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INTERNATIONAL RADIO CONSULTATIVE COMMITTEE

C.C.I.R.

DOCUMENTS OF THE
VIIIth PLENARY ASSEMBLY

WARSAW 1956

VOLUME II

LIST OF PARTICIPANTS
REPORTS OF STUDY GROUP CHAIRMEN
REPORT OF THE DIRECTOR, C.C.I.R.
REPORT OF THE CHAIRMAN OF THE FINANCE COMMITTEE
LIST OF DOCUMENTS
PLACE OF THE IXth PLENARY ASSEMBLY OF THE C.C.I.R.



Published by the
INTERNATIONAL TELECOMMUNICATION UNION
GENEVA, 1957

INTERNATIONAL RADIO CONSULTATIVE COMMITTEE

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LIST OF PARTICIPANTS

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Study Groups Nos. I to III.

REPORTS OF STUDY GROUP CHAIRMEN

Study Groups Nos. IV to VI

REPORTS OF STUDY GROUP CHAIRMEN

Study Groups Nos. VII to X

REPORTS OF STUDY GROUP CHAIRMEN

Study Groups Nos. XI to XIV

REPORT OF THE DIRECTOR, C.C.I.R.

**REPORT OF THE CHAIRMAN OF THE FINANCE
COMMITTEE**

LIST OF DOCUMENTS

A. Classified in numerical order

LIST OF DOCUMENTS

B. Classified by Study Groups

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PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

TABLE OF CONTENTS

<i>List of participants</i>	9
<i>Reports of Study Group Chairmen:</i>	
Study Group No. I	33
Study Group No. II	71
Study Group No. III	77
Study Group No. IV	83
Study Group No. V	97
Study Group No. VI	104
Study Group No. VII	111
Study Group No. VIII	126
Study Group No. IX	137
Study Group No. X	161
Study Group No. XI	163
Study Group No. XII	188
Study Group No. XIII	192
Study Group No. XIV	196
<i>Report of the Director, C.C.I.R.</i>	203
<i>Report of the Chairman of the Finance Committee</i>	225
<i>List of documents:</i>	
A. — Classified in numerical order	239
B. — Classified by Study Groups	299
<i>Place of the IXth Plenary Assembly</i>	359

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

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PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

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PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

LIST OF PARTICIPANTS

	Page
A. Officers of the VIIIth Plenary Assembly	9
B. Administrations	10
C. Private Operating Agencies	23
D. International Organisations	25
E. Scientific and Industrial Organisations	27
F. United Nations (Specialised Agencies).	28
G. International Telecommunication Union.	28
H. Secretariat	29
I. Special Secretariat of the Polish Administration . .	29

Note. — *Titles in this list are given in the languages in which the delegates presented them.*

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Observer

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Assistant Secretary General

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Secretary

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REPORTS OF STUDY GROUP CHAIRMEN

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REPORT BY THE CHAIRMAN OF STUDY GROUP No. I*

(TRANSMITTERS)

(Original language: French)

1. INTRODUCTION

1.1. Questions studied.

The VIIth Plenary Assembly allocated the following Questions and Study Programmes to Study Group No. I:

Question No. 1 — Revision of Atlantic City Recommendation No. 4

Study Programme No. 2 — Harmonic and parasitic emissions

Study Programme No. 3 — Frequency stabilisation of transmitters

Study Programme No. 39 — Bandwidth of emissions

Study Programme No. 40 — Methods of measuring emitted spectra in actual traffic

Question No. 18 — Telegraph distortion

Question No. 20 — Frequency-shift keying

Study Programme No. 41 — Frequency-shift keying

Question No. 74 — Arrangement of channels in multi-channel telegraph systems for long-range radio circuits operating on frequencies below about 30 Mc/s

Question No. 75 — Limitation of unwanted radiation from industrial installations

Question No. 18 is also being studied by C.C.I.T. Study Group I.

1.2. Membership of Study Group No. I.

Administrations

Argentine Republic, Australia, Austria, Belgium, Ceylon, China, Denmark, Spain, United States of America, Finland, France, Hungarian P.R., India, Ireland, Italy, Japan, Norway, Netherlands, P.R. of Poland, Morocco, Federal German Republic, F.P.R. of Yugoslavia, Roumanian P.R., United Kingdom, Sweden, Switzerland, Czechoslovakia, Union of Soviet Socialist Republics.

Private Operating Agencies

British Broadcasting Corporation (B.B.C.), London

Cable and Wireless Ltd., London

Compagnie Générale de Télégraphie Sans fil, Paris

Companhia Portuguesa Radio Marconi, Lisbon

Compania Internacional de Radio S.A., Buenos Aires

Internationale Marine Radio Company Ltd. (I.M.R.C.), London

Italcable S.A., Rome

Kokusai Denshin Denwa Company Ltd., Tokyo

Marconi Internationale Marine Communication Company Ltd., Chelmsford

National Association of Broadcasters in Japan, Tokyo

Nippon Hoso Kyokai, Tokyo

Nippon Telegraph and Telephone Public Corporation, Tokyo

Radio Austria A.G., Vienna

Radio Corporation of America (R.C.A.), New York

Transradio Española S.A., Madrid

* Doc. No. 101 (Warsaw, 1956).

International Organisations

Comité International Radio-Maritime (C.I.R.M.), London
International Chamber of Shipping, London
International Broadcasting Organisation (O.I.R.), Prague

Scientific and Industrial Organisations

Ateliers de Constructions Electriques de Charleroi (A.C.E.C.), Charleroi
Brown Boveri & Co. Ltd., Baden (Switzerland)
Hasler A.G., Berne
Manufacture Belge de Lampes et de Matériel Electronique (M.B.L.E.), Brussels
Siemens and Halske A.G., Munich
South African Council for Scientific and Industrial Research, Johannesburg
Telefonaktiebolaget L.M. Ericsson, Stockholm
Telefunken G.m.b.H., Berlin

1.3. Activities.

Following an examination of the progress made by Study Group No. I, the Director of the C.C.I.R. in consultation with the Chairman, taking account of the documentation available and the urgency of a number of questions, proposed that an interim meeting be called at Brussels before the Plenary Assembly in Warsaw.

The following Administrations took part in the work of Study Group No. I, at Brussels: Austria, Belgium, Denmark, Spain, United States of America, France, Hungarian People's Republic, Italy, Japan, Norway, Netherlands, People's Republic of Poland, Federal German Republic, United Kingdom, Sweden, Switzerland, Roumanian People's Republic, Czechoslovakia, U.S.S.R.

The following organisations were also represented:

Private Operating Agencies

British Broadcasting Corporation, Cable and Wireless Ltd., Compagnie générale de T.S.F. (France), Kokusai Denshin Denwa Co. Ltd. (Japan), Marconi International Marine Communication Co. Ltd., Radio Austria A.G., Radio Corporation of America, Transradio Española, S.A.

International Organisations

Comité International Radio-Maritime (C.I.R.M.), International Broadcasting Organisation (O.I.R.), European Broadcasting Union (E.B.U.).

Scientific and Manufacturing Organisations

Ateliers de Constructions Electriques de Charleroi, Brown Boveri & Co., Hasler A.G., Siemens and Halske A.G.

Organs of the I.T.U.

I.F.R.B., C.C.I.T.

Since the problems related to *bandwidth of emissions* (Study Programme No. 39) and *methods of measuring emitted spectra* (Study Programme No. 40) were the main subjects for discussion by Study Group No. I, it was decided, in conformity with a proposal made at the VIIIth Plenary Assembly (London 1953), to effect comparison in actual traffic of existing apparatus for measuring bandwidths. To that end, the members of Study Group No. I, who could provide such apparatus were invited to take part in a preparatory week of comparative measurements held from 14th to 22nd March, 1955.

Out of the seven countries which had provided descriptions of spectrum analysers at the Plenary Assembly in London, six agreed to compare the data obtained with their respective apparatus in actual traffic, viz. Belgium, France, United Kingdom, Japan, Netherlands and Switzerland. Altogether, seven sets, two of them provided by Japan, were used.

The results obtained were analysed and submitted to Study Group No. I, as a document (Warsaw Doc. No. 344).

2. ADMINISTRATIVE MATTERS

2.1. Vice-Chairman

In pursuance of the decision of the London Plenary Assembly, which, in conformity with para 3, Chapter 15 of the General Regulations annexed to the Buenos Aires Telecommunication

Convention (1952), had designated Lt. Col. Lochard (France) as Vice-Chairman of Study Group No. I, members were requested by Circular No. 596.0.13 dated 11th February 1954 to send him a copy of all letters and contributions relative to the work of the Study Group.

2.2. Text of Question No. 75.

The Director of the C.C.I.R. was kind enough to draft a final text for Question No. 75 allocated to Study Group No. I by the VIIth Plenary Assembly. After an exchange of correspondence between the Director of the C.C.I.R. and the Chairman, the text of Question No. 75, as given on page 294 of the London Green Book (Volume I), was adopted.

2.3. Radio vocabulary.

In response to Circular No. 8212 of 25th July 1954 by which Prof. Tullio Gorio, Chairman of C.C.I.R. Study Group No. XIV, requested that one or more experts, members of Study Group No. I, be designated to cooperate in drawing up a radio vocabulary, all members were invited by Circular 596.0.69 of 6th September 1954, to submit proposals. Twelve replies were received. The following members were appointed to represent Study Group No. I, and Prof. Gorio was informed accordingly:

a) For French

Mr. Luis Cáceres Garcia (Transradio Española)
Mr. Bernard Delaloye (Switzerland)
Colonel Jean Lochard (France)
Mr. Paul C. Moies (Belgium)

b) For English

Mr. K. S. Sainio (Finland)
Mr. B. J. Stöver (Netherlands)

In response to a request from Prof. Gorio, the Secretariat of the C.C.I.R. forwarded to the representatives appointed, three copies of Volume IV of the provisional list of terms and definitions used by the C.C.I.R.

By a letter dated 23rd October 1955, the Chairman of Study Group No. XIV requested the Chairman of Study Group No. I to consult its representatives regarding the definition of a number of terms. Their replies were communicated to the former.

Prof. Gorio forwarded to the Chairman four documents of the International Electrotechnical Commission (I.E.C.) for distribution to the representatives of Study Group No. I, for comment. Their replies were sent to the Chairman of Study Group No. XIV.

2.4. New Question No. 114.

At the meeting of C.C.I.R. Study Group IX in Geneva (10th - 22nd September 1954) the following new Question was proposed: *Frequency tolerances for transmitters used in wide-band radio relay systems operating on frequencies above about 30 Mc/s.*

Following a discussion with the Director of the C.C.I.R., it was agreed that the Question, while bearing on Study Programme No. 3 allocated to Study Group No. I, could conveniently be studied by Study Group No. IX which was especially qualified to deal with the service covered by the Question. It was also agreed that the relevant data assembled by the Chairman of Study Group No. IX (Mr. Stanesby) would be communicated to Study Group No. I for general study in connection with Study Programme No. 3.

2.5. List of circulars sent to members of the Study Group since the London Plenary Assembly.

Circular 596.0.13 of 11th February 1954 (concerning the Vice-Chairman)

Circular 596.0.47 of 5th July 1954 (concerning the programme of the work and the questionnaire on Study Programme No. 3)

Circular 596.0.69 of 6th September 1954 (concerning the vocabulary)

Circular 596.0.22 of 17th January 1955 (concerning the Brussels meeting)

Circular 596.1.9 of 3th February 1955 (concerning the Brussels meeting, Study Programme No. 40)

- Circular 596.0.163 of 18th November 1955 (concerning Question No. 75, together with Questionnaire)
- Circular 596.0.191 of 30th November 1955 (concerning Study Programme No. 3, together with a table of information available)
- Circular dated 5th January 1956 (concerning contributions for the VIIIth Plenary Assembly at Warsaw).

2.6. General.

The present report is designed as a working document for the Study Group meetings at the VIIIth Plenary Assembly in Warsaw. It gives an overall idea of the progress made in respect of the problems dealt with by the Group. For each question, the results of the Brussels meeting are given, preceded by a summary of the contributions used as a basis and followed by a summary of the contributions intended for the VIIIth Plenary Assembly in Warsaw. Finally, the Chairman's comments, suggestions and conclusions, together with useful and practical proposals, are given for each question.

3. THE WORK OF THE STUDY GROUP

3.1. Question No. 1: Revision of Atlantic City Recommendation No. 4.

This Question, stemming from Atlantic City Recommendation No. 4, has given rise to Study Programmes Nos. 2, 3, 39 and 40.

3.1.1. Study Programme No. 2 — Harmonics and parasitic emissions.

This Study Programme, conceived within the framework of para 3 of Atlantic City Recommendation No. 4, is designed to define the effect of the limit values given in Appendix 4 to the Atlantic City Regulations. The EARC (Recommendation No. 14, Geneva 1951) declared the study urgent; London Recommendation No. 89 (1953)—the first contribution to the problem—was followed by further study at the Brussels meeting (March-April 1955).

3.1.1.1. Contributions submitted to the Brussels meeting.

The following contributions were examined at the Brussels meeting:

a) United Kingdom (Brussels Doc. No. 6).

The United Kingdom considers that an amendment to Appendix 4 of the Radio Regulations should be proposed. Since the upper limit of the frequency band covered by the table in Appendix 4 does not coincide with the change of service in the Atlantic City Frequency Allocation Table, it is suggested that it be reduced from 30 to 29.7 Mc/s. A second amendment is designed to reduce the maximum tolerable power of harmonics from 200 to 50 mW. In addition, the document suggests that Note 1 to the present Appendix 4 whereby it is prescribed that every effort should be made to comply with the figures given in the table for mobile stations, should be deleted.

The contribution contains a draft new Recommendation intended to replace Recommendation No. 89. While retaining the "consideration", the new Recommendation would comprise in the "recommendation" definitions, the above amendments to Appendix 4, the methods of measurement described in Recommendation No. 89 under 1, 2 and 3, a paragraph recommending that the new tolerances should be made to apply to parts of the equipment other than the antenna, and finally, a paragraph calling for continued effort in combatting harmonics with a view to reducing progressively the interference caused to other services. Point 4 of Recommendation No. 89 would be deleted.

A number of preliminary considerations are suggested for the possible addition of values for the bands comprised between 29.7 and 235 Mc/s to the proposed table of tolerances.

b) Belgium (Brussels Doc. No. 9).

In this document, Belgium submits the results of measurements of several short-wave transmitters by the substitution method. The results obtained for a number of transmitters with twin-wire feeders are given for each harmonic, the data for the "series mode" and for the "parallel mode" being given separately.

c) *United States (Brussels Doc. No. 14).*

Two types of tolerances are proposed, one for the power fed into the antenna and the other for the maximum field measured under given conditions. The methods of measurement in each case are also defined. Tolerances established by the FCC are given in an annexed table.

d) *Japan (Brussels Doc. No. 17).*

Measurements have been made of a number of transmitters with and without harmonic filters, with the apparatus described in London Doc. No. 130. The results show that by using filters the harmonics radiated by the transmitters can be reduced appreciably.

The field measurements provided valuable information on the radiation of harmonics. The information in this document is not definitive since further studies are in progress.

e) *Switzerland (Brussels Doc. No. 37).*

This document contains the results of measurements of the power of harmonics radiated by two high-power short-wave transmitters, with and without harmonic filters.

f) *E.B.U. (Brussels Doc. No. 71).*

This document contains a list of harmonics and combination waves detected on medium and short waves over the period 1950 to 1955.

3.1.1.2. Conclusions reached at the Brussels meeting.

The conclusions regarding this Study Programme are given in the form of a draft Recommendation in Brussels Doc. No. 89. It was adopted without comment at Brussels and is reproduced unchanged in Warsaw Doc. No. 307.

The following are the main amendments to London Recommendation No. 89 suggested in this draft recommendation:

- addition of a definition of harmonics
- proposal that the tolerances for transmitters should continue to be expressed by the power supplied to the antenna on the frequency of the harmonic or of the unwanted emissions considered;
- proposal to extend to the power radiated on an unwanted frequency outside the band occupied, from any part of the transmitting system other than the antenna, the limit values specified for the antenna radiation on that frequency.

3.1.1.3. Contributions for the VIIIth Plenary Assembly in Warsaw.

Following consultation with the Chairman, three of the contributions to the Brussels meeting have been submitted by their authors to the Plenary Assembly in Warsaw, viz. those of the United Kingdom, Belgium and the United States. In addition, two new contributions, one from Japan and from the Federal German Republic, have been received.

a) *United Kingdom (Doc. No. 275).*

see 3.1.1.1. a) above.

b) *Belgium (Doc. No. 343).*

see 3.1.1.1. b) above

c) *United States (Doc. No. 276).*

see 3.1.1.1. c) above

d) *Federal German Republic (Doc. No. 99).*

It would be logical to distinguish between the various categories of unwanted radiation according to the costs entailed in their elimination. Four categories are therefore proposed:

1. *Harmonics*: whole multiples of the transmission frequencies. For commercial short-wave transmitters whose transmission frequencies are frequently changed, the present limit of 200 mW should be retained for harmonics below 30 Mc/s; for those above 30 Mc/s the limit

should be set at 25 mW. The maximum power for the harmonics of broadcasting transmitters on frequencies lower than 30 Mc/s should not exceed 25 mW.

2. *Intermodulated emissions*: involuntarily produced oscillations when the transmitter frequency is formed. The maximum power of intermodulated emissions of transmitters working below 30 Mc/s should not be greater than 0.1 mW if the transmitter power is lower than 1 kW, and be attenuated by at least 70 db in relation to the fundamental while not exceeding 1 mW, if the transmitter power is 1 kW or more.
3. *Parasitic emissions*: oscillations produced in the transmitter by undesirable self-excitation. The conditions laid down for these emissions must not be more rigorous than those for intermodulated emissions.
4. *Combination frequencies*: are produced in the power stages of the transmitter by the action of other transmitters. Their admissible power should be limited to 25 mW.

e) *Japan (Doc. No. 313).*

Because of the extreme complexity of the problem, the document is confined to a recapitulation of the results so far obtained. Since the problems raised by the radiation of harmonics and unwanted emissions are particularly serious in the sphere of VHF, study is being made for the establishment of methods for direct measurement of their power in this band. The document contains the results of measurements of harmonics made with the equipment described in London Doc. No. 130, for transmitters with a power varying from 2 to 20 kW and working on frequencies between 7 Mc/s and approximately 18 Mc/s. Measurements of fields within a radius of 1 to 4 km from the transmitters have made it possible to effect an interesting comparison of the two methods. The equipment described in London Doc. No. 130 has been improved. The new characteristics are given in the present document. The degree of precision is approximately 10%.

f) *Study Group No. I (Doc. No. 307).*

Conclusions of the Brussels (1955) meeting

g) *U.S.S.R. (Doc. No. 406).*

Description of a high-frequency wattmeter which can be joined to either a coaxial or a symmetrical feeder and which gives direct readings on a scale. The effect of different parameters on errors in power measurements is studied in detail and a definition is given of the technical requirements they must meet. Comparative tests have revealed that errors in the course of a measurement did not exceed $\pm 5\%$.

h) *E.B.U. (Doc. No. 457).*

This paper contains a list of the principal harmonics and combination frequencies of broadcasting transmitters recorded on medium and short waves in the course of the past few years. The parasitic emissions on medium waves, some of which interfere even with important stations, in all likelihood correspond to an antenna power of more than 200 mW.

As this value is the maximum tolerance laid down by the Atlantic City Radio Regulations, there would seem to be no immediate reason for lowering it.

Observations in the short-wave band show a high percentage of harmonics higher than the second. Since the harmonic filters of transmitters are generally made up of a circuit tuned to the second harmonic there would seem to be some grounds for providing a filter for the third harmonic in certain cases.

3.1.1.4. *Conclusions and proposals.*

No comments were made at the Brussels meeting on the draft recommendation prepared on the basis of the documents submitted. The fact that three administrations have expressed a desire to re-examine the Brussels contributions at Warsaw would seem to indicate that, on second thoughts, they are unable to give their full support to the draft recommendation. The Federal

German Republic, after participating in the Brussels meeting, has issued an entirely new proposal; finally, Japan believes that further detailed study must be made before a conclusion can be reached.

It seems likely therefore that the draft recommendation prepared in Brussels will be reconsidered in Warsaw. The Study Group will have to make an effort to reconcile the opinions expressed and to amend the Brussels text in such a way as to make it acceptable to all.

3.1.2. Study Programme No. 3 — Frequency stabilisation of transmitters.

The aim of this Study Programme is to revise the frequency tolerance Tables in Appendix 3 of the Atlantic City Radio Regulations. This study, declared urgent by the EARC (Recommendation No. 14, Geneva, 1951), was pursued at the Brussels meeting (March-April 1955).

3.1.2.1. Contributions submitted to the Brussels meeting.

Twelve members of Study Group No. I have sent replies to the questionnaire distributed with Circular 596.0.47 dated 5th July 1954, viz:

Brussels Document No.	27:	Australia
»	»	28: Belgium
»	»	15: United States
»	»	29: Finland
»	»	32: Hungarian People's Republic
»	»	30: Italy
»	»	31: Japan
»	»	12: Netherlands
»	»	3: Federal German Republic
»	»	33: Switzerland
»	»	34: Telefonaktiebolaget L. M. Ericsson
»	»	35: Italcable

In addition, the following documents were submitted:

Brussels Document No.	38:	United Kingdom
»	»	57: Czechoslovakia
»	»	70: European Broadcasting Union

The data contained in these contributions are published in the Warsaw documents, insofar as the administrations have not announced any changes since the Brussels meeting.

3.1.2.2. Conclusions reached at the Brussels meeting.

As a result of discussions a draft report was prepared with a reservation by the USSR delegation. The draft report is set out in Warsaw Doc. No. 306 and its conclusions are given in the table to be submitted to the Plenary Assembly under the heading of Study Group No. I.

3.1.2.3. Contributions for the VIIIth Plenary Assembly, Warsaw, 1956.

A recapitulatory table containing the information available after the Brussels meeting was circulated to members in letter 596.0.191 dated 30th November 1955, in which the Chairman asked for comments on the values contained in the tables.

In the analysis of contributions, the figures provided by administrations are set out in a new recapitulatory table. These are followed by comments of a general nature.

a) Belgium (Doc. No 375).

Considering the conclusions of the Brussels meeting on "fixed stations in the 4 to 30 Mc/s band" inadequate, Belgium maintains its point of view expressed at that meeting. As regards

broadcasting stations in the 30 to 100 Mc/s band, two separate tolerances are proposed, one for FM stations and one for television stations. For bands B and D, the Brussels conclusions are acceptable.

b) *United Kingdom (Doc. No. 165).*

It is considered that the limits should continue to be expressed in terms of the total frequency tolerance as defined by the Atlantic City Radio Regulations. Nevertheless in considering the performance of transmitters the total tolerance can usefully be divided into two elements: accuracy of the mean frequency and stability as shown by Study Programme No. 3.

The frequency of the majority of transmitters now in service is controlled by quartz crystal oscillators. There are of course other types of master oscillator which can be used; nevertheless, it is considered that the performance of such oscillators should be as good as that achieved by current crystal oscillators; consequently, particular consideration is given in the document to the latter.

For quartz crystal oscillators the total tolerance on frequency can be divided into three elements: inaccuracy of the mean frequency, slow drift of the mean frequency and instability of frequency. A first table gives the values of frequency errors in this type of oscillator assessed according to the crystal manufacturers' tolerances, the oscillator circuit tolerances, temperature variations and fluctuations in the mains voltages. The standards of performance for new equipments which might be achieved in some classes of service are given in a second table.

c) *France (Doc. No. 184).*

The French Administration points out that no tightening of the strictest tolerances given in the Atlantic City Table will reduce the incidence of interference in the more congested bands. If the frequency tolerance already constitutes a low percentage of the bandwidth occupied by the transmission, no decrease in interference can be obtained by rendering the tolerance more stringent. On the other hand, the C.C.I.R. should endeavour to persuade administrations to accept a reduction in the higher tolerances in the Atlantic City Table, particularly for certain mobile stations. In band D, a new category of stations is established—i.e. radio-navigation stations—for which a tolerance of 0.0015% is proposed if the power is over 500 W and 0.005% if the power is below 500 W.

With a view to simplification, the French Administration also submits a new draft definition of frequency tolerance for examination by the C.C.I.R.

d) *P.R. of Poland (Doc. No. 203).*

The document draws attention to the influence of various factors on the frequency of LC oscillators. The results of an analysis for a Clapp oscillator, based on the study of the influence of harmonic components due to the non-linear characteristics of the tube, taking account of grid current and interelectrode capacitance, are given. Two tables show the comparative results obtained by means of an oscillator calculated with the data provided by that analysis. The document may be regarded as a contribution to the questions dealt with in the document submitted by Czechoslovakia (Doc. No. 120).

The document is supplemented by a letter to the Chairman, dated 11th February 1956, in which the Polish Administration expresses the view that the Atlantic City tolerances should be retained, except for long-wave and medium-wave broadcasting stations.

e) *Czechoslovakia (Doc. No. 120).*

The document contains the results of studies carried out with a view to determining the various factors which influence the stability of flexible oscillators for short-wave transmitters. The long-term stability of a flexible oscillator manufactured with special care is of the order of $\pm 2 \times 10^{-5}$, and $\pm 1 \times 10^{-4}$ for a mass-produced oscillator. At the present stage of development, the regulations for frequency stability can be respected with a good margin. For economic reasons,

however, it would be premature to establish more stringent regulations. Thus it is proposed that any tightening of the present frequency tolerances should be deferred.

f) *Finland (Doc. No. 132).*

The document described the master oscillator of a long-wave telegraph transmitter with a power of 40 kW used for A1 and F1 operation. In addition the results of measurements of frequency stability obtained over a period of approximately 5 years, showing that the frequency variations for that period did not exceed $\pm 0.01\%$, are given.

g) *Italcable (Doc. No. 385).*

This company considers that a tolerance of 1×10^{-5} for fixed stations in band D (4 to 30 Mc/s working with a power of over 500 W can be attained with no greater difficulty than 1.5 parts in 10^6 . The advantages gained, however, as regards congestion, would be considerable.

h) *Union of South Africa (Doc. No. 166).*

The principles of variable frequency crystal control for transmitters and receivers have been further developed. The subject has already been dealt with in London Doc. No. 372. The heterodyne method of filtering the wanted harmonic from the harmonic spectrum of a crystal oscillator is used. This is done by means of a fixed filter with a frequency higher than the highest wanted frequency. Interpolation between the harmonics is effected with a variable oscillator with a relatively low frequency. A description of an oscillator built on these principles is given in the document.

i) *United States of America (Doc. No. 277).*

Information regarding commercially available frequency stabilisation devices and transmitting equipment indicates that, in general, degrees of frequency stability in excess of that required by Atlantic City are readily attainable without excessive additional expense. The maximum stability values attained with various transmitters of recent production are given in a first table, while a second table permits comparison to be made with the tolerances adopted in the United States and those of Atlantic City.

At present the data available are insufficient to warrant any conclusions as to whether or not more restrictive tolerances should be recommended for the future than those indicated in the tables annexed to the document.

j) *Netherlands (Docs. Nos. 126, Part a) and 127, Part b).*

Part a): Since 1954, systematic frequency measurements have been made in the Netherlands on transmitters equipped with driver-stages of high precision. The present document which is supplementary to Brussels Doc. No. 12 contains the results of measurements which show that over large time intervals the constancy of the transmitters in band D remains well within $\pm 1 \times 10^{-6}$ while in band A the constancy is better than $\pm 1 \times 10^{-5}$.

Part b): Considering that the frequencies in band A (10 to 535 kc/s) are relatively low, not much frequency spectrum can be gained by a high constancy of the transmitter. A tolerance of 1×10^{-5} would thus appear to be adequate.

However, that is not the case for bands C and D (1605 to 4000 kc/s and 4 to 30 Mc/s) in which a high constancy in the frequency of the transmitter causes the frequency spectrum to be used much more efficiently. If the transmitters have a sufficiently high frequency stability it is possible, at least on radio circuits for fixed services, to use spot-frequency receivers.

Experience has shown that if the apparatus is equipped with oscillators of high stability, a radio circuit can be used for traffic about a quarter of an hour earlier than when other apparatus, even that equipped with automatic frequency control, is utilised; the application of spot-frequency reception is, however, only possible in bands C and D if the tolerance on the frequency of the transmitter is of the order of $\pm 1 \times 10^{-6}$.

k) *Netherlands (Doc. No. 273).*

The document describes a frequency-shift keying premodulator provided with a crystal oscillator and endowed with a high degree of long term stability, frequency deviation being effected

by short-circuiting a condenser in series with the crystal. Measurements of the spectrum permit comparison of the bandwidth occupied by a transmitter containing the device and that occupied by a transmitter with standard frequency-shift keying equipment.

l) *Japan (Doc. No. 369).*

The Japanese Administration accepts the values contained in the Brussels draft report (Doc. No. 306) and submits proposals for other categories of stations.

m) *Australia (Doc. No. 371).*

This document shows that the tolerances for new stations working between 10 kc/s and 100 Mc/s could be tightened. The Australian Administration cannot accept the values proposed by Study Group No. I at Brussels (March-April 1955) for aeronautical stations working in band D with a power of over 500 W, and proposes that for these stations the Atlantic City tolerances should be retained.

n) *Study Group No. I (Doc. No. 306).*

Draft Report prepared at the Brussels meeting.

o) *Table of data available (See pages 43-54)*

p) *Federal German Republic (Doc. No. 384).*

The Administration of the Federal German Republic considers that even narrower tolerances could be established in certain cases and in particular for fixed land and mobile stations in bands E and F, and for band G.

q) *E.B.U. (Doc. No. 448).*

The aim of this statistical study is to find out what new standards might suitably be adopted in the light of technical progress and the state of affairs existing at present, as revealed in particular by the frequency measurements made. In conclusion, it is proposed to maintain ± 10 c/s for medium waves, and for short waves the tolerance of $\pm 0.0015\%$ suggested at Brussels, and finally to lower, for VHF, the Atlantic City tolerance to $\pm 0.0015\%$.

STUDY PROGRAMME No. 3: TABLE OF DATA AVAILABLE

Frequency band and category of station	Submitted by	W = Warsaw Doc. No. B = Brussels Doc. No.	Standard of performance attainable with new equipment	Number of transmitters or circuits observed	Percentage of transmitters or circuits meeting the requirement in col. 7	Tolerances met	Regulations on the national level	Atlantic City tolerances	Proposed tolerances	Remarks
1	2	3	4	5	6	7	8	9	10	11
A 10 to 535 kc/s 1. <i>Fixed stations</i> — 10-50 kc/s — 50-535 kc/s 2. <i>Land stations</i> a) <i>Coast</i> — P > 200 W . . . — P < 200 W . . . b) <i>Aeronautical</i> . . . 3. <i>Mobile stations</i> — <i>Ship</i> — <i>Aircraft</i>	USA USA HOL AUS AUS AUS USA AUS USA J AUS USA	277W 277W 126W 127W 371W 371W 371W 277W 371W 277W 369W 371W 277W	0.005* 0.01*				0.1* 0.02* 0.02* 0.02* 0.02 0.02* 0.1*	0.1 0.02 0.001 0.02 0.05 0.02 0.02 0.1 0.1 0.1 0.05 0.05	0.01 0.01 0.01 0.05 0.05 0.05	* Public fixed service * 14 to 515 kc/s; marine services on land, except maritime fixed services (coast stations) * Public fixed service * 14 to 515 kc/s; marine services on land, except maritime fixed services (coast stations) * Fixed from 150 to 550 kc/s * 500 kc/s and under * 100-515 kc/s * 200-415 kc/s

Frequency band and category of station	Submitted by	W = Warsaw Doc. No. B = Brussels Doc. No.	Standard of performance attainable with new equipment	Number of transmitters or circuits observed	Percentage of transmitters or circuits meeting the requirements in Col. 7	Tolerances met	Regulations on the national level	Atlantic City tolerances	Proposed tolerances	Remarks
1	2	3	4	5	6	7	8	9	10	11
— Emergency transmitter.	AUS USA	371W 277W					0.3 0.05*	0.5 0.5 0.5	0.5	* 500 kc/s (survival craft)
4. Radionavigation stations.	AUS	371W						0.02	0.01	
5. Broadcasting stations . . .	POL EBU	— 70B		30	35 75 90	1 c/s 5 c/s 10 c/s		20 c/s	10 c/s	
B. 535 to 1605 kc/s Broadcasting stations . . .	AUS USA F POL UK SWITZ EBU	371W 277W 184W — 165W 33B 70B	5 c/s 10 c/s	3 350	15 30 40 50 70	2 c/s 1 c/s 5 c/s 10 c/s 20 c/s 100 c/s	20 c/s	20 c/s 20 c/s 20 c/s 20 c/s 20 c/s 20 c/s	10 c/s 0.0015 10 c/s 5 c/s	Reservation: U.S.S.R.
C. 1605 to 4000 kc/s 1. Fixed stations	SG-I	306W						20 c/s	10 c/s	
— P > 200 W.	AUS	371W						0.005	0.003	

1	2	3	4	5	6	7	8	9	10	11
	USA	277W					0.003*	0.005		* 1605-3000 kc/s: (public fixed service)
	J	369W						0.005	0.003	
— P < 200 W	AUS	371W						0.01	0.01	
	J	369W						0.01	0.006	
2. Land stations										
a) Coast										
— P > 200 W	AUS	371W						0.005	0.003	
	USA	277W					0.005	0.005		
	J	369W						0.005	0.004	
— P < 200 W	AUS	371W						0.01	0.01	
	J	369W						0.01	0.008	
b) Aeronautical										
— P > 200 W	AUS	371W						0.005	0.003	* 2 to 24 Mc/s
	USA	277W	0.005*				0.005	0.005		
— P < 200 W	AUS	371W						0.01	0.01	
	USA	277W					0.01	0.01		
c) Base										
— P > 200 W	AUS	371W						0.005	0.005	* 1600-25000 kc/s: marine services on land except maritime fixed services (coast stations)
	USA	277W					0.005*	0.005		* 1606-2830 kc/s: remote pickup broadcast stations (land mobile)
								0.005*	0.005	
— P < 200 W	AUS	371W						0.01	0.01	* 1606-2830 kc/s: remote pickup broadcast stations (land mobile)
	USA	277W					0.01*	0.01		
3. Mobile stations										
— Ship	AUS	371W						0.02	0.01	* 1600-3500 kc/s
	USA	277W					0.02*	0.02		* Emergency in survival craft on 2182 or 2091 kc/s
							0.05*			
	J	369W						0.02	0.015	

Frequency band and category of station	Submitted by	W = Warsaw B = Brussels Doc. No.	Standard of performance attainable with new equipment	Number of transmitters or circuits observed	Percentage of transmitters or circuits meeting the requirement in col. 7	Tolerances met	Regulations on the national level	Atlantic City tolerances	Proposed tolerances	Remarks
1	2	3	4	5	6	7	8	9	10	11
— Aircraft	AUS	371W					0.01*	0.02	0.02	* From 500 kc/s
— Land mobile	USA AUS USA	277W 371W 277W					0.02*	0.02 0.02	0.01	
5. Broadcasting stations	AUS	371W						0.005	0.0015	
D. 4000 to 30000 kc/s										
1. Fixed stations										
— P > 500 W.	AUS BEL USA F HOL	371W 375W 277W 184W 126W 127W	0.003				0.003*	0.003 0.003 0.003 0.003	0.0015 0.0001 0.0015 0.0003	* Aeronautical fixed service
— P < 500 W.	UK * SG-I AUS UK F SG-I	165W 385W 306W 371W 165W 184W 306W	0.0015					0.003 0.003 0.003 0.01 0.01	0.001 0.0015 0.005	* Italcable Reservation: U.S.S.R.
2. Land stations										
a) Coast	AUS	371W	0.005					0.01 0.01	0.005 0.005	Reservation: U.S.S.R.
								0.005	0.0015	

1	2	3	4	5	6	7	8	9	10	11
	USA F	277W 184W					0.005	0.005 0.005	0.0015* 0.005*	* P > 500 W * P < 500 W
	HOL	126W 127W						0.005	0.0003	
	UK	165W	0.0015* 0.005*					0.005		* For P > 500 W * For P < 500 W
b) Aeronautical	SG-I	306W						0.005	0.0015*	* P > 500 W Reservation: U.S.S.R.
— P > 500 W . . .	AUS USA F	371W 277W 184W	0.005*				0.003	0.005 0.005	0.003 0.0015	* 2 to 24 Mc/s
— P < 500 W . . .	UK SG-I AUS USA F UK	165W 306W 371W 277W 184W 165W	0.0015				0.01	0.005 0.01 0.01 0.01	0.0015 0.01 0.005	Reservation: U.S.S.R.
c) Base	AUS USA	371W 277W					0.005*	0.005 0.005	0.005	* 1600-25000 kc/s: marine services on land, except maritime fixed services (coast stations)
— P < 500 W . . .	F AUS USA F	184W 371W 277W 184W					0.005*	0.005 0.01 0.01 0.01	0.0015 0.01 0.005	* For P > 5W 26.11-26.47 Mc/s
3. Mobile stations	AUS USA	371W 277W					0.005* 0.02*	0.02 0.02	0.01	* Radiotelephony * Other services
— Ship	J UK*	369W 165W						0.02 0.02** 0.005*	0.015	* See note 2 ** Telegraph * Telephone
— Aircraft	AUS USA UK	371W 277W 165W	0.01				0.01*	0.02 0.02 0.02	0.01	* Aircraft above 500 kc/s

Frequency band and category of station	Submitted by	W = Warsaw Doc. No. B = Brussels Doc. No.	Standard of performance attainable with new equipment	Number of transmitters or circuits observed	Percentage of transmitters or circuits meeting the requirements in Col. 7	Tolerances met	Regulations on the national level	Atlantic City tolerances	Proposed tolerances	Remarks
1	2	3	4	5	6	7	8	9	10	11
— Land mobile . . . — Survival craft transmitters. . . . 4. <i>Broadcasting stations</i> E. 30 to 100 Mc/s 1. <i>Fixed stations</i>	AUS USA AUS AUS USA F HOL UK EBU SG-I AUS USA	371W 277W 371W 277W 184W 126W 127W 165W 70B. 306W 371W 277W	0.0005* 0.0015 0.01*	500 500	60 75 85 90 95	0.001* 0.002 0.003 0.005 0.01	0.02** 0.005* 0.01*	0.02 0.02 0.003 0.003 0.003 0.003 0.003 0.02 0.02	0.01 0.02 0.0015 0.0015 0.0003 0.0015 0.0075	* 25 to 50 Mc/s; ** P < 5 W * P > 5 W A proposal to replace this value by 20 c/s is being examined * See Note 1 Reservation: U.S.S.R. * Aviation ground stations above 30 Mc/s

1	2	3	4	5	6	7	8	9	10	11
2. Land stations.	F FGR	184W 384W						0.02 0.02	0.0075 0.02* 0.003*	* for P < 10 W * for P > 10 W
	UK	165W	0.0075					0.02		
	AUS USA	371W 277W	0.005*				0.01* 0.01* 0.02*	0.02 0.02	0.0075	* 72 to 76 Mc/s * aviation ground stations above 30 Mc/s * 30 to 50 Mc/s P>3W Marine * 30 to 50 Mc/s P<3W services on land, except maritime fixed services (coast stations)
	F FGR	184W 384W						0.02 0.02	0.0075 2.5 kc/s* 8 kc/s*	* for P>1W * for P<1W
3. Mobile stations.	UK SWITZ	165W 33B	0.0075					0.02 0.02	0.005* 0.02*	* for P>5W * for P<5W
	SG-I	306W						0.02	0.0075	Reservation: U.S.S.R.
	AUS USA	371W 277W	0.0005*				0.01* 0.005* 0.01* 0.02* 0.01* 0.02*	0.02 0.02	0.0075	* 25 to 50 Mc/s * below 50 Mc/s: domestic public service (land mobile) * 50 to 100 Mc/s: domestic public service (land mobile) * P>3W 30 to 50 Mc/s: maritime service on shipboard * P<3W below 50 Mc/s: for public safety, industrial land transport

1	2	3	4	5	6	7	8	9	10	11	
F. 100 to 500 Mc/s 1. Fixed stations	FGR	384W					1 kc/s* 4 kc/s*			* 54 to 72 Mc/s and 76 to 88 Mc/s TV monochrome: picture * 54 to 72 Mc/s and 76 to 88 Mc/s TV monochrome: sound, or 4.5 Mc/s above the picture with a tolerance of 5 kc/s	
	UK SWITZ	165W 33B	0.005*				1 kc/s*			* 54 to 72 Mc/s and 76 to 88 Mc/s: colour TV (picture, sound): 4.5 Mc/s above the picture with a tolerance of 1 kc/s, sub- carrier: 10 c/s - A proposal for the alignment of tolerances for monochrome and colour TV is being exam- ined	
	USA	277W						0.01	0.01*	* for P<10W * for P>10W * 100 to 235 Mc/s	
									0.01	0.003*	
	2. Land stations								0.01	0.01	
											* 152.87 to 170.15 Mc/s: remote pickup broadcast stations (land mobile)
								0.01*		* 455.95 to 456.95 Mc/s: remote pickup broadcast stations (land mobile)	
							0.005* 0.01*			* P>3W\ 100 to 200 Mc/s: * P<3W\ marine services on land, except maritime fixed services (coast stations)	
	FGR	384W						0.01	2.5 kc/s* 8 kc/s*	* for P>1W * for P<1W * Aviation ground stations above 30 Mc/s	
							0.01*				

Frequency band and category of station	Submitted by	W = Warsaw Doc. No. B = Brussels Doc. No.	Standard of performance attainable with new equipment	Number of transmitters or circuits observed	Percentage of transmitters or circuits meeting the requirements in Col. 7	Tolerances met	Regulations on the national level	Atlantic City tolerances	Proposed tolerances	Remarks
1	2	3	4	5	6	7	8	9	10	11
3. <i>Mobile stations.</i>	UK SWITZ USA	165W 33B 277W	0.005* 0.0005* 0.0025* 0.005* 0.002*				0.005* 0.01* 0.005* 0.01* 0.01*	0.01 0.01 0.01	0.005* 0.01*	* 100 to 235 Mc/s * P > 5W * P < 5W * 148 to 174 Mc/s and 450 to 470 Mc/s * railroad 158 to 162 Mc/s * aircraft 118 to 136 Mc/s * maritime 152 to 174 Mc/s * 100 to 220 Mc/s: domestic service (land mobile) above 220 Mc/s as specified in authorisation * P ≤ 5W \ 152.87 to 170.15: * P > 5W / remote pickup broadcasting stations (land mobile) * 450.05 to 455.95 Mc/s: remote pickup broadcasting stations (land mobile) * survival craft

1	2	3	4	5	6	7	8	9	10	11
							0.01* 0.005* 0.01* 0.005*			* P<3W\ maritime services on * P>3W\ shipboard * P<3W\ 50 to 220 Mc/s: public * P>3W\ security, industrial land transport (land mobile)
	FGR	384W						0.01	2.5 kc/s* 8 kc/s*	* for P>1W * for P<1W
	UK	165W	0.01* 0.005*					0.01		* aircraft } 100 to 235 Mc/s * other stations}
	SWITZ	33B						0.01	0.005* 0.01*	* P>5W * P<5W
5. Broadcasting stations	BEL USA	375W 277W	1 kc/s*					0.003 0.003	0.00025*	* for television stations * television 470 to 890 Mc/s * FM 92 to 108 Mc/s * For television on 174 to 216 Mc/s, same regulations as for frequency band E. under 5
G. 500 to 10500 Mc/s	USA	277W	0.02* 0.1* 0.05* 0.02* 1 kc/s*					0.75		* microwave relays (1700 to 2100 Mc/s, close spaced triode) * microwave relays (3700 to 4200 Mc/s, klystron) * microwave relays (3700 to 4200 Mc/s, triode) * microwave relays (5975 to 8000 Mc/s, klystron) * TV on 470 to 890 Mc/s * For TV on 470 to 890 Mc/s, the same regulations as for frequency band E. under 5

Frequency band and category of station	Submitted by	W = Warsaw Doc. No. B = Brussels Doc. No.	Standard of performance attainable with new equipment	Number of transmitters or circuits observed	Percentage of transmitters or circuits meeting the requirements in Col. 7	Tolerances met	Regulations on the national level	Atlantic City tolerances	Proposed tolerances	Remarks
1	2	3	4	5	6	7	8	9	10	11
	FGR SWITZ	384W 33B	0.1*					0.75 0.75	0.02*	* wide-band relay * microwave relays (1850 to 2150 Mc/s)
	AUS	27B	considers that the frequency tolerances in Appendix 3 to the Atlantic City Regulations could be tightened; no final values are suggested for the moment.							
	USA	277W	<i>Radar</i> : the frequency at which maximum emission occurs should be within an assigned frequency band and should not be closer than $1.5/T$ Mc/s to the lower or upper limits of an assigned frequency band. T is the pulse duration in microseconds.							
	Ericsson		Doc. 34 B considers that for wide-band systems on frequencies below 500 Mc/s the Atlantic City tolerances could be tightened.							
	Note 1		Since no accurate data are available for the nominal frequency of a great many stations, the deviations given refer to the mean frequency. The percentages would probably have to be considerably reduced for deviations assessed in relation to the nominal frequency.							
	Note 2		Chapter III Article 9, numbers 270 and 271 of the Radio Regulations specify that the frequency tolerance requirements shall be the same for radiotelephone emissions of ship stations as for coast stations. The tolerance for the latter have been fixed at $50/10^9$. We consider that any new regulation should avoid establishing a connection between tolerances for mobile stations and for fixed stations. On the other hand, with different values for the telephone and telegraph emissions of ship stations, the tolerances should be indicated separately. This has been done in Doc. 165 and as a result it has become necessary to improve independently the tolerances applicable to coast stations for transmitters with a power of over 500 W.							

3.1.2.4. *Conclusions and proposals.*

Taking account of the communications from administrations summarised above, the Study Group will have to study the possibility of supplementing and amending the draft report prepared in Brussels. It should also decide to what extent the draft report, so supplemented and amended, would provide a suitable basis for a draft recommendation. The documentation available seems to confirm the general conclusion in London Report No. 18 that the technique of frequency stabilisation of transmitters—particularly for fixed services operating on frequencies below 30 Mc/s—is now such that degrees of frequency stability considerably in excess of those laid down in the Radio Regulations (Atlantic City, 1947) can be obtained by using either direct crystal control master-oscillators or continuously adjustable master oscillators with indirect crystal control. It has further been revealed that for these services, when stable tuned oscillators are used the frequency tolerances at present in force can be respected with a good margin. Several administrations are of the opinion that an effort should be made with regards to the mobile services.

3.1.3. *Study Programme No. 39 — Bandwidth of emissions.*

The C.C.I.R. was invited by the Atlantic City Administrative Conference (1947) to make a study as expeditiously as possible of the bandwidth necessary to ensure the quality of service required for the various classes of emission. The E.A.R.C. (Geneva, 1951) insisted that the study, entrusted to Study Group No. I, should be speeded up. A partial answer was provided by London Recommendation No. 87 and the problem also appeared on the agenda of the Brussels meeting (March-April, 1955).

3.1.3.1. *Contributions submitted to the Brussels meeting.*

a) *Belgium (Brussels Doc. No. 1).*

In this document, study is made of different ways of rounding telegraph signals, from the point of view of interference caused in receivers which are not tuned to the given transmission. The conclusion is drawn that transient phenomena caused in a receiver de-tuned from the frequency of a signal with \sin^2 buildup and decay may be considered practically non-existent if the build-up and decay times of the signal are of the order of a millisecond.

b) *Japan (Brussels Doc. No. 18).*

Measurements made on transmitters working on A1 transmissions, would seem to indicate that the limits fixed by Recommendation No. 87 for this class of transmission should be slightly modified.

3.1.3.2. *Conclusions of the Brussels meeting (March-April 1955).*

The Study Group agreed that certain points in Recommendation No. 87 should be clarified. A new course of study was envisaged and the following suggestions made:

1. to study the best shape for the signals from the viewpoint not only of the receiver tuned to the transmission but also of that tuned off the transmission, particularly in respect of transient phenomena to which the latter might respond;
2. to study, as a first step to the solution of the problem, the shape of signal which would result in the maximum energy in the passband of the receiver tuned to the transmission;
3. when the theoretical shape has been found, to study, as a second step, the practical means of obtaining the corresponding signal.

3.1.3.3. *Contributions for the VIIIth Plenary Assembly, Warsaw, 1956.*

a) *France (Doc. No. 174).*

Theoretical and experimental study of mutual interference of radio systems (thesis by Mr. Villepelet submitted to the Faculty of Science, University of Paris).

In the first part the author deals with the influence of the selectivity of a receiver on protection from step signal interference. In the second part, he examines the properties of the dynamic

selectivity curve of a step signal system, while the third part is devoted to checking such properties experimentally. Finally, in the fourth part, the author describes the properties of the dynamic selectivity curve of amplitude, phase and frequency modulated radio systems.

The basic conclusions may be summarised as follows:

- for the receiver affected, protection from transient interference is expressed in terms of channel separation by an out-of-band slope of the dynamic selectivity curve very different from that of the static selectivity curves;
- the dynamic slope is much more gentle than the static curve; for an identical bandwidth (at 3 db) an increase in the number of filter sections (which makes the static slope more marked) is not accompanied by any sharpening of the dynamic slope unless the interfering signal is rounded on emission;
- by filtering the signals on emission, the static selectivity slope of the receiver affected can be approached without greatly increasing the signal build-up time;
- if the transmitter and the receiver affected are taken as a whole, an overall dynamic selectivity slope can be defined. The slope is obtained if the filter sections (assumed to be identical) are equally distributed between the transmitter and the receiver.

b) *Belgium (Doc. No. 9).*

At the Brussels meeting it was suggested that signals with half Gaussian curve slope might be even more interesting than those studied. Document No. 9 describes the present position of the additional studies undertaken and shows that the choice of signal shape depends greatly on the type of receiver and that, in principle, no curve as such offers any particular advantages. Brussels Document No. 1 showed that for certain conditions of build-up and decay time of a \sin^2 signal, transients can be rendered practically imperceptible. This may likewise apply to signals with half Gaussian curve slopes; however, since the integrals for the latter case cannot be expressed in simple explicit form, this property cannot be easily revealed without numerical calculation. In order to throw light on the problem, the spectrum of a telegraph dot with Gaussian sides was considered; it was found that a Morse dot with half Gaussian curve slopes offers no advantages over that with \sin^2 slopes. This applies equally to the Morse dash.

c) *Belgium (Doc. No. 355).*

The document points out the difficulties involved in the practical application of the accepted definition of the bandwidth occupied by an omission and shows that the definition is inadequate for the study of interference in adjacent channels. It would thus be desirable to:

1. specify that the band occupied by an A1 radiotelegraph transmission is the one corresponding to the shortest signals in the transmission at the given speed, and that it should be measured whenever possible, at these signals;
2. to fix a reference level lower than the unkeyed carrier level at which the width of the spectrum is to be measured, to be regarded as an approximate practical value of the bandwidth occupied. The level could be between —25 and —30 db;
3. to fix other levels (e.g. —40, —50, —60 db) for measuring the bandwidth so as to obtain precise information on the out-of-band spectrum and thus enable a choice to be made between the various shapes of signals giving the same "occupied bandwidth" but causing a different type of interference in adjacent channels.

d) *P.R. of Poland (Doc. No. 216).*

This document, devoted mainly to a description of a spectrum analyser, concludes that because of continual variations in the bandwidth during a transmission, the definition should specify that the expression "bandwidth occupied by an emission" implies the maximum width attained during transmission of a text. It is further suggested that the present definition should be amended as to facilitate interpretation of the results obtained with the direct measurement method.

e) *Japan (Doc. No. 312).*

Measurements have been made of class F1 emission using rectangular and trapezoidal signals. The results are recapitulated in three tables which show, in terms of the modulation index for these

shapes: the bandwidth occupied, the slope of the spectrum envelope curve in db/octave and the basic ordinates of this curve.

f) *Study Group I (Doc. No. 305).*

Conclusions of the Brussels meeting

g) *I.F.R.B. (Doc. No. 442).*

Standards used by the I.F.R.B. for the technical examination of assignment notices and for the establishment of draft plans for H.F. broadcasting.

The following excerpt from the document is of particular interest to Study Group No. I:

"The nature of the missing information can most briefly be indicated by stating that the solution to the present technical problems of the Board relating to its standards would be greatly facilitated by the completion of all the studies, including Study Programmes Nos. 44 and 45, which are necessary for the reply to be given to Question No. 3.

This reply would remedy the present lack of data on particular elements, for instance on the distribution of power in the emitted spectrum for certain emissions. It would however still leave partly unsolved the problem of the principles to be followed in the integration of the various elements (such as receiver selectivity, the nature of the desired emission, the emitted spectrum of an interfering signal) which are required for the establishment of the criteria to be applied to the complete systems which must be studied in order to meet the Board's primary need; the need for the technical means to assess the potentiality which a given emission has of interfering with any other emission, under the most varied conditions, such as various frequency separations."

3.1.3.4. *Conclusions and proposals.*

The Study Group, taking account of the results of the Brussels meeting (March-April, 1955) and the documentation received, will have to decide whether Recommendation No. 87 and the definition of the bandwidth occupied by an emission should be supplemented or amended. Further studies should be pursued in line with the method prescribed in Brussels. The contributions received clearly show that, as regards interference, the question of bandwidth should not be regarded as pertaining to the transmitter only, but that the equipment as a whole, comprising both the transmitter and the receiver, should be considered.

3.1.4. *Study Programme No. 40.*

Method of measuring emitted spectra in actual traffic.

Atlantic City Recommendation No. 4 called for the establishment of practical methods of measuring the bandwidth actually occupied by each particular emission.

Recommendation No. 88, prepared by Study Group No. I at the Plenary Assembly in London, gives the first results of studies in this sphere. The problem was given priority by the Brussels meeting (March-April, 1955) which was preceded by a preparatory week organised by the Belgian Administration during which comparative measurements were made with seven different spectrum analysers working under identical conditions.

