements of administrations concerning the technical characteristics of equipments used in the VHF and UHF land mobile services would be advantageous in the development of those services;

(b) that an exchange of information among different countries concerning the practices applied to the assignment of channels and the experience gained in the operation of VHF and UHF land mobile services is of value in general;

(c) that a certain measure of agreement may be desirable on the characteristics of VHF and UHF land mobile equipments that are used in the border areas of neighbouring countries in order to minimise mutual interference;

(d) that a certain measure of agreement may also be desirable on the practices governing the allocation and use of channels in the VHF and UHF land mobile services in border areas;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what are the technical requirements of administrations concerning equipments used in the VHF and UHF land mobile services that are of international importance in the development of such services, e.g. transmitter power, type of antenna, emission characteristics, frequency tolerance;
2. to what extent would it be desirable to standardize the performance characteristics of VHF and UHF land mobile equipments internationally;
3. what are the broad practices adopted by administrations in the allocation of channels to the various kinds of user in the VHF and UHF land mobile service, e.g. channel separation, geographical spacing of stations in the same and adjacent channels, frequency separation for duplex operation, degree of frequency sharing in a particular service area;
4. to what extent is it desirable to reach international agreement on the practices for the allocation of channels in the VHF and UHF land mobile service?

RESOLUTION No. 60

CHARACTERISTICS OF EQUIPMENTS AND PRINCIPLES GOVERNING THE ALLOCATION OF CHANNELS IN THE VHF (METRIC) AND UHF (DECIMETRIC) LAND MOBILE SERVICES

(Question No. 163 (XIII))

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that land mobile services of various kinds are growing rapidly;

(b) that in border areas difficulties may arise between the services of different administrations;

(c) that it would be advantageous if there were a sufficient measure of agreement, where necessary, between administrations on the characteristics of equipments and on the principles adopted in the planning for land mobile services;

UNANIMOUSLY RESOLVES

1. that administrations should consult together as necessary to resolve any difficulties concerning their land mobile services and for the purpose of improving such services;
2. that those administrations that are interested in the provision of common land mobile services should consult together and should advise the C.C.I.R. of any technical and operational problems that require international study;
3. that administrations submit technical specifications of land mobile equipment used in their respective countries to the Chairman of Study Group No. XIII and the Director of the C.C.I.R. for circulation.

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QUESTION No. 206 (XIII)

DIRECTION FINDING BY SHIPS IN THE 2 Mc/s BAND

The C.C.I.R., (Los Angeles, 1959)

CONSIDERING

(a) that the use of radiotelephony by ships in the 2 Mc/s band is increasing;

(b) that an increasing number of ships are being fitted with direction-finding equipment capable of taking bearings in the 2 Mc/s band;

(c) that the taking of accurate bearings, and especially " homing ", by ships is important in cases of distress;

UNANIMOUSLY DECIDES that the following question should be studied:

1. what special technical measures and precautions should be taken in the design and the installation of 2 Mc/s direction finding equipment for use on board ships for taking bearings, or at least for " homing ";

2. what is the order of accuracy to be expected from 2 Mc/s direction-finding equipments on board ships, particularly on the international distress frequency of 2,182 kc/s ?

STUDY GROUP No. XIV

(Vocabulary)

Terms of reference :

To study, in collaboration with the other Study Groups and, if necessary, with the C.C.I.T.T., the radio aspect of the following: vocabulary of terms and list of definitions, lists of letter and graphical symbols and other means of expression, systematic classification, measurement units, etc.

Chairman : Mr. R. VILLENEUVE (France)
Vice-Chairman : Mr. A. FERRARI-TONIOLO (Italy)

* See Volume III, Section K.

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RESOLUTION No. 34 *

DEFINITIONS OF CERTAIN BASIC WORDS USED IN THE INTERNATIONAL TELECOMMUNICATION CONVENTION

(Study Group No. XIV)

The C.C.I.R., (Warsaw, 1956)

CONSIDERING

that the definitions given by the International Telecommunication Union ought to be simple and unambiguous, applicable to the activity of the Union and fit for use in national laws, regulations and recommendations and ought further to follow common parlance as far as possible;

UNANIMOUSLY RESOLVES

1. that the attention of administrations be drawn to the desirability of their studying further, with particular reference to the field of radio communication, the definitions of the words *telecommunicatton* and *Hertzian waves* and of the word *radio* (as used for example in *radio waves*), with a view to the formulation of more suitable definitions at the next Plenipotentiary Conference;
2. that administrations should forward their views to the Chairman of Study Group No. XIV by July 1957, if possible;
3. that the Chairman of Study Group No. XIV should endeavour to reach agreement with the C.C.I.T.T., upon the definitions, before the next administrative conferences.