3.1.4.1. *Contributions submitted to the Brussels meeting.*

a) *Belgium (Brussels Doc. No. 2).*

This document studies the behaviour of a spectrum analyser consisting of three RLC circuits in cascade, for an arbitrary order of rectangular dots and dashes transmitted strictly in accordance with the rhythm of the Morse code. It reveals that the spectrum of an arbitrary message in actual traffic is always within the envelope curve corresponding to a succession of dots and dashes.

b) *United Kingdom (Brussels Doc. No. 4).*

Measurements have been made of a Morse transmission by means of the spectrum analyser described in London Document No. 168. These measurements make it possible to compare the spectrum of a succession of dots with that of an actual communication. Measurements were taken both of rectangular signals and rounded signals. The spectrum of an actual communication is smaller than that produced by succession of dots. However, this difference tends to decrease as the spectrum analyser filter bandwidth increases.

c) *Belgium (Doc. No. 8).*

This document is designed to show that any assessment of the accuracy of results obtained with the spectrum analyser is subject to the existence in the spectrum to be analysed of a quantity which may be determined independently from the analyser and may serve as an element of comparison. There would appear to be no simple way of finding such elements, except for periodic or repeated signals.

d) *Switzerland (Brussels Doc. No. 11).*

Certain characteristics of the spectrum analyser described in London Document No. 191 have been modified. The modifications have been incorporated in this comprehensive description of the apparatus presented at the Brussels meeting.

e) *Netherlands (Brussels Doc. No. 13).*

This document describes the spectrum analyser presented at the Brussels meeting. Certain characteristics of the apparatus, already described in London Document No. 136, have been modified.

f) *Japan (Brussels Doc. No. 18).*

A comparison has been carried out in Japan of the different methods for measuring bandwidth. The results revealed by the direct measurement method, as described in London Document No. 128, were compared with the results obtained through calculations and those produced by the spectrum analyser. A fairly good agreement was revealed. An experiment has been carried out to determine the accuracy of the direct method by measuring the bandwidth of a known emission.

g) *Japan (Brussels Doc. No. 24).*

This document contains a new description of the spectrum analyser mentioned in London Document No. 127.

h) *Japan (Brussels Doc. No. 25).*

This document describes the H 308 apparatus for measuring bandwidth mentioned in 1.2. of Recommendation No. 88, presented at the Brussels meeting. This apparatus has already been described in London Document No. 128.

i) *Belgium (Brussels Doc. No. 55).*

This document contains a brief description of the spectrum analyser presented at the Brussels meeting. The apparatus had already been presented at the VIIIth Plenary Assembly in London (1953) and its main characteristics are described in Annex II to Recommendation No. 88.

j) *France (Brussels Doc. No. 56).*

A succinct description of the C.N.E.T. spectroscope. This apparatus has an automatic sweep and provides an oscillograph display of the spectrum of a radiotelegraph transmission keyed by signals of any form at a speed of 50 bauds or more. It is a perfect complement to the manually controlled spectrometer which enables accurate measurement to be made of each line of the spectrum. A description of the latter is contained in the *Annales des Télécommunications*, No. 4 (Volume 9).

k) *C.C.I.R. Working Group (Brussels Doc. No. 68).*

This document contains the final report on the comparative tests carried out in Brussels. The conclusions are summarised as follows:

1. The results obtained by using the various apparatus based on the principle of spectrum analysis presented at the Brussels meeting are in sufficient agreement to justify the assumption that, with a few improvements, these will provide comparable results in the near future.
2. For A1 emissions, the spectrum envelope obtained for periodic dots is valid for actual traffic signals. This seems to apply equally to F1 emissions.
3. It remains to establish how, and to what extent, the spectra obtained by means of analysers permit the "bandwidth occupied by an emission" within the definition of the Radio Regulations, to be determined.
4. The Japanese bandwidth meter gives a direct reading of the bandwidth within the definition contained in the Radio Regulations.

3.1.4.2. *Conclusions reached at the Brussels meeting.*

The Brussels meeting has provided the basic answer to Study Programme No.40. The conclusions set out in Warsaw Document No. 304 can be summarised as follows.:

Study Programme No. 40, paragraph 1 :

The experiments with A1 emissions seemed to show that the spectrum envelope for actual traffic is contained within that for dots, except in the vicinity of the carrier.

Concerning F1 emissions, the tests at Brussels seemed to show that the spectrum envelope for actual traffic was very similar to that for dots.

Study Programme No. 40, paragraph 2 :

The apparatus based on the spectrum analyser presented at the Brussels meeting provided sufficiently similar results to enable a statement to be made that after certain improvements such apparatus should in the near future give comparable results.

Document No. 18 (Japan) constitutes an answer to the problem of comparing bandwidth measurements by different methods. The conclusions seem favourable.

Study Programme No. 40, paragraph 3 :

Since a mathematical solution in the case of F1 emissions is not easily obtainable, practical tests should be made. It seems that the spectrum envelope of F1 emissions (where the modulation index is relatively large) depends very little on the shape of the signals but is a complex function of the characteristic instants of the modulation.

Study Programme No. 40, paragraph 4 :

It seems to be established that it is not absolutely necessary to use a very narrow band filter, relative to the value of B (bauds) for measuring the spectrum in actual traffic, provided that the sides of the selectivity curve are relatively steep.

Study Programme No. 40, paragraph 5 :

Determination of the accuracy of results obtained by the spectrum analyser is subject to the existence in the spectrum to be analysed of a quantity which may be determined independently from the analyser, and may serve as an element of comparison. To determine the degree of accuracy of a manual sweep apparatus, it would be necessary for that apparatus to have an output integrating system with a suitable time constant for measuring the mean power of each individual sideband.

3.1.4.3. *Contributions for the VIIIth Plenary Assembly, at Warsaw, 1956*

a) *Belgium (Doc. No. 10).*

This document deals with the operation of radio spectrum analysers. After considering the behaviour of a filter consisting of a series of identical resonant circuits to which a signal is applied, the author makes a special study of the operation of an analyser on non-periodic Morse signals. He recalls that the limit spectrum envelope of an emission is attained only, under certain conditions, when a series of dots or repeated dashes is present and that, in any case, the limit envelope corresponds to the shape of the spectrum likely to be occupied by the emission during the transmission of traffic consisting of Morse dots and dashes. The author further recalls the relation between the keying speed and the filter passband of the analyser and the requirements to be met, in the case of automatic sweep, by the scanning speed. Finally, he raises the problem of measurement accuracy, which cannot be obtained unless there is a certainty of finding characteristics peculiar to the spectra to be studied, to provide standards of comparison with the response of the apparatus.

b) *Belgium (Doc. No. 280).*

See 3.1.4.1. — i).

c) *R.P. of Poland (Doc. No. 216).*

The document describes a bandwidth meter based on the direct measurement method. A number of measurements made with this meter reveal that:

1. the method employed permits direct reading of the bandwidth occupied by telegraph transmissions. The equipment is convenient to use and easy to operate;
2. the results obtained are sufficiently accurate as regards the operational needs for transmitting equipment if the texts transmitted are periodic with periods no longer than 400 milliseconds;
3. the bandwidth measurements of actual texts with A1 emissions require suitable time constants in the system. Tests are now being made to adapt the bandmeter to such measurements.

d) *C.C.I.R. Working Group (Doc. No. 344).*

See 3.1.4.1. — k).

e) *Study Group No. I (Doc. No. 304).*

Conclusions reached at the Brussels meeting.

See 3.1.4.2.

f) *U.S.S.R. (Doc. No. 405).*

This document contains the results of radiotelegraph bandwidth measurements made in actual traffic conditions at the transmitting centre and at a control point, with a view to determining the accuracy obtainable, comparing the results obtained in the presence of fading in the immediate vicinity of the transmitter and at the control point, and to acquiring experience of measuring emission bandwidths with an automatic sweep analyser.

In addition, a description is given of the equipment used for measuring the band occupied by A1 and F1 transmissions of rectangular dots at various keying speeds.

The document shows that the method described in Recommendation No. 88, point 1.1., is not perfect and that a new way of measuring bandwidths should therefore be sought.

g) *Spain (Doc. No. 455).*

After mentioning the drawbacks involved in the use of automatic sweep in one direction only, the document proposes that spectrum analysers should use a double-spot oscillograph with one sweep from left to right and one from right to left. This method enables a symmetrical analysis to be made of the spectrum and affords a number of advantages. A description is given of an analyser based on that principle.

3.1.4.4. *Conclusions and proposals.*

While the work carried out at Brussels has supplied a partial answer to Study Programme No. 40, Administrations should be reminded that a useful purpose could be served by assembling for the Plenary Assembly at Warsaw data confirming the conclusion reached at Brussels that the actual traffic spectrum of F1 emissions resembles very closely that of a dot emission.

Further, a comparison could usefully be made of measurements obtained through different methods. To that end, build-up times should be so selected as to be as close as possible to 0.1 - 0.15 - 0.20 - 0.25 of the duration of a dot: $T = 1/B$, since these values correspond to the definition of build-up time contained in Recommendation No. 87.

At the Warsaw meetings, the Study Group will have to examine the possibility of supplementing the answer provided by the Brussels meeting to Study Programme No. 40 by data made available in subsequent documents.

3.2. *Question No. 18 - Telegraph distortion.*

It should be recalled that this question which concerns both the C.C.I.R. and the C.C.I.T. has been assigned to both these organs for study. A discussion took place at the Brussels meeting between Prof. Albanese, Chairman of C.C.I.T. Study Group No. I and the Working Group entrusted with the study of this question.

Members are reminded that by Administrative Circular AC/20 dated 19th November 1954, the Director of the C.C.I.R. requested administrations to name a representative of the C.C.I.T. to whom the results of study by the C.C.I.R. of Question No. 18 would be communicated.

3.2.1. Contribution submitted to the Brussels meeting.

Secretariat of the C.C.I.R. (Brussels Doc. No. 63).

This document, which is an excerpt from C.C.I.T. Doc. S.G. 1/6, contains various comments and proposals made by the Chairman of C.C.I.T. Study Group No. I concerning the efficiency factor of a telegraph communication, the quality index of telegraph operation and the distribution law for the various degrees of distortion relating to an isochronous modulation (or restitution).

3.2.2. Conclusions reached at the Brussels meeting.

The discussion between the Chairman of C.C.I.T. Study Group No. I and the Working Group of C.C.I.R. Study Group No. I has made it possible for study to be made of Brussels Document No. 63 and has thrown light on certain aspects of the question. The results of the discussion are contained in Brussels Document No. 95.

3.2.3. Contributions for the VIIIth Plenary Assembly, Warsaw, 1956.

a) *France (Doc. No. 178).*

The statistical distortion measuring set described in this document was designed by the French Administration as a contribution to C.C.I.R. studies on telegraphy based on a criterion more responsive and more constant than the number of faulty characters. The apparatus, which is designed for keying speeds of approximately 50, 100 or 200 bauds, can be used for measuring synchronous or start-stop distortion, or for obtaining the statistical distribution of the duration of the unit interval of the modulation received.

b) *France (Doc. No. 177).*

Statistical measurements under laboratory conditions of telegraph distortion in the presence of noise have been carried out by the French Administration by means of the statistical distortion measuring set described in Document No. 178. The arrangement used is described in this document; the attached table gives the results obtained by varying the frequency-shift, the rounding of the signal, the LF bandwidth at the input of the distortion meter and the ratio: (signal \pm noise) / noise.

c) *C.C.I.T. (Excerpt from C.C.I.T. Document SG I/13) (Doc. No. 309).*

This document reports the decision of C.C.I.T. Study Group No. I taken at its meeting in June 1955, concerning the amendments made to C.C.I.T. Recommendation B.1 (see C.C.I.R. Recommendation No. 93), the method to be recommended for determining the law of distribution for various degrees of distortion, the concepts of "conventional maximum distortion", "apparent degree of distortion" and "maximum degree of distortion".

d) *C.C.I.T. (Excerpt from C.C.I.T. Document SG I/6) (Doc. No. 311).*

See 3.2.1.

e) *C.C.I.T. (Excerpt from C.C.I.T. Document SG I/9) (Doc. No. 310).*

This Document contains the comments of the United Kingdom as communicated to the Secretariat of the C.C.I.T. concerning the efficiency factor of a telegraph communication, the quality index of telegraph operation, the law of distribution of the various values of the degree of distortion relative to isochronous modulation (or restitution), the notions of conventional maximum distortion, apparent degree of distortion and maximum degree of distortion.

f) *Federal German Republic (Doc. No. 436).*

The error rate and the definitions based thereon do not provide satisfactory standards for assessing the quality of a radio transmission path. In fact, the error rate can only be determined after the event, i.e. after the transmission is completed. Moreover, it is necessary that the correct text be known. By using TOM equipment it is possible to relate the quality coefficient directly to the number of incorrect incoming signals per minute. A number of values not to be exceeded for a good, satisfactory or unsatisfactory circuit are given in a table.

3.2.4. *Conclusions and proposals.*

The apparatus presented by the French Administration would seem to afford an efficient method for the further study of telegraph distortion, and particularly of the efficiency factor of a telegraph communication.

The Study Group will have to examine the amendments offered by Study Group No. I of the C.C.I.T. to C.C.I.T. Recommendation B.1 (see C.C.I.R. Recommendation No. 93), and make a study of the documents available with a view to preparing suggestions for transmission to the C.C.I.T. which might be of help in dealing further with the problem.

3.3. *Question No. 20 - Frequency-shift keying.*

3.3.1. *Study Programme No. 41 - Frequency-shift keying.*

The aim of this study is to fix one or several standardised values of frequency shift for the fixed and mobile services in the various frequency bands. A number of values to which preference should be given is proposed in London Recommendation No. 92. The matter was also dealt with at the Brussels Meeting.

3.3.1.1. *Contributions to the Brussels meeting.*

Japan (Brussels Doc. No. 19).

It would be desirable to standardise certain frequency deviation values. However, any such step would be premature, even for fixed services operating in favourable conditions. Certain values are quoted to which preference should be given.

3.3.1.2. *Conclusions reached at the Brussels meeting.*

The question was re-examined and the discussions showed that a separate study and a separate recommendation for systems with four significant conditions would be desirable.

3.3.1.3. *Contributions for the VIIIth Plenary Assembly, Warsaw, 1956.*

a) *U.S.S.R. (Doc. No. 121).*

This document contains a very detailed description of a two-channel twinplex radiotelegraphy system with four significant conditions. The two channels can operate independently with or without synchronisation.

The technical characteristics of the system are described and a brief study is made of the possibilities offered.

b) *Japan (Doc. No. 314).*

The Japanese Administration proposes that a single value—e.g. 400 c/s—should be adopted at least for fixed services working under favourable conditions. Pending adjustment of the equipment to that single value, 840 c/s and 560 c/s could continue to be used.

For systems operating on more than two frequencies—particularly as these are still in a state of development—the Japanese Administration suggests that continued study should be made of Question No. 74 and Study Programme No. 46.

c) *United States of America (Doc. No. 297).*

The Note to Recommendation No. 92 appears to contradict paragraph 6 of the Recommendation when applied to teleprinters. To avoid confusion, the new text suggested in the document could usefully be adopted. In support of the proposal, a description is given of the various keying systems involved.

d) *United Kingdom (Doc. No. 163).*

Further to a decision of the Brussels meeting to make a separate study of systems using four frequencies, the United Kingdom Administration submits a draft new Study Programme to cover:

1. the choice of frequencies for each significant condition;
2. the minimum spacing between adjacent frequencies for satisfactory operation of 100 baud channels;

3. the minimum spacing for any other keying speed considered necessary.

e) *United Kingdom (Doc. No. 164).*

The United Kingdom provides a partial answer to the Study Programme proposed in Document No. 163 in the form of a draft recommendation containing, in particular, spacing for adjacent frequencies for different keying speeds.

f) *U.S.S.R. (Doc. No. 404).*

Since a translation of this document was not made available to the Chairman by the beginning of the VIIIth Plenary Assembly, it was not possible to issue a summary of it in time to be of use in the work of the Study Group.

3.3.1.4. Conclusions and proposals.

With the documents submitted by the United States and Japan as a basis, the Study Group will have to decide what amendments should be made to Recommendation No. 92. In pursuance of the Brussels decisions, the Study Group should examine whether the Study Programme submitted by the United Kingdom, supplemented or amended if necessary, should be adopted. In addition, the Study Group should decide whether the data available are sufficiently comprehensive to permit the establishment of a recommendation. The Chairman would like to point out that such study should extend to four-frequency systems combined with time-division multiplex.

3.4. Question No. 74 - Arrangement of channels in multi-channel telegraph systems for long-range radio circuits operating on frequencies below about 30 Mc/s.

Until the Plenary Assembly in London, the Study Group's programme of work included a similar programme in the sphere of telephony. The establishment of an analogous standard for telegraph systems would be desirable. The problem was dealt with at the Brussels meeting (March-April, 1955).

3.4.1. Contributions submitted to the Brussels meeting.

a) *Japan (Brussels Doc. No. 20).*

This document contains a proposal for telegraph channel designation. It suggests that for the telegraph systems covered by Questions No. 20 (Study Programme No. 41) and No. 43 (Study Programme No. 46) study should also be made of channel designation.

b) *United Kingdom (Brussels Doc. No. 5).*

While standardisation of a specific multi-channel system would be premature, a useful purpose would be served by specifying the characteristics to which preference should be given.

Study Group Nos. II and III should be requested to supply the relevant data. In view of the diversity of systems at present in use, it would be desirable to classify them into broad categories, taking into account the bandwidths occupied and the magnitude of out-of-band radiation. The systems in current use are listed in the Annex.

3.4.2. Conclusions reached at the Brussels meeting.

The Study Group agreed that the data available to it at the Brussels Meeting was insufficient. A questionnaire on the telegraph systems in use was prepared with a view to the Plenary Assembly in Warsaw and the Director of the C.C.I.R. was requested to circulate it to administrations.

3.4.3. Contributions for the VIIIth Plenary Assembly, Warsaw, 1956.

a) *Japan (Doc. No. 315).*

The Japanese Administration proposes that the channels obtained by frequency-division should be designated by figures and those obtained by time-division by letters. In addition, designations are given for different combinations of systems.

b) *Federal German Republic (Doc. No. 1).*

As regards the arrangement of channels, the Administration of the Federal German Republic proposes, for VF telegraph systems using frequency-division, a channel separation of 170 c/s for all

start-stop channels operating with a maximum speed of 50 bauds. In order to provide for time-division multiplex systems super-imposed on the systems, double (2×170) or quadruple (4×170) frequency spacing could usefully be envisaged.

It is proposed that letters should be used for the designation of channels, viz. F for frequency-division, T for time-division and P for systems using more than two significant conditions. A method of designation in which figures are used for F systems and letters for T and P systems is suggested.

Once the method has been adopted, a list of existing systems, together with their designations, should be compiled.

c) *C.C.I.T. (Doc. No. 308).*

The question of a definition for "transmission channel" has been dealt with by C.C.I.T. Study Group No. I and the conclusions reached are reported by the Chairman in this document.

d) *Secretariat of the C.C.I.R. (Doc. No. 359).*

26 replies were received by the Secretariat of the C.C.I.R. to the questionnaire prepared at the Brussels meeting. The replies which were communicated to the Chairman, have been classified into four categories:

1. Time-division multiplex (see page 65);
2. Frequency-division multiplex (see page 66);
3. Systems using more than two significant conditions (see page 66);
4. Systems using a combination of different multiplex processes (see page 67).

3.4.4. *Conclusions and proposals.*

The replies received to the questionnaire and the contributions to Question No. 74 show that a basis for the classification and designation of systems will have to be established. The documents available may help to prepare a new question to that end, unless the Study Group, at the Plenary Assembly, in Warsaw, issues a recommendation providing a solution to the problem.

The contributions from Japan and the Federal German Republic to Question No. 74 contain proposals which might serve as a basis for discussion.

3.5. *Question No. 75 - Limitation of unwanted radiation from industrial installations.*

This question arises from Resolution No. 5 annexed to the International Telecommunication Convention, Buenos Aires (1952). The VIIth Plenary Assembly (London, 1953) assigned to Study Group No. I the study of the determination of such radiation and to Study Group No. III (Question No. 84) the determination of the maximum interference levels tolerable in complete systems. Question No. 75 was broached at the Brussels meeting (March-April, 1955).

3.5.1. *Contributions to the Brussels meeting.*

a) *United States (Brussels Doc. No. 16).*

This document describes the regulations in force in the United States, where industrial, scientific and medical apparatus is classified into three categories. The technical requirements to be met by such apparatus and the methods of ensuring that the requirements are fulfilled are given for each category.

b) *Japan (Brussels Doc. No. 21).*

This document contains the summary of a method for determining the radiated field strength of industrial, scientific and medical apparatus in the open field and along supply lines.

GROUP 1

Time-division multiplex

a) 2-channel systems				
Country	Designation of system	Designation of channels	Bauds/channel	
Australia	DCCC	AB	50	
»	TED (TOR)	AB	50	
Belgium	TOR	AB	50	
Canada	DCCC	AB	50	
»		AB	45.5	
India	DCCC	AB	64 max.	
Japan	TOR	AB	42	
Netherlands	TOR	AB	50 max.	
Portugal	TOR		50 max.	
Union of South Africa	DCCC	AB	50	
Argentine	Multiplex 2 x		50	
»	2 x 1/2 channel		50	
Switzerland	TOR	AB	50	
»	DCCC	AB	50	
United Kingdom	DCCC	AB	50	
»	TOR	AB	50	
»	TED (RECS, ECM)	AB	50	
b) 4-channel systems				
Australia	Multiplex RCA		42.8	
Belgium	TOM (RCA)	ABCD	42 6/7	
Japan	Multiplex RCA	ABCD	42 6/7	
»	TOM	ABCD	42 6/7	
»	Multiplex Teletype Corp.	ABCD	37 1/2	
Netherlands	TOM		50	
Philippines	Multiplex RCA	ABCD	50	
Federal German Republic	TOM	ABCD	42 6/7	
France	Multiplex	ABCD	50 max.	
Switzerland	TOM	ABCD	42 6/7	
United Kingdom	Multiplex RCA	ABCD	42.8	
»	TOM	ABCD	50	
United States	Multiplex RCA	ABCD	42.8	
c) Systems with more than 4 channels				
Country	Designation of system	Number of channels	Designation of channels	Bauds/channel
Australia	Multiplex RCA Sub-divided	16	A ₁ A ₄ B ₂ B ₄	42 6/7

GROUP 2

Frequency-division multiplex

Country	Designation of system	Number of channels	Designation of channels	Bauds/channel
Kenya	BLI	3	1,2,3	200 max.
Australia	BLI	3	1,2,3	100 max.
Japan	BLI	2	1,2	indefinite
Portugal	BLI	2	—	100
Federal German Republic	WTK V	8	1,2 . . . 7,8	80 max.
» » »	WTK VI	16	1,2 . . . 16	80 max.
Union of South Africa	BLI	3	1,2,3	50
» » »	BLI	6	1,2 . . . 5,6	50
France	BLI	12	1,2 . . . 12	50 max.
Argentina	BLI*	12	a,b . . . m,n	50 max.
»	BLI*	2	—	50 max.
United Kingdom	BLI	6	1,2 . . . 5,6	66 max.**
» »	BLI	24	1,2 . . . 24	80 max.
» »	BLI	3	1,2,3	200 max.
United States	BLI	16	1,2 . . . 16	75

* uses several channels of a multi-channel telephone transmitter
 ** distortion 6%

GROUP 3

Systems using more than two significant conditions

Country	Designation of system	Significant condition	Number of channels	Designation of channels	Bauds/channel
Australia	Diplex	4	2	AB	100 + 50
Canada	Diplex	4	2	—	100 max.
Ceylon	Diplex	4	2	HL	90 + 45
Japan	Twinplex	4	2	AB	50 env.
Philippines	Duplex	4	2	AB	64 + 50
»	Twinplex	4	2	AB	160 max.
»	Polyplex	2 × 4	4	ABCD	160 max.
Portugal	Diplex (Twinplex)	4	2	AB	100 + 50
Federal German Republic	Duoplex	4	2	AB	50
U.S.S.R.	Twinplex	4	2	1,2	300 max.
Argentina	Twinplex	4	2	—	50
Switzerland	Twinplex	4	2	AB	50
United Kingdom	Diplex	4	2	AB	100
United States	Twinplex	4	2	AB	160 max.
» »	Polyplex	2 × 4	4	ABCD	160 max.

GROUP 4

Systems using a combination of different multiplex processes

Country	Designation of system	Significant conditions	Number of Channels	Designation of Channels	Bauds/Channel
Japan	Twinplex	4	8	A ₁ A ₄	42 6/7
	Subdivided			B ₁ B ₄	
»	BLI - MUX	2 × 2	8	1 _A 1 _D 2 _A 2 _D	42 6/7
»	BLI - MUX	3 × 2	12	1 _A 1 _D 2 _A 2 _D 3 _A 3 _D	42 6/7
»	TWIN-MUX	4	8	1 _A 1 _D 2 _A 2 _D	37 1/2
Philippines	Multiplex	4	8	1 _A 1 _D 2 _A 2 _D	—
Federal German Republic	WTF 3/6	3 × 2	6	1,2 5,6	250
United States	BLI - MUX	3 × 2	12	A ₁ A ₄ B ₁ B ₄ C ₁ C ₄	42.8
«	Multiplex	4	8	1 _A 1 _D 2 _A 2 _D	—

c) *Federal German Republic (Brussels Doc. No. 53).*

This document describes the methods of measuring the fields of interference produced by industrial, scientific and medical HF equipment. The valid field-strength limits are assembled in a table for the various categories of apparatus.

3.5.2. Conclusions reached at the Brussels meeting.

The Study Group agreed that the data available were insufficient to warrant the preparation of a draft recommendation and that administrations should supply, in time for the next Plenary Assembly, information regarding their domestic regulations for limiting unwanted radiation. It was also decided to circulate a questionnaire to that effect. As a result the following questionnaire was prepared by the Chairman and circulated to members on 18th November 1955:

1. Point 1 of Question No. 75.

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

1.1. Characteristics of the measuring equipment.

1.1.1. What types of wave collector are to be used in each frequency band? (see C.C.I.R. Recommendation No. 113).

1.1.2. What should be the characteristics of the receiver used for the measurements, particularly concerning the bandwidth?

1.1.3. What method should be used for the calibration of the receiver?

1.2. Method of measurement.

1.2.1. What should be the working conditions of the apparatus to be measured during the measurements?

1.2.2. At what distance from the industrial, scientific or medical apparatus should the field strength be measured? How many measurements are necessary? Are the observations to be made along one or more radii? In the horizontal plane? In the vertical plane?

1.2.3. What should be the height of the receiving antenna above ground?

1.2.4. Is it necessary to make measurements in different planes of polarisation?

1.2.5. Is it necessary to measure both the electric and the magnetic field or one of them only?

1.2.6. Is it necessary to measure the field radiated by the mains? If yes, how?

1.3. What is the best method of expressing the measured field? (effective value, peak value, etc.)

2. Point 2 of Question No. 75.

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

2.1. What classification do you suggest for industrial, scientific and medical apparatus? (According to their utilisation? The working frequencies? The technical data?)

2.2. Can you give some information concerning the levels to which it is possible to reduce the radiation, taking into account the economical incidences for the different classes of apparatus proposed under 2.1.?

3. *Do regulations on this matter exist in your country?* If yes, will you please attach a copy to your answer.

4. *According to your experience, do you think that:*

4.1. more frequencies should be allocated to the industry?

4.2. the bands allocated at present should be broadened?

3.5.3. Contributions for the VIIIth Plenary Assembly, Warsaw, 1956.

a) *United States (Doc. No. 278).*

See 3.5.1. a).

b) *Federal German Republic (Doc. No. 279).*

See 3.5.1. b)

c) *Federal German Republic (Doc. No. 395).*

This document is a reply to the Chairman's questionnaire. A limited number of copies of the relevant national regulations will be available to delegates at the Warsaw Assembly.

d) *Netherlands (Doc. No. 372).*

In its reply to the questionnaire, the Netherlands Administration states that no general solution has so far been found for the interference measuring sets envisaged in Question No. 75. Considering that no such solution is likely in the near future, the Netherlands Administration proposes that studies should be continued in close cooperation with the U.R.S.I. and that meanwhile the C.I.S.P.R. standards should be provisionally adopted.

e) *Japan (Doc. No. 316).*

This document contains the reply of the Japanese Administration to the Chairman's questionnaire. Excerpts from current regulations are annexed.

f) *P.R. of Poland (Doc. No. 392).*

Reply to the questionnaire. General comments and a description of an interference measuring set built by the Administration are given in another document.

g) *P.R. of Poland (Doc. No. 207).*

Several types of measuring apparatus are in use; however, because of the diversity of their technical characteristics the measurements obtained for the same interference source are not in agreement. A standard for the methods of measurement and the principal technical characteristics must be established before the results can be compared. The technical data of an interference measuring set are likewise given in the document.

h) *France (Doc. No. 185).*

In pursuance of the Brussels decision, the French Administration submits information on the relevant legislation. The summary is restricted to the main technical bases and no mention is made either of the juridical foundation or the methods of application.

The first part is devoted to protection for broadcast and television receivers, while the second part develops the notion of "easement areas" around the antennae of radio reception centres.

i) *United States (Doc. No. 419).*

Replies to the Chairman's Questionnaire. A summary of the regulations existing in the United States for industrial, scientific and medical installations is given in Document No. 278.

j) *Netherlands (Doc. No. 432).*

This document contains the replies from the Netherlands Administration to the Chairman's Questionnaire, and a study of the difficulties encountered when measuring interference. The national regulations governing interference from industrial installations are set out in an Annex to the document.

k) *Sweden (Doc. No. 441).*

Replies from the Swedish Administration to the Chairman's Questionnaire. While no relevant regulations exist in Sweden at present, studies are being carried out for the preparation of rules, which will, in all likelihood, be similar to those existing in the United States and in Germany.

3.5.4. *Conclusions and proposals.*

The questionnaire has elicited eight replies, including one from South Africa, indicating that there is no relevant legislation in force in that country. It would therefore be desirable, in accordance with the wish expressed at the Brussels meeting, to prevail on those administrations whose countries provide for such legislation to supply the additional information required. The data would be of great help to countries where regulations to that effect are being drawn up.

Examination of the contributions received shows that the *methods of measuring the level of interference must be standardised*. The Study Group will have to decide in Warsaw how the study can best be pursued and, should it think fit, draw up a study programme.

As regards cooperation with the C.I.S.P.R. mention should be made of C.C.I.R. circular G.I/128 dated 31 May 1955, circulated to the members of Study Group No. I.

3.6. New Question.

The Chairman has received a draft new Question (Doc. No. 481) from the Swedish Administration designed to standardise certain characteristics of UHF and VHF equipment for the fixed and mobile services. This proposal concerns both Study Group No. I and Study Group No. II. The proposed text should be examined and if necessary redrafted so as to define clearly the tasks of the two Study Groups.

4. GENERAL CONCLUSIONS

The report shows that there are still many gaps to be filled. Arduous though the tasks of administrations have been in preparing contributions for the VIIIth Plenary Assembly in Warsaw, the Chairman hopes that additional information for the furtherance of the Study Group's work will be forthcoming in the intervening months.

E. METZLER, Dr. Ing.
Chairman of Study Group No. I

REPORT BY THE CHAIRMAN OF STUDY GROUP No. II*

(RECEIVERS)

(Original language: French)

1. The work of the Study Group.

The Plenary Assembly in London, 1953, had thought that it might be necessary to call an interim meeting of Study Group No. II, possibly jointly with Study Groups Nos. III and XI.

The matter was dealt with by the Chairman in Circular No. 7 (September 1954). But (as reported in Circular No. 8) out of the nine replies received by the appointed date, 7 (USA, Hungarian People's Republic, Switzerland, Netherlands, France, Sweden and United Kingdom) were definitely against such a meeting, one (USSR) was neutral and one (Federal German Republic) could not accept the date suggested and proposed an alternative date. Therefore no meeting was held**.

The Study Group's activity was thus restricted to the work carried out by administrations and to exchanges of documents and correspondence between the Director of the C.C.I.R., the Chairman and members (in particular the Chairman's Circulars Nos. 7, 8 and 9).

2. Table of contributions received and subjects dealt with ***

(See following page).

3. Contributions received - General.

The contributions as a whole contain interesting information which can be classified into three categories:

3.1. Data on the performance of receivers, in answer to the Questions and Study Programmes set by the London Plenary Assembly of the C.C.I.R.

Numerous figures have been supplied on the basic qualities such as sensitivity, stability and selectivity, including "two-signal" selectivity, and new types of receivers, e.g. FM, television, etc.

The new figures for the types of receivers already studied under London Recommendations Nos. 94, 95 and 96 are generally in good agreement; sometimes an improvement is shown.

3.2. Criticisms and suggestions for improving the measurement methods prescribed in existing Recommendations.

Although on the whole the measurement methods advocated in Recommendations Nos. 94, 95 and 96 proved to be suitable for obtaining the results mentioned in paragraph 3.1., certain operational and presentation details and various numerical values pertaining thereto have given rise to objections which, although perhaps not entirely tenable, should be examined.

3.3. Proposals for the extension of these methods to new types of receivers for which no regulations were issued at the London Plenary Assembly, with particular reference to *television* receivers. In this instance, the cooperation of Study Group No. XI will most likely have to be sought.

It should be noted that none of the contributions contains any proposals for a definite Recommendation, Resolution or Question. Thus the Study Group itself will have to draft a suitable text to cover the conclusions reached.

* Doc. No. 102 (Warsaw, 1956).

** Out of three replies received after the closing date only one (Japan) was in favour of a meeting being held; however, no specific programme was suggested. The Australian Administration could not attend, and that of Italy was prepared to accept the decision of the majority.

*** Some of the contributions were received well after the closing date; this has greatly hampered the preparation of the present report.

CONTRIBUTIONS RECEIVED
(Warsaw 1956)

Administrations	Question No. 76 Sensitivity	Question No. 77 Stability	Question No. 78 Choice of IF	Question No. 79 Impulsive interference	Question No. 80 Receiver radiation	Study Programme No. 42 Selectivity	Study Programme No. 43 Keyed interference
Federal German Republic	(Doc. No. 7)	(Doc. No. 3)	(Doc. No. 6)	(Doc. No. 5)	(Doc. No. 8)		
Int. Radio Maritime Committee							(Doc. No. 9)
France	(Doc. No. 199)	(Doc. No. 174)		(Doc. No. 180)	(Doc. No. 181)		
Italy	(Doc. No. 398)	(Doc. No. 398)			(Doc. No. 398) (Doc. No. 399)	(Doc. No. 398)	
Japan	(Doc. No. 317)			(Doc. No. 368)		(Doc. No. 318)	(Doc. No. 319)
Netherlands						(Doc. No. 257)	(Doc. No. 2)
Poland	(Doc. No. 215)				(Doc. No. 302)		
United Kingdom	(Doc. No. 162) (Doc. No. 161) (Doc. No. 227)	(Doc. No. 158) (Doc. No. 159) (Doc. No. 160)	(Doc. No. 157)	(Doc. No. 156)	(Doc. No. 136)	(Doc. No. 137) (Doc. No. 231)	
Czechoslovakia		(Doc. No. 119)					
U.R.S.I.				(Doc. No. 4)			

Let us now examine separately the information provided on each question.

4. Sensitivity and background noise (Recommendation No. 94 and Question No. 76).

4.1. Numerous results of measurements have been provided by the Federal German Republic, France, United Kingdom, Italy and Japan in response to Question No. 76, paragraph 1.

These results, confirming or supplementing as they do those in Annex IV to Recommendation No. 94, will have to be added to it.

4.2. The definitions and measurement methods prescribed in Recommendation No. 94 have been more or less severely criticised, the most adverse criticism being levelled at two specific applications of the formulae in Annex II (relation between noise factor and sensitivity):

Recommendation No. 94 { Paragraph 2 — A3b (single-sideband) - comment by the Federal
Annex II { German Republic.
{ Paragraph 3 — F3 (frequency-modulation) - comment by France
{ (paragraph d and Annex II).

Requests have been received for textual amendments to certain definitions and numerical values:

Recommendation No. 94 { Paragraph 1.5. — Comments by France a, b, c and e.
{ Annex II, paragraph 4 — Reference sensitivity (comment by the
Federal German Republic);
source resistance and dummy antenna
(United Kingdom).

4.3. Finally, interesting proposals have been received on the measurement of noise and sensitivity of:

4.3.1. telegraphy receivers, from:

— *United Kingdom* pointing out the inadequacy of the concept of “distortion”, the importance of accidental “mutilation” and suggesting a precise definition for F1 receivers (frequency-shift);

— *Japan* adhering to a 20% distortion measurement with a probability of 1/1000;

4.3.2. television receivers, from:

— *United Kingdom* submitting a complete discussion on all possible parameters and a conclusion for a definition of the *reference sensitivity* and *maximum sensitivity*, together with a description of the test methods and curves;

— *P.R. of Poland* defining the “usable sensitivity” obtained with a test pattern;

— *France* giving various suggestions on the usable sensitivity and various limitations, i.e. gain, noise, synchronisation.

Much useful information can also be obtained from other results of measurements supplied (Federal German Republic, Italy).

5. Stability (Recommendation No. 96 and Question No. 77.)

5.1. The contribution from the United Kingdom is particularly important. In addition to providing a quantity of figures for the various classes of receivers, including FM and television receivers, it draws attention to two points raised for the first time:

5.1.1. the enormous differences existing between “nominally identical” receivers, i.e. receivers built as part of the same series by the same manufacturer; the “drift”, varying as it does by as much as 1 to 16 over a dozen receivers, implies widely different temperature coefficients for certain components and a degree of chance compensation;

5.1.2. the sharp variations in the stability of the same receiver depending on the sub-range and the frequency to which it is tuned, and even from day to day.

Results have also been submitted by the Federal German Republic, France, Italy and Czechoslovakia. The French and the Italian figures show a considerable dispersion which would seem to confirm the statement of the United Kingdom above.

5.2. No comments have been received regarding the definitions and methods of measurement proposed in Recommendation No. 96.

5.3. In reply to Question No. 77 a number of hints and suggestions are given by the United Kingdom for generally improving stability (1st part) and in particular that of filters (3rd part); further results and comments are contained in the contribution from the Federal German Republic.

6. Selectivity (Recommendation No. 95, Study Programmes Nos. 42 and 43, Questions Nos. 78 and 79).

6.1. A great many measurements, supplementing those in Annexes I and II to Recommendation No. 96 and obtained both with "single-signal" and "two-signal" methods are given for various types of receivers, including television—see contributions from the United Kingdom and Italy.

6.2. Comments have been received on the definitions, figures and methods prescribed in Recommendation No. 95.

The United Kingdom, in particular, has requested that the attenuation levels used for plotting the "single-signal" selectivity curve, and the output level for the "two-signal" curve be modified. Further, the United Kingdom maintains that the "two-signal" method described is not applicable to F3 frequency modulation.

Comments on the "two-signal" method have likewise been received from Japan (paragraphs III and V).

6.3. Specific cases of interference in broadcasting.

The Director of the C.C.I.R. has referred to the Chairman a specific question from the I.F.R.B. regarding the calculation of interference between broadcast transmitters operating on very close frequencies (from 5 to 12 kc/s apart). Following a preliminary exchange of views, the Chairman, by Circular No. 9, forwarded the question to all participating administrations.

Unhappily, up to now only one reply has been received. It describes tests carried out by the United Kingdom since 1950, first with two standard receivers (and seven listeners) and later with three other receivers. A dispersion of about 15 db was revealed between the interference levels considered "bearable" and "unbearable" by different listeners. However, for a single listener, when the frequency separation increases from 5 to 10 kc/s the bearable interference level (in db) increases almost linearly and the signal-to-noise ratio is then comprised between:

		<i>5kc/s</i>	<i>10 kc/s</i>
level of interfering signal	{ always bearable	52	18 db
	{ always unbearable	37	3 db

It is to be hoped that additional figures will be forthcoming before the Plenary Assembly in Warsaw.

6.4. Three important replies have been received to Question No. 78 (choice of intermediate frequency and protection from undesired responses of super-heterodyne receivers) i.e. from the Federal German Republic (general comments, tables of values and diagrams of resulting interference); from the United Kingdom (general discussion according to types of receiver and table of spurious responses); and, finally, from the EBU (a voluminous report Doc. No. 3062 on investigations with television receivers).

From the above contributions only rules of a very general nature can be deduced whose application to a certain type of receiver in a given country constitutes no more than a specific case.

6.5. Paragraphs 3 and 4 of Study Programme No. 42 concern methods of measuring the "phase/frequency" or "group-delay/frequency" characteristics. Although interesting in principle, the programme does not seem to have attracted much attention.

The Netherlands has submitted a brief description of a measurement apparatus which has been instrumental in improving television receivers (however, no results are given); the United Kingdom (paragraph 4) seems dubious that the results might serve a useful purpose (at least for telegraph receivers) and believes that a direct observation of transient and ringing would adequately reveal any excessive phase distortion; in this connection a particularly note-worthy example is given of the advantages of a "rounded" filter (Fig. 3).

6.6. Question No. 79 (quasi-impulsive interference) and Study Programme No. 43 (protection against keyed interfering signals) raise, in a slightly different form, the inexhaustible problem of *transients in receivers*.

Four replies—to a great extent mutually complementary—have been received to Question No. 79*.

General comments are offered by the Federal German Republic on the characteristic parameters of interference and their effect. The use of an "impulse generator" of the type described by the C.I.S.P.R. is recommended (Brussels, May 1954).

* In addition, the question was referred by the General Assembly of the U.R.S.I., 1954 (The Hague) to its National Committees (see Doc. No. 4).

The reply from France contains a very similar analysis in which a conclusion is, however, reached that when the interference is fairly brief and scattered the harmful effect produced is dependent on two parameters only, i.e.:

1. the amplitude of the spectrum component of the interference at the tune frequency of the receiver;
2. the repetition frequency.

A method for measuring interference is then discussed and three types of "impulse generators" suggested.

Certain comments from Japan appear to be in good agreement with those above.

Finally, the results of certain tests are given by the United Kingdom. With preselected interference parameters (duration: 0.1 microsecond; repetition frequency 100 c/s) and an apparatus for measuring the harmful effect produced thereby (R I No. 1, a peak voltmeter with different time constants, 1ms charge and 500 ms discharge), the experiments revealed, for several receivers (towards 1 to 2 Mc/s and 80 to 84 Mc/s):

- the start of the disturbance when the interfering signal attains a certain level (of the order of —30 db in relation to the signal);
- its growth, at first linear, then restricted by inevitable saturation when the interference reaches and then exceeds the signal level;
- the influence of the output level of the receiver;
- that of the limiter, when the interference reaches the level of the signal (e.g. an improvement of 4 db), or even when the former is lower (—15 db with a wide IF band).

It may be possible to use these data as a basis for a Recommendation.

6.7. Study Programme No. 43 (Protection against keyed interfering signals).

Many important contributions, some dealing with the theoretical and some with the experimental aspects of the question, have been received:

- a contribution from the C.C.R.M., Brussels, based on Mr. Marique's articles, discussing the influence of the shape of the signal (vertical, oblique, exponential, \sin^2 or Gaussian curve sides). In order to reduce transients to a minimum, \sin^2 or Gaussian curve signals or arcs of a parabola of a sufficiently high degree (higher than the number of resonators) must be used while at the same time avoiding the interfering effect of a porch of constant amplitude;
- contribution from France based on a paper by Mr. Villepelet, already mentioned at the Plenary Assembly in London, and now submitted to Study Group No. I. The paper shows that the best protection is obtained in a network of transmitters and receivers when the transmitter's keyed dots are "rounded" in such a way that the spectrum has the same asymptotic slope as the receiver's selectivity curve, a condition which is at present by no means fulfilled, the transmitter slopes being of the order of 12 db/octave and those of the receivers between 40 and 60 db/octave.

These theoretical conclusions should be collated with the experimental results obtained by the Netherlands (the selectivity of a receiver in the presence of two transmitters with their spectra reduced by an inserted filter; in some cases the improvement is considerable) and Japan (using one receiver).

These contributions show that protection from keyed interference should not be sought in receivers, which are already sufficiently selective to act as "spectrum analysers" in the presence of ordinary signals; interference can only be reduced by reducing the spectrum of the transmitters, i.e. by "rounding" the dots. The matter has been brought to the notice of Study Group No. I.

7. Undesired emissions from receivers (Question No. 80).

Several detailed contributions have confirmed the importance of this problem:

The reply from France contains a general analysis of the many possible sources of such unwanted emissions, the way in which they are propagated (by the mains, the antenna or directly) and the consequent measurements required for their assessment. The results of several sets of measurements are given in tables which show the maximum, minimum and "tolerance" values. Finally, practical methods for reducing radiation are discussed. The important specific case of television receivers is dealt with in a separate annex which also contains a table of values.

The reply from the United Kingdom contains similar information classified according to the type of receiver and the frequency range (marine, television, general purpose, VHF, FM, etc.) and showing certain standards already in use (in particular the I.E.C.). Attention is drawn to the way in which interference varies with distance.

The regulations and arrangements in force in Germany are described in the contribution received from the Federal German Republic. Limit values are given and the precautions required are enumerated.

In its reply, as well as in the article attached, Italy gives special consideration to television receivers; a new element in the shape of a "directional re-radiation diagram" is incorporated.

Finally, the contribution from the People's Republic of Poland contains comments, descriptions of measurements and the results obtained for broadcast receivers on frequencies below 30 Mc/s.

It is to be hoped that these documents may provide a basis for a Recommendation, which though possibly incomplete, would define the position of the C.C.I.R. with regard to the I.E.C. and the C.I.S.P.R., which are likewise concerned with this question*.

8. Conclusions.

A considerable number of documents have been received by Study Group No. II. These could be used in three ways:

1. to supplement the tables of sensitivity, selectivity and fidelity values in Recommendation Nos. 94, 95 and 96;
2. to amend (discreetly) certain details in the measurement methods prescribed and to extend such methods to other types of receivers;
3. to issue Recommendations or to define the additional studies to be undertaken on the following matters:

quasi-impulsive interference (Question No. 79);
choice of intermediate frequency (Question No. 78);
undesired emissions from receivers. (Question No. 80).

Joint meetings with Study Group No. I for Question No. 80 (keyed interference) and with Study Group No. XI (test conditions for television receivers) should perhaps be arranged.

The contributions received to date are neither comprehensive nor precise enough to enable the Chairman to draft forthwith and unaided "final texts" for discussions. That task will have to be undertaken by Study Group No. II at the Plenary Assembly in Warsaw.

PIERRE DAVID

Chairman, Study Group No. II

* The Chairman has already pointed out to the Director of the C.C.I.R. that if the unwanted emissions could be reduced by providing the receivers with *external* devices (e.g. mains filters) which would in no way affect their performance, the C.I.S.P.R. would appear to be qualified to deal with the matter. If on the other hand, a rearrangement of the internal structure of the receiver were required (screening, choice of circuit, voltage levels, oscillation frequencies etc.) liable to affect the receiver's performance in other ways, then the help of C.C.I.R. Study Group No. II should be enlisted.

REPORT BY THE CHAIRMAN OF STUDY GROUP No. III*

(COMPLETE RADIO SYSTEMS EMPLOYED BY THE DIFFERENT SERVICES)

(Original language: English)

1. Introduction.

Study Group No. III held no interim meetings between the Plenary Assembly in London and the coming Plenary Assembly at Warsaw.

As can be seen from the interim report, Study Group No. III took part in the work of Study Group No. XIV by nominating a number of experts as specialists for Study Group No. III.

A proposal has been made by the chairman to expedite the studies by distributing the work. However, no unanimous agreement could be reached. The U.S.A. and the U.K. delegations were not in agreement with the proposal. They hoped to be able to contribute to all questions and study programmes. However so far no contributions have been received from the U.S.A. and only two from the U.K. It is hoped that the practical outcome or perhaps too idealistic an attitude may have changed the point of view somewhat and that at Warsaw we may be able to find a way of co-operating in experimental work acceptable to all concerned.

2. Contributions received.

2.1. Question No. 3. Recommendation No. 98. Study Programme No. 45.

FRANCE. *Theoretical and experimental study of mutual interference of radio systems.* (Doc. No. 174).

This paper is an abstract from a thesis submitted by Mr. J. Villepelet.

Important conclusions can be reached from this document. In the first place it has been shown that the method for calculating the effect of interference as proposed for the first time in the Atlantic City Radio Regulations (resolution relating to the preparation of the new international frequency list, Appendix 1) is a good approximation as long as the attenuation of the interfering signal is greater than ± 20 db. It may be mentioned that this method was proposed by Dr. Llewelyn (U.S.A.) in the Subcommittee responsible for the preparation of the first part of the above mentioned Appendix 1.

A simple formula is given for the slope of the dynamic selectivity curve

$$\begin{aligned} S_d &= S_t + 6 \text{ db/octave} & \text{if } S_t + 6 \leq S_r \\ S_d &= S_r \text{ db/octave} & \text{if } S_r \leq S_t + 6 \end{aligned}$$

Moreover it was pointed out that any improvement in the selectivity of the receiver has little or no effect unless comparable measurements of the filtering at the transmitting end have been taken.

FRANCE. *Channel separation achieved in practice* (Doc. No. 176).

Information is submitted regarding the channel separations used at the French Control Centre at Noiseau. At the same time the difference in received field strength is given for a great number of cases.

NETHERLANDS. *Protection against keyed interfering signals* (Doc. No. 2).

Although marked Study Group No. II, the document is also useful for the studies of Study Group No. III.

Data are given of laboratory measurements with two low power transmitters producing a wanted and an interfering signal. Both signals could be taken as A1 or F1 signals.

In addition, some figures are given for tolerable signal-to-noise ratios.

* Doc. No. 103 (Warsaw, 1956).

ITALY - NETHERLANDS. *Multiplex radiotelegraph system using frequency division with restricted bandwidth (Doc. No. 422).*

Results are given of the test made on the circuit Rome-Amsterdam v.v. with the so-called "madfas" system. It is shown that it is possible to work with a very limited channel separation using two channels at a speed of 100 bauds each.

These contributions make it possible to redraft Study Programme No. 45, part 2, and to give an answer to a number of questions raised on this Study Programme. It seems important to indicate that for the present the major contribution to interference is due to insufficient filtering of the emitted telegraph signal and the frequency tolerances of the transmitters.

2.2. Question No. 81. Study Programme No. 48. Recommendation No. 103.

FRANCE. *Protection from interference obtained in practice with directional rhombic antennae (Doc. No. 175).*

The method of measurement described in Geneva Document No. 23 is used.

The median values of the protection obtained range from 8 db - 16 db.

FRANCE. *Average power gain obtainable through use of a directional antenna as opposed to a dipole (Doc. No. 194).*

Reception of WWV (Washington) is used for these measurements. The results are given as the median value for 10 days of the half-hourly median values for every half hour of the voltages on a feeder of 75 ohms.

The power gain varies considerably during the 24 hours.

UNITED KINGDOM. *Directivity of aerials (Doc. No. 139).*

Thirty bi-directional rhombic aerials arranged in a circle with a mean diameter of about 2000 ft. were used in the measurement. Median values of 20 - 22 db and 23 - 28 db were measured for the protection in the front arc and the back arc respectively. In the front arc measurements in the main lobe were excluded.

FEDERAL GERMAN REPUBLIC. *Improvement obtainable from the use of directional antennae (Doc. No. 17).*

Average signal power gain over a half-wave horizontal dipole was measured.

For WWV signals the median value of the gain was estimated at ≈ 12 db. On the shorter link Darmstadt—Davenport different results were obtained. The discrepancy can be explained by the fact that scattered radiation can be considered as the cause of the disagreement.

FEDERAL GERMAN REPUBLIC. *Directivity of antennae at great distances (Doc. No. 19).*

Azimuthal variations of the incident wave from several stations were measured. In the supplement data were supplied on the same subject but reception from stations over a path in the vicinity of the polar area. For more southern routes a maximum deviation 1.2° was measured while on the northern routes deviations of 2.7° and 4.1° were found.

PEOPLE'S REPUBLIC OF POLAND. *Limitation of the parameters of directional antennae in ionospheric and tropospheric radio communication (Doc. No. 299).*

It is pointed out that the maximum gain that can be obtained by using directional antennae is limited by deviations of the wave in horizontal as well as vertical directions.

A study of this problem is proposed.

NETHERLANDS. *Directivity of antennae used in the frequency band 3-30 Mc/s (Doc. No. 265).*

Values are given of the median gain of rhombic antennae.

For 7.7 Mc/s	13.7 Mc/s	17.6 Mc/s
8.3 db	11.4 db	13.3 db

are considered as values representative of the median gain that can be obtained in practice.

The gain in directions deviating from the main direction was also measured and the results are given.

Moreover it has been shown that by arranging the antennae for suppression in the known direction of an interfering station a suppression of about 8 db can be obtained in practice.

JAPAN. *Directivity of antennae at great distances (Doc. No. 320).*

Measurements were made using the method described in Geneva Document No. 23. The protection measured ranged from 8 db to 20.3 db for several values of the deviation from the

main direction. A deviation of 6° can probably be considered as insufficient to be considered as falling outside the main lobe. The value of 3.8 db corresponding to this deviation is therefore not included in this summary.

JAPAN. *Revision of use of directional antennae (Doc. No. 321).*

A revision of the table in the Annex to Recommendation No. 103 is proposed. A formula is given for calculating the gain of a rhombic antenna.

The results obtained in the contributions on Question No. 81, Study Programme No. 48 and Recommendation No. 103 show a fair amount of agreement. However, certain differences have still to be cleared up. Therefore it is considered that the best way of dealing with the problem is to set up a working group consisting of the delegations which have submitted contributions and to draft a new Recommendation No. 103 at the Plenary Assembly in Warsaw.

2.3. Recommendation No. 99. Recommendation No. 150. Study Programme No. 45.

FRANCE. *Statistical measurements of telegraphic distortion in the presence of noise (Doc. No. 177).*

Data are supplied on the degree of distortion of teletype signals in the presence of noise.

From the data, the figure in the table of Annex I to Recommendation No. 99 for F1 frequency-shift telegraphy 50 baud printer can be verified. The result is between -3 and -4 db if the figures are corrected for a noiseband of 6 kc/s.

FRANCE. *Description of a statistical distortion measuring set (Doc. No. 178).*

This document contains the description of the distortion meter used in the experiments mentioned above.

NETHERLANDS. *Protection against keyed interfering signals (Doc. No. 2).*

Although the title suggests experiments with interfering signals only, data are supplied for tolerable signal-to-noise ratio for 50 baud teleprinter signals. The best combination of receiver passband shift and low-pass filter gives a figure of -4 db for the tolerable signal-to-noise ratio (corrected for 6 kc/s noiseband).

There is a remarkable agreement between the results obtained in France and in the Netherlands. Neither does the figure in the table, although somewhat on the safe side, seem to be unreasonable.

JAPAN. *Interim report on experiments on the minimum value of signal-to-noise ratio necessary for various communication services (Doc. No. 16).*

Interesting data are supplied relating to measurements made for five services.

- A. A1 telegraphy, 24 baud,
- B. F1 telegraphy, 50 baud printer,
- C. F1 telegraphy, 171 baud printer,
- D. Facsimile (radio photo) A4,
- E. Facsimile (Hellschreiber) F4.

As pointed out in the interim report, there appear to be considerable discrepancies with earlier data, on which the table in Annex I to Recommendation No. 99 was based. The difficulty could perhaps be solved in a discussion at the Warsaw Plenary Assembly.

PEOPLE'S REPUBLIC OF POLAND. *Minimum signal distortion and noise power in linear filters (Doc. No. 212).*

A theoretical contribution to the problem. One of the conclusions reached is that the so called "white noise" is the most unfavourable kind of noise.

PEOPLE'S REPUBLIC OF POLAND. *Quality measure of Chebyshev filters (Doc. No. 204).*

A relation is obtained between external interference and the linear distortion caused by the filters. This relation is dependent only on the number of tuned circuits of the filters and of course on the position of the interfering station.

2.4. Question No. 84.

FEDERAL GERMAN REPUBLIC. *Determination of the maximum interference levels tolerable in complete systems. (Doc. No. 18).*

A list is given of limit values for interfering voltage, interfering field strength and HF power, obligatory in the Federal German Republic.

The view is expressed that sound and television broadcasting services are the most susceptible radio services to be protected, because the receivers frequently operate in the proximity of interfering installations.

If this argument is acceptable to the Study Group, a recommendation can be drafted stating that the limit values suitable for sound and television broadcasting services are also suitable for other services.

2.5. Question No. 44. Study Programme No. 47.

Comments by the U.R.S.I. at its General Assembly at the Hague, 1954:

— *On C.C.I.R. Study Programme No. 47. "Communication theory" (Doc. No. 13).*

A definition is given of the information emitted by a source. From this definition it is clear that information is not a physical quantity which can be measured.

The unit of information, e.g. a choice between two equally probable messages (Shannon) is now well established. It is therefore proposed to delete paragraph 2 of Study Programme No. 47.

— *On C.C.I.R. Question No. 44. "Communication theory" (Doc. No. 14).*

A new point is proposed by the U.R.S.I.

"What is the relation between permissible delay and residual uncertainty and how does this depend on bandwidth utilisation"?

— *On C.C.I.R. Recommendation No. 107. "Communication theory" (Doc. No. 15).*

It is suggested that the American papers be reviewed by a member of the American delegation and other papers by a member of the Netherlands delegation. The co-operation could be effected by sending a list of papers before 1st March each year to the respective delegates together with a note on their place in the theory, and whenever possible an abstract. It is suggested that the American delegation should publish the combined list and the Secretariat of the C.C.I.R. the abstracts which have a more direct bearing on communication.

PEOPLE'S REPUBLIC OF POLAND. *The problem of communication when signals and noise are non-stationary Gaussian processes (Doc. No. 211).*

It is not clear how far definite conclusions can be drawn from this study to answer problems put forward in Study Programme No. 47.

PEOPLE'S REPUBLIC OF POLAND. *On the concept of entropy of continuous distributions (Doc. No. 210).*

The fundamental idea of this document is the interpretation of entropy as a measure of scatter. The following conclusion is obtained:

The signal and the noise are suggested to be represented by stationary Gaussian processes. In that case the linear filter gives the absolute minimum of error and nothing better can be achieved by non-linear filters.

NETHERLANDS. *Communication theory (Doc. No. 348).*

In this document an endeavour is made to answer Question No. 44. It is shown that as it stands the question cannot be answered, because an exchange between bandwidth and power is always possible. If the power is given, the maximum channel capacity can be obtained by using a telegraph code with two distinguishable amplitudes.

2.6. Question No. 83. Study Programme No. 50.

FEDERAL GERMAN REPUBLIC. *The use of radio circuits in association with 5-unit start-stop telegraph apparatus (Doc. No. 11).*

A new telegraph system is proposed with 10 elements per signal particularly suited for use in one-way (broadcast) radio circuits.

Attention is drawn to London Document No. 285 in which the conclusion is reached that 6-unit and 7-unit systems are sufficiently reliable, only if an ARQ (automatic request) device is used.

FEDERAL GERMAN REPUBLIC. *The use of radio circuits in association with 5-unit start-stop telegraph apparatus (Doc. No. 12).*

In a former contribution of the Federal German Republic the errors of six different telegraph systems were compared (London Document No. 285).

In this document the results are presented in a form in accordance with Study Programme No. 50, paragraph 3.

UNITED KINGDOM. *The use of radio circuits in association with 5-unit start-stop telegraph apparatus (Doc. No. 138).*

This document contains the data obtained in a considerable number of tests with 7-unit code ARQ systems on the circuit United Kingdom - Ascension Island and back. The undetected error rate (transpositions) and the number of rejections have been tabulated.

3. **Meetings:** none.

4. **Proposals for new Recommendations.**

No definite drafts for new recommendations or study programmes are given at this moment. However, it is expected that the discussions in Warsaw will clarify certain remaining uncertainties and will enable the Study Group to frame a number of new recommendations and redraft some of the study programmes.

A short review of what can be done follows.

4.1. *Study Programme No. 45.*

Paragraph 2 can be redrafted and simplified in view of the contributions received.

4.2. *Question No. 44.*

An answer to this question can be drafted. It may be usefully pointed out that any technical method to restrict the bandwidth necessarily occupied fails to have any noticeable effect unless the frequency tolerances of the transmitters are improved appreciably. It is not practical to use a bandwidth as narrow as that occupied of necessity because of the instability of the transmitters and receivers. The fact that many telegraph transmitters use insufficient filtering of the signal lends even more weight to the statement made above. Moreover the instability causes the channel separation to be far in excess of the occupied bandwidth which in turn is, in some cases, many times greater than the bandwidth occupied of necessity.

4.3. *Study Programme No. 47.*

In view of the remarks made by the U.R.S.I. the Study Programme must be redrafted. In the first place paragraph 2 can be deleted; and secondly, a useful purpose might be served by issuing a separate Recommendation giving the definition of the unit of quantity of information as recommended by the Xth General Assembly of the U.R.S.I. (Sydney 1952).

4.4. *Recommendation No. 103.*

The provisional data given in the Annex can be revised in view of the data supplied by a number of administrations.

4.5. *Study Programme No. 48.*

It is proposed to delete paragraph 2 and the note, because it does not seem appropriate to prescribe too detailed a course for administrations. It is obvious that the equipment available has to be used.

4.6. *Recommendation No. 98.*

Some new data have been received; it may thus be possible to give some additional information.

4.7. *Recommendation No. 99.*

The figure in the table given in the Annex can be revised in the light of newly available information.

4.8. *Recommendation No. 104.*

It may be possible to give some additional information.

4.9. *Question No. 83.*

United Kingdom and the Federal German Republic reported on 7-unit code ARQ systems. The results are in good agreement with earlier information such as:

Geneva Document No. 62 (Netherlands),
"Über Beobachtungen und Erfahrungen mit der TOM Anlage", NTZ 1956 Heft 2, M. Corsepius
and K. Vogt.

"Telegraph codes and code convertors", by T. Hayton, C.J. Hughes, R.L. Saunders,
Proceedings of the Institution of Electrical Engineers, Part III 101 (1951), 137 - 150.

"Recent advances in international radio communications", by Irving K. Given, RCA Commu-
nications Inc., a paper delivered at the IRE symposium on global communications, profes-
sional group on communications systems, Washington, D.C., 24 June 1954.

It is believed that a draft recommendation on the use of the 7-unit ARQ system can be prepared
and a number of technical data of the system specified in the interests of uniformity.

An answer from the C.C.I.T. is expected before the opening of the Plenary Assembly in Warsaw
on Questions No. 109 and 110.

4.10 *Question No. 84.*

If the Study Group agrees with the point of view put forward by the delegation of the Federal
German Republic, an answer to Question No. 84 can be drafted.

5. **General Remarks.**

5.1. The number of contributions has been somewhat disappointing. Perhaps a way to
improve the situation can be found. I do not consider the arguments against the distribution of
work very weighty. It might, however, be easier to make some definite arrangement between
a number of administrations whereby a particular question would be tackled during the conference
rather than after it by correspondence.

It is proposed to devote some time to the problems at the next Plenary Assembly in order to
expedite the work. Suggestions from the members of the Study Group on how to organise the
work would be most welcome.

5.2. When no interim meeting takes place, an interim report by the Chairman is in my
opinion of little or no use.

5.3. In Stockholm the organisation of what is now Study Groups Nos. I, II and III was
changed. Before that date the three study groups constituted a single study group. The reason
for establishing three separate groups was that the work was too heavy for a single study group.
This argument still holds true. However, there is a distinct disadvantage in that there is less
co-ordination between the study groups. It may be possible perhaps to combine the favourable
features of both solutions by returning to the idea of one study group, with, however, a number
of permanent sub-groups. If this course were adopted, the question would arise whether the
division into the existing groups is the best or not. A division in accordance with the services
concerned may serve a better purpose.

H.C.A. VAN DUUREN
Chairman, Study Group No. III

REPORT BY THE CHAIRMAN OF STUDY GROUP No. IV*

(GROUND-WAVE PROPAGATION)

(Original language: French)

1. General.

1.1. No meetings of Study Group No. IV have been held since the VIIth Plenary Assembly London 1953.

As Chairman of Study Group No. IV, I circulated on 9th, March 1954 a summary of the work accomplished in London and invited members to pursue investigations in the most promising directions. By a further circular dated 25th October 1955 (No. 773) I recalled the questions to be studied, mentioned the contributions already received or expected, and asked that the investigations be expedited and the results forwarded in due course.

1.2. By circular VO/27 dated 16th November 1955, the Director of the C.C.I.R. recalled the questions assigned to Study Group No. IV, i.e.

Reports Nos. 3, 20 and 21;

Resolutions Nos. 10 and 11;

Question No. 6

Study Programmes, Nos. 51, 52, 53 and 54.

1.3. Eleven administrations, members of the C.C.I.R., have responded by sending thirty-two contributions on certain of the questions enumerated above.

2. Reports Nos. 3, 20 and 21.

No papers have been received on Report No. 3.

Likewise, no direct contributions have been received on Reports Nos. 20 and 21; however, the contributions dealing with Study Programmes Nos. 52 and 54 can be regarded as a partial answer to these reports since in substance the subject matter covered by them is the same. A summary of the contributions is given below.

3. Resolution No. 10 - Extension of the C.C.I.R. propagation curves below 300 kc/s.

3.1. The United Kingdom has submitted a document (Doc. No. 20) recalling that consideration (e) of Resolution No. 10 recognises that "ionospheric reflections on the frequencies under consideration may, even in daytime, become of major importance." This must be borne in mind when making use of the curves. In this connection, I would point out that paragraph 2 of Resolution No. 10 invites Study Group No. IV to seek information from Study Group No. VI. As stated in paragraph 3.1. of my circular No. 773 dated 25th October I drew the attention of Study Group No. VI to this point and Dr. Dellinger invited the members of his group to give the matter due consideration.

3.2. It should be borne in mind (see paragraph *i* of the Annex to Recommendation No. 52) that the curves are still applicable when the effect of the ground wave can be separated from that of the sky wave by the use of pulse transmissions.

A joint meeting of Study Group No. IV and Study Group No. VI might advantageously be held during the VIIIth Plenary Assembly for the study of this question.

4. Resolution No. 11 - Publication of ground-wave curves between 30 and 300 Mc/s.

As stated in Circular No. 773 (paragraph 2.1.), the curves were published in February in the form of a well-compiled and inexpensive atlas. The copies ordered are now being despatched and I am confident that by the time the VIIIth Plenary Assembly takes place the task of the Secretariat of the C.C.I.R. will have been brought to a praiseworthy conclusion.

* Doc. No. 104 (Warsaw, 1956).

5. Question No. 6 - Ground-wave propagation.

5.1. This question, sub-divided into several Study Programmes, has been dealt with for ultra-short waves in a contribution by the Compagnie Générale de T.S.F. (Doc. No. 393) "The various theories of the propagation of ultra-short waves beyond the horizon."

5.1.2. This is a summary of an article entitled "La propagation des ondes métriques et centimétriques - Détermination de l'équivalent de transmission" published in the *Annales de Radioélectricité*, Volume IX - No. 37, July 1954, in which the author refers (Annex 1) to the knife-edge diffraction theory and uses it (Annex 2) to determine the field beyond the horizon. A simple assumption regarding the distribution of the field in the vertical plane equidistant from the transmitter and the receiver is used as a basis for the calculation.

In this way the author eventually obtains formulae which appear to be valid judging by the results of the measurements made, particularly in the U.S.A. (Bullington - PIRE, January 1953) and which coincide, to within a few decibels, with the Stockholm curves (London Doc. No. 201).

5.1.3. The article in the *Annales de Radioélectricité* provides a very detailed analysis of the various modes of ultra-short wave propagation, and is further reinforced by numerous nomograms designed to facilitate its application.

5.1.4. Because of the ever-growing importance of ultra-short waves in practical application it is to be hoped that discussion of Doc. No. 393 will further our knowledge of their propagation.

5.2. The PTT Ministry of the Federal German Republic has submitted two contributions (Doc. No. 96 and supplement) to Question No. 6 para 2, and Study Programme No. 54 "The effect of hills and other obstacles on the diffraction of waves in the horizontal and vertical planes."

5.2.1. These two contributions are intended to make it easier for engineers to predict variations in the intensity and phase of the electrical field propagated over irregular terrain.

To that end simple laws derived by approximation from more rigorous laws and confirmed by numerous measurements, are proposed.

These contributions are thus a real help to the technician in obtaining simple solutions to complex problems often regarded as theoretically insoluble.

The twelve extremely clear figures annexed make for easier understanding of the rules proposed and enhance the usefulness of the contributions.

5.2.2. A supplement to the above contribution prepared by the "Nordwestdeutscher Rundfunk" contains an interesting diagram showing the way in which the electrical field varies with the land profile for the 90.6, 217.26 and 485 Mc/s bands, with the fields referred to a radiated power of 1 kW.

The theoretical field according to the FCC is likewise shown. The best agreement is obtained for the 90.6 Mc/s band.

6. Study Programme No. 51 - Effect of tropospheric refraction on frequencies below 10 Mc/s.

6.1. This programme deals with the frequencies covered by Recommendation No. 52 "Ground wave propagation curves below 10 Mc/s".

As stated in the Annex to the Recommendation, the curves have been calculated for the actual radius of the earth and a homogeneous atmosphere, for application, in particular, as navigational aids for which pulse transmissions are used.

Two contributions have been received: one dealing with the experimental aspect of the matter, from France, and one, theoretical, from the United Kingdom.

6.2. The French contribution (Doc. No. 196) gives the result of field recordings made daily from 0800 - 2400 hours across the sea, over paths 10 and 230 km long on 1554 Mc/s during a period of three months beginning August 1955. It was observed that the field varied but little (6 to 10 db) and that the influence of the troposphere was very slight (See Annexes 1 and 2).

6.3. The United Kingdom contribution (Doc. No. 23) raises rather a delicate problem by stating that the linear variation of the atmospheric refraction index observed near the surface of

the earth may safely be assumed to continue for several wavelengths above the surface of the earth for high frequencies; but that this condition no longer holds for the very low frequencies. It is shown that the diffraction theory does not produce, at the lowest frequencies, the results expected with a homogeneous earth, taking account of the decreasing influence of tropospheric variations on these frequencies. Hence further detailed study should be devoted to the matter.

6.4. As a theoretical contribution to paragraph 2 of Study Programme No. 51, Annex 1 to the present report describes a method for deducing from the curves in Recommendation No. 52 (plotted for $k = 1$) the field corresponding to any tropospheric index k . The method is based on Bremmer's theory summarised by formula (31) in his work.*

7. Study Programme No. 52 - Temporal variation of ground-wave field strengths.

7.1. The United Kingdom has submitted a Report (Doc. No. 140) as a supplement to London Doc. No. 96 based on measurements (made between March 1950 and April 1954 at Kingswood Warren, Surrey) of the field produced by Droitwich on 1088 kc/s at a distance of 175 km. The measurements confirm the conclusions in Report No. 20 that the variations observed were due to the conductivity of the sap in the trees rather than to that of the ground. It seems that the influence of the troposphere can be discounted.

7.1.1. In view of the poor conditions of medium-wave reception prevalent at present, the United Kingdom proposes that the relevant research work should be carried out by the URSI rather than by the C.C.I.R.

7.2. As regards the influence exercised by the troposphere (see 6.2. above) the measurements carried out by the French Administration (Doc. No. 182) over the Nice-Ajaccio sea path reveal that influence to be very slight on 1554 Mc/s.

7.3. In this same document, the French Administration states that for this path the field remained practically stable from week to week but that variations of 6 db were observed in the course of the same day or from one day to the next. No definite correlation could be established with meteorological phenomena.

7.4. The F.P.R. of Yugoslavia (Doc. No. 220) regards temporal variations of the field strength as a consequence of the variations in the electrical constants of the ground with temperature, and makes an analysis of their influence on the Sommerfeld numerical distance, using the electro-chemical laws governing the variation of resistivity and of the dielectric constant of the various constituents of the ground.

7.4.1. These theoretical concepts are applied to mixed paths at identical and different temperatures; it is shown that the overall numerical distance may increase or decrease with temperature.

It is stated that the attenuation factor of a given path can be represented as a function of temperature.

The application of these principles to the measurements submitted by Switzerland in London Doc. No. 335 would show a satisfactory agreement.

7.4.2. The matter has been dealt with in greater detail by Mr. Argirović in the *Annales des Télécommunications*, Volume 10, No. 5, May 1955.

7.5. In Doc. No. 274, the Netherlands Administration summarises a number of measurements made over extremely varied paths.

The document reveals that temporal variations are subject to seasonal influences due to plants; this would appear to confirm the deductions made by Switzerland and the United Kingdom on absorption by tree leaves during the summer months.

7.5.1. It is further pointed out that this effect may be concealed by the appearance or disappearance of a reflected ray caused by some irregularity of the terrain. The matter will be referred to again in the paragraph devoted to Study Programme No. 54.

7.6. In Doc. No. 24, the Federal German Republic reports on the measurements taken (since February 1954) of the field produced by the transmitter at Frankfurt (593 kc/s at 35 km) and Wolfsheim (1016 kc/s at 42 km).

* H. Bremmer - Terrestrial Radio Waves - 1949, page 145.

By taking all the measurements at 1300 hours, the influence of the space wave was eliminated

7.6.1. The fields of the two transmitters were also used to determine the conductivity and the dielectric constant of the ground. The modulus ρ and the phase φ of the relation (E_x/E_y) between the horizontal and vertical components of the Zennek elliptical field were determined, and the values of σ_{eff} and ϵ_{eff} deduced there from by the relations

$$2\sigma_{\text{eff}}/f = \frac{\sin 2\varphi}{|\rho|^2} ; \epsilon_{\text{eff}} = \frac{\cos 2\varphi}{|\rho|^2}$$

7.6.2. For a stratified ground the values of σ and ϵ thus calculated must be modified in accordance with the dielectric constants and the thickness of the two layers by means of the J. Grosskopf procedure.*

7.6.3. The measurements are set out in two graphs, one for the Frankfurt (593 kc/s) and one for the Wolfsheim (1016 kc/s) transmissions, showing the behaviour of the field, of σ_{eff} and ϵ_{eff} from February 1954 to May 1955. A seasonal variation of the three quantities is revealed, showing however, contrary to the results obtained elsewhere, that the field is maximum in winter and minimum in summer.

7.6.4. The negative value of ϵ_{eff} at the lowest frequency (593 kc/s) should be noted since it seems to indicate the existence at the reception point of a highly conductive layer under the sandy soil of the surface; this is further confirmed by the decrease in conductivity at the highest frequency.

An explanation of these anomalies has likewise been sought in the density and level of underground water and in rainfall.

7.6.5. The above considerations lead one to foresee the establishment of a new branch of radio, i.e. *radiogeology*.

8. Study Programme No. 53 - Ground-wave propagation over mixed paths.

This matter is of interest to a number of administrations. Numerous contributions have been received.

8.1. The People's Republic of Poland (Doc. No. 217) has submitted an interesting set of measurements made at the mouth of the Oder of the field emitted by the broadcasting station at Szczecin (Stettin) operating with 50 kW on 1304 kc/s. All possible precautions were taken to achieve reliable results.

Very varied grounds, but for the most part free from obstacles, were selected in six different directions.

8.1.1. The results obtained and the values calculated using the Millington, Sudy and Feinberg methods are given very clearly in a set of diagrams. As a general rule, the Millington method provided the best agreement.

8.1.2. Further, a much greater increase in the field at the point of passage from land to sea was observed than that forecast by the three theoretical methods above.

8.2. Two contributions have been received from the Federal People's Republic of Yugoslavia, i.e.

- a) Ground-wave propagation over mixed paths - equivalent conductivity method (Doc. No. 221);
- b) Calculation of the ground-wave phase constant (Doc. No. 222).

8.2.1. In the first document, Mr. Argirović recalls his contribution to the VIIth Plenary Assembly and states that his method has been checked over a number of different cases, i.e. mixed paths with varying degrees of conductivity, paths with several different conductivities, long distance paths, paths over irregular terrain, etc. Excellent agreement was obtained in every case.

8.2.2. A less satisfactory agreement was obtained in the case of $A = \frac{1}{2\rho}$ using the expression $\sigma_e = \sqrt[n]{\sigma_1 \sigma_2 \dots \sigma_n}$ as the equivalent conductivity, which according to Annex 1 to my report to the VIIth Plenary Assembly** render, for great numerical distances ($\rho > 15$), the equivalent

* J. Grosskopf- Bodenleitfähigkeitsmessungen in Schleswig Holstein - F.T.Z. - A.2 - N. 7, July 1949.

** Page 76, Volume II, Documents of the VIIth Plenary Assembly of the C.C.I.R.

conductivity method identical with that of Millington. It may be concluded therefrom that these two methods are invalid for great numerical distances; this argument will be further developed in the section dealing with the United Kingdom contributions (see § 9).

8.2.3. In Doc. No. 222, Mr. Argirović again reverts to his previous publications when deducing the overall phase constant of a mixed path from partial numerical distances (Divided into two types, i.e. capacitive and resistive). An example of the application of this theory is given in the article entitled "Variations de la constante de phase de l'onde de sol" in "*L'onde électrique*", No. 340, July 1955. No experimental confirmation is adduced.

9. The United Kingdom has submitted two contributions the first of which (Doc. No. 230) confirms the existence of coastal reflection of the waves at the moment of passage from land to sea, due to different conductivities.

9.1. A conventional Decca Navigator master transmitter was carried in a ship whose position was to be fixed. The signal was received at a slave site ashore from which a phase-locked transmission at a simply related frequency was returned to the ship. A receiver in the ship brought the master and slave signals to a common frequency at which the phase was compared. Comparison of the phase difference with that calculated on the assumption that the path was entirely over sea revealed the influence of coastal reflections.

9.2. The second contribution by the United Kingdom (Doc. No. 25) contains a particularly interesting review of the progress made in the study of mixed paths since the VIIth Plenary Assembly.

A good description of the state of the work is given in Recommendation No. 109; an analysis is made in the U.K. document of the various processes, with special attention devoted to a comparison of the Millington and the equivalent conductivity methods.

9.2.1. A conclusion is reached that the two methods provide very good agreement for numerical distances up to 3*. No experimental results are available for numerical distances greater than 15.

9.2.2. A further comparison was effected by using the two methods for determining the phase change over a mixed path. The Millington method gave the better agreement.

9.2.3. Finally, while the Millington method is considered to be the more satisfactory of the two, it is admitted that the equivalent conductivity method provides a more convenient way of determining the field strengths at medium and low frequencies over land paths which do not contain any great changes of conductivity and are not more than about 200 km long. For distances up to 100 km the Eckersley method can likewise be used.

The conclusions would appear to be justified.

9.3. The Japanese Administration has submitted three contributions on a method worked out by K. Furutsu:

a) a brief summary of the mathematical development of the method (Doc. No. 255),

b) a very detailed report on the calculation of field and phase for mixed path propagation (Doc. No. 322),

c) a report on the measurements made to test the method (Doc. No. 340).

9.3.1. Doc. No. 255 describes the procedure for solving the problem of propagation over ground discontinuities on a plane or round earth, and the cases for which the theoretical results can be used: for the longer distances, the series converge more rapidly.

9.3.2. Doc. No. 322 is a fairly complicated thesis on the formulation of the problem and on a rigorous three-dimensional solution to it. In the introduction it is stated that the document is based on a rigorous solution of the electro-magnetic equations in three dimensions under several boundary conditions for a plane earth and a spherical earth; the calculation methods are partly empirical and difficult to explain.

By calculating the basic functions numerically it has been possible to prepare charts for the determination of the fields received.

9.3.3. The charts for four typical mixed paths, annexed to the document, are given in a form suitable for practical application. They show the attenuation in respect of the field E_0 in free space in terms of distances r_1 and r_2 (from the point of separation of the media), of the conductivity and the wavelength. The abscissa gives the Sommerfeld numerical distance for a path wholly over land, and the ordinate the attenuation $A = E/2E_0$.

* From the above Annex it would appear that the agreement is likely to be maintained for numerical distances of up to 5

9.3.4. Doc. No. 340 is a report on measurements made on 1.85 Mc/s with a "Loran" pulse transmission, thereby separating and eliminating the space wave, and on 2.5 and 4 Mc/s using the Japanese standard-frequency transmission (JJY).

In principle the measurements were taken over a period of four hours around midday, when ionospheric absorption is at its maximum; further precautions were taken to eliminate the influence of abnormal tropospheric conditions.

9.3.5. The results of measurements over homogeneous paths have confirmed K.A. Norton's curves (PIRE 1936 and 1941) which were used as a check.

9.3.6. The influence of a stratified terrain which reveals itself as a change in conductivity with frequency has been noted.

9.3.7. Finally, the extensive measurements made over two mixed paths, i.e. land-sea-land and land-sea, 100 to 200 km long, have provided a means of comparing the various methods of calculation, viz, those of Millington, P.P. Eckersley, Somerville and K. Furutsu.

9.3.8. The following conclusions have been drawn:

- a) for homogeneous paths, excellent results can be obtained with the K.A. Norton method even over hills 100 or 200 metres high;
- b) a sharp variation of field strength on crossing the dividing line in mixed paths is very apparent;
- c) this effect is best confirmed by the Furutsu theory;
- d) the extent of the exposed area of the sea bed with the changing tide (from high tide to low tide), even if as much as 2 km wide, has no effect on the field.

9.3.9. It is intended to pursue the tests with a view to establishing a more reliable and well founded theory.

9.4. Examination of the contributions so far received shows that the problem of mixed paths is well synthesised in Recommendation No. 109, the various points of which have, as a general rule, been confirmed by these contributions.

Much important progress has been made as a result of the Japanese investigations which, if their true worth is to be brought out, should, in my opinion, be given the most detailed consideration both from the technical and theoretical points of view.

9.5. In the field of recent technical literature, an article by our colleague H. Bremmer linked with Study Programme No. 53 and published in "Physica" (August 1954), entitled "The extension of Sommerfeld's formula for the propagation of radio waves over a flat earth to different conductivities of the soil" should be mentioned.

10. Study Programme No. 54 - Ground-wave propagation over irregular terrain.

10.1. The Czechoslovak contribution (Doc. No. 416) contains a summary of an article by P. Beckmann published in "Slaboproudy Obzor" (1954, No. 8) entitled: "Diffraction of metric waves at mountain ridges, elongated hills and other obstacles."

The author sets out

- a) to derive the results of the Fresnel theory for radio-wave propagation;
- b) to tabulate them in a form directly applicable in practice;
- c) to investigate the case when the screen is not perpendicular to the direction of propagation;
- d) to take account of atmospheric refraction.

10.1.1. The paper contains an amplitude and phase table for the relation $E/E_0 = f(v)$, where v is the well known diffraction coefficient:

$$v = h \sqrt{\frac{2}{\lambda} \left(\frac{1}{d_1} + \frac{1}{d_2} \right)}$$

The values of the coefficient v considered are comprised between -5 and $+8.5$ (steps of 0.1).

10.1.2. Theoretical investigation of the case where the diffracting edge of the screen is not perpendicular to the direction of propagation shows that, if the edge is sufficiently distant from

the transmitter and the receiver, the diffracted field is independent of the angle between the two directions. This likewise holds good for a screen of great but finite length if it intercepts the same number of Fresnel ellipsoids in the various directions; this has been confirmed by measurements at an angle of 50°.

Measurements of the field at eleven points masked by a mountain ridge and by a seven-storey building have confirmed the calculations.

10.1.3. In substance, the contribution once again proves the validity of the Fresnel diffraction theory under the conditions recalled in London Report No. 21 (para 1.1 (a))

10.2. In Doc. No. 22 the United Kingdom stresses first and foremost the obstacle gain often observed whereby a greatly increased field strength is obtained beyond a high mountain ridge compared with the signal that would be obtained for the same distance over a smooth round earth. The implication is that the lower wave-front, which is cut off by the mountain, would in the absence of the mountain, produce a diffracted field which largely cancels the field due to the upper wave-front*.

10.2.1. The low diffraction field observed for a smooth round earth must be attributed to the almost total cancellation of the field (produced by the wave front well optical from the stations in correspondence) by that produced by the front nearer the ground. A check—either theoretical or experimental—should therefore be made to ascertain whether interposed small obstacles, by preventing the cancellation described above, could increase the field received.

10.3. In the contribution of the Netherlands Administration (Doc. No. 274) already mentioned in 7.5, study is made of paths over slightly irregular terrain; the variations in the measured field are attributed to the presence of obstacles which determine the appearance or disappearance of the reflected wave, or to partial or total occultation of the first Fresnel zone.

10.4. The PTT Ministry of the Federal German Republic has submitted a contribution to Study Programme No. 54 (Doc. No. 96), already examined under point 5.2. (Question No. 6 - para 2). The importance of the investigations carried out and the results obtained must be stressed; the rules, generally very simple, for the solution of practical problems in VHF radio communication are thereby confirmed.

In the twelve figures annexed the adapted (simplified) theoretical results are compared in a very clear way with those obtained through experiment.

10.5. In Doc. No. 183 the French Administration examines the effects of irregular terrain from the standpoint of:

- the influence of obstacles (attenuation or gain),
- the influence of ground reflection,
- the influence of absence of obstacles around the antennae,
- the influence of the profile and nature of the ground and vegetation,
- the influence of temperature inversions near the ground,
- duct effects due to obstacles in towns and mountain ranges,
- propagation in underground galleries and mine shafts.

10.5.1. For frequencies between 225 and 400 Mc/s the influence of screens at distances below 20 km is, in general, in conformity with the predictions obtained with the formulae derived from Fresnel's classic formula for knife-edge diffraction. A notable exception was obtained for three receivers sited immediately beyond a path over salt lakes and marshes for which the measured field was 6 to 14 db lower than that calculated.

10.5.2. On 91.6 Mc/s for distances of 190 km, with screens from 500 to 1450 metres high visible from both ends, a gain of 10 to 15 db was obtained over the field observed for a neighbouring maritime path free from obstacles; this would seem to confirm the beneficial effect of obstacles visible from both ends of the circuit.

10.5.3. The influence of SHF reflection led to field instability whenever there was reflection by the ground.

10.5.4. The absence of obstacles in the vicinity of the antennae was found to be a factor of paramount importance; rules were evolved for defining the antenna height as a function of the surrounding terrain.

* This effect has long since been noted in Italy; L. Sacco - Ricerche sulla propagazione terrestre delle onde metriche - Bollettino dell'I.S.M.T. - 1940 - N.5 - 6, page 194.

10.5.5. The influence of the profile and nature of the ground is rather more complex for distances of some hundreds of km, since in such cases the meteorological state of the lower atmosphere plays an important part.

10.5.6. The focusing effect was verified for a case where the ground adjoining the antenna sloped slightly in the direction of the transmission.

10.5.7. A duct effect due to rock walls was observed when the two terminals were in a direct line of vision with a rock suitably sited.

10.5.8. A very high degree of absorption was observed in tunnels on frequencies of 80 Mc/s

10.5.9. Attention is drawn to a theoretical paper by Mr. Poincelot providing for extension and application to certain problems of radio-wave diffraction.

10.6. The Radio Research Laboratories of the Japanese Administration have submitted a Report (Doc. No. 323) entitled "Ground-wave propagation over irregular terrain", which though of a mathematical nature, is facilitated in practice by seven nomograms covering the most interesting cases of diffraction by a spherical earth for different conductivities and by mountains of spherical or cylindrical shape. The studies of O.S. Rice and Furutsu are used for the purpose.*

10.6.1. As regards diffraction by spherically shaped mountains whose radius of curvature is naturally much smaller than that of the earth, the attenuation consists of three terms, the first being the knife-edge diffraction, the second a function of the radius of the mountain's curvature and the diffraction angle, and the third which depends, in addition, on the electrical constants of the ground and on polarisation. In practice, the third term disappears at very high frequencies.

10.6.2. The Radio Research Laboratory has also submitted a paper originally intended as a contribution to Study Programme No. 79 (Study Group No. V) but equally applicable to Study Programme No. 54 of Study Group No. IV, entitled "Report on the diffraction effect of mountains for VHF and SHF radio communication" (Doc. No. 325). The results of numerous experiments carried out around Mount Fuji are given together with the following conclusions.

10.6.3. Good agreement was obtained between the measurements and the values calculated using the knife-edge diffraction formulae for the summits and sides of mountains, particularly in the case of VHF. These frequencies seem eminently suitable for radiocommunication in mountainous countries like Japan because of the obstacle gain as described in the United Kingdom contribution (see 10.2. above).

10.6.4. The document also deals with fading in weak reception areas. Stronger and more stable reception areas have been observed; the explanation for this, although partly attributable to tropospheric variations, seems to reside in the profile and the nature of the terrain.

10.6.5. The following documents submitted to the VIIIth Plenary Assembly on matters dealt with by Study Group No. V are of interest to Study Group No. IV :

Doc. No. 160 (Study Programme No. 14) - Propagation formulae and calculation nomograms for VHF and UHF over mountains.

Doc. No. 161 (Study Programme No. 15) - Propagation formulae and calculation nomograms for VHF and UHF over mountains.

Doc. No. 202 (Study Programme No. 15) - Supplementary document to the above.

10.7. I should like to draw attention to the article by O.S. Rice referred to in 10.6. which gives a detailed mathematical conception of the problem of diffraction by cylindrically shaped mountains or hills.

10.8. The October 1955 issue of PIRE (U.S.A.), although in the main devoted to propagation by diffusion due to atmospheric turbulence, contains the following articles bearing on Study Programme No. 54:

Y. Kurihara: Trans-horizon microwave propagation over hilly terrain, page 1362

R.S. Kirby - H.T. Dougherty - P.L. Mc Quate: Obstacle gain measurements over Pike's Peak at 60 to 1016 Mc/s, page 1467.

* O.S. Rice - Diffraction of plane waves by a parabolic cylinder - Bell Technical Journal, March 1954.

K. Furutsu - "Field strength in the vicinity of the line of sight in diffraction by a spherical or cylindrical surface" - Journal of the Radio Research Laboratory, Vol. 3, No. 11, 1956.

11. Question No 49. Recommendation No 108, paragraph 3-

"3. That the possibility of using the concept of c.m.f. at frequencies greater than 30 Mc/s should be studied" (particularly as regards practical utilisation of the curves referred to in Resolution No. 11).

11.1. Two contributions have been submitted by Italy:

11.1.1. The first (Doc. No. 253), describing applications, summarises the advantages of using the concept of c.m.f. for frequencies higher than 30 Mc/s i.e.

a) the maximum c.m.f. (usually the only one of interest) is easily measured for these frequencies; since the fields are very high, a good degree of accuracy can be obtained even with low precision equipment;

b) a known maximum c.m.f. does away with the necessity of measuring the power supplied to, and radiated by, the antenna; it provides a simple and reliable way of confirming calculated values for planning radio links.

11.1.2. The second contribution (Doc. No. 386) puts forward the concept of vectorial c.m.f. and shows that it provides more comprehensive and detailed information than that provided by the concept of radiated power, which, incidentally, can be easily deduced from the vectorial c.m.f. (see Part III of the document).

This consideration is of particular importance for HF communication dealt with by Study Group No. VI.

11.1.3. In this connection, attention should be drawn to a paper by Prof. C. Micheletta published in "Piccole note recensioni e notizie" of the Istituto Superiore PTT in Rome - No. 1, 1956 on "the determination of the c.m.f. of parabolic antennae."

In this paper, by an approximation acceptable in practice, the c.m.f. is expressed geometrically. A method is suggested for determining the c.m.f. as a limit of the product Ed when $d \rightarrow \infty$, by short-distance measurements and the adoption of a correction factor.

12. Draft new question.

In Doc. No. 225 Czechoslovakia proposes the study of a new question for "The determination of the electrical characteristics of the earth's surface." Since the constants σ and ϵ are involved, the words "in the different frequency bands used in radio communication" should, I think, be added.

The considerations of the draft in the above document appear to be valid and would, I feel, provide a useful basis for discussion at the VIIIth Plenary Assembly.

LUIGI SACCO

Chairman, Study Group No. IV

ANNEX I

**APPLICATION OF PROPAGATION CURVES TO FREQUENCIES BELOW 10 MC/S
UNDER VARIOUS TROPOSPHERIC CONDITIONS**

1. The calculation of fields according to either the Bremmer* theory or the C.C.I.R. Atlas of Propagation Curves, 1955, is based on two parameters:

$$\text{Bremmer: } \chi = (2\pi)^{1/3} \frac{D}{\lambda^{1/3} a^{2/3}}$$

$$\text{Atlas: } m = \pi^{1/3} \frac{D}{\lambda^{1/3} a^{2/3}}$$

* H. Bremmer - Terrestrial radio waves - 1949.

$$\delta_e = i \frac{\epsilon_r + i 60 \lambda \sigma}{\sqrt{\epsilon_r - 1 + i 60 \lambda \sigma}} \left(\frac{\lambda}{2\pi a} \right)^{1/3}$$

$$b_{\text{vert}} = -i \frac{\epsilon_r + i 60 \lambda \sigma}{\sqrt{\epsilon_r - 1 + i 60 \lambda \sigma}} \left(\frac{\lambda}{\pi a} \right)^{1/3} \quad (\text{MKS units})$$

1.1. For frequencies below 10 Mc/s the curves in London Recommendation No. 52, pages 42-51, Volume I, VIIth Plenary Assembly, 1953, are valid.

2. For these frequencies (wavelengths $\lambda > 30$ m), often

$$q = 60 \lambda \sigma \gg \epsilon_r ; \text{ for example:}$$

very dry land	:	$\sigma = 10^{-3}, \epsilon_r = 4,$	$60 \lambda \sigma > 9 > 4$	for $\lambda > 150$ m
normal land	:	$\sigma = 10^{-2}, \epsilon_r = 4,$	$60 \lambda \sigma \gg 4$	for $\lambda > 15$ m
sea	:	$\sigma = 4, \epsilon_r = 80,$	„	for $\lambda > 1$ m

2.1. With $q = 60 \lambda \sigma \gg \epsilon_r$, δ_e et and ψ_e become respectively

$$\delta_e = i \sqrt{i 60 \lambda \sigma} \left(\frac{\lambda}{2\pi a} \right)^{1/3}, \quad \psi_e \approx \arctg \frac{\epsilon_r}{q} - \frac{1}{2} \arctg \frac{\epsilon_r - 1}{q} \approx 0.$$

3. The curves under consideration were calculated with $a = R_o =$ geodesical radius of the earth ($2\pi a = 40. \times 10^6$ m), while for cases where the tropospheric conditions justify a hypothetical radius R_{10} different from R_o we should put $a = R_{10} = \frac{R_o}{\alpha}$

3.1. The first of the two parameters thus becomes:

$$\delta'_e = i \sqrt{i 60 \lambda \sigma} \left(\frac{\lambda}{2\pi R_o / \alpha} \right)^{1/3} = \delta_e \cdot \alpha^{1/3}$$

The same result may be obtained by retaining $a = R_o$ and substituting $\lambda' = \lambda \alpha^{2/3}$. Thus

$$\delta'_e = i \sqrt{i 60 \lambda \alpha^{2/3} \sigma} \left(\frac{\lambda \alpha^{2/3}}{2\pi a} \right)^{1/3} =$$

$$= i \sqrt{i 60 \lambda \sigma} \left(\frac{\lambda}{2\pi a} \right)^{1/3} \cdot \alpha^{(1/3 + 2/3)} = \delta_e \alpha^{1/3}$$

3.1.1. The value of δ_e calculated with $a = R_o$ and $\lambda' = \lambda \alpha^{2/3}$ is thus equal to that obtained with $a = R_o/\alpha$ and λ .

3.2. The second parameter, χ calculated with $a = R_o/\alpha$, λ and D becomes

$$\chi' = (2\pi)^{1/3} \frac{D}{\lambda^{1/3} (R_o / \alpha)^{2/3}} = \chi \alpha^{2/3}$$

This value can also be obtained with R_o , λ et $D' = D \alpha^{2/3}$.

By using $a = R_o$ with $\lambda' = \lambda \alpha^{2/3}$ and $D'' = D \alpha^{1/3}$,

$$\chi'' = (2\pi)^{1/3} \frac{D \alpha^{1/3}}{(\lambda \alpha^{2/3})^{1/3} R_o^{2/3}} = 2\pi^{1/3} \frac{D \alpha^{(1/3 - 2/3)}}{\lambda^{1/3} R_o^{2/3}} =$$

$$= (2\pi)^{1/3} \frac{D}{\lambda^{1/3} (R_o / \alpha)^{2/3}}$$

a value which corresponds to $(R_o/\alpha, \lambda, D)$ and also to $(R_o, \lambda \alpha^{2/3}, D \alpha^{1/3})$.

4. Let us recall that the field E is given by the Bremmer formula (1 - IV):

$$E = \frac{300}{D} \sqrt{2\pi} \chi \left| \sum_{s=0}^{\infty} \frac{\exp(i\tau_s \chi)}{2\tau_s - 1/\delta_e^2} \right| = \frac{300}{D} A$$

where τ_s (for $\psi_e \approx 0$) are functions of δ_e only.

The two cases $(R_0/\alpha, \lambda, D)$ and $(R_0, \lambda \alpha^{2/5}, D \alpha^{4/5})$ thus provide identical values of δ_e and λ , and consequently of the factor A .

4.1. The field in the case of $(R_0, \lambda \alpha^{2/5}, D \alpha^{4/5})$ being $E_0 = \frac{300}{D \alpha^{4/5}} A$,

$$E = \alpha^{4/5} \frac{300}{D \alpha^{4/5}} A = \alpha^{4/5} E_0 \quad \text{is immediately deduced.}$$

5. To summarise, the field E_0 corresponding to $\lambda' = \lambda \alpha^{2/5}$ and $D'' = D \alpha^{4/5}$ can be read off from the curves calculated with $a = R_0$. E_0 multiplied by $\alpha^{4/5}$ gives the field E for $(a = R_0, \lambda, D)$ which corresponds to a tropospheric condition characterised by the parameter α .

6. Examples:

6.1. To calculate the field corresponding to $\lambda = 600$ m, $D = 500$ km over the sea and for $K = 1.33$ ($\alpha = 0.75$). The following are obtained: $(0.75)^{2/5} = 0.8913$, $(0.75)^{4/5} = 0.7950$, $\lambda' = 600 \times 0.8913 = 534.78$ m, $D'' = D \times 0.7950 = 397.5$ km. From page 42, Volume I of the Documents of the VIIth Plenary Assembly we get $E_0 = 288 \mu\text{V/m}$, which, multiplied by 0.795, gives 229 $\mu\text{V/m}$ instead of 186 as shown by the curve $\lambda = 600$ m at $D = 500$ km ($\alpha = 1$).

The change in the index K from 1 to 1.33 produces a gain of 1.8 db.

6.2. The same case for dry land $\epsilon = 4$, $\sigma = 10^{-3}$ S/m. In addition we have $60 \times 600 \times 10^{-3} = 36 \gg 4$. From page 46, for $\lambda' = 534.78$ m and $D'' = 397.5$ km, we get $E_0 = 1.10 \mu\text{V/m}$ and hence $E = 1.1 \times 0.795 = 0.875 \mu\text{V/m}$. The same curve $\lambda = 600$ m for $D = 500$ km ($\alpha = 1$) gives 0.562 $\mu\text{V/m}$. The gain due to the change from $\alpha = 1$ to $\alpha = 0.75$ is thus 3.8 db.

6.3. Nice - Ajaccio circuit (Doc. No. 196 submitted by France): frequency 1554 kc/s ($\lambda = 193$ m), $D = 230$ km. The nomogram on page 47 ($\alpha = 1$) gives by extrapolation $E = 500 \mu\text{V/m}$. For $\lambda' = 193 \times 0.8913 = 172.5$ m, $D'' = 230 \times 0.795 = 182.8$ km, we read $E_0 = 890 \mu\text{V/m}$ and hence $E = E_0 \alpha^{4/5} = 890 \times 0.795 = 708 \mu\text{V/m}$.

In this case the gain is 3.04 db for $\alpha = 0.75$ ($K = 1.33$).

6.3.1. If, for the same case, we assume that $\alpha = 0.5$ ($K = 2$), we find $(0.5)^{2/5} = 0.758$, $(0.5)^{4/5} = 0.574$, $\lambda' = 146.5$ m, $D'' = 132$ km, $E_0 = 63$ db or 1415 $\mu\text{V/m}$ and $E = 1415 \times 0.574 = 813 \mu\text{V/m}$, instead of 500 for $\alpha = 1$.

In this case the gain is 4.20 db.

6.3.2. Measurements on a transmission with a power of 100 kW have produced a field oscillating between 4 and 10 mV/m, i.e. between 400 and 1000 $\mu\text{V/m}$ for 1 kW. We have just found a variation of 500 to 813 $\mu\text{V/m}$ for α passing from 1 to 0.5 (K from 1 to 2) with 708 $\mu\text{V/m}$ for $\alpha = 0.75$ ($K = 1.33$). The agreement is satisfactory.

6.4. For a circuit 500 km long, $\lambda = 600$ m, over the sea, with $\alpha = 1.25$ ($K = 0.8 =$ infra-refraction) we have $(1.25)^{2/5} = 1.093$ and $(1.25)^{4/5} = 1.19$, $\lambda' = 654.8$ m, $D'' = 595$ km, $E_0 = 132 \mu\text{V/m}$, $E = 157 \mu\text{V/m}$ as compared with 186 for $\alpha = 1$.

The ratio is thus 0.844 and the gain — 1.47 db.

For dry land (nomogram on page 47), $\epsilon_r = 4$, $\sigma = 10^{-3}$ S/m, we find $E_0 = 0.316 \mu\text{V/m}$, $E = 0.377 \mu\text{V/m}$ as compared with 0.562 for $\alpha = 1$. The ratio is 0.67 and the gain — 3.46 db.

6.4.1. With $\alpha = 0.5$ ($K = 2$), $\lambda' = 600 \times 0.758 = 454.8$ m, $D'' = 500 \times 0.574 = 281$ km. From page 42 we get $E_0 = 562 \mu\text{V/m}$ and $E = 323 \mu\text{V/m}$ versus 186 for $\alpha = 1$. The gain is 4.76 db. The overall oscillation for this circuit, with α changing from 1.25 to 0.5 (K from 0.8 to 2) is $4.76 + 1.47 = 6.23$ db.

7. It may be concluded that the influence of the troposphere on these frequencies ($f < 10$ Mc/s) is slight, at least theoretically.

ANNEX II

APPLICATION OF CURVES IN THE C.C.I.R. 1955 ATLAS TO DIFFERENT
TROPOSPHERIC CONDITIONS

I. Sea Paths ($\sigma = 4 \text{ S/m}$; $\epsilon_r = 80$). Vertical polarisation.

1. For frequencies below 300 Mc/s ($\lambda > 1 \text{ m}$) considered in the Atlas, we have

$$60 \lambda \sigma > 240 > 80 = \epsilon_r$$

giving the same conditions as those considered in Annex I, except as regards the calculation basis, which for the curves in Recommendation No. 52, is $\alpha = K = 1$, and $\alpha = 3/4$ ($K = 4/3$) for the Atlas curves.

1.1. With $\alpha = 3/4$, the parameters become

$$(1) \quad \chi = \text{Const.} \frac{D}{\lambda^{1/3} \left(\frac{4}{3} R_o\right)^{2/3}} ; \delta_e = \text{Const.} \frac{\lambda^{5/6}}{\left(\frac{4}{3} R_o\right)^{1/3}} ; \chi_{12} = \text{Const.} \frac{h_{12}^{1/2}}{\lambda^{1/3} \left(\frac{4}{3} R_o\right)^{1/3}}$$

1.2. Let us try substituting.

$$(2) \quad \lambda' = \lambda \left(\frac{4}{3} \alpha\right)^{2/3} ; D' = D \left(\frac{4}{3} \alpha\right)^{4/3} ; h'_{12} = h_{12} \left(\frac{4}{3} \alpha\right)^{3/3}$$

we shall have

$$(3) \quad \chi' = \text{Const.} \frac{D \left(\frac{4}{3} \alpha\right)^{4/3}}{\left[\lambda \left(\frac{4}{3} \alpha\right)^{2/3}\right]^{1/3} \left(\frac{4}{3} R_o\right)^{2/3}} = \text{Const.} \frac{D}{\lambda^{1/3} (R_o / \alpha)^{2/3}}$$

$$(4) \quad \delta'_e = \text{Const.} \frac{\left(\lambda \left(\frac{4}{3} \alpha\right)^{2/3}\right)^{5/6}}{\left(\frac{4}{3} R_o\right)^{1/3}} = \text{Const.} \frac{\lambda^{5/6}}{(R_o / \alpha)^{1/3}}$$

$$(5) \quad \chi'_{12} = \text{Const.} \frac{\left(\lambda \left(\frac{4}{3} \alpha\right)^{2/3}\right)^{-1/3} \left(h_{12} \left(\frac{4}{3} \alpha\right)^{3/3}\right)^{1/2}}{\left(\frac{4}{3} R_o\right)^{1/3}} = \text{Const.} \frac{h_{12}^{1/2}}{\lambda^{1/3} (R_o / \alpha)^{1/3}}$$

which correspond to the case of $(R_o/\alpha, \lambda, D)$

1.3. Let us recall (see Annex I) that the field obtained from the curves is

$$E = \frac{300}{D} A ; \quad E_o = \frac{300}{D'} A$$

since the factor A, a function of $\lambda', \delta'_e, \chi'_{12}$, is identical in the two cases: $(4/3 R_o, \chi', \delta'_e, \chi'_{12})$ and $(R_o/\alpha, \chi, \delta_e, \chi_{12})$.

We shall then have:

$$(6) \quad E = \frac{300}{D} A = \frac{D'}{D} \cdot \frac{300}{D'} A = \left(\frac{4}{3} \alpha\right)^{4/3} \cdot E_o$$

1.4. From the Atlas we get the value of E_o for

$$(7) \quad D' = D \left(\frac{4}{3} \alpha\right)^{4/3} ; \lambda' = \lambda \left(\frac{4}{3} \alpha\right)^{2/3} ; h'_{12} = h_{12} \left(\frac{4}{3} \alpha\right)^{3/3}$$

which will be:

$$(8) \quad E = \left(\frac{4}{3} \alpha\right)^{4/3} \cdot E_o$$

II. Sea path - horizontal polarisation.

2. For horizontal polarisation and with $60 \lambda \sigma \gg \epsilon_r$, δ_m becomes

$$(9) \quad \delta_m = \left(\frac{\lambda}{2 \pi a} \right)^{1/3} \frac{1}{\sqrt{\epsilon_r - 1 + i 60 \sigma \lambda}} \approx \text{Const.} \frac{1}{\left(\frac{4}{3} R_o \right)^{1/3} \lambda^{1/6}}$$

2.1. Let us substitute

$$(10) \quad \lambda' = \lambda \left(\frac{4}{3} \alpha \right)^{-2}; \quad D' = D; \quad h'_{12} = h_{12} \cdot \left(\frac{4}{3} \alpha \right)^{-1};$$

we obtain

$$\chi' = \text{Const.} \frac{D}{\lambda^{1/3} \cdot \left(\frac{4}{3} \alpha \right)^{-2/3} R_o^{2/3} \cdot \left(\frac{4}{3} \right)^{2/3}} = \text{Const.} \frac{D}{\lambda^{1/3} \left(\frac{R_o}{\alpha} \right)^{2/3}}$$

$$(11) \quad \delta'_m = \frac{\text{Const.}}{\lambda^{1/6} \left(\frac{4}{3} \alpha \right)^{-1/3} \left(\frac{4}{3} R_o \right)^{1/3}} = \frac{\text{Const.}}{\lambda^{1/6} \left(\frac{R_o}{\alpha} \right)^{1/3}}$$

$$\chi'_{12} = \text{Const.} \frac{h^{1/2} \left(\frac{4}{3} \alpha \right)^{-1/2}}{\lambda^{1/3} \left(\frac{4}{3} \alpha \right)^{-2/3} \left(\frac{4}{3} R_o \right)^{1/6}} = \text{Const.} \frac{h^{1/2}}{\lambda^{1/3} \left(\frac{R_o}{\alpha} \right)^{1/6}}$$

2.2. The field E_o given by the curves for $4/3 R_o$, $\lambda' D'$, and h'_{12} will thus equal the field sought.

$$(12) \quad E \left(\frac{R_o}{\alpha}, \lambda, D, h_{12} \right) = E_o \left(\frac{4}{3} R_o, \lambda', D', h'_{12} \right)$$

III. Overland paths - vertical and horizontal polarisation

3. For overland paths $\sigma = 10^{-2}$ S/m, $\epsilon_r = 10$ and $\lambda < 10$ m with the Atlas curves we have $60 \lambda \sigma < 6 < \epsilon_r$ which enables us to put

$$(13) \quad \delta_e \approx \delta_m \approx i \frac{\epsilon_r}{\sqrt{\epsilon_r - 1}} \left(\frac{\lambda}{2 \pi \cdot \frac{4}{3} R_o} \right)^{1/3}; \quad \psi_e \approx \psi_m \approx \text{Const.} \approx 45^\circ$$

3.1. Let us try substituting

$$(14) \quad \lambda' = \left(\frac{4}{3} \alpha \right) \lambda; \quad D' = \left(\frac{4}{3} \alpha \right) D; \quad h'_{12} = h_{12} \left(\frac{4}{3} \alpha \right);$$

we shall get $\delta'_e = \delta'_m = \text{Const.} \left(\frac{\lambda}{R_o / \alpha} \right)^{1/3}$

$$(15) \quad \chi' = \text{Const.} \frac{D \left(\frac{4}{3} \alpha \right)}{\lambda^{1/3} \left(\frac{4}{3} \alpha \right)^{1/3} R_o^{2/3} \left(\frac{4}{3} \right)^{2/3}} = \text{Const.} \frac{D}{\lambda^{1/3} \left(R_o / \alpha \right)^{2/3}}$$

$$\chi'_{12} = \text{Const.} \frac{h^{1/2} \left(\frac{4}{3} \alpha \right)^{1/2}}{\lambda^{1/3} \left(\frac{4}{3} \alpha \right)^{1/3} \left(\frac{4}{3} R_o \right)^{1/6}} = \text{Const.} \frac{h^{1/2}}{\lambda^{1/3} \left(R_o / \alpha \right)^{1/6}}$$

3.2. The value of the field E can be deduced from E_o obtained from the curves for $(4/3 R_o, \lambda, D', h'_{12})$ by the formula :

$$(16) \quad E = \frac{4}{3} \alpha \cdot E_o$$

4. EXAMPLES. The numerical examples which could be examined are restricted by the limit values of the parameters considered in the Atlas (distance D 200 km and height $h_{12} \leq 1000$ metres) while the multiplication factors in α result in higher values, particularly for $\alpha > 1$.