Note. — Doc. No. 451 (Warsaw) and C.C.I.T. Recommendation I.2 refer to this subject.

RESOLUTION No. 62 **

MEANS OF EXPRESSION

Terms, definitions, graphical and letter symbols and their conventional usage

(Recommendations Nos. 26, 34 and 144 of the C.C.I.R.)

(Resolutions Nos. 66, 67, 175 and 283 of the Administrative Council of the I.T.U.)

The C.C.I.R., (Geneva, 1951 — London, 1953 — Warsaw, 1956 — Los Angeles, 1959)

CONSIDERING

(a) that it is important for the ease and efficiency of the work of the C.C.I.'s that means of expression of all kinds (terms, symbols, etc.) and the conditions of their use be rendered and maintained as uniform as possible;

(b) that the I.T.U. Administrative Council had established the subject (Resolution No. 283) with the purpose of compiling, as a first step, the *List of definitions of essential telecommunication terms*. Part I of this list, " general terms, telephony, telegraphy ", has been published (I.T.U., Geneva, June 1957) as the culmination of the work of the C.C.I.T.T. (after final editing by a joint working party C.C.I.T.T.-C.C.I.R.) while the portion relative to radio communications and which is the responsibility of the C.C.I.R. has made but little progress;

* See Report No. 173

** This Resolution replaces Resolution No. 5, Recommendation No. 144 and Report No. 94.

(c) that the desired unification means avoiding, unless imperatively necessary, real or apparent contradictions between the conventions accepted by the C.C.I.R. and those used by other qualified organizations, especially the International Electrotechnical Commission (I.E.C.) and that actual and efficient cooperation must be secured for this purpose, not only in the final stage of the work but also in the preparatory and subsequent stages, i.e. at the level of each of the countries who actively participate in such work; that the I.E.C. has, on its own part, demonstrated that it is willing to cooperate with the C.C.I.R.;

(d) that the means used to this end to date have proved somewhat lacking in efficiency;

UNANIMOUSLY RESOLVES

1. that the means indicated by the Chairman of Study Group XIV in his report (Doc. No. 14 of Los Angeles, 1959) be implemented in the manner which will appear as the most efficient in practice, so that, with the cooperation of its *active collaborators,* this Study Group be able to place at the disposition of the C.C.I.R. a vocabulary appropriate to its needs as quickly as possible, and that a practical document could be ready before the next Plenary Assembly;

2. that work on means of expression other than those in the vocabulary should also be considered, using a procedure based on the experience acquired in preparing the vocabulary, but this work should not hold up the production of the vocabulary.

ANNEX

EXTRACT FROM THE REPORT OF THE CHAIRMAN OF STUDY GROUP NO. XIV

(Vocabulary)

(Doc. No. 14 of Los Angeles, 1959)

. . . . . .

1. *Preparation of the vocabulary*

This is the first and much the most difficult and complicated of the tasks ascribed to Study Group XIV (Warsaw Volume 1, p. 12). A first stage was outlined in *Resolution No. 5* (Geneva, 1951) and a second in *Recommendation No. 144* (London, 1953). *Report No. 94* (Warsaw, 1956) indicated what still remained to be done.

1.1 Unfortunately, the forecast proved to be over-optimistic. When the " national correspondent " of the French Administration proceeded, in accordance with the instructions in point A3 of the Report, to investigate the data collected and prepared with so much effort, the results obtained proved to be most disappointing. Despite considerable effort and many attempts it proved impossible to extract from the mass of available information anything that would fulfil practical requirements, i.e. provide a fairly coherent whole without too many gaps nor contradictory or intrinsically worthless elements.