4.1. *First example:* sea path, horizontal polarisation $f = 60$ Mc/s ($\lambda = 5$ m), $D = 150$ km, $h_1 = 1000$ m, $h_2 = 50$ m; $\alpha = 1.25$ ($K = 0.8 =$ infrarefraction).

Substitution (10) is used with $(\frac{4}{3}\alpha)^{-1} = 0.60$; $(\frac{4}{3}\alpha)^{-2} = 0.36$.

4.1.1. The transformed data are $D' = D = 150$ km, $\lambda' = 5 \times 0.36 = 1.8$ m, $h'_1 = 1000 \times 0.6 = 600$ m, $h'_2 = 50 \times 0.6 = 30$ m. From the Atlas we get the field for $D = 150$ km by interpolation: $\lambda' = 1.8$ m between 1.5 m and 2 m, $h'_2 = 600$ m between 500 and 1000 m and $h'_1 = 30$ m between 20 and 50 m.

For $\lambda' = 2$ m, $h'_1 = 500$ m, $h'_2 = 30$ m, we read (page 27) $E = 28$ db.

For $\lambda' = 1.5$ m, $h'_1 = 500$ m, $h'_2 = 30$ m, we read (page 34) $E = 26$ db.

Thus for $\lambda' = 0.8$ m, the mean value $E = 27$ db.

For $\lambda' = 2$ m, $h'_1 = 1000$ m, $h'_2 = 30$ m, we read (page 28) $E = 44$ db.

For $\lambda' = 1.5$ m, $h'_1 = 1000$ m, $h'_2 = 30$ m (page 35) $E = 46$ db. Thus

For $\lambda' = 1.8$ m, the mean value is $E = 45$ db.

On the basis of these two values, i.e. $E = 27$ db for $h'_1 = 500$ m and $E = 45$ db for $h'_1 = 1000$ m, the field for $h'_1 = 600$ m is 31 db.

The nomogram on page 14 gives $E = 46$ db for $f = 60$ Mc/s ($\lambda = 5$ m), $D = 150$ km, $h_1 = 1000$ m, $h_2 = 50$ m and $\alpha = 0.75$ ($K = 1.33$). Since we have just obtained $E = 31$ for $\alpha = 1.25$ ($K = 0.8 =$ infrarefraction), the gain is -15 db.

4.2. *Second example:* overland path ($\sigma = 10^{-2}$ S/m), vertical polarisation; $f = 50$ Mc/s; ($\lambda = 6$ m) $D = 150$ km, $h_1 = 1000$ m, $h_2 = 50$ m and $\alpha = 1/2$ ($K = 2$). Substitution (14) is used; $4/3 \times 1/2 = 0.67$, and E_o is sought for $D' = 100$ km; $\lambda' = 4$ m; $h'_1 = 670$ m; $h'_2 = 33.3$ m. The relevant nomograms are given on pages 139 ($\lambda = 5$ m, $h_1 = 500$ m), 140 ($\lambda = 5$ m, $h_1 = 1000$ m), 146 ($\lambda = 3$ m, $h_1 = 500$ m) and 147 ($\lambda = 3$ m, $h_1 = 1000$ m).

The values obtained from the above source for $D' = 100$ km and $h'_2 = 33.3$ m, are respectively 48.5; 58.5; 51 and 62 db.; with, thus, a mean value of 55 db for $\alpha = 1/2$ ($K = 2$).

The field deduced from pages 133 and 140 ($\alpha = 3/4$) for $D = 150$ km, $h_1 = 1000$ m, $h_2 = 50$ m is 42.5 db for $\lambda = 10$ m and 47 db for 5 m. The value for $\lambda = 6$ m may be assessed at 46 db.

The change from $\alpha = 3/4$ to $\alpha = 1/2$ thus entails a corresponding change from 46 to 55 db, i.e. a gain of 9 db.

4.3. Thus it may be concluded that the troposphere has a greater influence on metric waves than on the longer waves dealt with in Annex I.

REPORT OF CHAIRMAN OF STUDY GROUP No. V*

(TROPOSPHERIC PROPAGATION)

(Original language: English)

1. Introduction.

Some 25 national administrations and 15 operating agencies and other organisations have expressed their interest in the work of Study Group No. V, which is concerned with the propagation of radio waves through that part of the lower atmosphere termed the troposphere. This work is in general confined to frequencies above 30 Mc/s, although there are examples in which waves of lower frequencies are affected by transmission through the troposphere. Because so much of its work is conducted by measuring the field strength of radio waves under various conditions, the Study Group has become the main co-ordinating section of the C.C.I.R. for examining the progress of the technique of field-strength measurement under various conditions.

The Reports, Questions and Study Programmes allocated to the Study Group at the London (1953) Plenary Assembly are listed in the appendix, together with details of the documentary contributions received, at the time of writing this report, from France, Germany, Italy, Japan, Netherlands, Secretariat of the C.C.I.R., and from the United Kingdom. In addition, correspondence between the writer and Mr. E. W. Allen, vice-chairman of the Study Group, contains references to published material in the U.S.A., which will be referred to where appropriate in this report.

2. Reports Nos. 4, 5 and 22 - Measurement of field strength.

These reports, dealing with the technique of field-strength measurement, were drawn up at Geneva in 1951, and No. 22 was revised at London in 1953. They are still considered to represent correct statements on the subject; but recent progress in this subject is dealt with under Study Programme No. 19 (see section 5 below).

3. Question No. 85 - Propagation data required for wide-band radio systems**

A number of reports have been received describing the results of investigating this question, and it is proposed that these, together with any other which become available later, should be co-ordinated during the Plenary Assembly.

The contribution from France (Doc. No. 170) contains the results of measurements made over paths from 70 to nearly 250 km in length on various frequencies from 87 to 3640 Mc/s. While all the paths illustrated are optical, some are over sea and others over mountainous terrain. The fields observed over periods of several months are presented statistically in relation to the free-space values to be expected under the various conditions. In several cases the range of fading experienced for daily and monthly periods is illustrated.

The first (Doc. No. 354) of two documents from Italy attempts an answer to Part 1 of Question No. 85 for a frequency of 2500 Mc/s and an optical path length of 72.5 km, with an overall free-space attenuation of 69 db. The result of about one year's observations shows that the median path attenuation was exceeded by 2, 5 and 12 db for 10%, 1% and 0.1% of the total observation time. The median value appeared to be within ± 2 db of the free-space field. The second contribution from Italy (Doc. No. 353) comprises an examination of propagation conditions over one section, 54 km long, of a 4000 Mc/s wide-band relay system under construction. The path is optical and the first Fresnel zone is well clear of the irregular and mountainous terrain. The

* Doc. No. 105 (Warsaw, 1956).

** Note: In the English version of the printed London Documents, Vol. I, p. 319, the last two lines of (b) should read: "distance for UHF (decimetric) and SHF (centimetric), and up to twice or three times the optical range for VHF (metric)"

observations were made mainly with vertically polarised waves, but experiments confirmed that a change to horizontal polarisation made no difference. Some two months' observations showed that the calculated free-space value of path attenuation was exceeded by 2.5, 6 and 12.5 db for 50%, 1% and 0.1% of the time.

Document No. 367, from Japan, relates to studies of a special case of the diffracted field behind obstacles in the frequency band 3000 to 4000 Mc/s, and at distances ranging from 100 to 160 km. The range of fading of the field strength passes through a maximum for an angle of diffraction of about 4 milliradians and steadily decreases for greater angles (i.e. within the shadow of the obstacle).

The United Kingdom contribution (Doc. No. 142) comprises an account of experience obtained over various sections of the television radio relay links on a frequency of about 4000 Mc/s. Five sections of the system are overland and from 46 to 75 km long, while two are over sea and about 77 km in length. Measurements have also been made over an experimental link, 46 km long over sea on the same frequency. Over all the land paths, the median field strength during several months observations was equal to the free-space value; while over the sea paths there was an increased attenuation of 1 to 3 db. The fading observed was, however, more severe on overseas links than on the overland links. The relevant figures appropriate to the question being studied are therefore as follows: the increased path attenuation over the free-space value for 50%, 1% and 0.1% of the time were 0, 10 and 15 db for land, and about 2, 25 and 30 db for the sea paths. Additional measurements made on a frequency of about 500 Mc/s over a land path of 120 km gave corresponding values of 20, 30 and 34 db.

In all the above cases there was a clear optical path between sender and receiver.

In pursuance of part 2 of Question No. 85, extensive measurements have also been made in the United Kingdom in the VHF band and over land paths, varying from 200 to 600 km in length and on frequencies between 48 and 63 Mc/s. Other measurements have been made on higher frequencies of about 180 Mc/s and over two distances of 153 and 340 km. The results are given in detail in Document No. 142; but as an indication of typical values, in the frequency range 50 to 180 Mc/s, it is seen that at a distance of 350 km the path attenuation has approximate values of 180, 200 and 210 db for 50%, 1% and 0.1% of the total time of observation. It is not considered that sufficient information is yet available to make firm deductions as to the influence on these results of various factors such as season, and type of terrain as required by part 3 of the question being studied.

With regard to part 4 of Question No. 85, the contribution from the United Kingdom suggests that as far as frequencies between 40 and 90 Mc/s in the VHF band are concerned, experience indicates that the C.C.I.R. curves given in Recommendation No. 111 are quite representative of the conditions prevailing. They are transformed in the document to give the path attenuation values exceeded for 1% of the time, and an additional curve for 0.1% of the observation time has been obtained from the more recent results.

The United States of America have drawn attention to the contribution they made in Doc. No. 58 to the VIIth Plenary Assembly in London, 1953, in reporting on Study Programme No. 28 (wide-band radio systems operating in the VHF, UHF and SHF bands) which was then considered by Study Group No. IX. Appended to Doc. No. 58 were reproductions of two papers previously published in the Proceedings of the Institute of Radio Engineers (N.Y.). Annex A gives information regarding the influence of frequency, distance, antenna heights, curvature of the earth, atmospheric conditions and the presence of hills and buildings on radio-wave propagation. Annex B discusses the variations of received signal with location (shadow losses) and with time (fading) which greatly affect both the usable service area and the geographical separation between co-channel stations.

While no specific document has been submitted by the United States at the time of writing, attention is drawn to the large amount of information on the subject of propagation by wave scattering in the troposphere contained in some 30 papers in the special issue of the Proceedings of the Institute of Radio Engineers for October, 1955. The material has not so far been reduced

to a form suitable for a C.C.I.R. report but it is available for study in connection with this Question No. 85, and it is expected that new propagation curves for the UHF band will be available for submission to the VIIIth Plenary Assembly at Warsaw.

4. Question No. 86 - *Measurement of field strength in the neighbourhood of obstacles.*

Both France (Doc. No. 168) and the U.S.A. report that while methods of measuring field strength in the vicinity of trees, buildings, powerlines, etc., have been developed and used by organisations as meeting their individual requirements, none of the apparatus has gained general acceptance. Although the subject is of some importance in, for example, assessing the coverage of a television service in a town or residential district, no specific study appears to have been possible of the effect of obstacles on the structure of the radio field. It is suggested that the Study Group may like to consider whether it is necessary and useful to retain this question on its programme.

5. Study Programme No. 19 - *Measurement of field strength of radio signals.*

The methods and equipment developed in France for field strength measurement for metre and decimetre wavelengths are described in Document No. 169. The classical substitution method is adopted, and the local electromotive force is induced in the receiving aerial even when this is as much as several tens of metres from the measuring equipment. The United Kingdom contribution (Doc. No. 73) includes a bibliography to the papers published during the past few years describing the advances made in apparatus and technique. Since the VIIth Plenary Assembly considerable progress has occurred in the technique of power measurement at centimetre wavelengths. The document points out that at frequencies above about 600 Mc/s, the radio engineer almost invariably makes use of aerials having apertures large compared with the wavelength, and is therefore more concerned with the total power flux across the aperture than with the field strength at any particular point. The United States of America, while not having any additional information to submit at the present time, has indicated that the Institute of Radio Engineers is considering standards for field intensity measurements, but those are not yet available for submission.

6. Study Programme No. 55 - *Tropospheric propagation curves for distances well beyond the horizon.*

The contribution from France (Doc. No. 171), gives the results of observations of the field strengths measured over periods of several months at several receiving stations at distances of from 130 to 750 km on transmissions from Wrotham (over four mixed land and sea paths), Corsica (one oversea path) and Paris (one overland path). The results are expressed graphically in statistical form related to the free-space values of field strength, and should provide a useful addition to the information relevant to the curves given in Recommendation No. 111 (London 1953).

The Administration of the Federal Republic of Germany has described in Document No. 32 the results of the measurements of abnormal ranges of transmission of VHF signals over 22 overland paths using sending stations operating at frequencies near 100 Mc/s. For distances up to 200 km the measured values as a function of distance are somewhat below the London curves (Recommendation No. 111); whereas at greater distances they are above these curves. The differences appear, however, to be no greater than the annual variation of ± 5 db, with a maximum in summer and minimum in winter. There are also diurnal variations of field strength which are most marked in transmission over flat country, the highest values reached in summer.

In Document No. 267 the Netherlands Administration reports that over a period of five months, measurements have been made in Holland of the field strength received from the Sutton Coldfield television transmitter on a frequency of 58.25 Mc/s, and over a distance of 460 km, of which one-third was over sea. The polarisation of the received field was measured, and the ratio of vertical to horizontal field strength was found to be 18 db in all cases when the horizontal field was strong enough to observe. The strengths of the vertical field exceeded for 1% and 10% of the time were somewhat greater than the curves given in Recommendation No. 111; a result which is within the statistical variation to be expected for a mixed land/sea path.

The United Kingdom Document No. 141 describes conclusions drawn from further observations made in the VHF band. For overland paths, the additional information obtained at frequencies between 41.5 and 90 Mc/s has produced no significant modification to the 1% curve in Recommendation No. 111; but an additional curve representing the field strength exceeded for 0.1% of the time is now put forward. Furthermore, with the co-operation of the Netherlands Postal and Telecommunications Services, observations have been made on a sending station in Holland at four sites in the United Kingdom giving oversea paths ranging from 200 to 950 km in length. The results, which refer to a frequency of 94.35 Mc/s, are summarised in graphical form and could be the basis of additional curves for oversea transmission. For 1% of the time this curve is 6 db and 10 db higher than the corresponding land curve at distances of 200 and 700 km respectively.

While no information is available in the United Kingdom on the effect of varying the height of the transmitting aerial (see para. 6 of Study Programme No. 55), some experience has been obtained on the result of varying the height of the receiving aerial. The general conclusion from several sets of observations described in the document is that there is a steady reduction in height-gain relative to the theoretical value for a smooth earth, as the distance between sending and receiving stations increases well beyond the horizon.

7. Study Programme No. 56 - Tropospheric wave propagation.

Several national contributions show that this subject is being actively pursued in accordance with the Study Programme, although it is clearly realised that to obtain a close correlation between radio information and meteorological conditions is very difficult. In Document No. 173, the French Administration suggests that most progress is likely to be obtained by restricting the investigations to a few radio transmission paths, and attempting to study in some detail the refractive index of the atmosphere at heights up to 1000 m at several stations along these paths.

The experimental work being conducted in the Federal German Republic is described in Document No. 31. It is concluded that while there is no direct relation between the values of radio field strength and meteorological data at ground level measured at the same time, a good correlation exists between the daily median value of the field strength and the barometric pressure measured at ground level. A better correlation can be found between the median values of field strength over long periods and the modified index of refraction calculated from measurements at ground level.

The above conclusions are largely confirmed by experience in the United Kingdom (Doc. No. 72), in which it is stated that, save in special circumstances, only a broad and statistically-based correlation between radio propagation characteristics and meteorological conditions is likely to be achieved. It is suggested also that the problem for investigation under this study programme is mainly a meteorological one. What is required is a detailed knowledge of (a) the refractive index/height profiles likely to occur in given air masses; (b) the manner in which these profiles depend upon the history of an air mass before it arrives over the radio transmission path; and (c) the effect on the refractive index profile of the interaction of different air masses. Given this information, it may then be possible to estimate the propagation characteristics in the manner required by the radiocommunication engineer, from a knowledge of the general meteorological situation.

Two other documents submitted by Italy (No. 352) and by the International Broadcasting Organisation (No. 440) describe theoretical studies of the propagation of very short radio waves through a refractive atmosphere to distances beyond the normal optical horizon.

8. Study Programme No. 57 - Investigation of multipath transmission through the troposphere.

Document No. 351 from Italy refers to a paper already published in „Alta frequenza” describing a meteorological investigation at heights less than 500 m above sea-level along a radio link, in connection with which the possibility of wave-focusing and multiple-reflection phenomena is indicated.

A contribution from Japan (Doc. No. 366) described experiments performed with a multi-ray measuring device with a frequency sweep of 3850 ± 250 Mc/s of a similar nature to earlier work carried out at the Bell Telephone Laboratories, U.S.A. It is suggested that a knowledge of separate statistical distributions of path difference (l) and amplitude ratio (ρ) of the various individual paths is of much less value in assessing the effects of multipath transmission than a knowledge of the statistical distribution of the product ρl . If the latter quantity is known, the amount of distortion due to multipath transmission can be conveniently estimated from the magnitude of fading which can be easily measured. This deduction was confirmed by the results of experimental tests made in summer, when multipath transmission was expected to occur most frequently.

A further document (No. 330) from Japan describes a useful method of extracting from a mass of field strength observations the mean signal level and its variance, or any other distribution of field strength with respect to time. The method is equally applicable to the study of ionospheric and tropospheric fading, so that it refers to Study Programme No. 66 of Study Group No. VI as well as to the third paragraph of Study Programme No. 57.

A number of tests carried out at a frequency of 4000 Mc/s on two oversea paths, 58 and 88 km long, are described in Document No. 131 from the United Kingdom. Observations on diversity reception and selective fading were made and the results are deemed to provide some information on the effects of multipath transmissions over sea on centimetre wavelengths. It is, however, clearly necessary for further tests to be made over longer periods and over a variety of paths to provide more representative and conclusive results.

9. Study Programme No. 79 - *Tropospheric propagation across mountain ridges.*

This is a new study programme adopted in February 1955, in accordance with the recognised official procedure. Observations which are relevant to this programme have been continued by the Secretariat of the C.C.I.R. in Geneva, where measurements have been made of the field strengths of signals from two FM broadcasting stations, one in the Federal German Republic at a distance of 308 km and operating on a frequency of 93.0 Mc/s, and the other in Italy at a distance of 296 km and on a frequency of 97.4 Mc/s. The results are given in Document No. 167 in continuation of reports given previously to the Plenary Assembly in London, 1953. A new method of presenting the results along the lines laid down in Recommendation No. 110 has been adopted; and they are expressed in both graphical and tabular form. The results obtained in the first example over a period of 26 months show a log-normal distribution of field strength, with monthly variations ranging up to 10 db or more. Markedly different results of both field strength and fading were obtained in the other case, for which the path was of a quite different profile. An appendix to the document describes an analysis of the effect on fading of the quantity of water vapour in the atmosphere and of the actual form of the cross-section of the obstacle.

Document No. 30, submitted by the Federal German Republic, describes similar measurements made on transmissions from an Italian television station on a frequency of 67.25 Mc/s over a non-optical mountainous path 330 km long. It was not possible to make continuous observations over unit periods of one hour as suggested in Recommendation No. 110; but median values of the field strength over quarter hour periods were obtained daily. During several months' observations, the median values varied over a range of about 12 db with an approximately log-normal distribution. It is estimated that for the conditions of the measurements, the increase in field strength due to diffraction over the path as compared with that which would obtain over a smooth earth was about 20 db, a value supported by the observations.

Two contributions from Japan (Docs. Nos. 324 and 325), describe investigations of propagation over mountain ridges on various frequencies between 60 and 4000 Mc/s and over paths of lengths from 200 to 400 km. The spatial distribution of field strength behind a ridge has been examined and also the variation of field strength with time at different points. It is found that in a region of high field strength the signal obtained is relatively stable and the fading is slight; whereas in a region where the field is normally weak, the signal fluctuates very much with variations in atmospheric refractive index. At frequencies of 60 and 150 Mc/s, the observed field strengths behind a ridge agree quite well with those calculated from the Fresnel knife-edge diffraction

theory described in documents presented by Japan at the London Plenary Assembly (1953). At a frequency of about 3000 Mc/s, the difference between the observed and theoretical results is very much greater than at the lower frequencies, and there was considerably more fading behind the ridge due to atmospheric changes. Under these conditions it is expected that the range of fading could be reduced by using a simple method of diversity reception. It is considered more promising, however, in a country like Japan, to use the VHF band for long-distance communication by waves diffracted over the mountain ridges.

10. Recommendation No. 110 - *Presentation of data in studies of tropospheric-wave propagation.*

This Recommendation refers to the manner in which the results of investigations in radio-wave propagation should be presented in order to secure the maximum guidance and benefit to engineers in the planning of radio services, while at the same time facilitating the scientific study of the dependence of the radio phenomena on meteorological conditions and on the nature of the terrain between sending and receiving stations. The French Administration have made a most useful examination of this recommendation in the light of recent research (Doc. No. 172); and it is suggested that the Study Group should consider the desirability of revising it at the VIIIth Plenary Assembly. In an appendix to the French document, a new method of statistical presentation is suggested to give sufficiently precise and clear information for practical applications. It should also provide a good basis for future scientific studies, and facilitate comparison between radio and meteorological data, which is one of the objects of Study Programme No. 56.

11. Recommendation No. 111 - *Tropospheric-wave propagation curves.*

The new information obtained in the pursuit of Study Programme No. 55 and reviewed in section 6 supports the curves put forward in Recommendation No. 110 for transmission over land. Additional results are now available, however, for propagation over mixed land and water paths and over sea.

It is proposed that the Study Group should endeavour at the VIIIth Plenary Assembly to draw up supplementary curves for 50% and 0.1% of the time for transmission over land.

12. New Recommendations.

a) In view of the additional information which is now available, it is proposed that the Study Group should draft a new recommendation corresponding to Recommendation No. 111, but dealing with the case of propagation over sea. It would appear from section 6 above that a curve could be suggested as applicable to 1% of the time of observation and also possibly for 10% of the total time.

b) The Study Group should also consider whether sufficient information is now available to make a provisional recommendation on the statistical values of path attenuation likely to be experienced in the operation of wide-band radio systems.

R. L. SMITH-ROSE
Chairman, Study Group No. V

APPENDIX

LIST OF DOCUMENTS REFERRED TO IN THIS REPORT

Origin	Subject	Title	C. C. I. R. Document No
VIIth Plenary Assembly London (1953)	Report No. 4	Methods of measuring field strength	—
	» » 5	Measurement of field strength (respective merits of the two main types of equipment now in use)	—
	» » 22	Field-strength measurements (merits of a standard noise generator as the source of the locally-generated signal)	—
France	Question No. 85	Propagation data required for wide-band radio systems	170
Italy (1)	» » »		354
Italy (2)	» » »		353
Japan	» » »		367
United Kingdom	» » »		142
U.S.A.	» » »		—
U.R.S.I.	» » »		29
France	» No. 86	The measurement of field strength in the neighbourhood of obstacles	168
U.S.A.	» » »		—
France	S.P. No. 19	Measurement of field strength of radio signals	169
United Kingdom	» » »		73
France	S.P. No. 55	Tropospheric propagation curves for distances well beyond the horizon	171
Germany (F.R. of)	» » »		32
Netherlands	» » »		267
United Kingdom	» » »		141
France	S.P. No. 56	Tropospheric wave propagation	173
Germany (F.R. of)	» » »		31
Italy	» » »		352
United Kingdom	» » »		72
U.R.S.I.	» » »		28
O.I.R.	» » »		440
Italy	» No. 57	Investigation of multipath transmission through the troposphere	351
Japan (1)	» » »		330
Japan (2)	» » »		366
United Kingdom	» » »		131
C.C.I.R.	S.P. No. 79	Tropospheric propagation across mountain ridges	167
Germany (F.R. of)	» » »		30
Japan (1)	» » »		324
Japan (2)	» » »		325
France	Rec. No. 110	Presentation of data in studies of tropospheric wave propagation	172
—	Rec. No. 111	Tropospheric wave propagation curves	—
—	Rec. No. 112	Best methods for expressing field strength for pulse transmissions	—
—	Rec. No. 113	Field strength measurement (types of wave collector and equipment)	—
—	Rec. No. 114	Field strength measurement (influence of local conditions)	—

REPORT BY THE CHAIRMAN OF STUDY GROUP No. VI*

(IONOSPHERIC RADIO PROPAGATION)

(Original language: English)

General.

All the topics assigned to the Study Group have been examined. The work has been done by correspondence except the collaboration on Recommendation No. 120 reported below. Several topics additional to those assigned on page 381 of the London 1953 Documents Vol. I were studied because: (a) work programmes were included in some Recommendations (Nos. 120, 121); (b) participants submitted contributions on certain other topics (Recommendations Nos. 59, 115, 117, 118).

MATERIAL FOR THE VIIIth PLENARY ASSEMBLY

Study Programme No. 58 and Report No. 25: - Basic index for ionospheric propagation.

This subject has been under study in the C.C.I.R. for many years. The objective is to find and adopt the optimum index for use as a basis of long-time and medium-time predictions of median ionosphere characteristics which determine radio propagation conditions (not including predictions for only one to five days). Much progress has been made, as summarised in Report No. 25, the several contributions to Question No. 53 at the London 1953 Plenary Assembly, and the papers for this Plenary Assembly listed below. The time is apparently not yet ripe for a final decision. It does not yet appear that solar radio noise or any other solar index is certainly superior to the long-used mean relative sunspot number. It seems likely that an ionospheric index, based largely or wholly on the F2 layer, will eventually be found to present the best combination of advantages.

The Plenary Assembly may well continue Report No. 25, revised in the light of the information before it, and continue Study Programme No. 58 with minor changes such as eliminating "solar" from the title and making it clear that this pertains to long-time and medium-time predictions of median values for undisturbed conditions.

U.R.S.I. — Comments at the 1954 General Assembly on Study Programme No. 58 (Doc. No. 88).

United Kingdom — Report on Study Programme No. 58 (Doc. No. 80).

New Zealand — Paper re Report No. 25 (Doc. No. 286).

**Study Programme No. 59, Report No. 26, Resolution No. 13, and Recommendation No. 59:
*Short-time ionospheric forecasts and warnings.***

This has to do with the forecasting of ionospheric conditions for from, say, five hours to five days ahead, and also for the 27-day solar-cycle recurrences. Studies have yielded valuable data in response to Study Programme No. 59, leading to the contributions listed below. These should lead to improved revisions of all four of the items in the above headings; it might perhaps be an improvement to cancel Resolution No. 13 and Report No. 26 and place their substance, revised, in Recommendation No. 59.

* Doc. No. 106 (Warsaw, 1956).

List of contributions.

- U.R.S.I. — Comments at the 1954 General Assembly on Study Programme No. 59 (Doc. No. 87).
- U.R.S.I. — Comments at the 1954 General Assembly on Recommendation No. 59 (Doc. No. 75).
- Federal Republic of Germany — Contribution on Study Programme No. 59 (Doc. No. 78).
- Czechoslovakia — The relationship between the daily sum of the geomagnetic K indices and a certain coefficient, characterising the state of the F2 layer on certain days (Doc. No. 124).
- Czechoslovakia — Index for activity of solar flares and SID (Doc. No. 123).
- United Kingdom — Report—Ionospheric storm forecasting (Doc. No. 79).
- U.S.A. — Report on Study Programme No. 59 (Doc. No. 347).
- U.S.A. — Report re Recommendation No. 59, Comparison of short-term forecasts with observed results (Doc. No. 282).
- U.S.A. — Draft Report, to supersede Report No. 26 (Doc. No. 283).
- U.S.A. — Draft Study Programme, related to Study Programme No. 59, Multipath propagation effects and their reduction (Doc. No. 248).

Study Programme No. 60 and Report No. 23 - Ionospheric prediction data and methods.

This subject, under study by the C.C.I.R. for many years, concerns mainly long-time and medium-time predictions for practical purposes. Much information was presented on this in papers submitted at the 1951 Plenary Assembly in connection with Recommendation No. 14 and at the 1953 Plenary Assembly in connection with Question No. 50 and in Reports Nos. 3 and 23. More recent information is given in papers submitted for this Plenary Assembly, listed below. Hundreds of papers of direct application to this topic have appeared in technical periodicals. Some of the papers listed under Study Programme No. 64 are also applicable.

The methods in wide use for prediction have been used without much change for many years. Ways to improve them are indicated in some of the papers listed here; examples are the replacement of zone charts by world charts for every two hours UT and the more quantitative use of sporadic E data. With the contributions here available the Plenary Assembly can prepare a much improved Report No. 23 and perhaps a Recommendation.

List of contributions.

- U.R.S.I. — Comments at the 1954 General Assembly on Study Programme No. 60 (Doc. No. 86).
- Poland — Study of the possibility of high-frequency long-distance reception at frequencies in excess of the MUF (Doc. No. 301).
- United Kingdom — Report on Study Programme No. 60 (Doc. No. 74).
- United Kingdom — Report on Section 2 of Study Programme No. 60 (Doc. No. 148).
- Japan — Report on Study Programme No. 60 (Doc. No. 81).
- Japan — Experimental confirmation of the influence of ground scatter in long distance propagation (Doc. No. 326).
- Switzerland — Comparisons of predicted data with practical results (Doc. No. 251).
- Federal Republic of Germany — Results gained from pulse transmission tests over a 1320 km path (Doc. No. 242).
- Czechoslovakia — Predictions of relative sunspot number R (Doc. No. 218).
- Czechoslovakia — Predictions of the diurnal curves of critical frequencies $f_F^c(t)$ and $f_E^c(t)$ of MUF and LUF. (Doc. No. 219).
- Czechoslovakia — On the statistics of the occurrence of the sporadic E layer above central Europe. Part 1: Basic treatment and long-term treatment (Doc. No. 83).
- Spain — Contribution on Study Programme No. 60 (Doc. No. 249).
- Spain — Contribution on Report No. 23 (Doc. No. 430).
- U.S.A. — Report on modifications to Report No. 23 (Doc. No. 245).
- U.S.A. — Report on Study Programme No. 60 (Doc. No. 346).
- U.S.A. — Draft Recommendation re Study Programme No. 60 (Doc. No. 246).

Study Programme No. 61 - Non-linear effects in the ionosphere.

The interference to broadcast reception by intermodulation in the ionosphere has continued under observation by various administrations and companies. The study of the basic causation by non-linear effects is the field of a sub-commission (IIIb) of the U.R.S.I. Only one contribution on this topic has been received:

United Kingdom — Report on Study Programme No. 6 (Doc. No. 94).

As proposed by UK, it is recommended that the study of this topic by the C.C.I.R. be discontinued.

Study Programme No. 62 - Special modulation on standard-frequency transmissions for radio propagation measurements.

Standard-frequency transmissions serve many purposes, among them research on propagation. The recording of received intensities would be facilitated by the special modulations proposed. This topic has been under study jointly with Study Group No. VII which is also assigned this topic in Section 6 of Study Programme No. 68. Two papers have been submitted.

United Kingdom — Contribution on Study Programme No. 62 (Doc. No. 146).
Chairmen of Study Groups Nos. VI and VII - Draft Recommendation (Doc. No. 287).

This subject will be dealt with more particularly by Study Group No. VII, as the work to be done by the C.C.I.R. is not the study of propagation but is to provide the means to facilitate such study.

Study Programme No. 63 - Propagation on frequencies below 1500 kc/s.

Information has been accumulated in the researches and in the operations of numerous organisations; some of it has been published in periodical literature. Summaries of some of the progress are given in the contributions;

U.R.S.I. — Comments at 1954 General Assembly on Study Programme No. 63 (Doc. No. 85).

Australia — Interim Report on Medium frequency sky-wave measurements (Doc. No. 77).

Japan — Report on field intensity measurement of Loran waves (Doc. No. 327).

United Kingdom — Report on studies completed since 1st January 1953 (Doc. No. 145).

Germany (F.R. of) — Pulse transmission tests at oblique incidence: field-strength measurements during night-time (Doc. No. 387).

U.S.A. — Night field strengths, 540 to 1600 kc/s (Doc. No. 289).

The information in these contributions bear upon Question (c) in the Annex of Report No. 24. The U.S.A. contribution, in particular, is a step toward the needed replacement of the three night propagation curves adopted at Cairo in 1938.

Study Programme No. 64 and Report No. 7 - Ionospheric propagation at 30 to 300 Mc/s.

This is a very active field, both in respect to research and application. Extensive literature is appearing, notably the entire October 1955 issue of Proceedings of the Institute of Radio Engineers, some 34 technical papers. Reliable long-distance propagation by scattering is now demonstrated to be a very useful addition to the utility of the radio spectrum. At some frequencies and distances, ionospheric scattering predominates, and at others the principal phenomenon is tropospheric scattering. The following contributions have been received:

Netherlands — Draft Recommendation, Ionospheric scatter propagation (Doc. No. 378).

United Kingdom — VHF propagation by scattering from the ionosphere (Doc. No. 155).

Czechoslovakia — Possibility of long-duration propagation of radio waves around the earth on the lower boundary of the F - layer (Doc. No. 122).

The contribution of Czechoslovakia on sporadic E statistics (Doc. No. 83) is regarded by that country as pertaining more to Study Programme No. 64 than to Study Programme No. 60, Section 3, under which it was issued. It, and some of the papers from other countries also, may well be considered under both.

The material available should lead to a new Report to supersede Report No. 7.

Study Programme No. 65 - Measurement of atmospheric radio noise.

Although this is a basic and extensive field of study, only a few contributions have been received. They are:

- URSI* — Comments at the 1954 General Assembly on Study Programme No. 65 (Doc. No. 93).
- India* — Contribution on Study Programme No. 65 (Doc. No. 143).
- Japan* — Report on Study Programme No. 65 (Doc. No. 328).
- U.S.A.* — Report on Study Programme No. 65 (Doc. No. 345).

In addition, the World Meteorological Organisation compiled and made available the results of a world-wide survey of the frequency of occurrence of thunderstorms. This was in two parts: 1. Tables showing the number of thunderstorm days for land stations throughout the world; 2. Marine data tables and world maps of monthly, seasonal, and annual distribution of thunderstorm days. These two parts are large pamphlets, sold by the W.M.O. at 9 Swiss francs each. They are very useful for comparison with atmospheric radio noise data.

The progress on radio noise measurement (some of it in response to Recommendation No. 119), is fortunately such as to insure the availability of good methods and equipment for extended surveys to be made during the International Geophysical Year, 1957-58.

The material available should make possible the preparation of a useful Report.

Response to Section 6 of this Study Programme is given below under Recommendation No. 121.

Study Programme No. 66 and Report No. 27 - Fading in ionospheric propagation.

Progress has continued on both the theoretical and experimental phases of this field. The following contributions have been received:

- U.R.S.I.* — Comments at 1954 General Assembly on Study Programme No. 66 (Doc. No. 92).
- Poland* — Some observations concerning fading (Doc. No. 298).
- United Kingdom* — Contribution on Study Programme No. 66 (Doc. No. 147).
- Germany (F.R. of)* — Contribution on Study Programme No. 66 (Doc. No. 82).
- Japan* — Report on the general time distribution of amplitude and its practical uses in the observation of rapid fading (Doc. No. 76).
- Japan* — A simple graphical method to estimate fading statistics in diversity reception (Doc. No. 331).
- Japan* — A simplified method of observation of intensity distribution by measuring fading parameters (Doc. No. 330).

It should be possible to revise and substantially improve Report No. 27.

Study Programme No 67 - Oblique incidence pulse transmission tests.

In accordance with the terms of the Study Programme, the thirteen countries named were invited to participate in the work. Nine accepted, and the Netherlands member, Mr. A.H. de Voogt, served as chairman of the Working Group to coordinate the work. Two reports of the group, U.R.S.I. comments, and contributions of some of the members are listed here:

- Working Group* — Report on pulse transmissions between Radio-Kootwijk and Casablanca (B.I.F.) (Doc. No. 288).

- Working Group* — Report of the Working Group on pulse transmission tests to the Chairman of Study Group No. VI (Doc. No. 425).
- U.R.S.I.* — Comments at 1954 General Assembly on Study Programme No. 67 (Doc. No. 91).
- Germany (F.R. of)* — Contribution to Study Programme No. 67 (Doc. No. 125).
- Germany (F.R. of)* — Second contribution to Study Programme No. 67 (Doc. No. 241).
- U.S.A.* — Summary of U.S.A. work on Study Programme No. 67 (Doc. No. 98).

The experience acquired in this programme has led the Chairman of the Working Group to propose three Study Programmes for various aspects of pulse transmission research. These Study Programmes might go further and list a number of particular problems for study. It is not clear whether a Working Group should again be established to promote such work. Perhaps some alternative can be devised to direct attention of qualified organisations to the urgently needed studies and to the possibilities of mutual arrangements for cooperative observations.

Report No. 9 - *Interference to radio reception at sea due to atmospheric causes.*

No contributions have been received. This Report has served its purpose and may be deleted by the Plenary Assembly. The work done pursuant to Recommendation No. 120 in particular renders this Report obsolete.

Report No. 24 - *Questions submitted by the I.F.R.B.*

As the Report states, the C.C.I.R. is not in a position to supply direct and unequivocal replies to the three specific questions submitted by the I.F.R.B. The basic information may never be so complete and definite that strictly authoritative curves of general applicability can be set forth. Some assistance can be provided at any given time, however, and the accumulation of information in publications and in the C.C.I.R. Study Programmes provide the basis.

Contributions to Annex Questions (a) and (b) are given, respectively in the following:

- U.S.A.* — Modification of master FOT curves used by the 1948 H.F. Broadcasting Conference (Doc. No. 284).
- U.S.A.* — Calculation of field strength above 1500 kc/s (Doc. No. 285).

Annex Question (c) is dealt with in Study Programme No. 63, Section 7. See in particular the U.S.A. contribution listed above under Study Programme No. 63. That type of information, much extended, is needed for the I.F.R.B. purpose.

Report No. 28 - *Centralising agencies for the rapid exchange of information on propagation.*

This is a Report of continuing value. The following changes are proposed.

In the parentheses just following the title, replace "Recommendation No. 11, Section 1" by "Replaces Report No. 10".

In the address for U.S.A., replace "Washington 25, D.C." by "Boulder, Colorado".

In the address for New Zealand, replace entirely by "The Superintendent, Geophysical Observatory, P.O. Box 1171, Christchurch, New Zealand".

Resolution No. 12 - *Use and meaning of MUF.*

This requested clarification by the U.R.S.I. This is covered by the following:

- U.R.S.I.* — Comments at the 1954 General Assembly on Resolution No. 12 (Doc. No. 90).

This Resolution may now be deleted.

Resolution No. 14 - *Circularly polarised emitted waves.*

The following contributions have been received:

- U.R.S.I.* — Comments at the 1954 General Assembly on Resolution No. 14 (Doc. No. 89).

Netherlands — Measurement of the polarisation of radio waves reflected by the ionosphere (Doc. No. 256).

This is an extensive field of study. Possibly a revised Resolution or a Study Programme should be prepared. The U.R.S.I. should be invited to emphasise the investigation of interrelations of wave polarisation and ionospheric propagation, and to inform the C.C.I.R. from time to time of the results.

Recommendation No. 115 - Ionospheric absorption.

This recommended that studies be expedited, looking towards more efficient utilisation of the radio spectrum. One contribution has been received:*

France — Report on theoretical values of ionospheric absorption (Doc. No. 188).

The U.R.S.I. made the following comment on Recommendation 115, at its 1954 General Assembly: This recommendation is strongly endorsed. It is recommended that the programme outlined receive high priority during the International Geophysical Year, 1957-58”.

Recommendation No. 117 - Prediction of solar index.

This resulted from extensive consideration of the subject at the 1951 and 1953 Plenary Assemblies. The subject was principally left in the hands of the Director of the C.C.I.R. (See Doc. No. 254). The Director issued a brief Technical Circular, December 9, 1955, calling attention to the expected arrival of the 1957 maximum unusually early and of unusual intensity. Two contributions were received:

Poland — Some methods for the prediction of sunspot numbers (Doc. No. 303).

U.S.A. — Draft Study Programme: Prediction of solar index (Doc. No. 281).

With these, and review of the extensive contributions to this topic at the 1951 and 1953 Plenary Assemblies it should be possible to revise Recommendation No. 117 or to replace it by a Study Programme. Incidentally, some of the papers on Study Programmes Nos. 58 and 60 shed some light also on this topic.

Recommendation No. 118 - Protection of frequencies used for radio-astronomical measurements.

One contribution has been received on this:

U.R.S.I. — Comments at the 1954 General Assembly on Recommendation No. 118 (Doc. No. 84).

The Geneva 1951 Plenary Assembly had adopted Recommendation No. 56 which provided for the reservation of seven specific frequencies, with guardbands, for this purpose. At the request of the U.R.S.I. this was rescinded and Recommendation No. 118 adopted in its place. In September 1955, the International Astronomical Union adopted a Resolution adding its voice to that of the U.R.S.I. in requesting adequate reservation of spectrum space for observations in radio astronomy.

It is not clear what, if any, action beyond that of Recommendation No. 118 would be useful. In view of the rapid advances in radio astronomy, it may be impossible to achieve stabilisation of requirements. Certainly, however, administrations should be strongly encouraged to provide genuinely practicable protection.

It should not be overlooked that in adopting Recommendation No. 118, the C.C.I.R. adopted in the Minutes of the October 5, 1953, Plenary Session: “Radio astronomers should be encouraged to site their equipment to avoid interference”.

Recommendation No. 120 - Revision of atmospheric radio noise data.

This called for the preparation of revised charts and curves of atmospheric radio noise, the work to be organised by correspondence. After some discussion among members of Study Group No. VI, arrangements were made for two very active groups to get together on this task. Mr. F. Horner of the National Physical Laboratory, England, went to the Central Radio Propagation Laboratory, U.S.A., and worked there with Mr. W. Q. Crichlow and others from February 17th to

* Note by Secretariat: see also Doc. No. 370 (New Zealand).

April 23rd, 1955. The preparation of the extensive detailed charts and curves went forward in the two laboratories after Mr. Horner returned to England. Appreciation is due the officers of the two laboratories for these arrangements and for the extensive work on this project.

The report giving the results was not yet available when the present report was prepared. It gives the results in terms of average radio noise power as well as r.m.s. voltage. The main quantity presented is the median value of the hourly average radio noise for the hours of a seasonal "time block" (of four hours on each of about 90 days). Charts show this quantity at 1 Mc/s for all places in the world and for each time block. Radio noise at other frequencies is deduced from that at 1 Mc/s by the use of a series of curves, one set of curves for daylight at the receiving point and one for darkness.

The U.R.S.I. prepared comments on this topic at its 1954 General Assembly, endorsing the C.C.I.R. Recommendation (Doc. No. 95).

Recommendation No. 121 - Local lightning-flash counters.

In accordance with the terms of the Recommendation, a group was established with a member from each of the six nations named. Mr. F. Horner of the United Kingdom was coordinator chairman. One formal contribution was received:

Japan — Report on local lightning-flash counters (Doc. No. 329).

After correspondence and testing of several designs of counters in several countries, Mr. Horner drafted a summary report. The text is not yet available.

New Questions

Only one new question has been submitted, as follows:

Czechoslovakia — Draft Question: Doppler effect in ionospheric propagation. Influence on Communication utilising frequency shift keying (Doc. No. 223).

Miscellaneous

Some thought has been given to the topics of other study groups which depend heavily on propagation information. For example, Resolution No. 10 (assigned to Study Group No. IV) requests information from Study Group No. VI concerning sky-wave field strength below 300 kc/s at long distances. I brought this to the attention of all participants of Study Group No. VI in a letter of October 26th, 1955. I have received no material on it, but have been informed that contributions may be supplied by Germany and U.S.A. and that an abstract of a published article from New Zealand will be furnished.

Some clarification was evolved in the matter of the handling of pertinent papers which have been, or soon will be, published. Sometimes such papers are very valuable for the purposes of a C.C.I.R. topic; on the other hand, the C.C.I.R. has not the resources to serve as a publishing house for the vast amount of technical literature in its field. The participants of Study Group No. VI have been able to solve this problem by employing one or more of the following solutions: (a) supplying enough reprints for distribution to the Study Group; (b) preparing a short abstract with special attention to the C.C.I.R. interest; (c) bringing some copies of the article to the Plenary Assembly to hand to interested parties.

J. HOWARD DELLINGER
Chairman, Study Group No. VI

REPORT BY THE CHAIRMAN OF STUDY GROUP No. VII*

(STANDARD-FREQUENCY TRANSMISSIONS AND TIME SIGNALS)

(Original language: French)

I. Basic documents of Study Group No. VII.

1. *Question No. 87* merely recalls the problem raised by the Atlantic City Conference, 1947.
2. *Recommendation No. 122* prescribes certain requirements for standard-frequency and time-signal transmissions, for the dissemination of results and for measures to be taken to reduce interference. A table of the principal characteristics of transmissions existing in 1953 is attached.
3. *Study Programme No. 68* provides for the experimental application of new transmission methods designed to improve the service and especially the transmission of time signals. Tests with special modulations in accordance with Study Programme No. 62 are also envisaged.
4. *Study Programme No. 62*, drawn up in London by Study Group No. VI, was assigned, by agreement between the Chairman concerned and the Director of the C.C.I.R., to Study Group No. VII. It provides for tests with special modulations or transmissions to facilitate identification of stations when taking field measurements.
5. *Report No. 29* outlines the work accomplished between 1947 and 1953 and gives the motives which have led to the establishment of the texts above.

II. Activities of Study Group No. VII since the London Plenary Assembly.

No meetings of the Study Group have been held since the Plenary Assembly in London. An exchange of correspondence with administrations has taken place, particularly with regard to new transmissions and the tests described in Section III of the present document. Two circulars, dated 9th August 1954 and 29th September 1955 concerning various aspects of the work undertaken were sent by the Chairman to the members of the Study Group.

III. Contributions submitted and work carried out.

The following documents were used as a basis for the present report:

<i>United States of America</i>	Docs. Nos. 27 and 247
<i>France</i>	Doc. No. 179
<i>Italy</i>	Doc. No. 341
<i>Japan</i>	Doc. No. 332
<i>New Zealand</i>	Doc. No. 252
<i>Netherlands</i>	Docs. Nos. 272 and 342
<i>P.R. of Poland</i>	Doc. No. 213
<i>Argentine Republic</i>	Doc. No. 396
<i>United Kingdom</i>	Docs. Nos. 149 and 151
<i>Switzerland</i>	Doc. No. 382
<i>Czechoslovakia</i>	Docs. Nos. 97 and 376
<i>Union of South Africa</i>	Doc. No. 114
<i>International Scientific Radio Union (U.R.S.I.)</i>	Doc. No. 26
<i>Study Group No. VI</i>	Doc. No. 287

In addition, information not issued as preparatory documents has been collected from various administrations and organisations, in particular from the United States, French Oversea Territories,

* Doc. No. 107 (Warsaw, 1956).

the International Time Bureau (B.I.H.), Sub-Committee III of the U.R.S.I., the International Astronomical Union (I.A.U.) and from the Special Committee for the International Geophysical Year (S.C.I.G.Y.).

Studies were made and observations submitted on the following main points:

- a) Stations in operation and planned stations
- b) Service areas
- c) Interference by stations other than standard-frequency stations
- d) New types of time signals
- e) Time schedules and mutual interference
- f) Extension of standard-frequency transmissions to other frequency bands
- g) Accuracy; publication of results of measurements
- h) Publication of characteristics and modifications
- i) Study of propagation

a) *Stations in operation and planned stations*

Since 1953, a number of new stations has been brought into service. On the other hand, some of the existing stations have modified their schedules. The main innovations in this sphere described below are also enumerated in the table of characteristics attached to the present report.

Buenos Aires. The transmissions are made by the Naval Observatory with the LOL transmitter of the Marine Ministry's communication centre at Darsena Sur. There are 5 transmissions at 3 hourly intervals each week-day on 2.5, 5, 10, 15, 20 and 25 Mc/s. Each transmission lasts one hour and consists of modulations of 4 minutes out of 5, alternatively on 440 and 1000 c/s, and a 4 minute period of one second impulses (Doc. No. 396).

Hawaii and Johannesburg. As before, but modified as explained in *d*), *e*) and *g*) (Doc. No. 247) (Doc. No. 144).

Lower Hutt (New Zealand). A0 transmission with low power, using the call sign ZLFS, is provided by the Dominion Physical Laboratory on 2.5 Mc/s every Tuesday from 0100 to 0400 hours UT (Doc. No. 252).

Moskva. Transmissions every weekday from 0715 to 0745 hours UT, on 10 Mc/s on even days and on 15 Mc/s on odd days, by the Central Institute for Physico-technical and Radiotechnical Measurements. There is no modulation, but the carrier is A1 keyed from 0715 to 0718 hours and from 0743 to 0745 hours with signals 0.1s long every second; the signal at the full minute is elongated (Information provided by the B.I.H.).

Rugby. As before, but with a new full minute signal (see *d*) and (Doc. No. 149).

Tokyo. Henceforth, daily transmissions are made on 2.5 Mc/s from 0700 to 2300 hours UT and on 15 Mc/s from 2100 to 1100 hours. There are transmissions on 5 Mc/s on Mondays from 0000 to 2400 hours and on 10 Mc/s on Wednesdays from 0000 to 2400 hours. A special type of signal is used (see *d*) and *e*). Transmissions on 4 and 8 Mc/s as before (information supplied by the Japanese Administration).

Torino. Transmissions on 5 Mc/s now take place every weekday from 0700 to 0730 hours and from 1100 to 1130 hours UT. The full minute signal has been modified (see *d*) (Doc. No. 341).

Uccle. A0 transmission with low power, emitted continuously on 2.5 Mc/s by the Royal Observatory, bexcept etween 1130 and 1230 hours and 2030 and 2130 hours (information provided by the U.R.S.I.).

Washington. Transmissions as before, but modified as shown in *d*), *e*) and *g*) (Doc. No. 247). It should be emphasised, however, that from now on, except on 25 Mc/s, the audio modulation will be on a single sideband (upper) with full carrier. The power in the sideband is 1/3rd that of the carrier. The announcements and time pulses are 100% modulated double sideband.

Transmissions planned. The French Administration is organising experimental daytime transmissions starting in the summer of 1956 on 2.5 Mc/s, with short transmissions on 5 and 10 Mc/s (Doc. No. 179).

The Swiss Administration intends effecting transmissions on 2.5 Mc/s and possibly intermittent transmissions on 5 Mc/s (Doc. No. 382).

Experimental transmissions are under study in Germany, India and Australia, with particular reference to the International Geophysical Year 1957-1958.

b) Service areas

There is no need to refer again to reception conditions as described in documents submitted to the Plenary Assembly in London, in 1953. As a whole, conditions remain unchanged, except of course for modifications due to the evolution of the sunspot cycle.

A more useful purpose would be served by summarising the comments on new transmissions or on areas for which no information has so far been available.

Rugby MSF is very strongly received within a radius of 1600 km (Doc. No. 149). Reception has been reported in Togoland (Central Africa) in the early morning and sometimes in the afternoon on 10 Mc/s and from time to time in the early morning on 5 Mc/s. It has never been received in South Africa.

Torino IBF is strongly received throughout Europe. During the three month's tests made by the U.R.S.I., reception was reported in the United States and Australia. It has not been received in South Africa.

Moskva is very well received in Europe both on 10 and 15 Mc/s; has been received on 15 Mc/s in South Africa.

Afternoon reception of Buenos Aires LOL has been reported only from the Belgian Congo on 10 and 15 Mc/s. Johannesburg ZUO has likewise been received in the Belgian Congo.

In South Africa reception of WWV is becoming more and more difficult, being usable only in the morning on 10 and 15 Mc/s. Daytime reception of WWVH is more reliable.

In Togoland, in addition to regular reception of WWV, WWVH is received in the early morning and at night in winter on 5 Mc/s, in the early morning and late afternoon on 10 Mc/s and at various times, mostly in the morning and evening, on 15 Mc/s. JJY is received in the early morning and sometimes in the late afternoon on 10 Mc/s but never on 5 Mc/s.

Tokyo reports reception, generally of WWV on 5 and 10 Mc/s during the day and on 15 and 20 Mc/s at night. WWVH is received on 10 Mc/s almost continuously, on 5 Mc/s at night and on 15 Mc/s in the daytime.

In Australia, WWV is received on 10 Mc/s in the early evening. WWVH is received on 5 Mc/s at night in winter, on 10 Mc/s in the evening in summer and until nightfall in winter, and on 15 Mc/s in the afternoon. JJY is received at night.

There is still some doubt as to the extent of service areas in certain parts of the world and particularly in the southern hemisphere and in Asia.

As a general rule, it would seem that transmissions on 5 Mc/s are limited in range, although less so than those on 2.5 Mc/s, thereby facilitating the coexistence of several remote stations operating on that frequency. On the other hand, the frequencies of stations transmitting at present only on 2.5 or 5 Mc/s cannot be easily intercompared. Thus it might be advisable for these stations to make short transmissions from time to time on higher frequencies (Docs. Nos. 341 and 144).

It should be recalled that the Special Committee for the International Geophysical Year 1957-1958 at its meetings in Rome in 1954 and in Brussels in 1955 underlined that „the importance of establishing other permanent or temporary stations emitting time signals of the new type* in additional regions (in particular in the U.S.S.R., India, South Africa, Australia, New Zealand and in South America) should be called to the attention of governments concerned through the intermediary of the C.C.I.R. or directly by the International Geophysical Year National Committees, or by other means possible”.

c) Interference by stations other than standard-frequency stations.

All the reports received contain complaints of extensive and intensive interference by transmissions other than standard-frequency transmissions working in the bands allocated to the latter. The problem has been raised at every Plenary Assembly of the C.C.I.R. since 1948 and Recommendations Nos. 18, 70 and 122 all contain both a consideration and a recommendation concerning this serious state of affairs.

This problem is among the most important to be discussed in Warsaw. Various suggestions have been made with a view to remedying the defect. Recommendation No. 70 which already

* Signal superimposed on standard frequencies.

provided for the collection and dissemination of information on interference from stations has hardly been followed up and has failed to produce the required result. Recommendation No. 122 no longer makes any provision to that effect; a way of providing a useful substitute for such information should be devised.

The number of frequencies assigned in the Radio Frequency Record in the standard-frequency bands to stations other than those belonging to that service is lower than that shown in the last report of Study Group No. VII (London Docs. Nos. 107 and 343); however, the third edition of the Record (30th September 1955) still contains:

- 4 stations on 2500 kc/s
- 49 between 4995 and 5005 kc/s, including 45 on 5000 kc/s
- 8 on 10 000 kc/s
- 10 between 14 990 and 15 010 kc/s, including 8 on 15 000 kc/s
- 3 between 19 990 and 20 010 kc/s, including 2 on 20 010 kc/s

Only the stations admitting to operation in these bands are given here; the actual number is probably far greater.

d) *New types of time signals*

In conformity with paragraph 5 of Recommendation No. 122, certain stations show the full minute by a positive signal.

Johannesburg ZUO uses a minute signal lasting 500 ms (modulated at 1000 c/s). Rugby MSF prolongs the pulse of the 0 second to 100 ms. Torino IBF repeats the pulse of the 0 second 7 times at a rate of one impulse every 10 ms. In all three cases, the pulse of the 59th second is not suppressed.

Washington WWV continues to suppress the 59th pulse, but the 0 second pulse is followed, 100 ms later, by an additional pulse.

Because Tokyo JJY also makes use of the system whereby the time-signal transmissions are discontinued for short periods (process 2 in paragraph 3, Study Programme No. 68), the 0 second is likewise indicated by an interruption lasting 200 ms.

The second signals proper have been modified in various ways.

Washington WWV which transmits pulses continuously, suppresses the superimposed audio modulation during a time interval of 40 ms around the pulse (see Study Programme No. 68, paragraph 3, first procedure). The suppression takes place exactly 10 ms before the seconds pulse. This method efficiently clears the time signal, which is as good on the oscillograph as in the absence of modulation. On the other hand, for certain uses, there is an element of uncertainty as to the signal received or recorded, which may be either the genuine signal or the stop or re-start of the modulation. The signals of Hawaii WWVH which does not use suppression consist of 6 cycles of 1200 c/s tone (see Recommendation No. 122, paragraph 4) (Doc. No. 247). Similarly, it has been suggested that the terms of that paragraph should be extended to cover 8 cycles of 1600 c/s, 9 cycles of 1800 c/s etc. The signals emitted by Johannesburg ZUO consist of 10 cycles of 1000 c/s tone.

In the tests arranged by Prof. Boella, Vice-chairman of the Group, under the auspices of the U.R.S.I. for the determination of the duration of the paths, IBF made use of an additional pulse (0.2 ms) 5 ms before the ordinary signal. By observing this pulse on a cathode-ray oscillograph, a better separation of the various modes of propagation can be made. Its use in daily transmissions is envisaged (Doc. No. 341).

Finally, the signals emitted by Tokyo JJY are constituted by interruptions of the transmission lasting 20 ms in conformity with the second procedure in paragraph 3 of Study Programme No. 68. The re-start of the transmission constitutes the time marker.

The third procedure mentioned in Study Programme No. 68, paragraph 3, had originally been proposed by the Netherlands delegation (London Doc. No. 439). The Netherlands Administration again underlines (Doc. No. 272) the advantages offered by a method whereby the transmission is interrupted for a short time, preceding and following a short carrier pulse with full power. The Japanese Administration has tested this "pulse-inserted" method (Doc. No. 332) and considers that it has the following advantages: a high degree of precision, possibility of separation of multi-path signals, greater facility in identification etc. This Administration has made a study of the best design characteristics both for transmission and reception.

Document No. 272 also recalls the proposal made in London Document No. 158, to classify the stations into groups transmitting simultaneously, the groups and the minute announcements being time shifted by $1/2$ or $1/3$ s.

In Document No. 382, the Swiss Administration announces a new time signal system for its proposed transmissions. At each second, 5 pips of 1 ms separated by 1 ms will be transmitted; at the full minute, this modulation will last 500 ms.

e) *Time signals and mutual interference.*

The coexistence of several transmissions on the same frequency often leads to serious difficulties in their utilisation when the propagation conditions are such that several of the transmissions are received simultaneously with very similar field strengths. For average precision, the inconvenience caused is not serious; but that is not the case when the greatest degree of accuracy is required. First, beats are produced between the carriers and the modulations, further aggravated by irregularities in propagation. Then the signals overlap because of the spacing between the transmission instants and the different propagation times. When audio modulations are present, the use of the time signals is practically precluded. Even the method of interrupting the modulation adopted by WWV does not generally make it possible to measure the signals of other stations since they arrive at the receiver at a moment when the WWV modulation is present. That is why, for instance, during the quarterly tests by the U.R.S.I., the IBF signals were put systematically forward so as to ensure their arrival in America at a moment when the modulation of WWV was being interrupted.

It would appear that the best way of overcoming these difficulties, at least to some extent, would be by adopting carefully thought out and coordinated schedules. The matter has already been examined at previous meetings of the C.C.I.R. and both Recommendation No. 122 and Study Programme No. 68 contain relevant provisions. In particular, paragraph 6 of Recommendation No. 122 provides for periods of at least 4 minutes long for time signal transmissions without any audio modulation. The recent adoption by WWV and WWVH of such intervals of 2 minutes instead of 1 minute utilised previously has already resulted in a considerable improvement.

On the whole, it is desirable that the transmission periods of time signals should be extended. In the absence of a permanent transmission feasible only in certain cases, e.g. WWV and JJY, and of the procedure proposed by the Netherlands, it would seem that periods of 10 minutes would be preferable to those of 5 minutes often used.

Complete interruption of the transmission provides a very valuable way of obtaining the accurate intercomparison required for the service to operate with precision. For instance, the interruption from 45 to 49 minutes past each hour recently adopted by WWV constitutes a considerable improvement.

It should be recalled that several attempts have been made to obtain simultaneous interruption of all transmissions, especially for the measurement of noise. The International Astronomical Union at its General Assembly in Dublin in 1955 emphasised the importance of simultaneous interruptions for certain radio-astronomical measurements (e.g. ionospheric absorption).

Unfortunately, simultaneous interruptions in transmission would serve no useful purpose in practice unless—and the paramount importance of such a step has been emphasised in section c)—the standard-frequency bands were cleared.

Many stations transmit ionospheric predictions. Those of WWV for the North Atlantic are always transmitted at $19 \frac{1}{2}$ and $49 \frac{1}{2}$ minutes past each hour, and those of WWVH for the North Pacific at 9 and 39 minutes past the hour. LOL and JJY transmit predictions at each announcement, i.e. every 5 minutes.

f) *Extension of standard-frequency transmissions to other frequency bands.*

The Atlantic City Conference instructed the C.C.I.R. to make a study of standard-frequency transmissions in the bands allocated to that service comprised between 2.5 and 25 Mc/s. Nevertheless, many suggestions have been made for using other bands for standard-frequency transmissions (see for instance Stockholm Docs. Nos. 30, 37, 46 and 137). As regards the HF band, many obstacles are encountered because of ionospheric oddities, e.g. irregularity of field, phase and sometimes frequency, all of which have a most deleterious effect on reception.

That is the underlying reason for RUGBY MSF transmissions on 60 kc/s. Recent experiments based on phase measurements have shown that with these transmissions, as well as with the telegraph transmissions by RUGBY GBR on 16 kc/s (using the same master oscillator as

MSF), a precision of the order of 1×10^{-9} can be obtained when comparing frequencies at distances of more than 5000 km, even in the case of a keyed wave. This is a great improvement on the results obtained in the HF band, for which the degree of precision is often a hundred times lower (see Doc. No. 213).

Document No. 151 contains detailed information on tests carried out in the United Kingdom.

The United States Administration suggests that the radio-navigation stations envisaged for bands 4 and 5 should likewise be used as standard-frequency stations. A special study of the frequency of 10 kc/s is proposed (Doc. No. 27).

These problems have likewise been dealt with by the International Astronomical Union which adopted the following resolution at its General Assembly in Dublin:

“In view of the high precision which has been achieved in inter-comparisons of time and frequency, and in the measurement of variations in propagation time, by means of the experimental standard frequency transmissions on a frequency of 60 kc/s, which precision is not attainable on any of the frequencies allocated by the C.C.I.R. for standard-frequency transmission, the I.A.U. desires to draw the attention of the C.C.I.R. to the importance of frequencies being allocated for the continuation and extension of standard-frequency transmissions on frequencies below 100 kc/s”.

The Czechoslovak Administration, in Document No. 97, proposes that standard-frequency transmissions should be made in band 8 (VHF) for local distribution with a very high degree of precision. This would permit transmissions to be made by modulation with high frequencies such as 100 kc/s. Transmissions of this type are actually being effected in Canada. The Swiss P.T.T. Administration transmits from the Châtonnaye station to the Neuchâtel Observatory currents at 100 kc/s from its standard oscillators by direct modulation of metric waves. In Document No. 376, the Czechoslovak Administration describes methods of comparison used for standard-frequency and time-signal transmissions on frequencies in bands 6 and 7 (other than those assigned to the standard-frequency service).

In the present state of radio communication, it would not be opportune to suggest to the next Radio Conference that exclusive frequency bands should be allocated in bands 4, 5 and 8. Nevertheless, study must be made of the problem or at least of the possibility of effecting transmissions with characteristics suitable for standard-frequency transmission.

g) Accuracy; publication of results

Since 1953, there has been a general improvement in the precision with which the transmissions have been effected, both as regards their absolute value and the successive adjustment steps. For instance WWV can guarantee for the future an accuracy of $\pm 1 \times 10^{-8}$; the adjustment steps have been reduced to 0.1×10^{-8} . Similarly, the frequency of MSF transmissions is maintained at approximately 0.1×10^{-8} in relation to the N.P.L. caesium atomic resonator.

WWV (and consequently WWVH) time signals, up to now adjusted exclusively on a frequency/time basis, are subjected to occasional phase/time adjustment. When required, they are made on Wednesdays at 1900 hours UT.

The quarterly correction tables are still published for MSF, WWV, WWVH and ZUO. But the fact that they are still distributed as much as six months after the end of the quarter detracts greatly from their value. Sometimes serious discrepancies are revealed between the daily values of a frequency shown direct and the corresponding values deduced from the differences between the time signals. This complicates matters for users wishing to verify their standard frequencies by means of the transmissions; since different results are obtained depending on whether the frequencies themselves or the movement of the clock compared with the time signals are used.

The measurement tables published by ZUO give simultaneously the values obtained by comparison with the time signals emitted by WWV and with those of Rugby GBR. The results show serious disagreement.

This is one of the many serious problems created by the system proposed by the United States Administration (Doc. No. 27) whereby the frequencies of different stations are referred to a common

standard and the time signals are synchronised on emission. The matter was raised at the Plenary Assembly in London where it encountered several objections, particularly on the part of the B.I.H. (London Doc. No. 342). The examples above show that great caution must be exercised in the choice of a common frequency standard and a common source for the signals.

h) *Publication of transmission characteristics and modifications*

Up to now the only official publications of the characteristics of transmission have been the table annexed to C.C.I.R. Recommendation No. 122 and the information given in the List of Special Service Stations published by the Secretariat of the I.T.U. The List, although in theory kept up to date by the issue of supplements, provides, in actual fact, only inadequate information, often old and sometimes inaccurate, and thus cannot serve a useful purpose. As an example, it may be mentioned that the latest edition shows among the frequencies used by MSF, those of 15 and 20 Mc/s which, to the best of my knowledge, have never been used in the ordinary service.

The table annexed to Recommendation No. 122 shows the general position for September 1953 and is thus no indication of the present state of affairs; this is clearly shown by the table annexed to the present report. It would therefore seem undesirable that any such tables should be included in the documents of a C.C.I.R. Plenary Assembly.

Arrangements should be made for the speedy publication of information relating to the standard-frequency service, providing precise data on the characteristics of existing transmissions, their modifications and the bringing into service of new transmissions.

A similar problem concerning the publication of the transmission characteristics of classical time signals has been dealt with by the International Astronomical Union; the following resolution was issued by its General Assembly in Dublin:

“The I.A.U. recommends that all modifications in the programme of radio time-signal transmissions should be communicated to the Central Bureau of Astronomical Telegrams in Copenhagen and published in the circulars issued by the Bureau.”

This procedure could, to my mind, be usefully extended to standard-frequency and time-signal transmissions. On the other hand, any schedule modifications or innovations as a whole should be *speedily* published by the I.T.U. in some such publication as, for instance, the *Telecommunication Journal*, which could also be responsible for publishing the correction tables. As an example, let us recall that tables relating to MSF transmissions are published in similar circumstances in the “*Wireless Engineer*”.

Annexes I, II, III and IV to the present report contain a summary of the current characteristics of stations, their daily and hourly schedules and geographical distribution (including planned stations).

i) *Study of propagation and special modulations.*

Apart from their main use for frequency and time measurements, standard-frequency transmissions are being more and more extensively utilised for other purposes, and in particular for the study of propagation.

The tests organised by the U.R.S.I. at the instigation of Prof. Boella for the study on the propagation time of time signals may be cited as an example. These tests are made at three-monthly intervals on signals emitted by standard-frequency stations. Much valuable information has already been obtained. In addition, a great deal of new information on reception conditions has been collected.

In pursuance of a French proposal (London Doc. No. 308), made at the Plenary Assembly in London, Study Group No. VI and Study Group No. VII had studied the feasibility of special modulations for the study of propagation. The study of this method was provided for in paragraph 6 of Study Programme No. 68 and in Study Programme No. 62. The standard-frequency transmitter would be characterised by a high-frequency (or a shifted-carrier) modulation emitted in turn by each transmitter, thus permitting each transmitter to be singled out in automatic field-strength recordings.

At the suggestion of Dr. Dellinger, Chairman of Study Group No. VI, a draft Recommendation is submitted to Study Group No. VII for examination (Doc. No. 287). In Annex V to the present report a time sharing basis is proposed taking account of any new stations, shown in brackets. Tests might usefully be carried out with a view to providing data for the Plenary Assembly in Warsaw.

To obtain quantitative results from such special modulations, the powers used in the sideband or sidebands as well as in the carrier should be made known (e.g. see Doc. No. 247, paragraph 4).

Similar information for the normal audio modulations used in existing transmitters would likewise serve a useful purpose. Extensive measurements made, especially in France, on these normal modulations have shown that the transmitters could generally be identified without any special modulation since the normal modulations are usually effected at different times and on different frequencies. Simple filters can be used for their separation. With a known power and modulation rate quantitative results could be obtained.

IV. Conclusions and Proposals.

The following overall conclusions emerge from the contributions received and information assembled.

First, the service areas are being extended thanks to new stations being brought into operation. On the other hand, there is an increased risk of interference. There has been no improvement as regards interference from stations other than standard-frequency stations.

Another tendency to be noted is the increased importance of time signals superimposed on standard frequencies proper, as well as of processes designed to improve their use. This is due to a great extent to the disturbance caused by the propagation of decametric waves which reduces the degree of precision obtainable for measurements on reception. For the same reason, several administrations have suggested that other, quite different, frequency bands be used.

I should like to propose, as I did in London in 1953, that the following points be used as a basis for discussion at the Plenary Assembly in Warsaw.:

Draft Agenda

1. Present position as regards service areas; distribution of stations.
2. Reduction of mutual interference; removal of other stations from the standard-frequency bands.
3. Time schedules; individual and simultaneous interruptions.
4. New types of time signals; ways to facilitate their use.
5. Arrangements for a higher degree of precision; possibility of common control for different stations.
6. Methods designed to facilitate field measurements; possibility of special modulations.
7. Speeding up of the publication of correction tables.
8. Publication from time to time of station characteristics. Speedy dissemination of information on new transmissions or modifications to characteristics.

B. DECAUX

Chairman, Study Group No. VII

ANNEX I

DAILY SCHEDULES

Notes to the table on pages 120 and 121

- 1) Weekdays.
- 2) From 1100 to 1200, 1400 to 1500, 1700 to 1800, 2000 to 2100 and 2300 to 2400 UT.
- 3) Pulses of 5 cycles of 1000 c/s tone; no 59th pulse of each minute.
- 4) Alternately 440 or 1000 c/s.
- 5) Interruptions from minute 0 to minute 4, and from minute 30 to minute 34 of each hour, as well as from 0700 to 0734 and from 1900 to 1934 UT.
- 6) Pulses of 6 cycles of 1200 c/s tone; no 59th pulse of each minute.
- 7) Alternately 440 and 600 c/s.
- 8) Occasionally time corrected by steps of 20 ms.
- 9) Interruption from 0630 to 0700 UT.
- 10) Pulses of 10 cycles of 1000 c/s tone; the first pulse of each minute is prolonged (500 ms).
- 11) If required, the first Monday of each month.
- 12) Tuesdays.
- 13) From 0100 to 0400 UT.
- 14) From 0715 to 0745 UT.
- 15) Even days.
- 16) Odd days.
- 17) Signals A1 keyed. Duration of each signal 100 ms; the first signal of each minute is prolonged.
- 18) From 0715 to 0718 and from 0743 to 0745 UT.
- 19) Interruption from minute 15 to minute 20 of each hour.
- 20) Transmissions also on 60 kc/s.
- 21) Pulses of 5 cycles of 1000 c/s tone; the first pulse of each minute is prolonged (100 ms).
- 22) If required, the first day of the month.
- 23) See (24) to (26).
- 24) From 0700 to 2300 UT; interruption from minute 29 to minute 39 of each hour.
- 25) Mondays. Interruption from minute 9 to minute 19, from minute 29 to minute 39, and from minute 49 to minute 59 of each hour.
- 26) Wednesdays. Interruptions as for (25).
- 27) Transmission suspended for 20 ms; the suppression before second 0 lasts 200 ms.
- 28) Maximum radiation NW - SE.
- 29) From 0700 to 0730 and from 1100 to 1130 UT.
- 30) Pulses of 5 cycles of 1000 c/s tone; the first pulse of each minute is repeated 7 times at intervals of 10 ms.
- 31) Interruptions from 1130 to 1230 and from 2030 to 2130 UT.
- 32) Interruption from minute 45 to minute 49 of each hour.
- 33) Pulses of 5 cycles of 1000 c/s tone; no 59th pulse of each minute. The first pulse of each minute is repeated 100 ms later.

ANNEX I

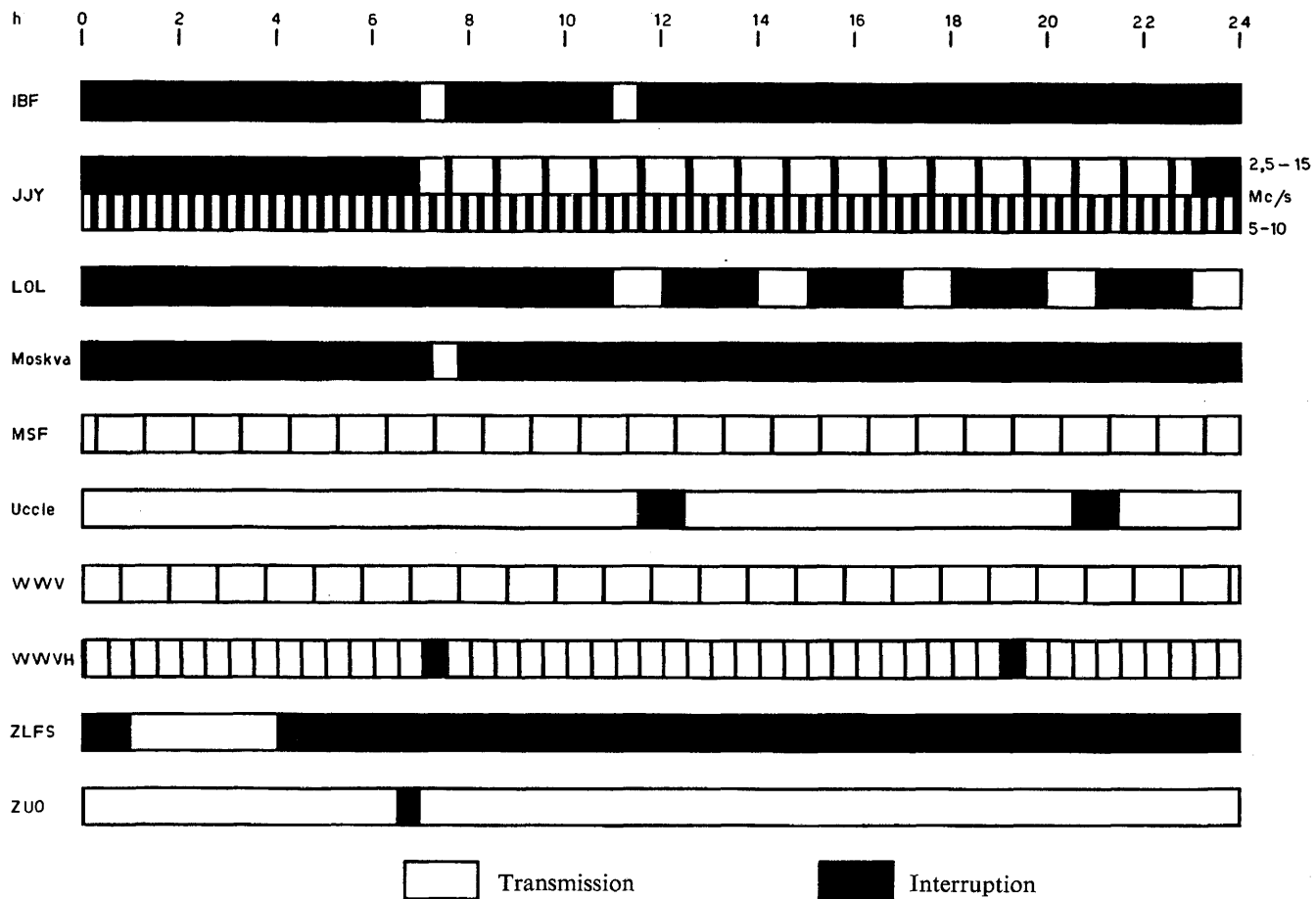
MAIN CHARACTERISTICS OF STANDARD-FREQUENCY AND TIME SIGNAL STATIONS *

1	Stations	Buenos Aires	Hawaii	Johannesburg	Lower Hutt	Moskva	Rugby	Tokyo	Torino	Uccle	Washington	
2	Call signs	LOL	WWVH	ZUO	ZLFS	—	MSF	JJY	IBF	—	WWV	
3	Service	Experim.	Experim.	Experim.	Experim.	Experim.	Experim.	Experim.	Experim.	Experim.	Regular	
4	Carrier power (kW)	2	2	0.1	0.035	—	0.5	1	0.3	0.02	0.1 — 10	
5	Type of antennae	—	Vertical dipole	Inverted L	—	—	Vertical dipole	Vertical dipole	Horizontal dipole ⁽²⁸⁾	—	Vertical dipole	
6	Number of simultaneous transmissions	6	3	1	1	1	3	2-3	1	1	6	
7	Number of carrier frequencies used	6	3	1	1	2	3	4	1	1	6	
8	Transmissions	Days per week	6 ⁽¹⁾	7	7	1 ⁽¹²⁾	6 ⁽¹⁾	7-1 ⁽²³⁾	6 ⁽¹⁾	7	7	
9		Hours per day	5 ⁽²⁾	23 ⁽⁶⁾	24 ⁽⁹⁾	3 ⁽¹³⁾	½ ⁽¹⁴⁾	24 ⁽¹⁹⁾	24 ⁽²³⁾	1 ⁽²⁹⁾	22 ⁽³¹⁾	24 ⁽³²⁾
10	Standard frequencies used	Carriers (Mc/s)	2.5; 5; 10; 15; 20; 25	5; 10; 15	5	2.5	10 ⁽¹⁵⁾ ; 15 ⁽¹⁶⁾	2.5; 5; 10 ⁽²⁰⁾	2.5 ⁽²⁴⁾ ; 5 ⁽²⁵⁾ ; 10 ⁽²⁸⁾ ; 15 ⁽²⁴⁾	5	2.5	2.5; 5; 10; 15; 20; 25
11		Modulation (c/s)	1 ⁽³⁾ ; 440; 1000	1 ⁽⁶⁾ ; 440; 600	1 ⁽¹⁰⁾	None	1 ⁽¹⁷⁾	1 ⁽²¹⁾ ; 1000	1 ⁽²⁷⁾ ; 1000	1 ⁽³⁰⁾ ; 440; 1000	None	1 ⁽³³⁾ ; 440; 600
12	Duration of audio modulation (minutes)	4 out of 5 ⁽⁴⁾	3 out of 5 ⁽⁷⁾	Nil	Nil	Nil	5 out of 15	4 out of 5	5 out of 10 ⁽⁴⁾	Nil	3 out of 5 ⁽⁷⁾	

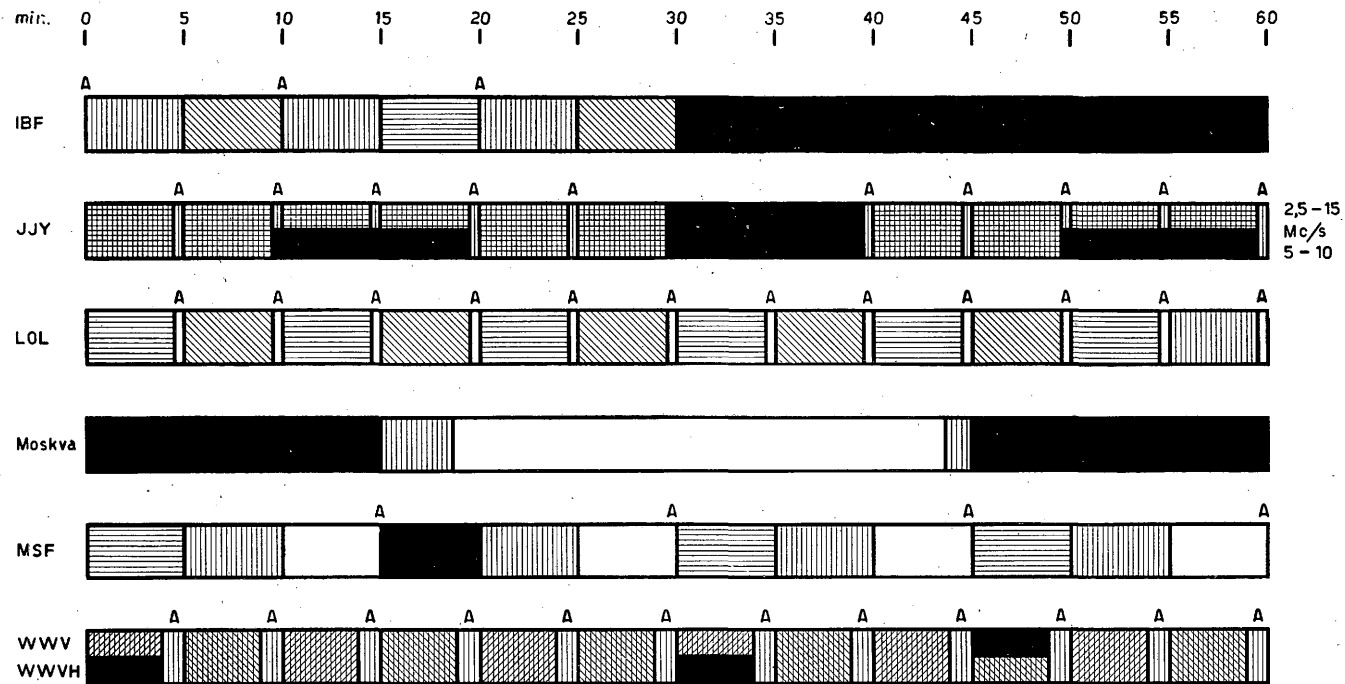
* For notes to this table, see page 119,

	Stations	Buenos Aires	Hawai	Johannesburg	Lower Hutt	Moskva	Rugby	Tokyo	Torino	Uccle	Washington
13	Frequency accuracy (10^{-8}) . .	± 2	± 1	± 2	± 10	—	± 2	± 2	± 2	± 1	± 1
14	Maximum monthly drift of oscillator (10^{-8})	—	+ 2	+ 1	—	—	+ 0.5	+ 1	+ 2	—	+ 1
15	Maximum frequency adjustment steps (10^{-8})	—	0.5	1	—	—	2	2	2	—	0.1
16	Duration of time signal transmissions (minutes) . . .	4 out of 60	Continuous	Continuous	Nil	5 out of 30 ⁽¹⁸⁾	5 out of 15	4 out of 5	5 out of 10	Nil	Continuous
17	Accuracy of time intervals	$\pm 2 \times 10^{-8}$ ± 1 microsecond	$\pm 1 \times 10^{-8}$ ± 1 microsecond	$\pm 2 \times 10^{-8}$ ± 1 microsecond	None	—	$\pm 2 \times 10^{-8}$ ± 1 microsecond	$\pm 2 \times 10^{-8}$ ± 1 microsecond	$\pm 2 \times 10^{-8}$ ± 1 microsecond	None	$\pm 1 \times 10^{-8}$ ± 1 microsecond
18	Method of time signal adjustment .	± 20 ms approx.	By frequency and steps ⁽⁸⁾	By steps of 20 ms ⁽¹¹⁾	None	—	By steps of 50 ms ⁽²²⁾	By time signal mean	By frequency	None	By frequency and by steps ⁽⁸⁾





DAILY PROGRAMMES OF STANDARD-FREQUENCY TRANSMISSIONS AND TIME SIGNALS

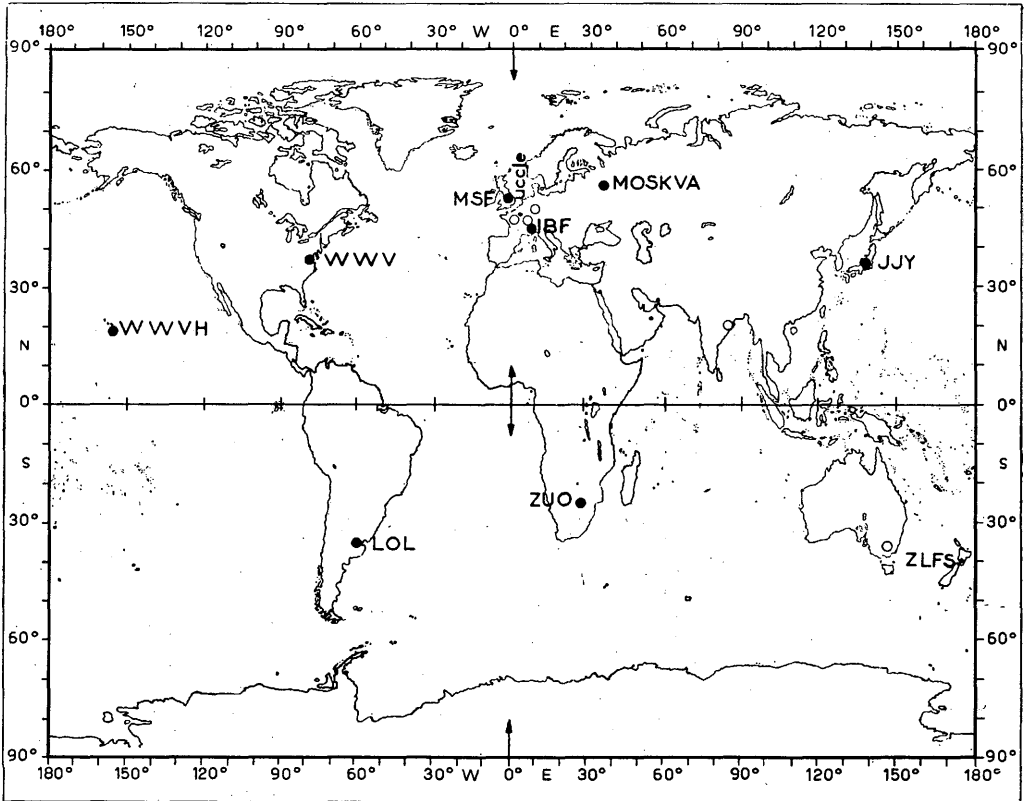


A Announcements

TIME SCHEDULES FOR STANDARD-FREQUENCY TRANSMISSIONS AND TIME SIGNALS

ANNEX IV

WORLD-WIDE DISTRIBUTION OF STANDARD-FREQUENCY AND TIME-SIGNAL STATIONS



- Station in service
- Low-power station operating on 2.5 Mc/s
- Projected station

ANNEX V

PLAN FOR SPECIAL MODULATIONS FOR FIELD MEASUREMENTS

*Proposal for time sharing **

<i>Minutes</i>	<i>Stations</i>
0 - 5	WWV — (India)
5 - 10	MSF — (Australia)
10 - 15	IBF
15 - 20	WWVH — LOL
20 - 25	JJY — (Switzerland)
25 - 30	ZUO — Moskva
30 - 35	WWV — (India)
35 - 40	MSF — (Australia)
40 - 45	(France)
45 - 50	WWVH — LOL
50 - 55	(Germany)
55 - 60	JJY — ZUO

* Taking account of possible new stations in the countries shown in brackets.

REPORT BY THE CHAIRMAN OF STUDY GROUP No. VIII*

(INTERNATIONAL MONITORING)

(Original language: English)

This Report deals with the work of Study Group No. VIII since the VIIIth Plenary Assembly (London 1953) and incorporates the material presented in the Chairman's Interim Report which dealt with the period up to 31st December, 1954.

1. Chairmanship and vice-chairmanship.

On Friday 22nd October, 1954, Mr. A. H. Cannon, the Chairman of Study Group No. VIII, died suddenly at his home in Melbourne after a day of work as usual at the P.M.G.'s Research Laboratories. I feel sure that the members of the Group will miss the efficient guidance which was given to the affairs of Study Group No. VIII by Mr. Cannon, and his passing is deeply regretted.

As provided for under the Buenos Aires Convention of 1952, I assumed the duties of Chairman in place of Mr. Cannon and early in 1955 sought nominations from the members of the Group for the vacant position of Vice-Chairman. At the same time, I was able to indicate to members that Australia was prepared to nominate Mr. E. Sandbach (an expert on monitoring work in the Australian administration) for the position. However, a second nomination was received—that of Mr. George S. Turner of U.S.A. and after correspondence with the administrations concerned, I was advised that the Australian nomination was withdrawn in favour of Mr. Turner.

Mr. Turner's name was then proposed to the Group and as favourable replies and no objections were received by me, I notified the Director of the C.C.I.R. on 26th September, 1955, that Mr. Turner was elected.

2. Participants.

The countries and organisations which have notified that they will participate in the work of Study Group No. VIII are:—

Countries

Argentine Republic, Australia, Belgium, Canada, Spain, United States of America, France, Hungarian People's Republic, India, Italy, Japan, Netherlands, People's Republic of Poland, Morocco (French Protectorate of), Federal German Republic, Federal People's Republic of Yugoslavia, People's Republic of Roumania, United Kingdom, Sweden, Switzerland, Czechoslovakia, U.S.S.R.

Private operating agencies

British Broadcasting Corporation (U.K.), Cable and Wireless Ltd. (U.K.), Compagnie Générale de Télégraphie Sans Fils (France), Marconi International Marine Communication Co. Ltd. (U.K.), Radio Corporation of America (U.S.A.), Radio-televisione Italiana (Italy), International Marine Radio Co. Ltd. (U.K.).

International organisations

International Broadcasting Organisation (O.I.R.)

3. Meetings.

As the questions being studied by the Group are small in number and are not of great urgency, it was considered that a meeting of the Group would not be necessary before the VIIIth Plenary Assembly and the Director was notified accordingly on 7th December, 1954. This decision followed from the opinion expressed by the Group in London that a meeting appeared unnecessary and because no urgent work has since arisen which required a meeting by the Group.

All work has therefore been carried out by correspondence.

* Doc. No. 108 (Warsaw, 1956).

4. Work of the Group.

The work assigned to Study Group No. VIII is the consideration of:—

- | | |
|-------------------------------|--|
| <i>Question No. 88</i> | Automatic monitoring of occupancy of the radio-frequency spectrum. |
| <i>Question No. 89</i> | Frequency measurements above 50 Mc/s by monitoring stations. |
| <i>Study Programme No. 69</i> | Accuracy of field-strength measurements by monitoring stations. |
| <i>Study Programme No. 70</i> | Spectrum measurement by monitoring stations. |

Contributions have been received on all of these subjects and these are discussed in Section 5 of this Report.

In addition, there is also the study of the vocabulary, definitions etc. which have been referred to the Group by the Chairman of Study Group No. XIV.

There are also some new topics which are under consideration by the Group and which will be discussed at the VIIIth Plenary Assembly. The topics arose from correspondence with the Vice-chairman, Mr. G. Turner who prepared the list in the following form:—

- a) what is the accuracy and frequency range of frequency measurements which can be accomplished at monitoring stations using a stable transfer oscillator and electronic frequency counter;
- b) what procedures would be most effective in obtaining coordinated assistance by monitoring stations of various administrations in the solution of international interference problems;
- c) what are the limitations in the kind of measurements and the accuracy of the same which are capable of being made by a mobile monitoring unit;
- d) what are the limitations and the effect of the same on wave-form observations (such as T.V. transmissions) performed at a distance by monitoring stations?

5. Report on contributions received.

5.1. *Survey of the topics and contributions received.*

Question No. 88 - *Automatic monitoring of the occupancy of the radio-frequency spectrum.*

This question was formulated at the VIIth Plenary Assembly (1953) because of the increasing use of automatic equipment of various types at monitoring stations. It is desired, if possible, to decide on the characteristics which can be recommended and standardised for such equipment, the data to be gathered and the form of presentation and analysis of the records.

It will be recalled that prior to, and at the VIIth Plenary Assembly, the I.F.R.B. indicated interest in this Question and expressed the hope that an early recommendation would be made.

Four reports on this Question have been received—from U.S.A. (Doc. No. 39), Japan (Doc. No. 36), Germany (Doc. No. 116), and United Kingdom (Doc. No. 33), and comments are summarised as follows:—

Part 1 of Question No. 88.

The U.S.A. contribution considers that it is desirable to evaluate the following parameters requested in the data required from administrations by the I.F.R.B.:

- (1) call sign of the transmitter;
- (2) measured frequency;
- (3) time of measurement;
- (4) date of measurement;
- (5) strength of signal (QSA code);
- (6) class of emission;
- (7) class of station;
- (8) bandwidth occupied;

- (9) call sign or other indication of point of reception;
- (10) remarks on the type of system;
- (11) name and location of the monitoring station.

Other parameters could include knowledge of either occupancy or vacancy of channels without station identification, noise, and absolute signal intensity.

The contribution from Japan lists the following parameters to be measured:—

- (1) characteristic frequency corresponding to the reference frequency;
- (2) frequency spectrum occupancy;
- (3) frequency distribution of noise;
- (4) field strength;
- (5) incoming direction.

The contribution from Germany lists the following parameters:—

- (1) frequency;
- (2) approximate signal field intensity;
- (3) bandwidth;
- (4) operation time;
- (5) class of emission;
- (6) deviation;
- (7) signal-to-noise ratio of the received signal.

The contribution from the United Kingdom states that, ideally, it would be useful to know:

- (1) the frequencies;
- (2) the bandwidths;
- (3) the types of emission;
- (4) the median field strengths and their variations over 24 hours;
- (5) the directions of arrival;
- (6) the operating schedules;
- (7) the identities;
- (8) the median field strength of atmospheric noise and its direction and variation on the same frequencies.

Part 2 of Question No. 88.

The U.S.A. contribution considers that little of the data requested by the I.F.R.B. could conveniently be obtained wholly by automatic means. The role of automatic monitoring equipment appears to be that of obtaining an overall coarse picture of occupancy versus vacancy of a desired frequency band. Information can be obtained rapidly and must necessarily be followed by manual observations of identity and signal characteristics. If the equipment is sufficiently sensitive, information on atmospheric noise levels can also be obtained.

The Japanese contribution states that, if there is no limitation on the size of the equipment, the parameters measurable with a wholly automatic monitoring equipment are those mentioned in the contribution to Part 1 of the Question.

The contribution from Germany states that all of the seven parameters mentioned can be recorded by a wholly automatic recording equipment.

The United Kingdom contribution states that of the factors listed, (1), (4) and (6) can be evaluated automatically; Nos. (2), (5), (8) could perhaps be evaluated automatically with a further elaboration of technique; (3) cannot easily be evaluated automatically and the evaluation of (7) would require the universal use of suitable identification signals.

Part 3 of Question No. 88.

The U.S.A. contribution considers the evaluation of recordings showing the presence or absence of signals in a band would not be complete without a follow-up of manual observations. Automatic sweeping ensures that signals are not missed and a better appreciation of frequency of usage, noise and signal intensities is obtained, thus aiding frequency allocations to services or areas.

The contribution from Japan considers that the addition of identification of the emission, communication speed and type and wave-form of emission would make it more valuable.

The contribution from Germany states that knowledge of the parameters mentioned in Part 1 is valuable and often, in conjunction with station identification, is sufficient for exploiting the radio frequency spectrum more efficiently than is done at present.

The contribution from United Kingdom considers that the knowledge of the information listed in Part 2 would be valuable in frequency planning. Fully automatic equipment however may not be economical or practical and automatic measurements must be supplemented by manual observations.

Part 4 of Question No. 88.

The U.S.A. contribution states that the equipment in use and under development in the U.S.A. is of the form suggested in the Question. Brief descriptions are given of a type of receiver and recorder in use, a second type in use but still under development and a third under development but not in use. There is also a description of an "occupancy-vacancy weighted recorder" which is still in the developmental-experimental stage.

The following comments and suggestions regarding desirable characteristics of automatic spectrum occupancy monitoring equipment are given:—

- (1) total frequency range : 2 to 30 Mc/s at least;
- (2) swept frequency range : 1000 kc/s below 3.5 Mc/s,
200 kc/s above 3.5 Mc/s;
the need for standardisation of this parameter is not yet substantiated);
- (3) number of sweeps per hour : }
(4) maximum rates of sweeping (kc/s/s) : } discussed but not concluded, although useful comment given;
- (5) sensitivity : should be adjustable and the best possible ($> 1 \mu\text{V/m}$);
- (6) resolving power : closer than 5 kc/s for approximately equal signals;
- (7) signal characteristics recorded : a) presence or absence of signal;
b) carrier frequency;
c) activity of signal;
d) bandwidth;
e) signal strength;
f) time;
- (8) records : chart recordings, in which time indication within single sweep and frequency are shown across the width of the chart, and intervals of sweep repetition progress along the length of the chart, are preferred. A suitable width for the chart is 8 inches. Automatic calibration hourly by 10 kc/s markers is suggested.

It is considered that further studies are needed to determine whether analysis of the records would produce occupancy data that could be reported to the I.F.R.B. and used by administrations for planning the use of the spectrum.

The Japanese contribution states that the combination of radio receiver and recorder may generally be considered as stated in Question No. 88.

Comments are made on the equipment characteristics and the following suitable values are suggested:—

- (1) total frequency range : minimum, 6-18 Mc/s,
desirable, 3-27 Mc/s,
if possible, 1.6-60 Mc/s;

- (2) Swept frequency range : formula given leading to typical value of 1500 kc/s;
- (3) number of sweeps per hour : 60;
- (4) maximum rate of sweeping : 26 and 31.25 kc/s/s;
- (5) sensitivity : better than $1 \mu\text{V/m}$;
- (6) resolving power : 0.69 to 0.75 kc/s;
- (7) signal characteristics recorded :
 - a) bandwidth (including all components above a certain field strength);
 - b) signal strength (estimated from the density of the trace from a phototelegraphy recorder);
- (8) records : chart width 20 cm, length 36 cm.
Frequency calibrating marks 20 kc/s and 200 kc/s.

Several types of equipment for the same purpose are in use in Japan and the specification for a type which is a little different from those mentioned is attached to the report with an example of the data.

The contribution from Germany outlines the measurement of the seven parameters listed under Part 1, describes equipment in use and gives the results and analysis of a number of types of emission.

The equipment characteristics are discussed and the following values are suggested:—

- (1) total frequency range : 10 kc/s to 300 Mc/s (desirable).
- (2) swept frequency range : a number of sweep ranges necessary, the width being dependent on the parameters being studied. (Typical values given: 40-350 kc/s);
- (3) number of sweeps per hour : this is dependent upon the available receiver but might be 60 or 90 sweeps per hour. 180 sweeps per hour is practical with existing receivers;
- (4) maximum rates of sweeping kc/s/s : variable—in some cases not greater than 1 kc/s/s; other cases 10 kc/s/s and at VHF the maximum might be up to 100 kc/s/s;
- (5) sensitivity : recommended maximum sensitivity $> 1 \mu\text{V/m}$ reducible by steps of 10 db over a range of 90 db;
- (6) resolving power : with the equipment described the resolving power can be 100 c/s but the resolving power might also be stated as 1/10th of the bandwidth swept per second;
- (7) signal characteristics recorded :
 - a) carrier frequency;
 - b) bandwidth;
 - c) field strength;
 - d) time of transmission;
 - e) class of emission;
 - f) FM deviation (where applicable);
- (8) records : a wax coated paper is used in German P.T.T. equipment. For international exchange photostatic copies of recordings should be used, 20 cm (8 inches) width and covering 24 hours, with the lowest frequency on the left hand edge. The frequency calibration should appear on the edge of the chart with additional adjustable frequency-marker tabs 1, 5 and 10 kc/s intervals. A timing line should be inscribed at 0.5, 1 or 2 hours with a double line at 24 hours.

The contribution concludes that manual monitoring is essential for positive identification. A subjective analysis of the recording is made by the operator and the information gained is transferred to punched cards for further study. Cases of spurious radiation and interference are thus readily traced and several examples are shown.

The United Kingdom contribution gives the following characteristics of automatic monitoring equipment in use in United Kingdom, which is of the form quoted in the Question:—

- (1) total frequency range : 14 kc/s to 30 Mc/s;
- (2) swept frequency range : variable between 100 kc/s and 1000 kc/s;
- (3) number of sweeps per hour : 30;
- (4) maximum sweep rate : The maximum rate used 10 kc/s/s approximately;
- (5) sensitivity : at least 1 μ V/m (reducible in steps of 10 db) if directional aerials used. With non-directional aerials, +10 db above 1 μ V/m;
- (6) resolving power : resolution to a few hundred cycles desirable;
- (7) signal characteristics :
 - a) carrier frequency primarily;
 - b) existing receivers give indirect indication of bandwidth, but further development desirable;
- (8) size and form of records : British receivers use a wet electrolytic method to produce direct records on thin white paper (8 $\frac{1}{2}$ inches by 12 inches long for a 24 hours record) with frequency calibration markers at 10 and 100 kc/s intervals at 2 hourly intervals and a thick mark at midnight;
- (9) analysis of records : ideally the scanning receiver should produce its information in the form finally required so that no subsequent analysis is necessary.

Comment on responses to Question No. 88.

There is a considerable measure of agreement shown in the responses and it is considered that by discussion at the VIIIth Plenary Assembly, it should be possible to draft a Recommendation on the main characteristics of automatic monitoring equipment.

It appears that further study and experience is needed to derive the greatest benefit from the additional assistance given by automatic monitoring and also, if possible, to develop methods of analysis of the records which can produce spectrum occupancy data of value to the I.F.R.B. and to administrations in planning the use of the spectrum.

A new study programme may therefore be drafted to cover these aspects.

Question No. 89 - Frequency measurements above 50 Mc/s by monitoring stations.

This is a new topic, required because of the increasing use of frequencies above 50 Mc/s and because frequency measuring techniques applicable to lower frequencies are probably unsuitable.

Four contributions have been received, reports from Japan (Doc. No. 35), Belgium (Doc. No. 41) and Germany (Doc. No. 117), and a recommendation from U.S.A. (Doc. No. 37).

Part I of Question No. 89.

The contribution from Japan points out that suitable measuring equipment is already in use in Japanese monitoring stations. Based on this experience, the accuracy of measurement for sta-

tions between 50 Mc/s and 500 Mc/s should be better than ± 3 parts in 10^6 for at least 95% of the measurements.

The report from Belgium describes briefly equipment for measurements between 100 and 250 Mc/s—with a suitable receiver the range could be extended. The following accuracy is attained:

- a) frequency of the standard ± 1 part in 10^7 to ± 2 parts in 10^8 ;
- b) the determination of frequency f_0 (measurement in 10 seconds) ± 0.1 c/s i.e. ± 1 part in 10^7 .
(f_0 is between 1 and 1.01 Mc/s);
- c) total accuracy ± 2 parts in 10^7 (stable emissions);
- d) on weak or less stable emissions (zero beat within 50 c/s)
 ± 7 parts in 10^7 at 100 Mc/s,
 ± 4.5 parts in 10^7 at 200 Mc/s.

The U.S.A. contribution answers the parts of questions specifically:—

- a) fixed monitoring stations shall be able to make frequency measurements with an accuracy of ± 2 parts in 10^6 ;
- b) measurements of television stations using offset carrier on frequencies above 470 Mc/s should be made with an accuracy of ± 5 parts in 10^7 ;
- c) routine measurements of communication equipments above 50 Mc/s may be made by mobile stations with an accuracy of ± 1 part in 10^6 or better.

The contribution from Germany states that the desirable accuracy of measurements should be not lower than ± 3 parts in 10^6 which is 1/10th of the smallest frequency tolerance. It is also desirable to measure the channel separation of the transmitters with an accuracy of 1%. The minimum channel spacing which is foreseen for many years in 16 kc/s and 1% of this is 3.2 parts in 10^7 at 500 Mc/s. This is also more than sufficient for the measurement of stations above 500 Mc/s.

Part 2 of Question No. 98.

The contribution from Japan describes small, lightweight and portable equipment which is used for both fixed and mobile measurements. It is capable of an accuracy of better than 3 parts in 10^6 in the range 20-500 Mc/s and uses the following principle.

The frequency to be measured is substituted by the harmonic frequency from the substitute oscillator operating in the range 10-15 Mc/s, and the fundamental frequency from the oscillator is measured by direct reading by means of the beat-down method and interpolation method. The value thus obtained is multiplied by the order of harmonic of the substitute oscillator to obtain the final frequency to be measured.

The Belgian report states that the equipment used at the Mobile Service Monitoring Centre (C.C.R.M.) incorporates the well-known principles of the "gliding harmonics" method used with the 1110-A interpolating frequency standard. The installation consists of:—

1. I.F.S. 1110-A. (General Radio of U.S.A.);
2. multivibrator;
3. receiver;
4. frequency meter;
5. frequency standard.

The I.F.S. 1110-A is regulated so that the appropriate harmonic of the multivibrator gives a zero beat with the frequency being received. The driving frequency of the multivibrator is measured by means of the frequency meter (which is controlled by 100 kc/s from the frequency standard) The driving frequency f_0 is always between 1 and 1.01 Mc/s and is multiplied by n , the order of harmonic used.

A comment received from U.S.A. on the Belgian report describes the method as excellent and states that the accuracy obtained is sufficient for monitoring station purposes.

The U.S. contribution gives details of the preferred equipment which consists of a frequency standard, a very stable frequency transfer unit, an electronic frequency counter and receivers. In the frequency transfer unit a harmonic of the frequency standard is selected and modulated by an interpolation oscillator, the combination frequency controlling a locked search oscillator. The locked search oscillator may be brought to zero beat with the unknown frequency. With some additions, the method may be extended to 12 000 Mc/s.

For transportable mobile use, the frequency standard for the frequency counter may be used as the portable frequency standard, being set to frequency by reference to a standard-frequency transmission. Other desirable characteristics are given.

Portable frequency meters accurate to 1 part in 10^5 are available.

The response from Germany states that preference should be given to an equipment functioning on a principle which will allow comparison of the signal to be measured with a *single* tunable measuring frequency. The comparison frequency is derived from a locally generated secondary standard frequency of 100 kc/s by a step-up process employing several decade stages and allowing the exact output frequency to be read on dials, each covering one decimal decade step (frequency filtering, frequency synthesis and frequency analysis method). The accuracy of 3.2 parts in 10^7 is easily attainable with the equipment described. There is a reduction in the accuracy attainable by mobile stations unless considerable precautions are taken.

When measuring unmodulated or amplitude-modulated transmitters the difference frequency between the comparison frequency and the transmitter frequency may be measured using exactly the same equipment as on lower frequencies, the zero beat being observed either by CRO or by aural means. Wide-range frequency meters are a useful adjunct. Methods for dealing with FM signals are outlined.

Part 3 of Question No. 89.

The contribution from U.S.A. states that the generation of harmonics of the frequency standard for frequencies above 50 Mc/s in the same manner as below 50 Mc/s may be accomplished. However, a stable frequency transfer unit is more useful at the higher frequencies using harmonic techniques as in the bands below 50 Mc/s. The use of stable frequency transfer units facilitates the measurement of emissions which are not sufficiently stable to be measured by direct beat means. It is conceivable that a scanning type of spectrum analyser (or similar device) might be used to adjust the transfer unit to the unknown frequency. The transfer unit generates standard harmonics, modulates selected harmonics with a variable interpolation oscillator and uses the sum or difference frequency of the selected standard harmonic and the variable interpolation oscillator to control a locked search oscillator. These may all be combined in one unit.

The method used for mobile working is essentially the same with the exception of the frequency standard.

In the case of the contributions from Japan and Belgium the methods used are as described under Part 2 of the Question.

In the response from Germany, no step-by-step description is given of an actual frequency measurement, for, by employing a selective harmonic amplifier, the method of measurement is practically the same as that in use with frequency-measuring equipment for lower bands.

Comment on responses to Question No. 89.

The contributions received contain considerable information on techniques of measurement above 50 Mc/s and with further discussion at the VIIIth Plenary Assembly it is expected that a Recommendation can be prepared on this Question.

Study Programme No. 69 - Accuracy of field strength measurements by monitoring stations.

It will be recalled that this Study Programme was evolved because it was not found possible to cover all the conditions of measurement in Recommendation No. 123.

Two contributions have been received in the form of reports from U.S.A. (Doc. No. 40) and Belgium (Doc. No. 43).

Part 1 of Study Programme No. 69.

The U.S.A. contribution discusses the measurement of emissions of types A1, A2, P and emissions with suppressed or reduced carrier. For purposes other than propagation studies there is a tendency towards standardising three types of "weighting" circuit (peak, quasi-peak,

and average) for the final indicating meter. Evidence is needed to justify these time constants for all conditions. There is likelihood in the future of having standardised receivers (combining two or more for emissions of closely related characteristics).

The U.S.A. contribution also provides considerable material on the measurement of field levels for propagation studies.

In a summary, four points are made:—

- (1) the objectives of Study Programme No. 69 should be explicitly stated;
- (2) peak reading field-strength measuring equipment may be tried for a number of types of emission, which are listed and the results verified;
- (3) average voltage field-strength measuring and recording equipment may be used, with installations described in the Annex of Recommendation No. 123, for the measurement of all types of emissions except A1, A2, P and emissions with suppressed or reduced carrier;
- (4) field intensity measurements for propagation studies can be continued and expanded in accordance with proposals outlined in Section 3 of the contribution.

Part 2 of Study Programme No. 69.

The contribution from U.S.A. considers that the accuracy of RF voltage standards and measurements at these frequencies constitutes at present a source of a minor fraction of the total error in absolute field-strength measurement at monitoring stations. The discussion of this matter as presented in Doc. No. 170, Geneva 1953, Section 5, seems adequate for the present.