1.2 Meanwhile, the vocabulary work undertaken by the International Electrotechnical Commission (I.E.C.) pursued its course, and is now nearly finished. The secretary of the Committee concerned (I.E.C. Committee No. 1) is in a position to state that the final text of Booklet 60 devoted to radiocommunication will be available before the end of 1959. In the circumstances, there would appear to be but one solution to the problem assigned to S.G. XIV. Incidentally, it is quite in line with the recommendation for cooperation expressed in 1953 (considerings *c* and *d* of Recommendation 144) which, it must be admitted, have so far been no more than a matter of form. The solution is to recognize this Booklet 60 as being a suitable instrument for the double purpose indicated in Report No. 94 (part A, *in fine*), i.e.:

— first, as a *provisional working document* for the Specialized Secretariat of the C.C.I.R. and the Member Administrations,

— and, second, as a *reference framework* to be used in the work incumbent on S.G. XIV, i.e. preparing the vocabulary and keeping it up to date, after establishing—and this is a point of paramount importance—the *conditions required for the Study Group to carry out its task in an efficient manner.*

1.3 To do so, the Plenary Assembly, it is hoped, will appreciate that there is a basic difference, arising out of the Study Group's very nature, between the part it is called upon to play and those devolving on any of the other Study Groups, and that its work must therefore be organized accordingly.
While each of the other Study Groups is confined to a specialized technical and relatively autonomous field, Study Group XIV is called upon to act on behalf of the other Study Groups according to their needs and in close and constant cooperation with them. Its reason for existence is to relieve them of thankless material tasks and to save them laborious discussions. In short, it is their assistant, but it cannot work efficiently without their help and advice.
This means that it must have, as its active collaborators, permanent members of the various Study Groups, specifically nominated by the Chairmen concerned. That is what was envisaged in principle—although somewhat loosely expressed—by the appointment of *representatives* provided for in § 2 of Recommendation No. 144. In fact, the participation called for has been spasmodic, taking the form of occasional contributions. It is essential that it should become systematic.
The main task of the *specialized collaborators* appointed by the Chairmen (one for each Study Group, with, if possible, an assistant for cases where a single collaborator cannot cope with both English and French terminology) will be to ensure active and efficient liaison between their respective Study Groups and Study Group XIV, in both directions, i.e.

— on the one hand, to collect any specific questions of terminology which the Study Group may encounter in the course of its work, as well as any temporary solutions adopted, and to make then known to the Chairman of Study Group XIV;

— on the other hand, to receive from the Chairman of Study Group XIV the proposals prepared as described below (§ 1.4 and 1.5) for submission to the Study Group or Groups which are technically competent in the matter and to obtain the opinion of the Group or Groups, together with any observations, objections or counter-proposals, in accordance with the instructions of the Chairman concerned, and to forward them to the Chairman of Study Group XIV.

In practice, favourable opinions obtained in this way will mean the insertion of the terms and definitions concerned in the official vocabulary of the C.C.I.R.

1.4 The other active collaborators of Study Group XIV whose cooperation has been envisaged in principle are those referred to in § 2 of Recommendation No. 144 as *national correspondents.* In this case, too, the results have fallen short of expectations.
The Chairman of Study Group XIV earnestly requests the Administrations of each country, in which work on the vocabulary is being actively carried out and which can supply contributions in English or French, to designate by name a *national collaborator* for Study Group XIV.
The help of such collaborators will be a decisive factor in the establishment of terms and definitions to be adopted by the C.C.I.R. whose vocabulary must be as close as possible to any vocabularies appearing in the countries of certain member Administrations.
The cooperation must not, however, be limited to communicating to the Chairman of Study Group XIV the final result of the work whose slow and laborious nature is well known. In the interests of efficiency and speed which are particularly desirable in such a rapidly expanding field as radiocommunication, drafts and other working documents should be available at the beginning of the work and at the successive stages.

1.5 It is this body of *active collaborators,* designated individually as specified above (§ 1.3 and 1.4), which can transform the Vocabulary Study Group from an almost impotent body lacking in consistency into an industrious and efficient organ.

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For the material tasks—and these are generally arduous—entailed in the preparation of a terminology (compilation, classification, comparison, adaptation, editing), the Chairman of Study Group XIV must have suitable means at his disposal. These are available in France at the Centre National d'Etudes des Télécommunications, whose Documents Section could, as an experiment, serve as a " permanent secretariat for vocabulary" until the Xth Plenary Assembly of the C.C.I.R., by agreement with the French Administration. Satisfactory relations will, of course, be established with the Specialized Secretariat of the C.C.I.R.

To make the machinery described above work in a satisfactory way, a suitable adjustment will have to be made. The Chairman of Study Group XIV will take upon himself, in the light of the experience acquired, to adjust the procedure within the Group (both at the Plenary Assemblies and in the intervals in between) to the specific tasks with which it has to deal. He will be especially careful to ensure that the Study Group's work is not slowed down due to the fact that certain Members who inscribe do not participate actively in it.