The contribution from Belgium describes in particular, apparatus which is in daily use for making measurements of field strength of MF radio beacons in the presence of interference and discusses the difficulties encountered and the accuracy obtained. The solution adopted consists of terminating the field-strength measuring instrument in a spectrum scanner with an output oscilloscope; the input of the scanner is connected to one of the intermediate-frequency, 475 kc/s, amplification stages of the field-strength measuring device, before the detection stage. The scanner was specially designed for this purpose. It has an amplitude range of 20 db, a filter of less than 100 c/s bandwidth; the scanning frequency is about 1 c/s and the scanning range can be adjusted from 1 to 6 kc/s. The device is completely successful particularly in the case of emissions whose spectra are composed of easily separable lines.

The use of a spectrum scanner as an indicating device for the measurement of field strength in the presence of interference was supported "as an excellent method" in comments received from the U.S.A. on this document.

Comment on responses to Study Programme No. 69.

The responses are a useful contribution to the Study Programme but undoubtedly further studies are needed. It may also be necessary to consider a revision of the Study Programme to include the effects of interference and state the objectives of the Study Programme more explicitly. It has been stated by U.S.A. that there may not be justification for further study on the improvement of accuracy. These points will be discussed at the VIIIth Plenary Assembly and therefore it is likely that a Report and an amended Study Programme will be drafted on this subject.

Study Programme No. 70 - Spectrum measurement by monitoring stations.

The subject of spectrum measurement by monitoring stations is closely related to the studies of bandwidth of emissions which are being made by Study Group No. I. In the case of such measurements made at monitoring stations there are the additional complication of fading and interference. Study Programme No. 70 was designed to take into account the work of Study Group No. I and obtain information on the design and use of spectrum-measuring equipment at monitoring stations and the accuracy which can be achieved in practice.

Three contributions have been received on this subject in the form of reports from Germany (Doc. No. 38), Belgium (Doc. No. 42), and U.S.A. (Doc. No. 34).

Contributions.

The contribution from Germany gives a short description of a spectrum-measuring device based on the principle of recording or storing the keyed emission of the distant transmitter. A

suitable pulse can then be selected for subsequent analysis (for example, by specially trained personnel at a central station).

A comment from U.S.A. on this document states that the paper should be a valuable contribution to the study of spectrum measurement by monitoring stations since it offers a plan for measuring the bandwidth of signals partially covered by noise.

However, later advice from the Administration of Germany indicates that a further contribution on this device may not be available for at least two years.

The contribution from Belgium gives details of equipment which has been used for some years in Belgium for spectrum measurement at a distance. The equipment uses a spectrum scanner with automatic scanning, the display unit using a long afterglow oscilloscope so that a photographic record may be made. The principal characteristics of the scanner are given in Annex II of Recommendation No. 88 and in C.C.I.R. Doc. No. 55 (Brussels 1955). For measurements at a distance the scanner is preceded by a superheterodyne receiver whose intermediate frequency is the same as the input frequency of the scanner itself.

Precautions to be taken in the receiver design and in making the measurements are discussed, particularly the effects of fading. The report states that it seems reasonable to refrain from conducting actual measurements when there is considerable fading and above all when there is selective fading. Nevertheless an examination of spectra during fading may yield useful information when investigating interference.

A comment from U.S.A. on the point made by Belgium on selective fading considers "that if observations are made over a number of fading cycles the ratio of the maximum levels of the sideband components to the maximum level of the carrier can be determined even when selective fading is present. The use of spectrum analysers at monitoring stations on skywave signals is sufficiently extensive to justify a more definite determination by further study of the effect of selective fading on the accuracy of determination of the relative levels of spectral component".

With regard to the possible or necessary accuracy of measurements by monitoring stations, it is considered in the Belgium report that this question is rather premature. Moreover it is thought that the question on the accuracy of spectrum measurements is one which has no point in itself since the actual spectrum cannot be determined for real traffic. A number of instruments were demonstrated at Brussels to Study Group No. I in 1955 and it appears desirable to await results of tests of these instruments in the monitoring service.

The United States report discusses the problem of spectrum measurement by monitoring stations in considerable detail. The principal difficulties which are peculiar to monitoring are:—

- (a) adverse conditions, i.e. noise, selective fading and interference;
- (b) that the primary interest of monitoring work is compliance or non-compliance with regulations;
- (c) the diverse spectrum-measuring equipment needed by monitoring stations to cover many types of emission;
- (d) that as co-operation with the transmitter may not be possible, rapidity of measurement without ambiguity is essential.

There are, too, a number of technical aspects which limit the accuracy attainable at monitoring stations such as the wide range of emission bandwidths (a few c/s to 6 Mc/s) and the range of levels of harmonics and spurious emissions (up to 80 db in some cases, referred to the carrier level).

The report surveys the three main methods considered to be applicable to measurements made at points distant from the transmitters.

The desirable characteristics of analyser equipment for monitoring stations are also listed:—

- (1) *ease and rapidity of operation*;
- (2) *wide frequency range* : (one instrument can serve to 50 Mc/s);
- (3) *variable scanning range* : 100 kc/s and adjustable down to 1 kc/s, or perhaps 500 c/s,
10 kc/s to 6 Mc/s, above 30 Mc/s;

- (4) *variable scanning speed* : Maximum sweep frequency 50 sweeps per second commonly used. Minimum scanning speed for automatic scanning should be at least as low as 100 c/s. using sweep frequencies as low as 10 seconds per single sweep;
- (5) *suppression of recurrent scanning* : to be provided;
- (6) *resolution* : 50 c/s at —60 db;
- (7) *satisfactory amplitude range* : at least 40 db and preferably 60 db;
- (8) *relative immunity from interference* :
- (9) *suitable indicating device* : cathode ray display preferred to chart recordings.

The conclusion is reached in this report that measurement accuracy comparable with that obtained near the transmitter, can be obtained at monitoring stations provided signals are of sufficient strength to override noise and interference, and when fading is present observations are made over a number of fading cycles.

Comment on responses to Study Programme No. 70.

The contributions received so far are valuable but it is clear that further study and experience is required in making spectrum measurements at monitoring stations, before a recommendation can be made. It is likely that a brief report will be drafted at the VIIIth Plenary Assembly.

5.2. Work on the draft vocabulary.

On behalf of the Group, I received copies of the drafts of Volumes I, II and III of the draft vocabulary for study from the Chairman of Study Group No. XIV. This work is not yet complete and I have received no material in response to my invitation to members of the Group to supply lists of terms and definitions appropriate to the subject of international monitoring.

In a communication dated May 27th, 1955, the Administration of U.S.A. provided this comment: "Consideration was given by the U.S.A. prior to the VIIth Plenary Assembly to a list of terms and definitions appropriate to international monitoring. However, we did not find much material and therefore our contribution was rather limited. I do not believe that there has been much, if any, new material that could be presented under this heading at this time "

(Signed Geo S. Turner)

J. D. CAMPBELL

Chairman, Study Group No. VIII

REPORT BY THE CHAIRMAN OF STUDY GROUP No. IX*

(GENERAL TECHNICAL QUESTIONS)

(Original language: English)

Since the VIIth Plenary Assembly, Study Group No. IX has considered Questions Nos. 90, 91, 92, 93 and 96 and Study Programme No. 28, all of which were assigned to it by that Assembly, and are concerned with the study of radio relay systems. The Study Group has not, however considered Questions Nos. 94 and 95, relating to the transmissions of documentary material and pictures. These questions are being handled by a joint C.C.I.T./C.C.I.R. Study Group (C.C.I.T. Study Group No. V) and are therefore not considered in this report.

A meeting of Study Group No. IX was held in Geneva in 1954, to study Questions Nos. 90 to 96 inclusive and Study Programme No. 28. At this meeting three new Questions, Nos. 113, 114 and 115, were formulated and were subsequently adopted by correspondence. They also have been considered by the Study Group. The C.C.I.F. recently adopted a Question for study jointly with the C.C.I.R., C.C.I.R. Question No. 116, which is the joint concern of C.C.I.F. Study Group No. V and C.C.I.R. Study Group No. IX. As material of the type sought in this question was obtained for the 1954 meeting of Study Group No. IX and, unfortunately proved difficult to analyse and of little use in the Study Group's work, I have asked members of the Study Group to send any contributions on the question directly to the C.C.I.F.

The attached table lists some fifty-eight contributions grouped according to the Question or Study Programme concerned. Draft recommendations and reports formulated during the 1954 meeting are listed first, followed by contributions received more recently. All this material is surveyed in annexes to the report.

I should like to take this opportunity of thanking all those who have contributed so effectively to our work.

H. STANESBY

Chairman, Study Group No. IX

* Doc. No. 109 (Warsaw, 1956).

TABLE OF CONTRIBUTIONS

Note: The contributions originating from the 1954 meeting of Study Group No. IX in Geneva are given the document numbers assigned at that meeting preceded by "G" (Geneva). The numbers of more recent contributions are preceded by "W" (Warsaw).

Question or Study Programme	Subject	Source	Document number
Question No. 90	Interconnexion of multiplex radio relay systems	S.G. IX (1954) S.G. IX » Fed. German Rep. Japan Netherlands	G. 46 (rev.) G. 71 (rev.) W. 239 W. 339 W. 258
Question No. 91	Television and multichannel telephony on the same radio relay system	S.G. IX (1954) S.G. IX » Czechoslovakia Netherlands Netherlands	G. 63 (rev.) G. 79 (rev.) W. 118 W. 259 W. 260
Question No. 92	Standards for TDM radio relay systems	S.G. IX (1954) S.G. IX » S.G. IX » S.G. IX » Fed. German Rep. France Japan	G. 49 (rev.) G. 57 (rev.) G. 58 (rev.) G. 59 (rev.) W. 295 W. 191 W. 334
Question No. 93	Standards for FDM radio relay systems	S.G. IX (1954) S.G. IX » S.G. IX » S.G. IX » S.G. IX » S.G. IX » Fed. German Rep. » » » » » » » » » France Japan Netherlands U.K. U.K.	G. 42 (2nd rev.) G. 62 (2nd rev.) G. 64 (rev.) G. 69 (rev.) G. 70 (rev.) G. 79 (rev.) W. 243 W. 244 W. 296 W. 444 W. 190 W. 337 W. 261 W. 44 W. 133 W. 134
Question No. 96	Maintenance procedure for radio relay systems	France Japan Netherlands Netherlands U.K. U.K. U.K.	W. 189 W. 335 W. 270 W. 271 W. 130 W. 134 W. 135

Question or Study Programme	Subject	Source	Document number
Question No. 97	Hypothetical reference circuit for radio relay systems	S.G. IX (1954) Fed. German Rep. France Japan Netherlands Netherlands U.K.	G. 66 W. 237 W. 420 W. 336 W. 262 W. 263 W. 228
Study Programme No. 28	Wide-band radio systems	Nil	
Question No. 113	Connexion of systems with different characteristics	Fed. German Rep. France Japan Netherlands	W. 238 W. 195 W. 333 W. 264
Question No. 114	Frequency tolerances	Fed. German Rep. France Netherlands	W. 45 W. 192 W. 269
Question No. 115	Computation of intermodulation noise	U.S.S.R. Fed. German Rep. Fed. German Rep. France Netherlands	G. 29 W. 388 W. 444 W. 193 W. 268
Question No. 116	Operational characteristics of long-distance radio relay systems	Nil	

ANNEX I

SURVEY OF CONTRIBUTIONS TO QUESTION NO. 90

International wide-band radio relay systems operating on frequencies above about 30 Mc/s

Interconnexion of multiplex systems

1. *Contributions received.*

At Geneva, in 1954, Study Group No. IX produced two final documents dealing with Question No. 90:

G. 46 (revised): draft Recommendation
G. 71 (revised): draft Report

Since the Geneva meeting three further contributions to the study of this Question have been received:

Federal German Republic : W. 239;
Japan : W. 339;
Netherlands : W. 258.

2. *Summary of contributions.*

Document G. 46 (revised) answers Part 2 of Question No. 90, while the draft report in Document G. 71 (revised) answers Parts 1 and 3 of the Question.

The Federal German Republic's document, W. 239, does not seek to amend either of the two Geneva documents, and as it relates mainly to that part of Question No. 90 which has now become a separate Question (Question No. 113) it is considered under that heading.

The Japanese document, W. 339, describes the results of tests on systems using mixed time and frequency division to provide 24 or 60 channels.

The Netherlands document, W. 258, affirms support for the draft Recommendation of Geneva, 1954, Document G. 46 (revised).

3. *Discussion.*

In the light of these documents the draft Recommendation in Document G. 46 (revised) might be amended as shown in Section 4, below. In this amended form the Recommendation answers the whole of Question No. 90, and this Question need not then remain for study.

4. *Proposed Recommendation.*

The text of the proposed Recommendation as amended is shown below:

i) alter the last few words of consideration (b) to read: "must be made channel by channel at audio frequencies."

ii) add to the considerations:

"c) that future time-division multiplex systems may combine small blocks of speech channels by frequency-division multiplex before multiplexing these blocks by time-division methods;

d) that the interconnexion of multiplex systems channel by channel at audio frequencies, rather than by extending undivided blocks of channels from one system to another, requires the use of additional equipment at the connexion point for translation to and from audio frequencies, which involves economic and operational disadvantages, as well as some degradation of performance and increased maintenance;

e) that, for level stabilisation etc, some frequency-division multiplex systems transmit pilot signals which it is advantageous to transmit from one switching section to the next, and that the extension of such pilot signals over a time-division multiplex system may give rise to appreciable complications with corresponding disadvantages;

f) that the interconnexion of basically different types of multiplex systems would generally add to the problems of maintenance, since circuit techniques, routine measurements and fault-finding procedures would tend to differ;

g) that time-division multiplex and frequency-division multiplex systems may provide different and incompatible numbers of traffic channels;

h) that time-division multiplex and frequency-division multiplex systems may use different methods of signalling, e.g. D.C. methods by pulse displacement in time-division systems and voice-frequency methods in frequency-division systems”;

iii) add to the recommendations:

“4. that where the interconnexion of time-division multiplex and frequency-division multiplex systems cannot be avoided, the interconnexion should be made on a 4-wire basis in accordance with the relevant C.C.I.F. rules, either at audio frequencies or, if appropriate, at the baseband frequencies corresponding to the blocks of channels combined by frequency-division methods before time-division-multiplexing”;

iv) change point 4 in Document G. 46 (revised) to point 5, and delete the note which follows it.

ANNEX II

SURVEY OF CONTRIBUTIONS TO QUESTION NO. 91

International wide-band radio relay systems operating on frequencies above about 30 Mc/s Transmission of telephony and television on the same system

1. Contributions received.

At Geneva, in 1954, Study Group No. IX produced two final documents dealing with Question No. 91:

G. 63 (revised, with corrigendum): draft Report

G. 79 (revised): extension of Doc. No. 63.

Since the Geneva meeting three further contributions to the study of this Question have been received:

Czechoslovakia	: W. 118
Netherlands	: W. 259; W. 260.

2. Summary of contributions.

Documents G. 63 (revised) and G. 79 (revised) together form a Draft Report on the Question and this:

i) draws attention to certain economic and operational advantages in the *alternative* use of a wide-band system for telephony or television;

ii) comments briefly on the *simultaneous* transmission of telephony and television over the same system, and lists five points for further study;

iii) proposes some standards for intermediate-frequency and radio-frequency characteristics for the transmission of monochrome television.

The Czechoslovak contribution relates to part 2 of the Question, on essential technical characteristics, and analyses the transient-response requirements of the 625-line Czechoslovak television system in terms of the resolving power of a picture monitor at a television broadcast transmitter.

It concludes that a video bandwidth of 6 Mc/s is necessary, and that this could be accommodated for transmission by frequency modulation in a channel 19 Mc/s wide, provided that the differential delay does not vary by more than ± 25 millimicrosec. over that band.

The first Netherlands contribution points out certain operational difficulties in the alternative use of a wide-band system for telephony or television, and formulates a draft Recommendation calling instead for the use of as many similar units of equipment as possible in the telephone and television relay systems. It also proposes a new Question on the characteristics of wide-band systems for relaying monochrome and colour television. The second Netherlands document proposes some changes and additions to Document G. 79 (revised).

3. *Discussion.*

It is perhaps still too early to formulate a Recommendation completely answering part 1 of the Question on the advantages to be derived from planning systems to transmit television and telephony simultaneously or alternatively; but a useful Report might be prepared based on the text of Document G. 63 (revised and corrected), with the amendments and additions listed in Section 4, below.

Before Part 2 of the Question can finally be answered it is desirable, as the Netherlands contribution indicates, to have the answers to similar questions about systems used exclusively for either multi-channel telephony or for television. The answers to Questions Nos. 92 and 93 will provide the required information for telephony, and Study Group No. XI is considering the baseband characteristics required for systems transmitting television signals. However, as the Netherlands contribution points out, it is desirable for both systems, as far as possible, to use similar components. It may therefore be desirable to formulate a Recommendation on the subject, and a draft text is given in section 5 below. It is suggested also that the additional information that has been collected in reply to part 2 of Question No. 91 should be presented as a Report. The proposed text of this Report is given in section 6, below. The study of both parts of Question No. 91 should continue.

4. *Draft Report on part 1 of Question No. 91.*

The text of the proposed report on part 1 of Question No. 91 is that of Document G. 63 (revised and corrected), amended as shown below:

- i) page 1, 1st line of para. 2, delete "considerable";
- ii) page 1, para. 2, insert at the end of sub-para. (a):
"even so there may be considerable operational difficulties if it is necessary to re-route some or all of the telephony channels displaced by the television circuit;"
- iii) page 1, para. 2, insert at the end of sub-para. (c):
"but this facility may be limited by the fact that the telephony and television terminal stations are located in different places."
- iv) page 2, para. 2, insert after sub-para. (b):
"(c) the essential technical characteristics for the relaying of multi-channel telephony and television signals should, wherever possible, be chosen in such a manner that the use of the greatest number of similar or common units is possible, and costs are thereby reduced."

5. *Draft new Recommendation.*

*International wide-band radio relay systems operating on frequencies above about 30 Mc/s
Intermediate-frequency and radio-frequency characteristics for the transmission
of television signals*

The C.C.I.R.

considering

- a) that complete study of the preferred characteristics of radio relay systems for multi-channel telephony, under Questions Nos. 92 and 93, and of the requirements for the transmission of television over long distances, under Study Programme No. 32, may occupy a considerable time;

- b) that meanwhile radio relay systems are being designed and installed for the transmission of multi-channel telephony and television;
- c) that the factors governing the choice of radio relay system parameters for television and for multi-channel telephony are largely similar;
- d) that if radio relay systems for television are considered independently from those for multi-channel telephony, an unnecessary diversity of characteristics may result;
- e) that at times it may be desirable to interconnect two systems one of which is designed primarily for multi-channel telephony and the other for television;

recommends

that as far as is practicable and economic, and without sacrificing performance, it is preferable that the major intermediate-frequency and radio-frequency parameters of international radio relay systems for television should conform with those for multi-channel telephony.

6. *Draft Report on part 2 of Question No. 91.*

*Some preferred characteristics of radio relay systems
for the transmission of monochrome television*

The preferred values of the baseband characteristics for the transmission of monochrome television are being considered by Study Group No. XI, (1) and Recommendation No. (see preceding draft Recommendation) refers to the major intermediate-frequency and radio-frequency parameters of radio relay systems for television. This report gives certain additional information on the preferred characteristics of radio relay systems for television.

The proposed values of frequency deviation (2) at intermediate and radio frequencies are:

6 Mc/s deviation for television signals with 625 lines or less;

8 Mc/s deviation for television signals with 819 lines.

The above values are for systems without pre-emphasis, and are provisional. It may be found desirable to increase them in the future.

It is preferred that, at points of international interconnexion, the intermediate and radio frequencies corresponding to the tips of the synchronising pulses shall be stabilised at values which are one-half the frequency deviation either above or below the centre values (3) of the intermediate and radio frequencies. The choice should be left to the administrations concerned.

Documents referring.

- a) Document No. 79 (revised), Study Group No. IX Geneva, 1954;
- b) Warsaw, 1956, Document No. 259 (Netherlands);
- c) Warsaw, 1956, Document No. 118 (Czechoslovakia).

Notes.

- (1) Study Group No. XI is also invited to consider the need for a difference between the input and output baseband levels to accommodate some loss in interconnecting cables.
- (2) The frequency deviation is the peak-to-peak excursion of the carrier frequency when fully modulated.
- (3) The centre value of the radio frequency is the channel frequency defined in (reference to Warsaw Doc. concerning the channel frequency plan).

ANNEX III

SURVEY OF CONTRIBUTIONS TO QUESTION NO. 92

Multi-channel radiotelephone systems using time division multiplex and operating at frequencies above about 30 Mc/s

1. Contributions received.

At Geneva, in 1954, Study Group No. IX produced four final documents dealing with Question No. 92 :

G. 49 (revised): draft Recommendation
G. 57 (revised): draft Report
G. 58 (revised): » »
G. 59 (revised): » »

Since then further contributions to the study of the Question have been received from three administrations:

Federal German Republic : W.295
France] : W.191
Japan : W.334

2. Summary of contributions.

Document G. 49 (revised) recommends that for time-division multiplex systems forming part of an international circuit, the methods of making audio connexions and of signalling should conform to the Recommendations of the C.C.I.F. Document G. 57 (revised) considers and lists the characteristics that should be specified to enable two time-division multiplex systems using pulse-position modulation to be interconnected. Document G. 58 (revised) considers the essential characteristics of time-division multiplex channelling equipment, and reaches some conclusions about 12-channel and 24-channel equipments using pulse-position modulation. Document G. 59 (revised) lists preferred values for the baseband parameters of 12-channel and 24-channel time-division multiplex systems using pulse-position modulation.

The Federal German Republic's contribution, W.295, draws attention to one limitation of the sequence of 28 pulses proposed in Doc. No. 58 (revised) for a 24-channel system, and gives details of a 48-channel system with a 48-pulse sequence. The view is expressed that any recommendations on pulse-position modulation systems should leave room for future developments.

The French contribution, W.191, comments on Documents G. 58 and G. 59, and for the most part it supports and extends them, and recommends that the stated parameters should be standardised. The possibility of using bi-directional pulses on pulse-position-modulation/frequency-modulation systems is mentioned.

The Japanese contribution, W.334, refers to 23-channel and 40-channel pulse-amplitude modulation/frequency-modulation systems developed in Japan, but does not propose their standardisation at present. It agrees generally with the standards proposed in Document G. 59, except those for pulse amplitude at a point of baseband interconnexion, for which it proposes 10V output and 5V input in place of 1.4V and 0.7V respectively.

3. Discussion.

The documents discussed above indicate that the development of time-division multiplex systems is still in a formative stage, and that it is too early to formulate preferred characteristics for all systems. It would seem, however, that the draft Recommendation, Document G. 49, could with advantage be adopted. It may also be possible to adopt a Recommendation on the characteristics of 12-channel and 24-channel systems using pulse-position modulation, it being recognised that systems providing larger numbers of channels would not thereby be excluded

from future consideration. The draft of such a Recommendation, largely based on Documents G. 58 and G. 59, and incorporating some points mentioned in subsequent contributions, is given in Section 4, and might form a basis for discussion at Warsaw.

Document G. 57 (revised) is proposed for adoption as a Report. Question No. 92 would remain for further study.

4. *Proposed Recommendations and Report.*

4.1. *Draft Recommendation.*

Text as in Document G. 49.

4.2. *Draft Recommendation.*

*Standardisation of radiotelephone systems providing 12 and 24 speech channels
by time-division multiplex using pulse-position modulation
and operating at frequencies above about 30 Mc/s*

The C.C.I.R.,

considering

- a) that time-division multiplex radiotelephone systems may form parts of an international circuit;
- b) that general conformity with the relevant C.C.I.F. Recommendations in respect of overall performance measured between audio-frequency terminals, the method of making audio-frequency connexions, and the method of signalling over international connexions are already covered by Recommendations Nos. 40 and (see draft in Document G. 49) of the C.C.I.R.;
- c) that most time-division multiplex systems in current use employ pulse-position modulation, and provide not more than 24 speech channels;
- d) that the development of such systems has reached the stage when some indication of preferred characteristics is both possible and desirable, to facilitate international connexion at baseband frequencies;
- e) that groups of twelve traffic channels are widely used on frequency-division multiplex systems in accordance with C.C.I.F. Recommendations;

recommends

for international time-division multiplex systems using pulse-position modulation and providing not more than 24 traffic channels:

- 1. that the traffic channels should be provided in groups of twelve;
- 2. that when 12 traffic channels are provided there should be 14 equal time intervals, allowing for 12 traffic channels, one synchronising channel and one service channel;
- 3. that when 24 traffic channels are provided there should be 28 equal time intervals, allowing for 24 traffic channels and one synchronising channel, with three intervals for service channels or other purposes. One of these intervals should come immediately before that of the synchronising channel and the other two should come immediately after it;
- 4. that the service channels should be provided by using the time intervals immediately following those of the synchronising channels;
- 5. that the channel sampling rate should be $8000 \text{ c/s} \pm 8 \text{ c/s}$, and unless otherwise agreed between the administrations concerned, the pulse trains may be separately generated for the two directions of transmission;
- 6. that a preferred pulse shape is one which is unidirectional in form and has a duration of approximately $0.5 \mu\text{s}$ measured between 50% amplitude points, and the time required for it to rise or decay between 10% and 90% of its maximum amplitude should not much exceed $0.25 \mu\text{s}$;

7. that both for 12-channel and 24-channel systems the peak excursion in time of a channel pulse corresponding to an 800 c/s signal of 1 mW at a point of zero relative level should be $\pm 0.6 \mu\text{s}$, and the maximum excursion with speech modulation should not exceed $\pm 1.1 \mu\text{s}$;
8. that nevertheless, for systems with an ultimate capacity of no more than 12 traffic channels, and not intended for interconnexion at baseband frequencies with 24-channel systems, the peak excursion in time of a channel pulse corresponding to an 800 c/s signal of 1 mW at a point of zero relative level may be $\pm 1.6 \mu\text{s}$ and the maximum excursion with speech modulation may be limited to $\pm 3.5 \mu\text{s}$;
9. that a preferred form of synchronising signal is a double pulse, each component of which resembles a channel pulse. The first component occupies the same position as an equivalent unmodulated channel pulse, and the second component follows at an interval of 1.3 μs ;
10. that the nominal impedance of the baseband circuits at a point of international interconnexion should be 75 ohms, unbalanced, and the return loss relative to 75 ohms should exceed 24 db over the baseband frequency range;
11. that the pulse polarity should be positive at a point of international interconnexion;
12. that the pulse amplitudes at a point of international interconnexion should be 1.4 V at the output from the receiving equipment and 0.7 V at the input to the transmitting equipment.

4.3. *Draft Report.*

Text as in Document G. 57 (revised).

ANNEX IV

SURVEY OF CONTRIBUTIONS TO QUESTION NO. 93

Standardisation of multi-channel radio systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s

1. *Contributions received.*

At Geneva, in 1954, Study Group No. IX produced six final documents dealing with Question No. 93:

G. 42 (2nd revision)	: draft Recommendation
G. 62 (2nd revision)	: draft Report
G. 64 (revised)	: draft Report
G. 69 (revised)	: draft Report
G. 70 (revised)	: draft Report
G. 79 (revised)	: draft Report

Since then further contributions to the study of the Question have been received from five administrations:

Federal German Republic	: W.444, W.243, W.244, W.296
France	: W.190
Japan	: W.337
Netherlands	: W.261
United Kingdom	: W.44, W.133, W.134.

2. *Summary of contributions.*

Document G. 42 (2nd revision) recommends that frequency-division multiplex (FDM) radio relay systems should conform to C.C.I.F. recommendations in respect of audio-frequency interconnexions, FDM characteristics and method of signalling.

Document G. 62 (2nd revision) illustrates how a basic radio-frequency channel arrangement for 600-channel telephony can be adapted for 240-channel telephony or for two types of television signals requiring video bandwidths of 5 Mc/s and 10 Mc/s respectively.

Document G. 64 (revised) discusses in general terms the factors affecting the choice of frequency deviation for multi-channel telephony.

Document G. 69 (revised) is concerned with part 2 of the Question and sets out certain preferred characteristics for systems providing from 24 to 600 telephone channels. Proposals are made for baseband frequency ranges, levels and impedances for various intermediate-frequency parameters, and for the frequencies and polarisations of the radio-frequency channels.

Document G. 70 (revised), concerned with part 1 of the Question, lists those baseband, intermediate, and radio-frequency characteristics that need to be standardised to facilitate interconnexion.

Document G. 79 (revised) sets out certain preferred values for the intermediate and radio-frequency characteristics for relaying television signals over systems used alternatively for multi-channel telephony or for television (see Question No. 91.)

The first document of the Federal German Republic, W.444, deals with the linearity requirements of multi-channel radio links, and is considered under Question No. 115.

The supplementary contribution of the Federal German Republic, W.243, proposes to add to Document G. 69 preferred baseband characteristics for connexion to 120-channel balanced-pair cable systems. It comments also that the deviation of 200 kc/s per channel proposed in Document G. 69 (revised) is uneconomically high for 60-channel and 120-channel systems, for which it proposes deviations of 50 kc/s per channel and 100 kc/s per channel respectively. It is proposed that the deviation of 6 Mc/s quoted in Document G. 79 (revised) for 625-line television signals should be increased to 10 Mc/s. Finally, the radio-frequency channelling plan proposed in Document G. 69 (revised) is said to have serious drawbacks when a common aerial is used for the go and return channels.

The second additional contribution of the Federal German Republic, W.244, proposes a revision of the radio-frequency channelling plan contained in Document G. 69 (revised), namely that the radio-frequency channels should be spaced at intervals of 29 Mc/s instead of 32 Mc/s, and that the nearest go and return channels should be 69 Mc/s apart instead of 48 Mc/s. Moreover the interleaved, or staggered, frequency pattern should be displaced by 12.5 Mc/s instead of 16 Mc/s.

The third additional contribution W.296 of the Federal German Republic considers in some detail the choice of a pre-emphasis characteristic for frequency-division-multiplex frequency modulation systems with more than 60 channels.

The French contribution, W.190, generally supports the conclusions reached in Document G. 69 (revised), G. 70 (revised) and G. 79 (revised), but a deviation of 12 Mc/s rather than 8 Mc/s is proposed for 819-line television. It is considered premature to fix a pre-emphasis characteristic for 600-channel systems, but it is suggested that for a deviation of 200 kc/s per channel this characteristic could be allowed to range within the limits ± 5 db. It anticipates that the radio-frequency channelling plan (in Document G. 69 (revised)) will be re-examined in view of certain difficulties which may arise in some cases.

The Japanese contribution, W.337, discusses the advantages of using circular polarisation particularly when the aerials are affected by snow or ice, and indicates that it is being used in Japan.

The Netherlands contribution, W.261, generally supports Document G.69 (revised) but considers it premature in some respects. However, it proposes that 105 Mc/s as well as 70 Mc/s be a preferred intermediate frequency for systems using radio frequencies above 1000 Mc/s, and that the intermediate-frequency signal levels at a point of international connexion should

be 0.3 V (r.m.s.) output and 0.15 V (r.m.s.) input instead of 0.7 V (r.m.s.) output, 0.35V (r.m.s.) input. It also proposes that the intermediate-frequency impedances should each have a return loss relative to 75 ohms of at least 24 db over a bandwidth of ± 10 Mc/s about the centre frequency.

The first United Kingdom contribution, W.44, suggests that while it is premature to standardise pre-emphasis, allowance should be made in large-capacity systems for limits of ± 5 db relative to a uniform characteristic.

The second United Kingdom contribution, W.133, discusses certain difficulties that may arise in the use of the radio-frequency channelling plan given in Document G. 69 (revised) and proposes an alternative plan. This alternative has a spacing of 29 Mc/s between the centre frequencies of adjacent radio channels with the nearest go and return channels 68 Mc/s apart. The interleaved, or staggered, frequency pattern is offset by 14.5 Mc/s.

The third United Kingdom contribution, W.134, discusses methods of providing stand-by radio equipment and is considered in Annex V on Question No. 96.

3. *Discussion.*

Part 1 of Question No. 93 asks for a statement of the characteristics of frequency-division multiplex systems that must be specified to facilitate the interconnexion of two such systems. This part of the question is answered by the Draft Report in Document G. 70 (revised) and, as no revision of this report has been suggested in subsequent contributions, it might be adopted with the minor editorial amendments listed in section 4 below. This completes the study of part 1 of Question No. 93.

The French contribution asks for clarification of the phrase "a point of international interconnexion at baseband frequencies", and suggests that it should refer to points at the input and output of any baseband switching equipments forming part of the radio relay system and used, for example, to connect a stand-by channel when a fault occurs on a working channel. This view is supported.

The interconnexion of radio systems at audio frequencies is the subject of the draft Recommendation in Document G. 42 (2nd revision) and, as no amendment has been suggested, it is proposed for adoption as a Recommendation.

There appears to be sufficient measure of agreement on baseband characteristics for a Recommendation to be formulated, and a suitable text based on Document G. 69 (revised) is proposed in section 6, below, including provision for 120-channel balanced-impedance systems, and incorporating the levels adopted by the C.C.I.F.

The interconnexion of systems at intermediate frequency requires preferred values for the centre frequency, the input and output levels and the impedance at interconnexion points. At Geneva there was a general agreement on intermediate-frequencies of 35 and 70 Mc/s for systems operating, respectively, between 50 and 1000 Mc/s, and above 1000 Mc/s. It was recognised that an intermediate frequency of 105 Mc/s might be necessary for systems operating above 5000 Mc/s. However, the Netherlands contribution proposes 105 Mc/s as well as 70 Mc/s for systems working between 1000 and 5000 Mc/s. The choice of intermediate-frequency has an important effect on the radio-frequency channelling plan on account of various types of interference from the local oscillators and image signals (see Document G. 70 (revised)). It is apparent from other contributions that the choice of a satisfactory radio-frequency channelling plan is very difficult for only one intermediate frequency; for two the resulting choice might well be much less satisfactory. For this reason, in the draft Recommendation on intermediate-frequency interconnexions in section 7 below, 105 Mc/s is not included as a preferred intermediate frequency for frequencies below 5000 Mc/s. The Netherlands proposals to reduce the intermediate-frequency signal levels and specify the minimum return loss seem valuable and are included.

The frequency deviation of the intermediate-frequency and radio-frequency signals is an important parameter affecting the interconnexion of radio-relay systems. The proposals made for preferred values of deviation for systems without pre-emphasis are summarised in tabular form below.

System	Deviation proposed				
	Docs. G. 69 (rev) & G. 79 (rev)		Fed. German Republic	France	Netherlands
	R.F. below 1000 Mc/s	R.F. above 1000 Mc/s	R.F. above 1000 Mc/s		
Multi-channel telephony (1)					
24 channels	35 kc/s	—			} (4)
60 »	70 kc/s	200 kc/s (2)	50 kc/s		
120 »	70 kc/s	200 kc/s (2)	100 kc/s		
240 »	—	200 kc/s			
600 »	—	200 kc/s			
Television (3)					
405 lines	—	6 Mc/s			
625 »	—	6 Mc/s	10 Mc/s		
819 »	—	8 Mc/s		12 Mc/s	

- (1) R.m.s. deviation per channel for 1 mW 800 c/s-tone at zero level point.
- (2) In certain cases of systems transmitting 60 or 120 channels at frequencies above 1000 Mc/s and where it is desired to facilitate interconnexion with similar systems operating at frequencies below 1000 Mc/s, it is accepted that the deviation shall be the subject of agreement between the administrations concerned.
- (3) Peak-to-peak excursion, when fully modulated.
- (4) Provisionally 200 kc/s but may be higher in future if the state of technique permits.

On the basis of these proposals it appears reasonable to recommend deviations of 35 kc/s, 50 kc/s, 100 kc/s, 200 kc/s and 200 kc/s for telephony systems of 24, 60, 120, 240 and 600 channels respectively, working on radio frequencies above and below 1000 Mc/s. Equally it seems reasonable to adopt deviations of 6 Mc/s, 10 Mc/s and 12 Mc/s for systems relaying television of 405, 625 and 819 lines respectively. A suitable draft Recommendation is given in section 8. This Recommendation also covers the closely-related question of pre-emphasis. There is a general agreement that pre-emphasis offers advantages in multi-channel telephony systems using frequency-division multiplex and frequency modulation. The French and United Kingdom contributions state that it is too early to standardise a pre-emphasis characteristic, but they and the Federal German Republic contribution agree that the range of variation should be about 10 db. These points, and those made in Document G. 69 (revised), are all covered in the proposed draft Recommendation. Document G. 64 (revised) is a draft Report detailing the considerations relating to the choice of frequency deviation, and this report is proposed for adoption.

The most important remaining radio-frequency characteristics that affect the interconnexion of systems are the frequency pattern of the radio-frequency channels and the wave polarisations. A detailed radio-frequency channelling plan was proposed at Geneva, but certain difficulties have subsequently been reported, particularly in its application to systems using a common aerial for transmission and reception. These difficulties are discussed in the contributions of the Federal German Republic, France and the United Kingdom, and alternative proposals have been made. The proposals, like those of Geneva, 1954, are based on the use of horizontal and vertical polar-

isation alternately in adjacent channels. The Japanese contribution proposes that circular polarisation should also be allowed, and as polarisations in opposite sense could be used for adjacent channels this appears feasible.

The alternative proposals for a frequency-channelling plan are summarised in the table below:

Feature	Doc. G. 69 (rev.)	Fed. German Republic	United Kingdom
Spacing between the centre frequencies of adjacent channels	32 Mc/s	29 Mc/s	29 Mc/s
Spacing between the centre frequencies of the "go" and "return" channels	48 Mc/s	69 Mc/s	68 Mc/s
Displacement of the "main" and "stagger" frequency patterns	16 Mc/s	12.5 Mc/s	14.5 Mc/s

The contributions of the Federal German Republic and of the United Kingdom both consider in some detail a number of possible sources of interference in radio relay systems using several wide-band channels. An ideal frequency plan would simultaneously minimise the interference arising from all sources, but clearly in practice the best that can be achieved is a good compromise. The particular compromise reached will depend upon the relative importance attached to the various sources of interference, and upon the baseband frequency range within which interference should be minimised. There may well be different opinions upon these points, for the choice is complicated by the use of:

- a) either separate or common aerials for transmission and reception;
- b) repeaters either with or without intermediate-frequency amplification;
- c) systems catering for different numbers of radio-frequency channels.

It is clear that the selection of the best compromise is a matter of some importance and urgency. However, because many administrations have not had the opportunity of expressing their views on the alternative proposals before the Study Group, it is not proposed to formulate a draft Recommendation here. All members of Study Group No. IX are, however, urged to give the proposals the fullest possible consideration, so that a firm decision can be reached at Warsaw. It is proposed, for simplicity, that the frequency pattern should be considered first in terms of six radio-frequency channels for each direction of transmission, each radio-frequency channel being suitable for 600-channel telephony systems. Consideration should then be given to adapting the chosen pattern for use with telephony systems having fewer channels, and for television systems, having wider bandwidth on the lines of Document G. 62 (2nd revision).

4. Draft Report on part 1 of Question No. 93

The text of Document G. 70 (revised) amended as shown below:

- a) page 1 - section 1: delete paragraph 5;
- b) page 3 - footnote 1: delete all after "unmodulated carrier frequency";
- c) page 4 - last line: amend to read: "being made under Question No. 114".

5. Draft Recommendation on the interconnexion of systems at audio frequencies.

Text as in Document G. 42 (2nd revision).

6. *Draft Recommendation.*

Interconnexion at baseband frequencies of multi-channel radio systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s.

The C.C.I.R.,

considering

- a) that frequency-division multiplex radio relay systems may form part of an international circuit;
- b) that international connexions between such systems among themselves and with other radio relay and line systems may at times have to be made at baseband frequencies;

recommends

That as far as is practicable, frequency-division multiplex radio relay systems forming part of an international circuit should conform to the preferred values shown below in the table below for the following baseband characteristics:

- i) maximum number of telephone channels;
- ii) highest and lowest frequencies of telephone traffic channels, that is, the frequency limits of the baseband;
- iii) nominal impedance of the baseband circuits at the point of interconnexion;
- iv) relative input and output power levels at the point of interconnexion.

Maximum number of telephone traffic channels	Frequency limits of baseband in kc/s	Nominal impedance at baseband	Relative power level per channel db (1)	
			Input	Output
24	12 - 108 (2)	150 ohms, bal.	-52	+ 4.5
60	12 - 252	150 ohms, bal.	-52	+ 1.75
	60 - 300	75 ohms, unbal.	-52	-15
120	12 - 552	150 ohms, bal.	-52	+ 1.75
	60 - 552	75 ohms, unbal.	-52	-15
240	60 - 1052	75 ohms, unbal.	-52	-15
600	60 - 2540	75 ohms, unbal.	-52	-15

Notes on the table

- (1) The level shown is referred to a point of zero relative level in the system, in accordance with the practice of the C.C.I.F.
- (2) For 12-channel systems either of the basic groups A (12-60 kc/s) or B (60-108 kc/s) recommended by the C.C.I.F. may be accommodated in the band 12-108 kc/s.

7. *Draft Recommendation.*

Interconnexion at intermediate frequencies of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s.

The C.C.I.R.,

considering

- a) that frequency-division multiplex radio relay systems may form part of an international circuit;
- b) that it may at times be desirable to make international connexions between such systems at intermediate frequency;
- c) that it is desirable to adopt a preferred intermediate frequency to facilitate the optimum choice of a radio-frequency channelling plan;

recommends

that as far as is practicable, frequency-division multiplex radio relay systems forming part of an international circuit should have intermediate-frequency circuits which, at a point of international interconnexion, conform to the preferred values listed below:

a) *Centre value of the intermediate frequency*

35 Mc/s for radio frequencies from 50 to 1000 Mc/s.

70 Mc/s for radio frequencies from 1000 to 5000 Mc/s.*

b) *Input and output levels of the intermediate-frequency signal*

output level : 0.3 V r.m.s.

input level : 0.15 V r.m.s.

c) *Impedance of the intermediate-frequency circuit.*

75 ohms unbalanced with a return loss of at least 24 db relative to 75 ohms over a frequency range of ± 10 Mc/s about the centre value of the intermediate frequency.

8. *Draft Recommendation.*

Interconnexion at intermediate and radio frequencies of frequency-modulated multi-channel radio systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s.

The C.C.I.R.,

considering

- a) that frequency-division multiplex systems using frequency modulation may form part of an international circuit;
- b) that it may at times be desirable to make international connexions between such systems at intermediate or radio frequency;
- c) that it is desirable to use the smallest satisfactory frequency deviation in order to allow the most economical use of the radio spectrum;
- d) that the use of pre-emphasis allows a more uniform distribution of signal-to-noise ratio in the various channels of a multi-channel telephony system;

recommends

that as far as is practicable frequency-division multiplex radio relay systems forming part of an international circuit should conform to the following characteristics:

1. *Frequency deviation.*

i) *multi-channel telephony systems*

<i>maximum number of channels</i>	<i>r.m.s. deviation per channel**</i>
24	35 kc/s
60	50 kc/s
120	100 kc/s
240	200 kc/s
600	200 kc/s

ii) *television systems.*

<i>number of lines</i>	<i>peak-to-peak excursion when fully modulated</i>
405	6 Mc/s
625	10 Mc/s
819	12 Mc/s

2. *Pre-emphasis characteristic (telephony).*

- (i) the pre-emphasis characteristic should preferably be such that the effective (r.m.s.) deviation due to the multi-channel signal is the same with and without pre-emphasis.

* Where it is desirable to interconnect systems transmitting 60 or 120 channels at frequencies above 1000 Mc/s with similar systems operating below 1000 Mc/s the intermediate frequency used shall be the subject of agreement between the administrations concerned.

** For 1 mW 800 c/s tone at a point of zero reference level.

(ii) the pre-emphasis characteristic should be within the range + 5 db to — 5 db relative to a uniform characteristic.

(iii) within the limits set by (i) and (ii) above the choice of pre-emphasis characteristic should be a matter for agreement between the administrations concerned.

9. *Draft Report on the choice of frequency deviation.*

Text as for Document G. 64 (revised).

ANNEX V

SURVEY OF CONTRIBUTIONS TO QUESTION NO. 96

Maintenance procedure for wide-band radio systems

1. *Contributions received.*

At Geneva, in 1954, Study Group No. IX produced no final documents dealing with Question No. 96. However, contributions were received from four administrations, and a working document was prepared, thus:

Federal German Republic	: G. 5
France	: G. 34
Japan	: G. 16
United States of America	: G. 27
Working Document	: G. 72

Since then, seven further contributions have been received:

France	: W. 189
Japan	: W. 335
Netherlands	: W. 270, W. 271
United Kingdom	: W. 130, W. 134, W. 135

2. *Summary of contributions.*

Document G. 5 from the Federal German Republic recommends that the same methods of measurement should be used on both cable and radio links, and lists certain additional parameters for radio-link measurement. Document G. 34 from France proposes close collaboration with the C.C.I.F. and states principles on which the maintenance of radio links should be based.

The second French Document W. 189 proposes to measure intermodulation noise by a "white noise" method. For telephony systems having several working wide-band channels the French Administration provides a complete standby channel switched at its ends. For television systems, having only one wide-band channel, the use of individual standby units is preferred. When there is only one wide-band channel supervisory and control signals may be sent over the system itself in the baseband range 0 - 60 kc/s. When there are several radio channels the use of a separate supervisory radio link is suggested.

Document G. 16 from Japan lists seven routine tests for telephony systems and four for television systems. Their subsequent contribution, W. 335 suggests suitable time intervals between the routine performance of these tests, and supports the use of "white noise" tests for intermodulation noise.

The first Netherlands contribution, Document W. 270, proposes maintenance tests for an international 625-line television system, and suggests test waveforms. The Netherlands has not yet formed an opinion about the method of providing standby equipment for telephony systems, but for television systems the use of a complete standby channel is preferred.

In Document W. 271, the Netherlands supports the use of white-noise testing for the measurement of intermodulation noise.

The first United Kingdom contribution, Document W. 130, gives values for the numbers and relative levels of speech and other signals, e.g. pilots, carrier leaks, signalling, test and voice-frequency telegraph tones, applied to frequency-division multiplex 600-channel telephone systems. This information is provided for the purposes of design, specification and testing.

The second United Kingdom contribution, Document W. 134, deals with the principles of provision of standby equipment in radio systems with several wide-band channels, and the use of a standby channel is recommended.

The third United Kingdom contribution, Document W. 135, considers the pilot-signal levels and frequencies and the frequencies of noise-monitoring channels for radio relay systems. It is proposed that the "continuity pilot" signal be located in the centre of a noise monitoring channel (N.B.: this is *not* related to a white-noise test) and pilot frequencies of 3.2 Mc/s and 7.0 Mc/s are proposed for 600-channel telephony and up to 625-line television systems respectively.

Document G. 27, from the United States of America, lists certain routine tests of radio relay systems.

Document G. 72, a working document of the Geneva, 1954, meeting, also lists quantities to be measured and facilities for maintenance.

3. Discussion.

The contributions from France, the Netherlands and the United Kingdom discuss the method of providing standby equipment, but the views expressed differ as shown in the table below. The broad alternatives are:

- a) provision of individual standby equipment switched at each station;
- b) provision of a complete standby channel switched at its ends.

Administration	System	
	Multi-channel telephony	Television
France	channel switching	station switching
Netherlands	not yet decided	channel switching
United Kingdom	channel switching	channel switching

The subject of standby equipment lies outside the range of the present Question but it is clearly one of considerable interest to administrations and might be very usefully discussed at Warsaw as a contribution to Study Programme No. 28.

The contributions show considerable agreement on the value of the white-noise method of measuring intermodulation noise in multi-channel telephony systems. This is also being studied by the 9th Study Group of the C.C.I.F. (as Question No. 9) and a joint Recommendation should be sought. Test equipment using this technique is known to be in use in a number of countries, and early agreement on the frequency bands in which the intermodulation noise is measured is clearly desirable and might be reached in advance of any more comprehensive standardisation.

The information on the loading of a 600-channel telephone system given in one of the United Kingdom contributions appears to be useful for determining the noise loading to apply when testing radio links, and it is proposed that it should be considered at Warsaw for adoption as a Report.

The contributions of France and the United Kingdom both touch on the question of pilot signals. The French contribution recommends the use of the C.C.I.F. pilots for the purpose of gain regulation. The United Kingdom contribution proposes frequencies for the "continuity

pilot" and noise monitoring channel used to control the change-over from faulty working to standby equipment. These two contributions are compatible and can be considered at Warsaw.

The television test signals proposed in the Netherlands contribution fall more properly in the province of Study Group No. XI in its work on Study Programme No. 32 and are not discussed here.

It is apparent from the contributions that have been received and from Document G. 72 (revised) that there is still considerable difficulty in formulating routine maintenance procedures for international radio relay systems. This is perhaps not surprising because the features of such systems have not yet been fixed. It is suggested that in the study of Question No. 96 the Study Group might first concentrate on a study of those facilities which are considered to be indispensable for ensuring that the system is functioning correctly, e.g. the provision of continuity pilots, noise-monitoring channels etc. Once these facilities have been decided it might then be helpful to specify only those routine measurements for which cooperation between administrations is considered to be indispensable in the efficient maintenance of international radio relay systems.

4. *Draft Report on the loading of multi-channel telephone systems.*

Text of the United Kingdom document entitled:

"Data on the numbers and relative levels of speech and other signals applied to frequency-division multiplex (FM) radio relay systems for 600 telephone channels" (Doc. No. 130 Warsaw, 1956).

ANNEX VI

SURVEY OF CONTRIBUTIONS TO QUESTION NO. 97

Hypothetical reference circuit for wide-band radio systems

1. *Contributions received.*

At Geneva, in 1954, Study Group No. IX produced one final document dealing with Question No. 97, namely:

Document G. 66 (revised): draft Recommendation.

Since the Geneva meeting, six further contributions have been received:

Federal German Republic	: W. 237
France	: W. 420
Japan	: W. 336
Netherlands	: W. 262, W. 263
United Kingdom	: W. 228

2. *Summary of contributions.*

Document G. 66 (revised) is a draft recommendation describing a hypothetical reference circuit for frequency-division multiplex radio relay systems with maximum capacities of 60 channels or more. The recommended circuit is 2500 km long and has nine constituent links each of about 280 km.

The contribution from the Federal Republic of Germany notes that insufficient data exists on which to recommend limits to the noise power for very small percentages of time. However, provisional limits are proposed for average noise power: for the 2500 km circuit an average psychometric noise power of 2500 pW might be allowed for the frequency-translating equipment, and 7500 pW for the radio link itself.

The French contribution considers that the hypothetical reference circuit might be 2500 km long and consist of nine equal 280 km links, each comprising five 56 km sections having their theoretical free-space loss. Only the average noise power can be easily determined; that for small percentages of the time seems to be very difficult to determine. It is proposed that the mean noise power be limited to 7500 pW for the 2500 km circuit, and 830 pW for each 280 km

link. It is proposed also to specify fading margins such that the normal level of the received signal should be 20 db and 30 db above the improvement threshold for non-demodulating and demodulating receivers respectively. Certain proposals are made for calculating intermodulation noise. Finally, a new Question is proposed on radio propagation.

The Japanese contribution considers that the noise-power limits for radio relay systems should have the same effect on telephone conversations as those for cable systems, due allowance being made for different noise characteristics. Tests show that the articulation of speech accompanied by a (rapidly) fluctuating noise depends approximately on the mean noise power and not on its peak value. The noise allowances proposed for the radio relay system itself are shown below:

Percentage of hour	Allowable noise power	
	For 15% of the hours of each month	For 85% of the hours of each month
1%	50 000 pW	7500 pW
50%	5000 pW	5000 pW
99%	5000 pW	5000 pW

The first Netherlands contribution agrees with the Draft Recommendation in Document G. 66 (revised) but proposes that values specified for the reference circuit should not apply to small systems never to be used in long international circuits.

The second Netherlands contribution discusses the time distribution of allowable noise power and proposes a basis for further study. A proposal is also made for a new Question on fading.

The United Kingdom contribution considers the noise power allowance for the hypothetical reference circuit and proposes that during any one month the noise power for the radio system itself should not exceed:

- a) 5000 pW for more than 10% of the month,
- b) 7500 pW for more than 1% of the month,
- c) 100 000 pW for more than 0.01% of the month.

In addition, it should not exceed 7500 pW for more than 1% of the busy hour in the absence of fading. The noise power allowances for each 280 km section should be such that nine similar sections in tandem would meet the total allowances.

3. Discussion.

The hypothetical reference circuit proposed in Document G. 66 (revised) appears to be generally acceptable and might be adopted with the supplementary footnote suggested by the Netherlands Administration as shown in Section 4 below.

The question of the noise-power allowance for the 2500 km hypothetical reference circuit, and of its sub-division between the nine constituent 280 km radio links, is the subject of all contributions and will clearly need discussion at Warsaw, perhaps under the following headings:

- a) the best method of specifying noise-power allowances for various proportions of time;
- b) what additional information (if any) is needed to do this?
- c) how the specification(s) of noise power for the 2500 km hypothetical reference circuit should be divided between its nine constituent 280 km links.

In view of these open questions it would be inappropriate to attempt to anticipate the discussion, by formulating Reports or Recommendations here.

Both the French and the Netherlands contributions propose new Questions for study relating to fading on radio relay systems. These proposals should be considered in relation to Question No. 85 (V) and Study Programmes Nos. 55 (V), 56 (V) and 57 (V).

4. *Draft Recommendation.*

Text as Document G. 66 (revised) with the addition of the footnote shown below.

Note 1. The performance related to the hypothetical reference circuit is not intended to apply to small radio relay systems of limited extent never intended to be used in long international circuits.

ANNEX VII

SURVEY OF CONTRIBUTIONS TO QUESTION NO. 113

Procedure for international connexions between radio relay systems with different characteristics

1. *Contributions received.*

Question No. 113 was framed at the meeting of Study Group No. IX in Geneva, 1954 and contributions have been received from four administrations, namely:

Federal German Republic	:	W. 238, W. 239
France	:	W. 195
Japan	:	W. 333
Netherlands	:	W. 264

2. *Summary of contributions.*

Document W. 238 from the Federal German Republic considers that the international connexion of systems with widely different characteristics should remain a matter for agreement between the particular administrations concerned. Their second contribution, Document W. 236, considers in some detail the interconnexion of various types of radio systems, and suggests that when two frequency-division multiplex systems are interconnected the receiving side should accept the conditions of the incoming system, except where the frequency deviations differ; then, the wider-deviation system should adapt itself to the low-deviation system. When time-division multiplex systems are interconnected, the receiving side should accept the conditions of the incoming system provided that the pulse characteristics are compatible. Service channels are exempt from these proposals.