Provided the conditions of work described above can be effectively established, the Chairman believes that the C.C.I.R. may have an acceptable vocabulary available before the Xth Plenary Assembly. Some of the cards prepared by Professor T. Gorio will probably be suitable for inclusion in the *reference framework* mentioned above (§ 1.2., ***in fine***); a certain amount of time may thereby be saved. Subsequently, the task will become less difficult since it will then be a matter of merely bringing the vocabulary up to date, as frequently as possible.

. . . . . .

QUESTION No. 72 (XIV)

DECIMAL CLASSIFICATION

The C.C.I.R., (Geneva, 1951)

CONSIDERING

that it is advisable to standardize the classification of documents and articles on radio so as to facilitate librarians' work and make it possible for anyone to find the documents required without delay;

UNANIMOUSLY DECIDES that the following question should be studied:

the classification of documents and articles on radio by means of a decimal index, to be made, if possible, within the framework of the universal decimal classification (U.D.C.) and in agreement with the International Federation of Documentation.

QUESTIONS SUBMITTED TO THE C.C.I.T.T.

(Art. 7, § 2, International Telecommunication Convention, Buenos Aires, 1952)

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QUESTION No. 109

USE OF RADIO CIRCUITS IN ASSOCIATION WITH 5-UNIT START-STOP TELEGRAPH APPARATUS

Signals other than those specified in the International Telegraph Alphabet No. 2

The C.C.I.R., (London, 1953)

CONSIDERING

the problems raised in Question No. 83;*

UNANIMOUSLY DECIDES that the following question should be submitted to the C.C.I.T.T.:

is it necessary, on radio circuits used in association with 5-unit start-stop apparatus, to provide for the transmission of signals other than those specified by the International Telegraph Alphabet No. 2, e.g. in the International Telex Service? If so, what are the characteristics and tolerances of such signals, which are required to be transmitted over radio circuits?

QUESTION No. 110

USE OF RADIO CIRCUITS IN ASSOCIATION WITH 5-UNIT START-STOP TELEGRAPH APPARATUS

Maximum tolerable signal error rates

The C.C.I.R., (London, 1953)

CONSIDERING

(a) that the transmission difficulties present on certain types of radio circuits make some errors in telegraph transmission inevitable;

(b) that the type of telegraph system selected for a particular use over a radio circuit may depend upon the proportion of errors that can be tolerated:

UNANIMOUSLY DECIDES that the following question should be submitted to the C.C.I.T.T.:

what are the maximum tolerable signal error rates for various types of telegraph service?

QUESTION No. 111

SIGNAL AMPLITUDES IN INDIVIDUAL CHANNELS OF MULTI-CHANNEL TELEPHONE SYSTEMS

The C.C.I.R., (London, 1953)

CONSIDERING

(a) that in multi-channel telephone systems for line or radio transmission interference due to harmonics and intermodulation is an important limitation; C.C.I.T.T.

* This Question has been replaced by Study Programme No. 128 (III).

(b) that mathematical studies of various aspects of this interference have been published;

(c) that data on the statistical distribution of signal amplitudes with time are an essential basis for such studies;

(d) that studies of such data have been published in various countries;

UNANIMOUSLY DECIDES that the following question should be submitted to the C.C.I.T.T.:

what is the statistical distribution with time of the instantaneous signal amplitudes on individual telephone channels which can be regarded, for practical purposes, as representative of normal operating conditions at a point of zero reference level?

QUESTION No. 112

INFORMATION REQUIRED ON THE TRANSMISSION CHARACTERISTICS OF LINE SYSTEMS FOR USE IN THE DESIGN OF RADIO-RELAY SYSTEMS

The C.C.I.R., (London, 1953)

UNANIMOUSLY DECIDES that the following question should be submitted to the C.C.I.T.T.:

1. for what percentage of the time are the specified transmission characteristics attained in existing line systems;
2. to what extent are these characteristics affected by the transmission of either multi-channel voice-frequency telegraph traffic or voice-frequency signalling tones over these line systems?

C.M.T.T.

(C.C.I.R./C.C.I.T.T. Joint Commission for Television Transmissions—Resolution No. 32)

Chairman : Professor Y. ANGEL (France)
Vice-Chairman : Mr. N. FRANKLIN (U.K.)

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