The French contribution considers that a general answer to Question No. 113 can be given only for the interconnexion of two systems of similar type. It is proposed that the administrations concerned should reach an agreement which would avoid the need for demodulation at a frontier station. Moreover, that when the interconnexion is made at intermediate frequency it is preferable to use the frequency recommended by the C.C.I.R. For radio-frequency interconnexions between systems working on different frequencies, receiving conditions might be adapted to those of the transmitter.

The Japanese contribution draws attention to the difficulties that may arise when interconnecting systems of different types and recommends standardisation.

The Netherlands document consists of a draft Recommendation proposing that the receiving side should accept the conditions of transmission normal to the incoming system, unless a more practical arrangement can be made.

3. *Discussion.*

There appears to be general agreement that where practicable and reasonable the receiving side should accept the conditions of transmission normal to the incoming system; but some danger is seen in making this rule universal. The draft Recommendation proposed by the Netherlands appears to meet the points expressed in the contributions received. This Recommendation would complete the study of Question No. 113.

4. *Draft Recommendation.*

Text as in Netherlands contribution (Doc. No. 264).

ANNEX VIII

SURVEY OF CONTRIBUTIONS TO QUESTION NO. 114

Frequency tolerances for transmitters used in wide-band radio relay systems operating at frequencies above about 30 Mc/s

1. *Contributions received.*

Question No. 114 was framed at the meeting of Study Group No. IX in Geneva, 1954, and contributions have been received from three administrations namely:

Federal German Republic	:	W. 45
France	:	W. 192
Netherlands	:	W. 269

2. *Summary of contributions.*

The contribution of the Federal German Republic quotes values of frequency tolerance representative of those already obtaining in wide-band systems. A tolerance of 0.02 % is proposed.

The French contribution proposes a definition of the frequency of an emission suggested in Document G. 79 (revised) namely: "the frequency of an emission is the arithmetic mean of the peak-to-peak limits of the carrier frequency when fully modulated". The tolerances proposed are ± 0.02 % for the range 30 - 500 Mc/s and ± 0.03 % for frequencies above 500 Mc/s.

The Netherlands contribution describes the design requirements for a national radio relay network working at 4000 Mc/s and using frequency modulation. They are:

- i) in a complete chain of 2 terminal and 15 repeater stations the total frequency drift of all the local oscillators including any frequency-shift oscillators, shall be less than ± 0.02 %;
- ii) for the terminal frequency modulator the frequency tolerance is ± 0.01 %.

It is considered that these tolerances could apply also for international connexions.

3. *Discussion.*

There is a good measure of agreement in the contributions received on the adoption of a frequency tolerance of about ± 0.02 %. The draft Recommendation in section 4 below is therefore proposed for adoption and would complete the study of Question No. 114. If agreed by Study Group No. IX, the text of this draft Recommendation will be transmitted to Study Group No. I for their concurrence.

4. *Draft Recommendation.*

Frequency tolerances for transmitters used in wide-band radio relay systems operating at frequencies above about 30 Mc/s.

The C.C.I.R.,
considering

(a), b), c), d), as for Question No. 114

recommends

that a frequency tolerance of $\pm 0.02\%$ should be adopted for the transmitters of wide-band radio relay systems operating at frequencies above about 30 Mc/s.

ANNEX IX

SURVEY OF CONTRIBUTIONS TO QUESTION NO. 115

Methods for the computation of intermodulation noise due to non-linearity in radio relay systems

1. *Contributions received.*

Question No. 115 was framed at the meeting of Study Group No. IX in Geneva, 1954, and Document G. 29 of that meeting contains a contribution by the U.S.S.R. to this Question. Since the Geneva meeting four further contributions have been received:

Federal German Republic	:	W. 444	W. 388
France	:	W. 193	
Netherlands	:	W. 268	

2. *Summary of contributions.*

Document G. 29 contains the U.S.S.R. contribution which, representing the multi-channel signal as a stochastic process, analyses in considerable detail various sources of non-linear distortion to determine the power spectrum of the intermodulation products. It is concluded that this method of analysis can be applied to practical frequency-modulated radio links provided the modes of addition of intermodulation products from various sources at a station, and of the products from various stations in a system, are known. Information on channel power levels in multi-channel systems is also required.

In the first contribution from the Federal German Republic, Document W. 444, the multi-channel signal is assumed to have the characteristics of random noise, and the intermodulation noise spectrum is calculated in terms of the harmonic distortion measured with sinusoidal signals. The effect of pre-emphasis is considered. The second contribution from the Federal German Republic in Document W. 388, presents two papers. The first is a theoretical paper in which the multi-channel signal is replaced by an equivalent noise voltage and the intermodulation noise is calculated for various sources of distortion. The second paper quotes some operational and test results as a check on the theory.

The French contribution, Document W. 193, refers to two published papers dealing with the calculation of intermodulation noise and comments on the mode of addition of noise components from various sources.

The contribution from the Netherlands indicates a method of calculation of intermodulation noise due to distortions up to the 3rd order, based on the quasi-stationary approach.

3. *Discussion.*

The contributions received make it quite clear that the computation of intermodulation noise is a matter for mathematical specialists and that the stage has not yet been reached at which

simple answers can be formulated to either part of Question No. 115. Nevertheless, the contributions represent a valuable source of information and it is proposed to adopt a brief Report calling attention to this work. The Question should remain for study.

4. *Draft Report.*

Methods for the computation of intermodulation noise due to non-linearity in radio relay systems.

The subject of intermodulation distortion in frequency-modulated radio relay systems, carrying multi-channel telephone signals, has been studied. It has not yet been possible to reach answers to Question No. 115 but the following documents contain valuable reference material.

1. Geneva, 1954, Document No. 29 (U.S.S.R.). The calculation of non-linear distortion in FDM radio relay systems with frequency modulation.
2. Warsaw, 1956, Document No. 444 (Federal German Republic). Demands on the linearity of multi-channel radio link systems with frequency modulation.
3. Warsaw, 1956, Document No. 388 (Federal German Republic). Methods for the calculation noise due to non-linearity in radio relay systems.
4. Warsaw, 1956, Document No. 193 (France). Methods of calculating intermodulation noise due to non-linearity in radio relay systems.
5. Warsaw, 1956, Document No. 268 (Netherlands). Methods for the computation of intermodulation noise due to non-linearity in radio relay systems.

Reference 1 presents a detailed statistical analysis determining the power spectra of various sources of intermodulation noise.

Reference 2 reproduces an extract from a paper by G. Bosse in which the intermodulation noise produced by loading a multi-channel system with "white noise" is computed in terms of the harmonic distortion measured with sinusoidal test signals.

Reference 3 reproduces in Annex A theoretical calculations of distortion coefficients and distortion noise power due to non-linearities in FDM systems, while in Annex B these theoretical considerations are supplemented by the results of practical measurements and tests on a radio relay circuit in actual service.

Reference 4 refers to papers by P. Clavier, M.D. Indjoudjian and Mlle Gervaise, and discusses the modes of addition of intermodulation noise components.

Reference 5 contains an analysis, in quasi-stationary terms, of intermodulation noise due to distortion of up to the third order.

REPORT BY THE CHAIRMAN OF STUDY GROUP No. X*

(BROADCASTING)

(Original language: English)

1. Background

With the possible exception of one Question submitted by the Polish People's Republic**, the matters under consideration by Study Group No. X since 1953 are those contained in Volume I of the Documents of the VIIth Plenary Assembly of the C.C.I.R., London, 1953, pages 344-350 inclusive. All work of the Study Group has been by postal exchange correspondence. It is noted that Resolution No. 16 of the VIIth Plenary Assembly recommended that if postal exchange correspondence was unable to resolve physical standards for the spools used for magnetic tape, a meeting of Study Group No. X should be held to agree upon such a recommended standard. Despite this, the Chairman has received no request from any administration for such a meeting. Several contributions were submitted on this subject and it is expected that a suitable conclusion may be reached by the Study Group at the VIIIth Plenary Assembly.

As a result of the absence of a meeting of Study Group No. X, no replies from the Study Group to the several Questions, Resolutions and Study Programmes have been possible. It will be necessary to convene the Study Group during the VIIIth Plenary Assembly for this purpose. A more detailed report will then be possible concerning the results of the work of the Study Group.

2. Questions and Study Programmes assigned to Study Group No. X.

The work of Study Group No. X includes several Resolutions, Reports, and Questions on the following general subjects:

A High-frequency broadcasting.

1. Transmission

- (a) Minimum number of frequencies necessary per programme (Report No. 13)
- (b) Directional antenna systems (Report No. 32, Question No. 23)

2. Reception

- (a) HF broadcasting reception (Report No. 14, Question No. 39)
- (b) Use of the 26 Mc/s band (Resolution No. 17)
- (c) Conditions for satisfactory reception (Study Programme No. 73)
- (d) Modification of receivers for closer spacing between carrier frequencies (Question No. 98)
- (e) The use of synchronised transmitters (Study Programme No. 72)
- (f) Single-sideband sound broadcasting (Question No. 62)

B Frequency-modulation broadcasting

In the VHF (metric) band (Question No. 99)

C Standardisation of cine-type spools for facility of international exchange of magnetic tape programmes. (Resolution No. 16)

D Further study of wow and flutter, disc recording and reproducing styli, absolute measurement of signal characteristics on tape, exchange of test tapes, etc. (Study Programme No. 74, Recommendations Nos. 134, 135, Question No. 42).

* Doc. No. 110 (Warsaw, 1956).

** What are the methods by which one could cover a desired reception area in such a way as to produce in it a field of more or less equal intensity? This Question has tentatively been placed under A 1 (b) reference Report No. 32, Question No. 23.

- E Sound recording on film for the international exchange of television programmes (Question No. 100).
- F Significant parameter to monitor at the input of a radio telephone circuit during transmission (Question No. 14 of the C.C.I.F. - Report No. 33).
- G Formulation of weighting factors for a provisional psophometer curve (Question No. 15, of the C.C.I.F. - Report No. 33).

3. Responses from administrations.

<i>Subject</i>	<i>Reference</i>	<i>Administration</i>	<i>Warsaw Document No.</i>
A 1 (a)	Report No. 13	none	—
A 1 (b)	Report No. 32 (Question No. 23)	Polish People's Republic	208, 206
A 2 (a)	Report No. 14 (Question No. 39)	none	—
A 2 (b)	Resolution No. 17	Spain	381
A 2 (c)	Study Programme No. 73	none	—
A 2 (d)	Question No. 98	none	—
A 2 (e)	Study Programme No. 72	United Kingdom	60
A 2 (f)	Question No. 62	none	—
B	Question No. 99	Czechoslovakia	59
		Federal German Republic	63, Annex C to Doc. No. 374
		United Kingdom	61
C	Resolution No. 16	Belgium	373
		France	197
		Federal German Republic	64
		New Zealand	363
		Japan	362
		European Broadcasting Union	291
		South African Broadcasting Corp.	484
D	Study Programme No. 74	Belgium	373
	Recommendations Nos. 134, 135	Denmark	Annex A to Doc. No. 374
		France	187, 198, Annex B to Doc. No. 374.
		Federal German Republic	65
		Switzerland	Annex D to Doc. No. 374
		United Kingdom	152, 233, 234, 235.
		European Broadcasting Union	292, 293.
		Japan	364, 365, 374.
		South African Broadcasting Corp.	485
E	Question No. 100	South African Broadcasting Corp.	486
		France	186
		European Broadcasting Union	294
		Federal German Republic	62 and Corr.
		Belgium	373
F	Question No. 14 of the C.C.I.F. Report No. 33	Polish People's Republic	214
G	Question 15, C.C.I.F. Report No. 33	none	—

A. PROSE WALKER
Chairman, Study Group No. X

REPORT BY THE CHAIRMAN OF STUDY GROUP No. XI*

(TELEVISION, INCLUDING QUESTIONS RELATING TO SINGLE SIDEBAND)

(Original language: English)

The VIIIth Plenary Assembly of the C.C.I.R. (London, 1953) referred the following items to Study Group No. XI:

- Report No. 34 : Ratio of the wanted to the unwanted signal in television
- Report No. 35 : Television systems
- Study Programme No. 32 : The requirements for the transmission of television over long distances
- Question No. 64 : Television standards
- Study Programme No. 33 : Television field frequency
- Study Programme No. 34 : Picture and sound modulation
- Study Programme No. 35 : Reduction of bandwidth for television
- Study Programme No. 36 : Conversion of a television signal from one standard to another
- Study Programme No. 37 : Black-and-white and colour television
- Question No. 65 : Assessment of the quality of television pictures
- Study Programme No. 75 : Measurement of the quality of television pictures
- Question No. 66 : Television recording
- Question No. 67 : Ratio of the wanted to the unwanted signal in television
- Question No. 68 : Resolving power and differential sensitivity of the human eye
- Study Programme No. 76 : Resolving power and differential sensitivity of the human eye
- Question No. 101 : Advantages to be obtained from consideration of polarisation in the planning of broadcasting services in the VHF (metric) and UHF (decimetric) bands (television and sound).

Addendum No. 2 to Volume I of the Documents of the VIIth Plenary Assembly of the C.C.I.R., London, 1953, contains a question submitted by the XVIIth Plenary Assembly of the C.C.I.F. which the Director of the C.C.I.R. allocated to Study Group No. XI as Question No. 117.

- Question No. 117 : Single value of signal-to-noise ratio for different television systems (Brussels, Doc. No. 10).

A Study Group meeting in Brussels from 22nd March to 6th April 1955 proposed some new Questions and Study Programmes. Of the Administrations of Members of the I.T.U. present at this meeting, twelve have requested that these Questions and Study Programmes should be studied, and accordingly they have officially become C.C.I.R. Questions and Study Programmes.

Addendum No. 3 to Volume I of the Documents of the VIIth Plenary Assembly of the C.C.I.R., London, 1953, contains these Questions and Study Programmes. They are:

- Question No. 118 : Colour television standards
- Study Programme No. 80 : Standards for video colour television signals
- Study Programme No. 81 : Standards for radiated colour television signals
- Question No. 119 : Ratio of the wanted to the unwanted signal in television
- Question No. 120 : Exchange of television programmes
- Question No. 121 : The transmission of monochrome and colour television signals over long distances
- Question No. 122 : The gain of a television transmission circuit.

Group meetings.

As mentioned above, the Study Group met in Brussels from 22nd March to 6th April 1955 for discussion of contributions sent in from different members.

The following contributions were sent in for this meeting:

*Doc. No. 111 (Warsaw, 1956).

	Country	Brussels documents	1955
Study Programme No. 32 .	United Kingdom	41	12th March
» » » » .	» »	42	12th March
» » » » .	European Broad- casting Union	61	24th March
Question No. 64	United Kingdom	40	15th March
» » » »	» »	43	25th March
Study Programme No. 35 .	United Kingdom	46	12th March
Study Programme No. 36 .	United Kingdom	47	12th March
Study Programme No. 37 .	Netherlands	26	11th March
» » » »	France	54	24th March
» » » »	»	58	29th March
Study Programme No. 75 .	United Kingdom	51	13th March
Question No. 66	» »	44	12th March
» » » »	France	60	25th March
Question No. 68	Japan	22 & annex	7th March
» » » »	United Kingdom	45	12th March
Study Programme No. 76 .	Japan	22 & annex	7th March
» » » »	United Kingdom	48	12th March
Question No. 101	Federal German Republic	7	3rd February
» » » »	United Kingdom	49	13th March
Colour Television Stan- dards (opinion on the "Me- morandum on colour tele- vision")	Japan	23	4th March
Proposals for reorganising the work of Study Group No. XI	United Kingdom	39	12th March

The Study Group held seven meetings. Whilst almost all items referred to Study Group No. XI were considered at these meetings, special attention was given to the following Questions and Study Programmes:

- Question No. 64
- Study Programme No. 37
- Question No. 117
- Study Programme No. 32 and the colour aspects of Study Programme No. 35
- Study Programme No. 36
- Question No. 66
- Question No. 68
- Study Programme No. 76

Brussels Document No. 39 - Proposal for reorganising the work of Study Group No. XI - was discussed in detail and resulted in the following proposal for the work of the Study Group (Brussels Doc. No. 65):

That the Questions and Study Programmes of Study Group No. XI should be arranged in the following classes:

- a) general problems concerning television systems;
- b) appraisal of television picture quality;
- c) television broadcasting;
- d) television recording;
- e) exchange of television programmes;
- f) long-distance relaying of television signals;
- g) reduction of the bandwidth for television.

The work of the Study Group during the meeting in Brussels was then organised accordingly. It was unanimously agreed to propose the new Questions and Study Programmes listed above and to recommend some re-arrangement of its work to take proper account of the present emphasis on standards for colour television.

A draft Report on the requirements for the transmission of television over long distances (Study Programme No. 32) was unanimously adopted by the Study Group (Brussels Doc. No. 91 rev.)

Colour television demonstrations.

During the discussions in Brussels, all members expressed a sincere desire to settle colour television problems in the best and most economical way. There was also a unanimous desire to collect information about the different systems being studied or in service. As it would be valuable to have a report on these systems, prepared in terms of the adopted Questions and Study Programmes, the Chairman asked which delegations thought that their administrations might be able to issue invitations, as the United Kingdom had already done. Invitations were later issued by France, Netherlands and by the United States.

It was decided by the Study Group that after the visits to the four countries the Chairman should prepare a report on the different systems, as part of his Chairman's report to the VIIIth Plenary Assembly. In preparing the report he should get the assistance of a small group of experts familiar with the various systems. This group should meet in Geneva immediately following the visits.

The visits took place between 5th March and 12th April 1956 and the small group met in Geneva from 16th to 19th April 1956. This part of the Chairman's report (Doc. No. 417) was distributed by the Secretariat to members immediately after the meeting in Geneva. (It is reproduced on page 166).

CONTRIBUTIONS SUBMITTED AFTER THE BRUSSELS MEETING

	Country	Warsaw Doc. No.
Report No. 34	Czechoslovakia	224
Study Programme No. 32	United Kingdom	153
Study Programme No. 32	» »	154
Question No. 64	Denmark	290
Study Programme No. 35	United States	397
Question No. 65	Federal German Republic	48
Question No. 65	» »	236
Question No. 65	United States	383
Study Programme No. 75	United States	383
Question No. 66	Federal German Republic	47
Question No. 101	Netherlands	267
Question No. 118	United States	389
Study Programme No. 80	United States	390
Question No. 119	Federal German Republic	240
Question No. 119	P.R. of Poland	209
Question No. 119	United States	391
Question No. 122	United Kingdom	129
Phase linearity of TV. systems	Netherlands	266
Proposal about the title of Study Group No. XI	Czechoslovakia	46

ERIC ESPING
Chairman, Study Group No. XI

APPENDIX*

REPORT BY THE CHAIRMAN OF C.C.I.R. STUDY GROUP NO. XI
ON THE COLOUR TELEVISION DEMONSTRATIONS
GIVEN FOR C.C.I.R. STUDY GROUP NO. XI

(March-April 1956)

(Original language: English)

During the meeting held in Brussels in the spring of 1955 (see extract from Brussels Doc. No. 103 attached as Annex I), Study Group No. XI decided that it would be useful for members of the Group to witness the development of colour television in a number of countries. The Secretariat of the C.C.I.R. was asked to make the necessary arrangements. Invitations to witness demonstrations were received from the U.S.A., France, the United Kingdom and the Netherlands; they took place between 5th March and 12th April, 1956, and were witnessed in the four countries by some 100 representatives from some 22 countries.

The Head of the Delegation of each demonstrating country furnished a report on the demonstrations given in his country, and these four reports are attached to this report as Annexes II to V, inclusive. They give a factual description of each of the series of demonstrations, and in some cases, present views on the possible future development of colour television.

The Chairman of the Study Group would draw special attention to the following extracts from these reports.

Extract from the report prepared by the Head of the U.S. Delegation.

"The basic principles involved have been fully described and detailed information made available during the United States demonstrations, in order to assist other countries in finding a common solution to the problem of establishing a colour TV system.

To assist in evaluating the merits of different systems, the Study Group adopted, in Question No. 118, ten criteria whereby the performance of such systems could be evaluated.

As the result of the demonstrations given by the four countries mentioned above, it is believed that:

1. the demonstrations by all countries should be judged by the criteria agreed to by the Study Group at Brussels, for regional application;
2. data are available now, judged by those criteria, to establish the principles to be used for common standards;
3. it is unlikely that additional systems yet to be proposed would be field tested satisfactorily in the near future;
4. the selection of principles on which to base common standards would provide a further advantage to the various administrations in that research effort could be focussed on the solutions to a number of remaining problems, rather than dissipated on the large number of problems associated with widely differing systems holding rather little promise of meeting all requirements;
5. failure of the C.C.I.R. to reach agreement on a basis for common standards may invite countries independently to adopt standards, and thus possibly repeat the chaotic situation now existing in Bands I and III in Region I;
6. therefore the C.C.I.R. should recommend a basis for common standards at an early date for regional application.

* Doc. No. 417 (Warsaw, 1956).

Extract from the report prepared by the Head of the French Delegation.

"The Radiodiffusion-Télévision Française wishes to stress that the demonstrations presented should only be considered as a contribution to the study of the trend of the present situation. They were only tests and not proposals for international standards. Nor should it be concluded that the R.T.F. intended now to choose its future colour TV system from amongst only the systems presented on this occasion.

At the present stage of the studies on the systems presented, the R.T.F. cannot give final answers on the question as to what extent they satisfy the criteria listed in Question No. 118 and the related Study Programmes Nos. 80 and 81.

The R.T.F. is fully conscious of the extent of the studies required before a choice can be made internationally. These studies must not only consist of the objective comparison of the characteristics of the images given by the various systems considered and of their technical requirements, but also the industrial and financial consequences which their adoption would imply in the countries concerned.

The R.T.F. believes that the establishment of a common system, at least in Europe, for the bands IV and V is possible and desirable.

The search for such a system, which probably will be applicable during several decades, must not necessarily limit itself to the considerations of systems already known, but also envisage several other solutions to arrive, on the basis of complete information, at the best choice, taking into account all the factors indicated above.

.....
The R.T.F. will continue the study of these different systems and inform the C.C.I.R. of the results. It also intends to study certain elements of other known systems, as it believes that all these studies are indispensable before any definite decision can be made by France."

Extract from the report prepared by the Head of the U.K. Delegation.

"Experimental work in colour television has been in progress for some time and increasing attention is being given to this subject. The British Broadcasting Corporation are conducting research into colour television and are making experiments on the 405-line system based on the principles adopted by the NTSC. They are at present engaged in an extensive series of test transmissions with the object of obtaining information on, amongst other things, the compatibility of the systems. The Radio Industry are also working on the problems of colour television, and various manufacturers are developing equipment on an experimental basis for both 405-line and higher definition systems. A number of manufacturers have produced experimental colour television receivers to further the study of reception. The Post office is studying problems associated with a colour television service, including transmission over cable and radio links and the effects of the introduction of colour upon frequency planning.

The data obtained from all these investigations will be placed at the disposal of the Television Advisory Committee, composed of representatives of the Broadcasting Authorities, the Radio Industry, the Post Office and other interested parties. It has the specific task of making recommendations to the Postmaster General on the system of colour television most suitable for use in the United Kingdom."

Extract from the report prepared by the Head of the Netherlands Delegation.

"The demonstrations in the Netherlands provided valuable material with regard to an assessment of the qualities of the demonstrated systems (adapted NTSC systems and two-carrier system) in connection with the criteria listed in Question No. 118 of Brussels.

Nevertheless, the information available at present is not considered sufficient to give definite and pertinent answers to the specific points raised in Question No. 118 and the related Study Programmes Nos. 80 and 81".

It will be evident that a very elegant solution has been adopted in the United States colour television standards as a result of the FCC directives that, to secure official approval, the system would have to be accommodated in the same 6 Mc/s channels as the existing black-and-white system. In addition, the U.S. television industry insisted on compatibility. This solution was the result

of long and detailed work by the whole U.S. television industry. It should be noted that in the USA the 525-line standards are definitely fixed and are applicable to all television bands and that many TV stations in the USA are already working in Bands IV and V (UHF).

In other countries, however, there is as yet no public television service in these higher frequency bands, although there are already a number of different standards in use for monochrome television in Bands I and III.

The opinion has been expressed by a number of these countries, committed to differing standards for monochrome television in Bands I and III, but not yet committed to colour television standards, that a common system for colour television in Bands IV and V, not necessarily compatible with the monochrome standards used in Bands I and III, was not only highly desirable, but possible. For that reason, subsequent to the Brussels meeting, a circular letter (Annex VI *) was sent to all administrations, seeking their cooperation in not prejudicing the future establishment of common standards in Bands IV and V.

It would appear that the European countries which have provided colour television demonstrations, do not consider that they have made sufficient progress with their studies as yet to enable them to assess the several systems under examination, and consequently, they are not in a position to make any recommendations on standards for colour television. Nor are they able at this stage to assess the systems they are examining in respect of the specific points raised in Question No. 118 and in the related Study Programmes, Nos. 80 and 81.

To summarise:— while the Chairman of Study Group XI wishes to achieve the maximum degree of standardisation as soon as possible (and before any action taken in individual countries might prejudice the future of international colour television), it seems clear to him that the European demonstrating countries at the present juncture are not able, for the reasons given above, to commit themselves to possible standards.

The Chairman therefore finds himself in a difficult position, and commends to the serious consideration of all members of Study Group No. XI the following:

In view of the tremendous amount of work and technical endeavour that is needed to develop and put into general public service any system of colour television, it is essential that whatever system be finally adopted it should:

- (a) from technical, economic, and picture quality aspects, be capable of satisfying public demand for a large number of years;
- (b) be shared by as many countries as possible;

and, because of the increasing demands on the radio spectrum,

- (c) use the minimum bandwidth consistent with (a) above.

If these three criteria are fulfilled it will, in the opinion of the Chairman of Study Group No. XI, hasten the progress of colour television and will ease the present shortage of technical man-power.

The Chairman urges most strongly that if, after full discussion at Warsaw, the Group is still not in a position to approve standards for colour television, the member countries will be prepared to agree not to take any action which would prejudice the ultimate adoption of colour standards, at least in Bands IV and V, without prior consultation between members.

Finally, the Chairman of Study Group No. XI wishes to express his very sincere and grateful thanks to all the administrations and organisations which have contributed to the series of demonstrations, to the members of Study Group XI who participated, to the experts: Messrs. Hirsch, Mallein, Booth and van der Wyck, who advised him when he was preparing the report, and to the Secretariat of the C.C.I.R., who did such splendid work in organising the visits.

* Does not include Document 79 referred to in the circular letter.

In his view, the results achieved and the knowledge gained will be of very considerable assistance to the future work of C.C.I.R. Study Group No. XI.

Geneva, 19th April, 1956.

ERIC ESPING

ANNEX I*

MEETINGS OF C.C.I.R. STUDY GROUPS NOS. I AND XI
(Brussels, 1955)

REPORT OF THE MEETING OF 4th APRIL 1955 AT 09.30 HRS.

Fifth meeting

Chairman: Mr. E. Esping.

.....
"Mr. *Esping* said that he felt that the documents expressed a sincere desire to settle colour television problems in the best and most economical way: these problems involved a great number of factors, some peculiar to Europe. He had gathered the impression that there was a unanimous desire to collect information about the different systems being studied or in service. It would be valuable to have a report on these systems, prepared in terms of the adopted Questions and Study Programmes. He asked which delegations thought that their administrations might be able to issue invitations, as the United Kingdom had already done.

Capt. *Booth* supported the proposal and stated that the United Kingdom would be happy to receive a party of experts, perhaps in November 1955.

Mr. *Mallein* indicated that colour television studies were under way in France and that it should be possible to arrange a visit on a date that he would notify later.

Mr. *Hirsch* said that the United States delegation would enquire at government level as to whether and how it would be possible to demonstrate colour television in the United States to experts from other countries.

The *Chairman* said that after such visits it might be possible to prepare an objective report on the different systems, as a part of his Chairman's report to the VIIIth Plenary Assembly. He felt, however, that he would need the assistance of a small group of experts familiar with the various systems, which might meet in Geneva immediately following the visits."

.....
Rapporteurs:

M. PAGÈS
R. MILWIDSKY

The Chairman:

E. ESPING

* Doc. No. 103 (Brussels).

ANNEX II

UNITED STATES OF AMERICA

*Report on the colour television demonstrations
given for C.C.I.R. Study Group No. XI*

(March, 1956)

1. Foreword.

A series of demonstrations in the United States, France, the United Kingdom, and the Netherlands was arranged as a result of the meeting of Study Group No. XI held at Brussels in the spring of 1955. At that meeting it was determined that such demonstrations were desirable to give television experts an opportunity to collect information on different colour systems currently under study or in service, as well as to assist administrations which do not yet have a colour television service to find a solution to their needs. It is the aim of the United States to encourage the interchange of ideas and cultures between countries and therefore to encourage the early adoption of colour television standards as a means of promoting such exchanges.

2. Conclusions.

The U.S. color signal specifications are the result of over 1 000 000 man-hours of effort by engineers of the United States television industry. The signal has been thoroughly field tested by actual broadcasting in the United States and found acceptable. (Pages 314-395, Reference A).

The basic principles involved have been fully described and detailed information made available during the United States demonstrations, in order to assist other countries in finding a common solution to the problem of establishing a color TV system.

To assist in evaluating the merits of different systems, the Study Group adopted in Question No. 118 ten criteria whereby the performance of such systems could be evaluated.

As the result of the demonstrations given by the four countries mentioned above, it is believed that:

1. the demonstrations by all countries should be judged by the criteria agreed to by the Study Group at Brussels for regional application;
2. data are available now, judged by these criteria, to establish the principles to be used for common standards;
3. it is unlikely that additional systems yet to be proposed would be field-tested satisfactorily in the near future;
4. the selection of principles on which to base common standards would provide a further advantage to the various administrations in that research effort could be focussed on the solutions to a number of remaining problems, rather than dissipated on the large number of problems associated with widely differing systems holding rather little promise of meeting all requirements;
5. failure of the C.C.I.R. to reach agreement on a basis for common standards may invite countries independently to adopt standards, and thus possibly repeat the chaotic situation now existing in Bands I and III in Region I;
6. therefore the C.C.I.R. should recommend a basis for common standards at an early date for regional application.

3. Introduction to the demonstration in the U.S.A.

The program of demonstrations was designed to show the present status of color TV in the U.S.A. and to provide answers to questions and study programmes which were set up at the C.C.I.R. Study Group No. XI meeting in Brussels 1955. Demonstrations under the sponsorship of the Department of State covered the period 5th to 13th March and ended with a question and answer session at United Nations conducted by NTSC. During the remaining period members of the Study Group were given the opportunity of seeing other demonstrations arranged privately by various companies.

Reference A : Book - "Color television standards NTSC" edited by D.G. Fink; McGraw - Hill Book Co. N.Y.

Reference B : Record of proceedings - United States color television demonstrations for the International Radio Consultative Committee arranged by the NTSC, New York, March 5th - 9th, 1956.

Background references:

Reference C : Program - United States color television demonstrations to the International Radio Consultative Committee, New York, March 5th - 13th, 1956.

Reference D : FCC Rules and Regulations - Part 3 - Radio Broadcast Services - Revision of Regulations: Federal Register - Vol. 20, No. 239, p. 9041, Washington, Friday, Dec. 9th, 1955.

Reference E : Federal Register - Wednesday, December 23rd, 1953, p. 8649: FCC decision on color television standards.

Other references are listed at the end of this paper, References A, B, C, and D have been supplied to all the delegates.

4. Brief description of the color TV signal.

The color TV signal adopted as standard by the FCC has been described at length and its history thoroughly covered in the above references. For convenience a brief description of the signal specification follows. The experiments on which these are based are described in detail on pages 93 - 134 of reference B.

The color television signal E_m consists of the simultaneous transmission of two signals $E_m = E_Y + E_C$. The first of these E_Y is the normal monochrome (luminance) signal transmitted by the usual monochrome standards and so proportioned as to transmit practically all the luminance in the picture. The second signal E_C , called the chrominance signal, supplies only the coloring information. Its amplitude varies directly with saturation and vanishes completely in the uncolored areas of the picture.

The chrominance is transmitted by a single suppressed subcarrier which carries two independent modulations, one for each of two components of chrominance E_Q and E_I . E_Q and E_I are two color-difference signals whose composition is given in terms of primary signals as follows:

$$\begin{aligned} E_Q &= 0.41 [(E'_B - E'_Y)] + 0.48 [(E'_R - E'_Y)] \\ E_I &= 0.27 [(E'_B - E'_Y)] + 0.74 [(E'_R - E'_Y)] \\ E'_Y &= 0.30 (E'_R + 0.59 E'_G + 0.11 E'_B) \end{aligned}$$

They represent the chromaticity axes shown in the CIE diagram in Fig. 2, page 113, of Reference B. Thus, as E_Q goes from positive to zero to negative values, it produces magenta, white and green. The corresponding colors for E_I are orange, white, cyan.

The experimental basis for choosing E_Y , E_Q , and E_I was demonstrated during the visit to Hazeltine Laboratories (pages 97-102 of Reference B).

The sub-carrier is described by the equation:

$$E_C = E_Q \sin(\omega t + 33^\circ) + E_I \cos(\omega t + 33^\circ)$$

This equation shows that E_Q and E_I , respectively, modulate in amplitude two components of the sub-carrier which are in quadrature. The equation can be rewritten as

$$E_C = E_Y \sqrt{\frac{E_Q^2 + E_I^2}{E_Y^2}} \sin(\omega t + \theta)$$

where $\theta = \tan^{-1} E_I/E_Q + 33^\circ$. the amplitude of E_C is seen to be equal to the luminance E_Y multiplied by the ratio of chrominance to luminance. This ratio is related to saturation. The signal is seen to decrease to zero as the chrominance $\sqrt{E_Q^2 + E_I^2}$ approaches zero, i.e., when there is no color, and also for saturated areas as the luminance approaches zero.

The phase θ depends on the proportion of E_I and E_Q and therefore on the hue. The angle θ is measured from a reference having the phase $-\sin \omega t$ which is transmitted as a burst of the unmodulated sub-carrier on the back porch of the horizontal synch pulse.

The ability of a single suppressed sub-carrier to carry two independent modulations and of a receiver to extract them uncontaminated from each other was demonstrated conclusively at Hazeltine. A sub-carrier was made to carry simultaneously two independent sound modulations (music and speech). A receiver selected the uncontaminated music or speech at will. The experiment was repeated with two independent color informations (pages 104-107, of Reference B). The tolerance with which the amplitude and phase of the subcarrier must be reproduced in the receiver was demonstrated. The small effect of random, impulse, and CW noise on the stability of color rendition were demonstrated.

The ability of the receiver rapidly to establish a local color reference signal from the transmitted reference burst was demonstrated under extreme conditions of random, impulse and CW noise, even when the reference signal was detuned by 3 kc/s to simulate aging components (pages 107-108, Reference B).

The color subcarrier and its sidebands are frequency interleaved within the components of the luminance signal to give them low visibility in black and white receivers (page 104, of Reference B).

5. Performance of the U.S. color television signal.

The performance of which the color television signal is capable can be reported in terms of the criteria of Question No. 118 of Study Group No. XI adopted at Brussels in 1955. Compliance with these criteria was demonstrated in the United States of America to the Study Group. The criteria are labelled respectively *a*, *b*, *c*, etc. Numbers in parentheses refer to specific references at the end of the paper.

a. *Satisfactory picture (color and monochrome) and sound quality.*

1. *Monochrome pictures.*

The television standards used in the United States of America allow a video bandwidth of about 4.0 Mc/s. During the last few years the average monochrome television receiver sold in the United States of America had an IF amplifier whose passband extends to 3.45 Mc/s for an attenuation of 6 db. The wide acceptance of this performance by the public is indicated by the 40,000,000 receivers sold to date in the United States of America. The standards used in the United Kingdom provide about 90% of the resolution given by the United States of America standards and have resulted in the sale of over 6,000,000 receivers. It appears from this data that the standards used in the United States of America provide satisfactory monochrome pictures.

2. *Color pictures.*

Since monochrome pictures having a bandwidth of at least 3.45 Mc/s are satisfactory, color pictures consisting of 4.0 Mc/s for each primary color (a total of 12 Mc/s) should have satisfactory resolution plus satisfactory color. It was demonstrated that negligible performance was lost in compressing the 12 Mc/s into the 4 Mc/s used by the U.S. color standard (page 96 - Reference B.) This is accomplished by rejecting submarginally visible information and reserving the available 4.0 Mc/s for visible information (pages 97-102, Reference B, and Chapter 3 of Reference A).

b. *Economical use of bandwidth.*

The color television transmission is contained within the same channel which was previously used for monochrome transmission only (Fig. A-1, page 505 of Reference A).

c. *Reliable receivers of reasonable cost.*

The cost of color receivers is believed to be reasonable for the present state of the art and is expected to decrease as production increased. The main reason for the present high cost of color receivers is almost entirely due to the cost of the display. Similar displays are required for any color television system so that the high cost is chargeable to color television and not to the U.S.

standards. There is now intensive effort being made to reduce this cost by improving production methods. Simultaneous development is proceeding on several different types of display; each potentially capable of giving satisfactory pictures.

A tour of inspection was made at the RCA, Lancaster, tube manufacturing plant to see the detailed processes being used in the mass production of shadowmask type of color picture tubes.

d. *Operation of studio, transmitting and relaying equipment.*

The operation of studios was studied by visits to the CBS and NBC studios where equipment and technique were demonstrated (pages 85-92 of Reference B).

The recording of color television programs on magnetic tape and on lenticular motion picture film was demonstrated by RCA.

Transmitting equipment was demonstrated by visits to the seven television transmitters on the Empire State Building. Three of these transmitters are now equipped to transmit color.

Relaying equipment was demonstrated by visits to the facilities of the American Telephone & Telegraph Company on March 9th, 1956 (pages 185-187 of Reference B). In addition, the program of the afternoon of March 5th was viewed simultaneously from the Channel 2 transmitter on the Empire State Building and after being routed about 2000 miles (3200 km) to Chicago and back. The programs shown during the afternoons of March 6th and 7th and during the evening of March 13th originated in California and travelled almost 3000 miles (about 5000 km) without appreciable impairment. This is about the distance from Paris to Teheran, Khartoum or Dakar.

e. *Susceptibility to interference* (pages 328-344 of reference A).

The demonstrations at Hazeltine and RCA showed that the color television signal is no more susceptible to interference than the monochrome signal except for CW interference having a frequency close to the color subcarrier at 3.6 Mc/s. Even there the interference is to chromaticity only, not to luminance, and is less annoying than a signal having the same amplitude but close in frequency to the main picture carrier. Monochrome and color receivers are equally susceptible to this last type of interference.

No appreciable interference with the reference color (phase of the sub-carrier) was experienced due to the very low signal-to-noise ratio caused by weak signals, from (a) random noise, (b) impulse noise, or (c) CW interference. In addition it was possible rapidly to establish the color-reference signal under the adverse conditions given above in switching from a monochrome to a color transmission even though the local oscillator had been displaced 3 kc/s from its specified frequency to simulate ageing components (pages 107-108 of Reference B. See also Reference A, pages 256-313 for a mathematical analysis of the synchronisation accuracy obtainable.)

The effects of co-channel and adjacent-channel interference were discussed at Princeton and experiments demonstrated the effectiveness of the offset carrier condition (1).

Multipath interference was also demonstrated by introducing various amounts of time delay with distinct ghosts for long delays.

f. *Compatibilities.*

The effect of the color subcarrier was shown by Hazeltine to be negligible on a monochrome receiver whose video passband is down 6 db at 3.6 Mc/s, the frequency of the color subcarrier. This is a higher passband than the average receiver which extends only to 3.46 Mc/s for the same attenuation. Other commercial monochrome receivers at the UN Building were also shown to be negligibly affected by the color subcarrier. On the other hand, Hazeltine demonstrated the effect of the color signal on a large (27-inch) laboratory monochrome receiver whose passband was made flat to 3.8 Mc/s specifically to illustrate the dots introduced by the color subcarrier. The dots were objectionable in this receiver but negligible in the others.

Reverse compatibility, the ability to see black and white pictures on a color receiver, was repeatedly demonstrated.

g. *Frequency planning.*

Since the color signal is not substantially more susceptible to adjacent or co-channel interference than the monochrome signal and since it is contained within the same channel, it poses no new problems of frequency planning.

h. *International exchange of programs.*

The television signal in the U.S. is not synchronized to the electric mains and is transmitted independently of the power-line frequency.

Standards conversion of color signals was not demonstrated in the U.S. but it is believed to be feasible between standards having the same number of fields by an extension of present-day monochrome techniques.

i. *Scope for development.*

(1) Since any three colorimetric quantities are simultaneously available (Red-Green-Blue; Y-I-Q), a wide choice of displays and decoders can be used. These can be either of the simultaneous or sequential types. The demonstrations at the UN Building on March 5th used receivers having shadow-mask, post-deflection acceleration, beam indexing (apple), and projection displays.

(2) The principle of adding a coloring signal to a monochrome transmission is applicable to all the TV systems listed by the C.C.I.R.

j. *The differences between Bands I and III as compared to Bands IV and V.*

The transmission of color on Bands IV and V was demonstrated and discussed at Philadelphia on March 8 (pp. 143-183 of reference B) and at Princeton on March 12th (2, 3, 4, 5). In addition, the reception of monochrome signals at UHF at the Empire State Building from transmitters at Reading (105 miles) and Bridgeport (50 miles) shown on March 14th illustrated the usefulness of UHF over these distances.

The use of the same standard in the United States of America for VHF and UHF facilitates the interchange of programs within these bands and makes possible the use of unattended satellite stations. Thus the city of Emporium, Pennsylvania, is located 90 miles from VHF transmitter at Johnstown, Pennsylvania and 100 miles from Buffalo, New York and, being surrounded by mountains, does not receive either program directly. However, unattended satellites on the mountain tops pick up these programs and retransmit them locally on Channels 22 (Band IV) and 82 (Band V), respectively.

The results of UHF propagation tests were described as a function of frequency and transmitting antenna height. In addition, details were given of field test experience with a number of different types of receiving antennae.

6. The U.S. standards in relation to Study Programme No. 80.

1. *Preferred colorimetric parameters.*

The reasons for choosing certain colorimetric parameters were demonstrated at Hazeltine (pages 97-102 of Reference B).

The preferred colorimetric parameters used by the U.S. standards include (a) luminance Y which is transmitted to about 4.0 Mc/s; (b) Orange-cyan axis, also called I axis, which is transmitted to 1.3 Mc/s, and (c) the Green-magenta axis, also called Q axis, which is transmitted to 0.4 Mc/s.

The limitation in the Q bandwidth is necessary because of the need for double sideband transmission of one of the chrominance components plus the bandwidth limit introduced by the sound carrier at 4.5 Mc/s. These limitations introduce no appreciable deleterious effect in the picture, but complicate slightly both the receiver and transmitter.

2. *The scanning standards recommended* are the simultaneous transmission of three independent colorimetric parameters.

3. *Comparison of the various methods of encoding and decoding the color picture information.*

Since the color subcarrier is suppressed and the amplitude of its sidebands is proportional to saturation, it is present only by the amount required, being absent in the uncolored areas of colored scenes, weak for pastel shades, and strong for saturated colors. Thus any disturbance to the color subcarrier can only affect the colored areas of the picture. Clipping of its peak will only reduce the saturation of the color.

In the U.S. standard, chrominance is transmitted by two independent characteristics, phase and amplitude, each with its own tolerance. This tolerance is greater for each component than if chrominance were transmitted by the amplitude modulation of a single component. Tests show that a phase tolerance of 5° can easily be held while the level can also be adjusted to better than 1 db. This allows $360 / 2 \times 5 = 36$ hues to be detected on the average and at least 7 levels of saturation, or a total of $36 \times 7 = 252$ different chromaticities.

Additional references:

- (1) A Study of co-channel and adjacent-channel interference of television signal.
Part I - RCA Review, Vol. XI, No. 1, pp 99-120, March 1950.
Part II - RCA Review, Vol. XI, No. 2, pp 287-295, June 1950.
- (2) "Comparative propagation measurements; television transmitters at 67.25, 288, 510 and 910 megacycles" RCA Review, Vol. IX, No. 2, pp 177-201, June 1948.
- (3) "An experimental study of wave propagation at 850 Mc/s" Proc. IRE, pp 595-611, May 1953.
- (4) "Field test of ultra-high-frequency television in the Washington area", RCA Review, Vol. IX, No. 4, pp 565-584, December 1948.
- (5) "Investigation of ultra-high-frequency television transmission and reception in the Bridgeport, Connecticut, area", RCA Review, Vol. XII, No. 1, pp 98-142, March 1951.

ANNEX III

FRANCE

*Report on the colour television demonstrations
given for C.C.I.R. Study Group No. XI
(28th - 30th March, 1956)*

The demonstrations presented to C.C.I.R. Study Group No. XI by the Administration of the Radiodiffusion-Télévision Française took place in Paris on 28th, 29th and 30th March, 1956.

The Radiodiffusion-Télévision Française wishes to stress that the demonstrations presented should only be considered as a contribution to the study of the trend of the present situation. They were only tests and not proposals for international standards. Nor should it be concluded that the R.T.F. intended now to choose its future colour TV system from amongst only the systems presented on this occasion.

At the present stage of the studies on the systems presented, the R.T.F. cannot give final answers on the question as to what extent they satisfy the criteria listed in Question No. 118 and the related Study Programmes Nos. 80 and 81.

The R.T.F. is fully conscious of the extent of the studies required before a choice can be made internationally. These studies must not only consist of the objective comparison of the characteristics of the images given by the various systems considered and of their technical requirements, but also the industrial and financial consequences which their adoption would imply in the countries concerned.

The R.T.F. believes that the establishment of a common system, at least in Europe, for the bands IV and V is possible and desirable.

The search for such a system, which probably will be applicable during several decades, must not necessarily limit itself to the considerations of systems already known, but also envisage several other solutions to arrive, on the basis of complete information, at the best choice, taking into account all the factors indicated above.

The demonstrations given can be divided into three parts:

- information and demonstrations by Professor Boutry, on the one hand, on the study of the performance of colour television systems, and on the other hand, by Prof. Le Grand, on flicker in colour television;
- the demonstrations of two colour television systems, one called the “Henri de France” system, being developed by the R.B.V. Radio Industrie Company, the other called the “double-message” system, being developed by the Laboratoires d’Electronique et de Physique Appliquée;

These demonstrations, in the first place, showed the results of connecting the output of the encoder to the input of the decoder by a video, frequency quadripole and then by replacing the latter by a radio link developed by the Cie Générale de TSF.

On both systems, test patterns, slides and live pick-up pictures were shown.

- the presentation of the first model of the “Georges Valensi” system, with a test transmission of an electronic colour test pattern.

These different demonstrations are described in more detail below:

A. Study of the performance of colour television systems.

Notwithstanding certain difficulty it appears possible to evaluate numerically certain factors important to the quality of colour television pictures. As a contribution to this study it is proposed that the following tests be made:

Given an image analyser A with three independent circuits and a 3-tube receiver B. Connect them via three independent circuits C.

Subsequently, a test pattern, having six scales of luminance is analysed. Each scale reaching from black to the same maximum luminance - i.e. a range of 40 db - but the number of sub-divisions varying according to the scale. There are 30 in the first and only 5 in the last.

The picture is observed on receiver B, and next to the receiver an illuminator is placed, on the screen of which the image of the same test pattern is projected, having the same dimensions as the picture observed on the receiver.

The assembly ACB is then adjusted to attain an image where the 30 degrees of luminance are discernible. This done, neither the “gamma” correctors of A, nor the adjustments of B should be touched.

The actual tests can then be made as follows:

- (a) restriction of the linearity and the range of the scale of luminances by the insertion of a coding and decoding system, with or without radio transmission;
- (b) “diaphotie” in a colour television system;
- (c) fidelity or distortions of the colour as received;
- (d) definition (or resolution) of the picture in the case of contrasts of pure luminance.

All measurements are made with a photometer or a colorimeter and, as they are given in figures and curves, they are objective.

B. Flicker in colour television.

On the screen, areas (both large and small) showing the three primary colours and which may be either partially or totally superimposed, are observed. Revolving shutters, having equal duration of opening and closing, permit the establishment of equal flicker frequencies for the three colours, but with a variable relative phase.

The luminance for each primary colour is:

$$R = 19.5 \quad B = 2.5 \quad G = 26.5 \text{ nits.}$$

At 50 c/s, flicker is nearly unnoticeable. At 33 c/s, the phenomena are quite distinct. The following conclusions are thus drawn:

flicker:

- does not in practice depend on blue;

- decreases to extinction for white and yellow when the primaries R and G go from corresponding to opposite phase;
- is much less distinct as the area observed becomes small;
- decreases when the luminance of the screen decreases, or when there is interfering light.

C. "Henri de France" system.

In this system, which is intended to be compatible, the R and G information is transmitted sequentially at the line frequency; the B information is continuously transmitted, simultaneously being added to the R and G information and modulating a sub-carrier located near the extremity of the channel.

The R and G information occupy a wide band, as the visual acuity is high and nearly equal for these two colours at normal luminances.

The B information occupies a narrow band, according to the experience of visual acuity.

If Y represents the luminance, where

$$Y = \alpha R + \beta G + \gamma B$$

and if a given element of the picture is considered, the following is transmitted:

- during the first frame: $\alpha R + (\gamma/2) B$
- during the second frame: $\beta G + (\gamma/2) B$
- during both frames, over the sub-carrier: $(\gamma/2) B$

Under these conditions, and for this element, a monochrome receiver, which does not detect the sub-carrier, reconstitutes Y by the addition, in time of the two frames, of $\alpha R + (\gamma/2) B$ and $\beta G + (\gamma/2) B$. For this same element, in a colour television receiver, which detects the sub-carrier, the B circuit continuously gives the signal $(\gamma/2) B$, which is alternatively cut off from $\alpha R + (\gamma/2) B$ and $\beta G + (\gamma/2) B$ in order to obtain R and G separately.

In the form shown, the cycle had 818 lines, divided over two frames, each lasting 1/50 of a second; giving in a fact a vertical definition of 409 lines non-interlaced.

During the first frame, the first line receives $\alpha R_1 + (\gamma/2) B_1$, the second line $\beta G_2 + (\gamma/2) B_2$, etc... up to line 409.

Line 410, i.e. the first line of the second frame, is *superimposed* on the first line of the first frame, receiving $\beta G_1 + (\gamma/2) B_1$, etc

The total video bandwidth is 10.4 Mc/s. A band of 7 Mc/s is attributed to the sequential components red-blue and green-blue. The sub-carrier is at 8.47 Mc/s (odd multiple of half line frequency) and is modulated by the blue information with double sideband, each 1 Mc/s wide. Its maximum amplitude is 15% of the main carrier. The audio is at 11.15 Mc/s.

Of course, a special signal is required to indicate to the colour receiver whether the line to be transmitted will carry R or G information. In the execution shown, this signal consisted of an extension of the duration of the line synchronisation pulse preceding the G lines. Other possibilities exist.

D. The "double message" system.

This system, also intended to be compatible, is based on the following principle:

Let M_1 and M_2 be two messages, given by the signals S_1 and S_2 . Each signal is sampled at a frequency F_s , which presupposes that the band of S_1 and S_2 is no wider than F_s . For each signal a series of sine-arcs is obtained, the duration of which is equal to the interval between them, and the envelope of which is proportional to S_1 and S_2 respectively.

If these two series are simply added, by dephasing the second by half a period, a continuous series of sine-arcs is obtained, so that the separation of the messages M_1 and M_2 then requires in the receiver a generator producing exactly the frequency F_s and which is exactly in phase with the sampling frequency.

But if the addition is made, while dephasing as above the second series by half a period and moreover inverting its polarity, two separate series, above and below a straight horizontal line, are obtained of which the envelope is proportional to S_1 for the upper series and to S_2 for the lower series. Two inverted diodes will then suffice in the receiver to separate the messages M_1 and M_2 .

Thus we have the possibility of receiving, with a very simple set, two messages on one single sub-carrier; for the sampling frequency may be considered as a sub-carrier.

A third message, occupying a narrow band, may be transmitted, either by modulating another sub-carrier near the limit of the channel, or by frequency or phase modulation of the main carrier.

For colour television, these three messages may be any linear combination of R, G and B, on condition that it is not negative.

In the execution shown, the R and G components of the video signal are treated symmetrically, as in the system described above and for the same reasons.

In fact, in order to avoid "diaphotie", it is necessary to sample at $G + \epsilon R$, and at $R + \epsilon G$, ϵ being smaller than unity.

The picture had 819 lines. The frequency separation between video and audio carriers was 10.1 Mc/s. The sampling frequency was 7.65 Mc/s, i.e. the product of 747 and the half line frequency.

The B signal has a bandwidth of 0.575 Mc/s and modulated a sub-carrier of 9.21 Mc/s, an even multiple of the line frequency.

The colour receiver is obviously very simple. R and G are given by the two inverted diodes, while B is given by a diode preceded by a passband filter (8.44 to 9.98 Mc/s).

The normal monochrome receiver has a "colour" switch, operating the double detection circuit and which supplies the picture tube with the sum $\alpha R + \beta G$ (simplified luminance).

A "de luxe" monochrome receiver is obtainable, which has all the circuits of a colour receiver, but an ordinary picture tube, which thus receives $\alpha R + \beta G + \gamma B$.

E. The "Georges Valensi" system.

In 1938, Mr. G. Valensi proposed the separate transmission of luminance and chrominance, which was a new departure at that time. But even to-day his system still has another original aspect: the reduction, to a single parameter, of the chrominance, or rather the chromaticity.

The system is still trichromatic, for the image is formed with the three usual primary colours. The luminance signal is transmitted by the usual monochrome standards. But instead of trying to reproduce, by means of the two usual parameters, all chromaticities within the RGB triangle, they are limited to those covered by a spiral, suitably inscribed within the triangle. In fact, as the transmitted parameter is quantized and can only have 30 discreet values, only 28 chromaticities are reproduced. In addition, this coded signal equals zero for white, while the 15 upper values correspond to highly saturated chromaticities.

In other words, the Maxwell triangle is divided into 28 sub-areas, starting from the white centre, while a chromaticity with trichromatic coordinates x and y , will be reproduced as the centre chromaticity of the sub-area containing the point (x, y) .

For this purpose, an encoding tube is used at the transmitting end, which is similar to a normal cathode-ray tube with its electron gun and two pairs of deflecting plates at right angles. But the screen is replaced by a reproduction of the Maxwell triangle, with the above mentioned 28 sub-areas, built up of mutually insulated metal plates, each connected to a separate output. These outputs are, in turn, connected to a resistance which is divided into 28 equal sections, the white being connected to the "ground" terminal of this resistance, while the plate representing saturated purple is connected to the other extremity. If voltages, proportional to x and y , are applied to the deflecting plates, the electron beam will strike a specific plate, e.g. No. 15, and for instance, 15 volts will be obtained at the output of the resistance, which voltage will form the coded chrominance signal.

Thus it is necessary to obtain first of all these coefficients x and y which are given by:

$$x = \frac{X}{X + Y + Z}$$
$$y = \frac{Y}{X + Y + Z}$$

In order to accomplish this, a matrix gives, from the R, G and B voltages coming from the analyser, the quantities X, Y and $(X + Y + Z)/3$. "Logarithmic formatrons" (tubes where the electron beam passes through a mask, having an aperture which is shaped as a logarithmic curve) together with conventional electronic adding devices, automatically perform the following operations:

$$\log x = \log X - \log (X + Y + Z)$$

$$\log y = \log Y - \log (X + Y + Z)$$

Voltages proportional to $\log x$ and $\log y$ are then applied to the deflecting plates of the encoding tube, where the Maxwell triangle has been replaced by its logarithmic transform. The signal Y is, of course, the luminance signal and is transmitted separately.

At the receiver, three "decoding formatrons", to which Y and the encoded chrominance signal are applied, give the R, G and B back at the output, which can be applied to the three electron guns of, for instance, a trichromatic tube.

The demonstration was limited to the transmission of a test pattern composed of vertical coloured bands, as the model was still being perfected.

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The RTF will continue the study of these different systems and inform the C.C.I.R. of the results. It also intends to study certain elements of other known systems, as it believes that all these studies are indispensable before any definite decision can be made by France.

ANNEX IV

UNITED KINGDOM

Report on the colour television demonstrations given for C.C.I.R. Study Group No. XI

(3rd - 7th April, 1956)

1. Introduction.

There is no colour television service in the United Kingdom at present, but an extensive monochrome service is in operation. The British Broadcasting Corporation, using the five channels in Band I, covers practically the whole of the population (97% by the Summer of 1956); the recently inaugurated Independent Television Authority is providing a rapidly expanding service using channels in Band III. Both of these services operate on the 405-line standard as described in Report No. 35, Documents of the VIIth Plenary Assembly, London, 1953, Volume I. In all, nearly six million television receivers are in use. No television service is operated in Bands IV and V.

Experimental work in colour television has been in progress for some time and increasing attention is being given to this subject. The British Broadcasting Corporation are conducting research into colour television and are making experiments on 405-line systems based on the principles adopted by the NTSC. They are at present engaged in an extensive series of test transmissions with the object of obtaining information on, amongst other things, the compatibility of the systems. The Radio Industry are also working on the problems of colour television, and various manufacturers are developing equipment on an experimental basis for both 405-line and higher-definition systems. A number of manufacturers have produced experimental colour television receivers to further the study of reception. The Post Office is studying problems associated with a colour television service, including transmission over cable and radio links and the effects of the introduction of colour upon frequency planning.

The data obtained from all these investigations will be placed at the disposal of the Television Advisory Committee, composed of representatives of the Broadcasting Authorities, the Radio

Industry, the Post Office and other interested parties. It has the specific task of making recommendations to the Postmaster General on the system of colour television most suitable for use in the United Kingdom.

In accordance with the invitation issued by the United Kingdom Delegation at Brussels in 1955, members of Study Group No. XI visited the United Kingdom, from 3rd to 7th April 1956, to examine the progress of work in colour television. A series of demonstrations was arranged jointly by the British Broadcasting Corporation, the Radio Industry, and the General Post Office, and is described in the following sections. More complete information is contained in the pamphlets issued to all the visiting delegates.

2. Demonstrations by the Radio Industry of the reception of experimental colour television transmissions.

A demonstration of colour television reception was given by the Radio Industry at the Dorchester Hotel. The test transmissions employed a version of the N.T.S.C. system scaled down to 405 lines and were radiated by the B.B.C. from a 5 kW asymmetric-sideband transmitter at Alexandra Palace (Channel I, Band I). A specification of the form of signal used for these transmissions is given in Chapter III of the booklet entitled "B.B.C. Television" issued by the Corporation to visiting members of the Study Group. Briefly the signal conformed to the 405-line standard occupying a video bandwidth of 3 Mc/s, with the addition of a colour sub-carrier at a frequency of 2.6578125 Mc/s, and I and Q colour components of bandwidths about 1 Mc/s and 0.4 Mc/s respectively. Eight manufacturers exhibited experimental colour receivers, of which there were 13 in all. In addition, a number of standard domestic monochrome receivers (21 inch tubes) were on view to demonstrate the degree of compatibility achieved. The majority of the colour receivers used the R.C.A. shadow-mask 21-inch tube; the remainder comprised sets in which the red, green and blue images produced on three separate tubes were combined optically and either projected on to a screen or viewed directly. Examples of high-level and low-level demodulation and of wide and narrow bandwidth chrominance channels were included in the designs exhibited. The degree of reverse compatibility of the colour receivers was demonstrated by the reception of the normal monochrome programme transmissions. The colour programmes shown included both live items and motion film and slide pictures.

3. Demonstrations by the British Broadcasting Corporation at Kingswood Warren.

3.1. Reception of colour television programme from Alexandra Palace.

Colour television signals were radiated from Alexandra Palace, as described in Section 2, received over a path of 21 miles (34 km) and displayed in monochrome and colour. One asymmetric-sideband television receiver was arranged to feed three monochrome displays and a colour-signal decoder; the latter in turn supplied red, green and blue signals to four colour displays.

3.2. Reception of locally-generated colour television signals.

Reception of locally-generated colour television signals, similar to those described in section 2, was demonstrated on a number of monochrome and colour receivers. The signals were obtained from 16 mm motion-picture film by means of a flying-spot film scanner. Transmission was arranged through coding equipment and radio-frequency low-power sound and vision modulators, connected via a radio-frequency (41.5 Mc/s sound and 45 Mc/s vision) distribution amplifier to the receivers.

3.3. Demonstration of various colour systems.

A simultaneous wide-band system with separate 3 Mc/s channels for the red, green and blue video signals was shown, the colour television reproduction of one slide being compared with the optically projected image of an identical slide.

A band-saving simultaneous colour television system, with a Y signal of 3 Mc/s, an I signal of 1 Mc/s, and a Q signal of 0.4 Mc/s bandwidth, was demonstrated. The total video bandwidth was 4.4 Mc/s instead of the 9 Mc/s used earlier. The demonstration showed the result that would be obtained if the chrominance signal were to be transmitted outside the luminance band, and was free from interference. The effect of the removal of each of the components, Y, I and Q, upon the colour displays and the effect on the sharpness of the colour picture of restricting the bandwidth of the I channel to that of the Q channel were also shown.

Some properties of a band-saving and band-sharing simultaneous-colour television system using one composite colour video signal formed by adding the Y, I and Q signals in a 3 Mc/s video bandwidth (a 405-line N.T.S.C. type system similar to that referred to in Section 2) were demonstrated. These included:—

- (a) the effects of the dot pattern on monochrome reproduction,
- (b) the use of a “notch” or narrow-band stop filter in the colour receiver to reduce desaturation of coloured images,
- (c) the use of a “notch” or narrow-band stop filter in the transmitter to reduce the crosstalk from the luminance to the chrominance channel,
- (d) the effect of errors in the phase of the colour reference signal used for synchronous detection,
- (e) the effects of differential phase and differential gain distortion on colour reproduction,
- (f) the effect known as “buzz” on sound (particularly in monochrome receivers),
- (g) the visibility of the colour reference burst,
- (h) the reception of colour signals under low field-strength conditions,
- (i) the effect of ignition interference on colour reception.

3.4. *Demonstration of equipment.*

The colour slide and film scanning equipment used to generate the signals for the demonstrations described in Sections 3.2 and 3.3 together with a high quality direct-view display were shown. The latter employs separate 17-inch cathode ray tubes to display the red, green and blue images, the three elements being optically super-imposed by a system of mirrors.

3.5. *Demonstration concerning the perception of transitions in chrominance and luminance.*

Experimental equipment which had been used to find out what measure of degradation in a transition from one colour to another could just be perceived by the human eye, and its dependence on the luminance contrast ratio, was demonstrated.

4. **Demonstrations by the British Broadcasting Corporation at Alexandra Palace.**

The demonstrations at Alexandra Palace covered three aspects of colour television as follows:

- (a) studio equipment,
- (b) transmission over cable and radio links,
- (c) the effect of certain transmission distortions.

4.1. *Studio equipment.*

The equipment used for producing the colour television pictures radiated from Alexandra Palace during the demonstrations described in Sections 2 and 3 was shown. This comprised a small studio with the appropriate lighting equipment, scenery and a single camera employing three image-orthicon tubes together with a slide and film scanner and the necessary control and monitoring equipment. A second camera, with the covers removed, was available for inspection.

4.2. *Transmission over cable and radio links.*

Picture signals generated locally were transmitted alternatively over two long-distance loop circuits as follows:—

- (a) an all-cable circuit from London to Manchester and back again via Birmingham, with demodulation to video frequency at Birmingham in each direction. The loop at Manchester was made without demodulation so that the complete circuit comprised three video-to-video links in tandem, the total distance being approximately 400 miles (640 km).
- (b) the cable circuit as used in (a) extended from Manchester to Kirk O'Shotts in Scotland and back to Manchester by means of a 4000 Mc/s radio link. In this case the signal

was demodulated to video frequency at Birmingham and Manchester in each direction, and at Kirk O'Shotts, so that the complete circuit comprised six video-to-video links in tandem of total length approximately 900 miles (1440 km).

In each case the circuits were made up of Post Office links designed and provided for the distribution of monochrome signals. The only special adjustment made for the purpose of the demonstration was a small amount of amplitude equalisation introduced at the colour sub-carrier frequency to preserve the correct relative levels of the chrominance and luminance components in the signal received via the looped circuits.

The local signal was displayed alternately with the signal passed over one or other of the looped circuits on two 21-inch colour monitors employing R.C.A. shadow-mask tubes and on two 21-inch monochrome reproducers. The quality of the picture received over the long-distance circuits could thus be compared with that of the picture as sent.

The effect of differential phase distortion introduced by the radio link was shown together with the partial correction that could be obtained for this defect by a compromise setting of the phase of the regenerated sub-carrier in the colour decoding equipment. In addition, to demonstrate the margin against noise on the two loops, a network was introduced at the input to depress the level of the chrominance signal by 12 db, a complementary network being used at the output to restore the signal to its normal form.

4.3. *The effect of certain transmission distortions.*

The effect of two forms of transmission distortion was demonstrated on the locally generated signal. In the first case, group-delay distortion was introduced amounting to about 1.0 microsecond between 2.3 and 3 Mc/s. Secondly, the effect of echoes 12 and 6 db below the level of the main signal was shown, the echo delay being variable in steps from 0.3 to 10 microseconds. In each case the effects of the distortions could be examined on both colour and monochrome displays.

5. **Demonstrations by Electric and Musical Industries Ltd., at Hayes.**

5.1. *Colour television systems.*

Three different colour television systems were demonstrated, all of which used the basic scanning standards of 625 lines, 50 fields/sec. interlaced. The source of signals for these demonstrations was a flying-spot scanner using slides or film. Three types of receiver were used for display, a laboratory-type receiver employing three direct-view picture tubes, a three-tube projection receiver and receivers using 21-inch R.C.A. shadow-mask tubes.

System A used three independent 5.0 Mc/s channels, one for the luminance or Y signal and the other two for the chrominance signals, R-Y and B-Y respectively; R, G and B being the N.T.S.C. primaries with $Y = 0.3R + 0.59G + 0.11B$. The total bandwidth occupied was 15 Mc/s; the three video signals were transmitted to the receivers over separate cables. This system was demonstrated to give a reference standard since, apart from the limitations associated with the signal generating and reproducing devices, it is capable of giving the highest quality possible with the scanning standards employed.

System B made use of several of the concepts of the N.T.S.C. system - the reduced acuity of the eye to colour detail as compared with brightness detail; the variation of acuity to colour detail with different colour axes; and the constant luminance feature. I and Q signals were derived as in the N.T.S.C. system and limited in bandwidth to 1.5 Mc/s and 0.5 Mc/s respectively. In the demonstration the I and Q signals were transmitted on one cable as modulations of quadrature components of a sub-carrier of 4.4 Mc/s, the luminance signal being transmitted over a separate cable. This system therefore corresponded to one in which the chrominance is transmitted outside the luminance band.

System C was similar to system B using a 4.4 Mc/s chrominance carrier but the chrominance signal was added to the luminance signal in a single 5 Mc/s channel. This system was, in fact the N.T.S.C. system adapted to 625-line standards. The use of a notch filter in the luminance channel of the receiver to remove the dot-pattern produced by the chrominance signal was demonstrated. The use of a 6 db filter at the chrominance sub-carrier frequency in the transmitter to

reduce the crosstalk from the luminance signal into the chrominance signal was also shown. This system was also demonstrated using a radio-frequency carrier together with frequency-modulated sound on a carrier 5.5 Mc/s higher.

5.2. Colour system converter.

A system converter translating colour signals from a field-sequential camera into the simultaneous signals required for a compatible colour system, such as the N.T.S.C. system, was demonstrated. The particular feature is the automatic compensation for variations of sensitivity over the picture area in each of the converter channels. Similar principles are applicable to the problem of conversion of simultaneous colour signals from one scanning standard to another.

5.3. Flying-spot colour television film scanner.

A flying-spot colour television film scanner employing continuous film transport was shown. This film scanner uses a single optical system and follows the film motion by moving the raster on the face of the scanning tube alternately to each of two positions.

5.4. U.H.F. television transmitter.

A U.H.F. television transmitter in the course of construction and designed to give a peak-output power of 12 kW in Bands IV and V was shown. The output stage used a three-cavity high-power klystron. The frequency response obtainable was demonstrated. The transmitting aerial is designed to provide a power gain of 20 and consists of a 4-bay side-fire helical array fed by an elliptical waveguide.

6. Demonstrations by the Post Office at Dollis Hill.

A series of five demonstrations was given; these were concerned with the effects of noise and interference on the reception of monochrome and colour pictures and with the transmission of colour pictures over cable and radio links. The colour signal described in section 2 was used for the tests.

6.1. The effects of noise and interference on the reception of 405-line colour pictures.

The effects of noise and interference on a colour television signal displayed in colour or in monochrome were shown. The noise signal comprised a band of random noise approximately 0.25 Mc/s wide, centred on a frequency which was varied through the video band. The output of the generator at a known level was added to the video colour signal and the combination used to modulate a suitable carrier; the resulting radio-frequency signal was fed to both monochrome and colour television receivers. For tests with periodic interference, an oscillator providing a sinusoidal output, which was varied in frequency over the video band, was substituted for the noise generator. Particular attention was paid to the effects of noise and interference at frequencies near to that of the colour sub-carrier.

6.2. Effect of interfering 405-line colour signals on 625-line monochrome reception.

The distribution of energy in the spectrum occupied by a colour television signal differs appreciably from that of a monochrome signal. Consequently, the character of the interference with monochrome reception caused by such a signal may be expected to differ from that caused by another monochrome transmission. The purpose of the demonstration was to show the subjective effect of this interference.

In the demonstration, the wanted signal was a 625-line monochrome signal comprising a 12-microsecond white bar on a dark background. The interfering signal comprised a 40-line colour picture on a carrier that could be varied in frequency and level. Particular attention was paid to the frequency differences between wanted and unwanted carrier frequencies that might occur under the Stockholm Plan. The wanted picture was displayed with a highlight brightness of 12 foot-lamberts and a contrast ratio of 12:1, a sensitive condition for the visibility of interference.

6.3. Measurement of linear waveform distortion on links for the transmission of colour television signals.

Waveform distortion effects on the luminance component of the colour television signals are essentially the same as for a monochrome signal and the same methods of measurement can be used. The method proposed uses a test signal consisting of a sine-squared pulse and smoothed half-line bar between line-synchronising pulses. The sine-squared pulse has a half-amplitude duration of alternatively T or $2T$, where T is the half-period of the upper frequency limit of the system. The response of the link can be determined with the aid of gratitudes from the displayed waveform, or more accurately by calculation from ordinates measured on a photograph.

Waveform distortion of the chrominance channel can be measured in an analogous manner using a pulse-and-bar signal of the same form, but amplitude-modulated on the colour sub-carrier, the half-amplitude durations of the pulses being adjusted to suit the nominal bandwidths of the chrominance channel.

If the chrominance-channel test signal is transmitted alternately with a corresponding luminance-channel test signal, the luminance-chrominance amplitude and delay inequalities can be measured by direct comparison.

The test waveforms discussed and their method of use were demonstrated.

6.4. Intermediate-frequency equipment for radio links carrying colour television or multi-channel telephony.

When a frequency-modulated microwave radio link has to carry colour television or frequency-division multiplex telephony signals, the group delay versus frequency characteristics of all units in the transmission path must be accurately controlled. The tolerances permissible for colour television and for 600 telephone channels are somewhat similar, though not identical, and the demonstration showed the limits applicable in the two cases. The set-up consisted of intermediate-frequency equipment for a wide-band micro-wave radio link comprising modulators, a number of intermediate frequency (70 Mc/s) amplifiers in tandem, and demodulators, separate modulators and demodulators being provided for television and multi-channel-telephony signals. Provision was made for introducing various forms of distortion in the group delay versus frequency characteristic of the complete path, and the effects on the transmission of colour television and of multi-channel telephony signals were demonstrated.

Subsidiary demonstrations showed some of the specialised test equipment used in developing and aligning intermediate-frequency equipment.

6.5. The transmission of colour signals over pairs in the telephone network.

This demonstration was concerned with the use of pairs in the telephone network for the transmission of television signals. The operation of a special equaliser-amplifier which enables a 3 Mc/s wide-band circuit to be set up over lengths of telephone pair up to about 2 miles, the maximum length depending on the gauge of the conductor, was shown. This equipment was designed for the transmission of monochrome signals, and its performance with colour signals was demonstrated using a circuit comprising about 2000 yards of 14 pair, 20 lb/mile cable.

ANNEX V

NETHERLANDS

Report on the colour television demonstrations given for C.C.I.R. Study Group No. XI

(10th and 11th April, 1956)

1. Introduction.

In the following, a report of the demonstrations in the Netherlands given by the Philips Research Laboratories is presented in a descriptive and factual form.

The demonstrations, pertaining to sections 2 and 3 (adapted NTSC system and two-sub-carrier system), provided valuable material with regard to an assessment of the qualities of the demonstrated systems in connection with the criteria listed in Question No. 118 of Brussels.

Nevertheless, the information available at present is not considered sufficient to give definite and pertinent answers to the specific points raised in Question No. 118 and the related Study Programmes Nos. 80 and 81.

2. Adaptation of the NTSC system to the 625-line TV standard.

Two versions of this system were demonstrated over a closed circuit operating at video frequency. In each version the chrominance sub-carrier was an odd multiple of the half-line frequency.

(a) Colour carrier = 4.429687 Mc/s.

Q and I colour signals similar to the NTSC system; the bandwidth of the Q-channel = 0.5 Mc/s (double-sideband) and of the I-channel = 1.3 Mc/s (vestigial-sideband).

(b) Colour carrier = 4.101562 Mc/s.

Bandwidth R - Y = 0.9 Mc/s,

» B - Y = 0.9 Mc/s.

The R - Y and B - Y information is transmitted double sideband.

Pictures obtained from slides with both these systems, were shown simultaneously on two colour monitors (projection-tube type), and on normal monochrome receivers to determine the degree of compatibility.

3. The two-sub-carrier system.

A general description of this system, developed at the Philips Laboratories, was given.

This system, which is intended to be a compatible colour system, consists of a luminance signal, transmitted in the normal way with normal bandwidth, and two sub-carriers, the lower carrier for the red and the higher for the blue information. The lower sub-carrier frequency is made equal to an odd multiple of half the line frequency and in addition the sub-carrier is given a phase shift at the beginning of each frame of + and - 90° alternately. The higher sub-carrier frequency is made equal to a multiple of the line frequency and is given a phase shift of + or - 180° at the beginning of each frame.

The frequencies of the sub-carrier are approximately 3.59 and 4.64 Mc/s respectively, their amplitudes being proportional to the amount of red and blue in the signal.

Vestigial-sideband transmission is used, the lower sideband being the full sideband. The video bandwidth of the red signal is 2 Mc/s and of the blue signal is 1 Mc/s.

In the transmitter, pre-emphasis has been applied to the sideband of the lower sub-carrier to reduce interference from the luminance signal into the red signal. Burst pulses of fixed amounts at the frequencies of the two sub-carriers are introduced alternately on successive lines, in order to maintain the right ratio of the luminance and the colour signals carried by the two sub-carriers (automatic ratio control).

At the receiver the composite signal is split into the luminance signal (with the sub-carrier suppressed to a certain extent) and the colour signal carriers. The latter are demodulated by envelope detection.

The green signal is formed by matrixing, the high frequencies of the luminance signal being obtained by means of a high-pass filter and added to the recovered colour signals (mixed highs).

4. Colour television display tubes.

A comparative demonstration, using full bandwidth for all three colours, was given with a number of display tubes of different types.

1. *Projection device.*

Composed of three 6 cm projection tubes with Schmidt optical system and dichroic mirrors.

Screen potential = 25 kV.

2. *RCA shadow-mask tube.*

Screen potential = 27 kV.

3. *Post-focussing tubes.*

(a) *One-gun type (Lawrence).*

Two grids are placed before the screen. The green, red and blue phosphors are deposited in horizontal lines upon the screen; the number of green lines is twice that of the red and the blue lines. By switching the potential between the two grids, any of the three phosphors can be excited.

Grid potential = 5 kV.

Screen potential = 20 kV.

The demonstration was given with a 22-inch "chromatic" colour tube and an experimental tube, made by the Philips Laboratories.

(b) *Three-gun type,*

One grid is placed before the screen. Three guns in a vertical plane are used. The phosphors are deposited in horizontal lines upon the screen. The angle of incidence of the electron beam of each of the three guns determines which phosphor is excited. The tube was an experimental tube of the Philips Laboratories.

Grid potential = 5 kV.

5. Colour studio equipment.

The equipment of a colour television studio was shown, it comprised as follows:

1. *Film-scanning equipment.*

(a) Flying-spot scanner with dichroic mirrors.

(b) Three-vidicon scanner for 16 and 32 mm film.

2. *Studio pick-up equipment.*

Two types of cameras were demonstrated, one using vidicon, the other using image orthicons, both containing a beam splitter and dichroic mirrors.

3. *Studio lighting.*

The studio lighting is provided partly by fluorescent lamps and partly by incandescent flood lights and spot lights. The fluorescent lamps have nearly the same colour temperature and spectral distribution as incandescent light sources and are being used as basic illumination. Luminance in the colour studio is 2500 lux.

6. Demonstration of measurement of amplitude and group-delay characteristics.

(a) *IF amplifier of a TV receiver.*

An amplitude-modulated carrier (modulation frequency = 100 kc/s) is put on the IF amplifier input. By comparing the phase of the 100 kc/s signal at the input and output of the amplifier, its phase and group-delay characteristics are obtained and, by measuring the output amplitude, the amplitude characteristic is determined. The two characteristics are shown simultaneously on two oscilloscopes.

(b) *IF amplifier and video amplifier.*

1. An amplitude-modulated carrier (the carrier frequency positioned midway down the slope of the IF characteristic on the low-frequency side), with video modulation frequency varying

between 300 kc/s and 5 Mc/s, is fed to the IF amplifier which is connected through the demodulator to the video amplifier. The video signals are amplitude-modulated at 100 kc/s.

By comparing the input and output phases of the 100 kc/s signal, the phase and group-delay characteristics are obtained; the overall amplitude characteristic is determined by comparing the amplitudes of the input and output signal.

2. As in 1. above, without video modulation, but with a sideband carrier (100 kc/s amplitude-modulated) shifted over the IF band.

7. Large-screen colour TV.

A closed circuit demonstration of the following systems was given:

- (a) full bandwidth of 7 Mc/s for each of the three primary colours;
- (b) NTSC system, sub-carrier on 4.43 Mc/s;
- (c) two-carrier system as described in section 3.

The projector uses three projection tubes (screen diameter 13 cm) one with red, one with green and one with blue phosphors. The final anode voltage is 50 kV. The three coloured images are projected on to the projection screen by means of three Schmidt optical systems and crossed dichroic mirrors. The highlight brightness of 5 foot-lamberts, obtainable with this equipment, is about the same as is obtained in an average cinema.

8. Radio reception of colour television signals.

Reception of colour television pictures was demonstrated in a locality about 3 miles from the transmitter, operating in Channel 6 (picture carrier = 182.25 Mc/s, sound carrier = 187.75 Mc/s) with a power of 50 W.

The receivers used were all of the projection type. During the transmissions, two transmission systems were used: the NTSC system, with sub-carrier on 4.43 Mc/s as described in section 2 (a), and the two-sub-carrier system as described in section 3. Slides were shown and a broadcast was made from the colour studio, as described in section 5.

In both cases, the colour transmissions were also received on monochrome receivers.

ANNEX VI

Palais Wilson, Geneva, 28th April, 1956.

To all Members and Associate Members of the I.T.U.

Dear Sir,

At the recent meeting in Brussels of Study Group No. XI (Television) of the C.C.I.R., the advantages and desirability of achieving a common television standard, especially for colour television, in the broadcasting bands between 470 Mc/s and 960 Mc/s (commonly called Bands IV and V), were emphasised (see Doc. 79 attached).

It was agreed that the realisation in certain parts of the world, and particularly in Region I and in some countries outside Region I, of a common standard for these bands was still a possibility, and that studies should be made.

At the request of the Chairman of Study Group No. XI, and with the unanimous agreement of the Group, I am writing to ask administrations to give full consideration to this possibility before taking decisions which might compromise the adoption of such a standard in the future.

I should be grateful if your Administration would give favourable consideration to this request, and forward its views to me by the 1st of July, 1955.

Yours faithfully,

Prof. Dr. Balth. VAN DER POL,
Director, C.C.I.R.

*Copy: International Broadcasting Organisation and the
European Broadcasting Union.*

REPORT BY THE CHAIRMAN OF STUDY GROUP No. XII*

(TROPICAL BROADCASTING)

(Original language: English)

1. Work programme.

1.1. The C.C.I.R. at its VIIth Plenary Assembly assigned the following Questions and Study Programmes to Study Group No. XII:

- | | |
|------------------------|---|
| Question No. 69 | — Best method for calculating the field strength produced by a tropical broadcasting transmitter; |
| Question No. 71 | — Determination of noise level for tropical broadcasting; |
| Question No. 102 | — Interference in the bands shared with broadcasting; |
| Question No. 103 | — Design of transmitting aerials for tropical broadcasting; |
| Study Programme No. 38 | — Short-distance high-frequency broadcasting in the tropical zone (tropical broadcasting); |
| Study Programme No. 77 | — Interference in the bands shared with broadcasting; |

1.2. It was recommended at the VIIth Plenary Assembly that:

- a) high priority be given to the standardisation of the methods of measurement of atmospheric noise and signal-to-noise and interference ratios (Question No. 71);
- b) Administrations be invited to:
 - collect extensive data by listening tests, to enable a statistical analysis to be made (Question No. 71);
 - conduct further theoretical investigations with a view to evolving a suitable formula for the calculation of field strength taking into account the correlation between the variation of field strength with sunspot activity and other factors (Question No. 69).

2. Composition of the Study Group.

2.1. Participants in the work of Study Group No. XII total 16 administrations, 7 private operating agencies, 1 international organisation and 1 scientific organisation.

2.2. The work of this Study Group was carried on by correspondence under the chairmanship of Mr. B.V. Baliga (India) and the vice-chairmanship of Dr. M.B. Sarwate (India).

2.3. No meetings of the Study Group were held or found necessary after the VIIth Plenary Assembly.

3. Contributions.

3.1. Contributions have been received from:

- i) the South African Broadcasting Corporation, Johannesburg, concerning Question No. 71 (Doc. No. 423);
- ii) the Oversea Territories of the French Republic, concerning Study Programme No. 38. para. 2 (Doc. No. 128);
- iii) India, concerning Question No. 102 (Doc. No. 356),
Question No. 69 (Doc. No. 357),
Study Programme No. 38 (Doc. No. 358);
- iv) The United Kingdom, concerning Question No. 69 (Doc. No. 229).

* Doc. No. 112 (Warsaw, 1956).

3.2. The contributions received from the participants are summarised below.

3.2.1. The South African Broadcasting Corporation has mainly dealt with:

- i) the question of the least signal-to-noise ratio that can be accepted for satisfactory broadcast reception;
- ii) the prevailing noise level in their territory;
- iii) the required power levels for tropical broadcasting and the implications of Recommendation No. 84;
- iv) the programme of further work to be undertaken by that organisation.

3.2.1.1. The following opinions have been expressed by the South African Broadcasting Corporation:

- a) in order to establish a satisfactory broadcasting service in tropical areas, a signal-to-noise ratio of at least 40 db would be necessary under non-fading conditions;
- b) with the powers that could normally be used for broadcasting, it is not found generally possible to maintain a 40 db signal-to-noise ratio, as noise values higher than 15 db above $1/\mu\text{V/m}$ are encountered in certain seasons of the year;
- c) the prevailing noise levels in the Union of South Africa and the Mandated Territory of South-West Africa are such that earlier finding of the Overseas Territories of the French Republic are not entirely applicable to these areas;
- d) Recommendation No. 84 of the C.C.I.R. continues to meet with the disapproval of the South African Broadcasting Corporation since the power limits recommended would prove to be entirely inadequate for maintaining the desired grade of service;
- e) further the Administration submits that the suggestion in Recommendation No. 84 to use greater power in the day than in the night is in itself a fallacy and, according to their judgment, higher powers would be required at night for over-riding the higher noise levels at night than during day when noise levels are observed to be lower;
- f) the best position for the transmitting aerials is in the geographical centre of the area to be served.

3.2.2. The Overseas Territories of the French Republic in Doc. No. 128, have reproduced data in a qualitative form concerning reception conditions in the various territories under the jurisdiction of the Ministry of France Overseas.

3.2.2.1. On the basis of these observations, they have expressed the opinion that in certain areas on the equator, powers of the order of 1 kW appear to be low and 3 kW to 5 kW may provide comfortable listening.

3.2.3. The Indian Administration in its report, has dealt with:

- i) the question of interference in the bands shared with broadcasting for determination of the protection required for a broadcast signal in the presence of interference;
- ii) best method for calculating the sky-wave field strength produced by a tropical broadcasting transmitter—measurements of ionospheric absorption at Delhi;
- iii) maximum power for short-distance high-frequency broadcasting in the tropical zone.

3.2.3.1. The following opinions have been expressed by the Indian Administration:

- a) investigations involving subjective listening tests as well as the use of an interference meter for quantitative estimation indicate that the protection required for a steady broadcast signal containing speech modulation as the desired programme, against A2 telephony and A3 telephony as interfering signals, varies from 31 to 54 db under various conditions of interference within a frequency separation of 0 to 5 kc/s;
- b) the total absorption that a wave suffers in the ionosphere is greater in India than that generally attributed for similar latitudes. The night-time residual absorption is at times found to be of the order of 8 to 15 db. Considering this high absorption, the Indian

Administration suggests that the diurnal variation factor of ionospheric absorption provides a different relationship from the commonly accepted figure. They appear to conclude that a new formula for calculating absorption, valid for Indian conditions, is required to be evolved in order to permit more reliable calculations of the sky-wave field intensity;

- c) the signal-to-noise ratio required to provide satisfactory broadcast service under steady-signal conditions only (a minimum of 80 per cent listener satisfaction) should be at least 40 db in the presence of atmospheric noise;
- d) in order to over-ride the prevailing noise at different times of the day, at different times of the year and on different frequencies, a power of the order of 100 kW at least is required under non-fading conditions. Suitable allowance should be made for fading conditions;
- e) the prevailing noise level and absorption conditions in India are such that the earlier conclusions of the Overseas Territories of the French Republic concerning the minimum satisfactory power limit are not valid for Indian conditions.

3.2.4. The Administration of the U.K. has submitted a contribution on Question No. 69 relating to calculation of field strengths of the indirect ray for broadcasting in the tropical zone (Doc. No. 229). They have expressed the necessity of suitably modifying the existing methods in published literature (CRPL and SPIN techniques) as the characteristics of propagation in the tropics are different from those in higher latitudes. The main differences in propagation appear to arise from the higher critical frequencies of the E layer, increased absorption loss due to the earth's magnetic field, degeneration of reflecting layers into scattering layers, rapid vertical movements of the F layer, horizontal gradients giving asymmetrical ray paths, incidence of sporadic E and the effect of low gyro-frequency on absorption in the tropical bands. Degeneration of layers into scattering layers also appears to result in rapid frequency-sensitive fading causing distortion even with high powers. They conclude that proper account of low values of gyro-frequency f_e , polarisation, scatter phenomena, etc., should be taken into account in the procedure for calculation of field strengths for broadcasting services in the tropical zones.

4. Conclusions.

4.1. Opinions have been expressed by India and South Africa that the power limits mentioned in Recommendation No. 84 are inadequate to establish a satisfactory tropical broadcasting service. On the other hand, the Overseas Territories of the French Republic consider that transmitters of low power of the order of 1 kW are adequate to provide satisfactory service in their territory except in some areas where slightly higher powers may be needed.

4.2. The noise levels and the degree of absorption in tropical countries are higher than those given in the published literature such as CRPL document No. 462.

4.3. Residual night-time absorption in the tropical countries is high.

4.4. A suitably modified formula for calculating absorption in tropical countries is necessary in order to permit more accurate calculation of the sky-wave field propagation.

5. Chairman's remarks.

Of 25 participants, only 4 have actively associated with the programme of Study Group No. XII. In view of the complexity of the problems it has not been possible to provide firm answers to the Questions and Study Programmes and a considerable amount of further work is essential before recommendations can be made.

B. V. BALIGA

Chairman, Study Group No. XII

ANNEX TO THE REPORT OF THE CHAIRMAN OF STUDY GROUP NO. XII

1. Since the submission of the Chairman's report, the United Kingdom has sent the following contributions:

- i) determination of noise level for tropical broadcasting with reference to Question No. 71 (Doc. No. 426);
- ii) interference in the bands shared with broadcasting with reference to Question No. 102 (Doc. No. 428);
- iii) design of transmitting aerials for tropical broadcasting with reference to Question No. 103 (Doc. No. 470).

2. Doc. No. 426 expresses the opinion that further data need to be collected before detailed conclusions can be drawn regarding atmospheric noise in the tropical broadcasting bands and that a set designed according to C.I.S.P.R. specification, preferably of an automatic type, might be considered for the measurements. It is also considered that amongst the parameters determining the characteristics of the noise, the r.m.s. voltage of the noise may prove to be of the greatest value for broadcast reception.

3. Doc. No. 428 deals with the question of minimum signal strength to be protected within a local service area (about 400 km). From the limited field strength data that have been collected it is considered that a four or more element, vertical incidence, aerial array would provide sufficient signal strength with a 5 kW transmitter to enable a signal/noise ratio of about 40 db being attained. According to the information available on atmospheric noise levels in the tropical zone, a signal strength of $100\mu\text{V/m}$ (median value) during daytime and $1000\mu\text{V/m}$ during night would be necessary for a signal/noise ratio of 36 db to be obtained. It is suggested that, within the service area, a field intensity of $150\mu\text{V/m}$ by day, and $250\mu\text{V/m}$ at night, might be protected.

4. Doc. No. 470 describes briefly the measurements carried out in Barbados of short-wave broadcast transmissions from Trinidad (350 km) on 3 and 6 Mc/s and the attempt made to observe the field intensities of transmissions from Jamaica. The observations made tend to indicate that it may be possible to limit the service area not far beyond 350 km with the use of vertical incidence arrays.

REPORT BY THE CHAIRMAN OF STUDY GROUP No. XIII

(OPERATION QUESTIONS DEPENDING PRINCIPALLY ON TECHNICAL CONSIDERATIONS)

(Original language: English)

1. Activities.

Study Group No. XIII has attempted to arrive at conclusions on the subjects which it has on its programme by means of correspondence only, so that no intermediary meeting of this Study Group has taken place. In particular during 1955 and 1956, several important contributions have been circulated among the members of this Study Group and it appears that on the basis of these contributions the Study Group can prepare its recommendations in Warsaw and can bring some of the subjects to a conclusion.

2. Contributions and comments.

In the following, the contributions are dealt with for each Question separately.

2.1. *Identification of radio stations* (Study Programme No. 78, Question No. 104, Resolution No. 19).

Regarding Study Programme No. 78 a contribution was received from the U.S.A. on item 1 (Doc. No. 70), which provides that studies should be carried out to determine the range of levels between which the amplitude of the reduced carrier or other pilot frequencies of a single or independent sideband transmission should be keyed in accordance with para. 3.2 of Recommendation No. 132.

Tests carried out by the A.T. & T. and the F.C.C. have shown that identification by carrier keying is — for the entire range of carrier levels tested — superior to identification by voice announcement. From the tests, results are given for carrier differences of 5, 10, 15 and 20 db.

A contribution from France draws attention to the fact that the possibility of identification is rather limited by manipulation of the amplitude of the carrier of a single-sideband transmission to a depth of 3 db. The quality of the transmission will, however, be unfavorably influenced by a higher depth of modulation.

Preference is given to identification by speech on one of the sidebands. Also for frequency shift, the application of amplitude modulation is thought to be less preferable for this purpose.

Furthermore, the U.S.A. has prepared a separate report on paragraph 6 of the already mentioned Recommendation No. 132 (Doc. No. 69), which report bears the title "Specification of intercontinental telephone and telegraph systems in which the frequent transmission of call signs for identification purposes constitutes a problem." The transmission of call signs for identification purposes does not present difficulties as far as radio telephony is concerned. In the case of telegraphy, however, and more specially for time-division duplex and/or for frequency-division duplex for several applications, no practical method has been developed whereby these systems may be identified without interrupting the transmission. As such interruption gives rise to a loss in continuity of several individual circuits and such loss is in many cases not acceptable, this solution seems undesirable.

For the time being it appears that—for the transmission systems mentioned—no satisfactory method is available for identifying the radiostations during the transmissions. Investigations of this problem by super-imposing call signs on these systems by phase modulation of the frequency-shifted carrier are in progress.

The conclusion can therefore be drawn that study on the subjects covered by Study Programme No. 78, and Question No. 104 should be continued.

* Doc. No. 113 (Warsaw, 1956).

No communications have reached me in connection with Resolution No. 19, although it appears to be of interest to get some idea of the measures taken so far by the administrations.

2.2. *Marine identification device* (Question No. 105).

Contributions have been made by the USA (Doc. No. 71) and the UK (Doc. No. 53). Attached to the American document is a paper of the Radio-Technical Commission for Marine Services, in which the problem of identification is discussed at some length and a number of devices fulfilling different aspects of this safety problem are described. The report is provided with a list of references, which increases its value from the point of view of documentation on the subject. In the paper of the UK, the difference between inter-ship identification and identification between a ship and a harbour radar station is accentuated. Concerning the first problem, the British point of view is even that doubt exists if such a device is able to increase the safety of ships navigating at sea during reduced visibility. It is considered that a study by nautical experts of different nationalities on the nature and extent of identification intelligence is necessary to decide whether short-distance contact between vessels for safety, navigation and communication purposes is desirable.

Identification to a harbour radar station has advantages because a pilot is aboard the vessels who knows the procedure and speaks the language of the harbour controller. Consequently, communication is more easily established and less ambiguity should exist when establishing and maintaining contact between a ship and a fixed station than between ship and ship. In cases where portable identification equipment is used, brought to the ship by the pilot launch, it appears that for such equipment international standardisation might not be a matter of great importance. It would seem, however, that seafarers hold the opinion that portable sets are less efficient and reliable than a fixed marine equipment. Moreover, pilots of sea-going ships may be embarked hundreds of miles from their destination. For this reason, a system that depends upon portable equipment carried on board by the pilot should perhaps be looked upon as a temporary expedient only, with at best a restricted application in the future.

The development of a radar identification device will be aimed at a solution which will be suitable both for inter-ship and harbour identification.

Regarding inter-ship identification, a more optimistic view is taken by the USA. This is probably due to the fact that on the Great Lakes an extensive use of VHF radio telephony and radar has been already made during a number of years. The navigator of any vessel is able to communicate directly with the navigator of any other vessel on matters of immediate interest, particularly in congested areas. From a technical point of view, in a marine identification device, the combined utilisation of a locating device (radar), a communicating link and identification is essential. In most identification systems the use of a communicating link (as a rule VHF) is an indispensable part. On the other hand, in many cases the act of identification appears to exist in associating the source of the radiotelephonic transmission to a particular pip in the radar-scope. The point of view taken by the American Radio Technical Commission for Marine Services is that a commercially adapted and positive all-weather marine identification device would aid in the reduction of marine casualties and facilitate the safe movement of vessels in congested and restricted areas.

A variety of methods accomplishing identification has been developed. It is essential to identify both range and distance. Transponder beacons are used for this purpose but the way the replies are displayed on the PPI is rather complex and, in the case of many vessels in congested areas, will again be ambiguous. Many suggestions are made but no definite solution has been found for the moment. It is of importance that installations of this type probably cost more than an expensive shipborne radar installation. This is a great inconvenience because an identification system will only be useful if a great number of ocean-going ships are equipped with it.

Many other devices with more limited possibilities have been developed, and may be useful under certain circumstances for harbour radar identification when traffic is low.

For the international use of telephony the language problem arises. In this respect the harbour radar is an advantage. For inter-ship communication, a code to carry out manœuvres and tactics may perhaps appear to be necessary. This problem seems to be satisfactorily solved in aircraft communication. However, there are still difficulties existing, which should be solved by international cooperation.

Considering these two contributions, it would seem that the present position can be summarised as follows:

Point 1 of Question No. 105: (Can a response on a radar display be automatically identified by a distinctive characteristic in such a way that it can be associated with the appropriate telegraph or telephone transmission?) The answer may be that if one of the radar stations is based on shore, a technical solution may be available. However, for inter-ship identification, there is a divergency of opinion regarding its usefulness.

Point 2 of Question No. 105: (Are any existing systems capable of offering the desired facility?) It could be replied that the most effective system for generally purposes using transponders is too expensive and it is necessary to find a more general attainable solution. An agreement on requirements for such a system between shipping authorities, administrations, shipowners and technical experts appears necessary. For harbour radar identification, different solutions, depending on the local facilities for an immediate solution, exist. In the future, similar equipment should be used for inter-ship identification as will be used for harbour identification.

Point 3 of Question No. 105: (What economic and practical factors, including the provisions required to make the device effective, affect the problem?) No answer to this question can be given before the operational requirements on an international basis have been defined.

Considering the above situation, it would seem that a possible way of making a step forward in this matter is to have a joint investigation carried out by the responsible governmental departments or administrations, the ship-owners, shipping experts and radar experts. In preparation thereof, it is suggested, if time still permits, that in the interested countries, individual approaches should be made between the categories mentioned, in order to find out whether such joint international investigation (e.g., by means of a working committee) could be further discussed and perhaps more definitely recommended by the VIIIth Plenary Assembly.

2.3. Bearing and position classification for HF (decametric) and VHF (metric) direction finding (Question No. 106).

Contributions have been received from the USA (Doc. No. 67) and the UK (Doc. No. 232).

In both papers it is agreed that the fix should be expressed in terms of probability areas. Much attention is given to this subject in the United Kingdom document and the information on the subject is valuable. As the formulation of the results of both studies is rather different, a further-exchange of views at the VIIIth Plenary Assembly seems necessary. It is hoped that these discussions may lead to a new Recommendation.

2.4. Technical characteristics of frequency-modulated VHF maritime equipments (Question No. 107).

Important contributions have been made on the subject and it seems that a universally adopted specification could be agreed upon during our forthcoming meeting.

Contributions have been received from the Federal German Republic (Doc. No. 58), the USA (Doc. No. 66), France (Doc. No. 201), the UK (Doc. No. 226), Japan (Doc. No. 338) and the Netherlands (Doc. No. 361), as well as from the CIRM (Docs. Nos. 55 and 377).

The various documents show in a number of points a large degree of agreement and a settlement on the following does not appear to present difficulties:

1. frequency deviation,
2. plane of polarisation,
3. protection ratio for common channel operation,

4. minimum frequency separation between adjacent channels,
5. minimum frequency separation between channels for duplex working.

For "means of selective calling" no solution has been found yet, and the study of this subject will have to be continued. The need for "other parameters" proposed by the different administrations does not diverge a great deal and it may be supposed that also on these points agreement may be reached. The contribution of the CIRM contains a suggestion for a technical specification.

2.5. *Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships* (Question No. 108).

Contributions were received from the UK (Doc. No. 56), the USA (Doc. No. 68), the Netherlands (Doc. No. 349) and the C.I.R.M. (Doc. No. 54). In particular, the document issued by the United Kingdom gives a detailed list of their requirements and these may prove useful to other administrations.

As on the main points there does not seem to be much difference of opinion, these documents may lead to a Recommendation.

2.6. *Publication of service codes in use in the international telegraph service* (Resolution No. 18).

This subject has been studied in cooperation with Study Group No. IX of the C.C.I.T. For Study Group No. XIII Mr. P. de Groen attended a meeting on Question No. 61 of that Study Group in Geneva, 17th - 25th October, 1955. It was proposed to reach the final goal of one uniform service code in two steps, the first of which would be to prepare a book containing all existing codes, but which would avoid the same code word appearing in different codes, or having different meanings, or that different code words should have nearly the same meaning.

This purification is, of course, a careful and lengthy work. Mr. de Groen is cooperating on behalf of Study Group No. XIII with a working group having the above task.

As the radio interests are strongest in the Q-code, a report is being prepared by the Netherlands, and it is hoped that a proposal can still be circulated, in order that the VIIIth Plenary Assembly of the CCIR could make a recommendation which would mean a contribution to the forthcoming Plenary Assembly of the C.C.I.T. later in the year in Geneva.

The above summarises the present position of the work of Study Group No. XIII, which has to be completed during the meeting of this group in Warsaw.

This report should, however, not be terminated before I express my gratitude and sincere thanks to all those who, with their valuable contributions (which often must have taken these members much time and effort), have helped this Study Group in attempting to solve the problems which it has on its programme.

J.D.H. van der TOORN,
Chairman, CCIR Study Group No. XIII

REPORT BY THE CHAIRMAN OF STUDY GROUP No. XIV*

(VOCABULARY)

(Original language: French)

1. Introduction.

The activities of Study Group No. XIV from the London Plenary Assembly up to 17th November 1955 are described in the provisional Report sent to all collaborators on that date (Warsaw Doc. No. 379).

The following paragraphs are an account of subsequent activities concerning the various subjects on the agenda of the Group.

The following contributions have been received:

A. Vocabulary (Resolution No. 5, Recommendation No. 144).

- Preparatory list revised by the national correspondent of the United Kingdom;
- » » » by the P.T.T. Administration of Australia;
- » » » by the national correspondent of the Federal German Republic;
- » » » by Mr. Niutta, specialist of Study Group No. III (Vol. II);
- » » » by Mr. Moies, specialist of Study Group No. I (Vol. IV);
- » » » by Mr. Cáceres García, Specialist of Study Group No. I (Vols. IV and VIII);
- » » » by Mr. Egidi, Vide-Chairman of Study Group No. II (Vol. V);
- » » » by Mr. Terzani, collaborator of Study Group No. X (Vols. IX and X);
- Additions proposed by the Chairman of Study Group No. IV;
- Letter from Dr. Metzler on the definitions of the terms proposed by Study Group No. I;
- Letter from Colonel Lochard on the same subject and on the French contribution;
- Letter from Dr. Dellinger on the contribution of Study Group No. VI;
- Letter from Mr. Jensen on the contribution of the United States of America to the vocabulary work;
- American Standards Definitions of Electrical Terms, by the national correspondent of the United States of America;
- I.R.E. Standards published since 1952, by the Secretariat of the I.R.E.;
- *Televísí Nasvosloví* (television vocabulary) of the National Standardization Committee by the Minister of P.T.T., Czechoslovakia;
- I.E.C. revision of the first edition (1938) of the International Electrotechnical Vocabulary, Group 60, Radiocommunications, by the Secretariat of the I.E.C.;
- C.C.I.T. contribution to the International Telecommunication Vocabulary;
- C.C.I.T. Draft list of definitions of essential telegraph terms, by the Interim Director of the C.C.I.T.

B. Symbols (Resolution No. 5, Recommendation No. 144).

- I.R.E. Standards of Graphical Symbols (1954), and Letter Symbols (1955), by the Secretariat of the I.R.E.;
- British standards for telecommunication symbols (Warsaw Doc. No. 51);
- Letter from the P.T.T. Administration of the Federal German Republic with annexes;

* Doc. No. 114 (Warsaw, 1956).

- German standards DIN 40700 (September 1955) on symbols relating to antennae and DIN 40719 (December 1955) on telecommunication circuit diagrams and pulse and switching signals, by the P.T.T. Administration;
- Schematic symbols used in electronics (in Czech) - Slaboprouby obzor (Prague), Vol. 13, 1954, pages T3 to T10.

C. *Decimal Classification (Question No. 72).*

- Report by the S.C.I.C.T. (Warsaw Doc. No. 380).

D. *Nomenclature of frequencies (Recommendation No. 52).*

- Proposal for numbering the ranges allocated to broadcasting in bands 8 and 9 (Warsaw Doc. No. 49, United Kingdom).

No meeting was held by Study Group No. XIV in the interval between the two Plenary Assemblies of London and Warsaw. A meeting of English-speaking and French-speaking national correspondents, scheduled for early March 1956, did not take place, as there were not sufficient opinions in favour of such a meeting.

2. **Vocabulary.**

Interesting comments on the drafting of the vocabulary have been put forward as follows:

— Dr. Metzler has expressed the view that the definitions of terms proposed by Study Group No. I should be drafted by the competent Study Groups.

— Colonel Lochard has announced that a draft radio vocabulary, now being prepared in France, will be submitted as a whole to Study Group No. XIV in Warsaw. He considers that the terms can be divided into three categories: 1) terms referring to "all concrete objects used in construction and operation and all abstract quantities that can be measured or expressed as functions of a variable or parameter in theoretical calculation." In his view, these terms should appear, together with definitions, in the C.C.I.R. radio vocabulary; 2) terms proposed by organisations with a view to fixing the limits or the scope of a particular set of regulations. It is up to the body which establishes the regulations to propose the relevant definitions. For instance, definitions of such terms appear in the Radio Regulations and in certain C.C.I.R. documents; 3) terms which are self-explanatory and need no definition.

— Dr. Dellinger has expressed the view that the C.C.I.R. should abandon the preparation of a vocabulary, which is far too difficult a task. He points out that the work could not be done by a restricted number of people if the definitions are to be accepted as standards. In such a case, a great many qualified persons should take part in the work, to which they would be obliged to devote considerable time, which is not possible. The work could not be carried out by correspondence nor by working groups during meetings of the C.C.I.R. Language is dynamic and as soon as agreement had been reached on a group of terms it is quite possible that many of them would be out-of-date before the vocabulary could be issued. He also feels that the preparatory list is not a satisfactory working basis and that the procedure prescribed in Recommendation No. 114 is not appropriate to the end in view.

— Mr. Jensen, as Chairman of the U.S. Committee of Study Group No. XIV, has discussed the matter at length with the standardisation organisations in the United States. After hearing Dr. Dellinger's view and noting that there is general agreement in the United States on the necessity of an international set of definitions for general use, he nevertheless thinks that this undertaking will take a very long time and will require considerable preliminary work carried out by people devoting their time to the compilation of the best possible list comprising all existing definitions in French and English. This would give the most favourable background for discussing amendments and additions with a view to ultimately obtaining standard international definitions.

The Chairman has entered in a single copy of the list all the amendments, variants and additions contained in most of the sheets returned by collaborators, with references to the other revised sheets.

For orderly assembly of the terms in the list, he felt it necessary first of all to make an alphabetical index of the terms in French or in English, using the initial of the most important noun in the case of compound terms. Thus he has been able to put together terms derived from a single concept, which is of help in subject indexing and has put some degree of order into each chapter.

The following main points will be on the agenda of the VIIIth Plenary Assembly:

- a) the examination of the amended list and of lists which have been, or will be, presented; this examination, if necessary, could be carried as far as the detailed analysis of the sheets containing a number of basic terms selected from the most characteristic in each category;
- b) the study of the criteria to be adopted for the utilisation of the documents available, bearing in mind the necessity of bringing the radio section into line with the telegraph and telephone sections of the International Telecommunication Vocabulary, of avoiding overlapping with the radio section of the I.E.C. vocabulary and collaborating with the I.E.C. as the I.E.C. collaborated with the C.C.I.R. in sending it the latest revision of its vocabulary;
- c) the examination of the proposals which have been put forward for the future organisation of the work and, in particular, for the possible creation of a "vocabulary" section in the C.C.I.R. Secretariat, the referring of the definition of certain terms to the appropriate C.C.I.R. Study Groups, the division of terms into three classes comprising terms to be defined as a function of particular texts, terms that are self-explanatory and concrete or abstract technical terms, and the treatment of terms in each class as regards their insertion in the C.C.I.R. vocabulary;
- d) the drafting of a Study Programme for submission to the plenary meetings for approval.

3. Graphical and letter symbols.

It has not been possible to start work on the broad lines set forth in Recommendation No. 144, paragraph 5. Experience has clearly shown that the procedure prescribed for the vocabulary cannot be applied to graphical symbols since, in addition to the inherent difficulties, a drawing and reproducing office would be required.

The Administration of the Federal German Republic has expressed the view that it will hardly be possible in the near future to draw up a uniform list of graphical symbols binding on all the members of the C.C.I.R., especially as these symbols are now being treated by the various national standardisation committees and at the international level in the I.E.C. It accordingly proposes that "the C.C.I.R., pending the establishment of international standards in this connection, should enter the symbols submitted to it on a given subject in such a way that they are regarded as equally valid."

Study Group No. XIV will have to decide what shall be the role of the C.C.I.R. in relation to the work of international standardisation carried out by the I.E.C. in the sphere of symbols.

4. Decimal classification (Question No. 72, Report No. 37).

In Warsaw Doc. No. 380, the Chairman of the S.C.I.C.T. (International Sub-Committee for the application of the U.D.C. to telecommunication, belonging to the F.I.D.) points out the advantages of the universal decimal classification. Should the C.C.I.R. decide to adopt the U.D.C., the Chairman of the S.C.I.C.T. offers the assistance of the Sub-Committee for a preliminary application of the classification to the volume of Warsaw documents which will be published after the Assembly and to the terms in the preliminary draft vocabulary of Study Group No. XIV.

No proposal for classifications other than the U.D.C. had been submitted to Study Group No. XIV at the time of writing.

5. Nomenclature of frequency bands (Recommendation No. 142).

The Administration of the United Kingdom, in Warsaw Doc. No. 49, reverts to the naming of frequency bands and points out that the numbering of the broadcasting bands between 41

and 960 Mc/s from I to V, which has been in use since the Stockholm Regional Conference (1952), may give rise to confusion with the logarithmic numbering adopted by the C.C.I.R. in London, It proposes that these bands be designated by Roman figures and called "broadcast bands", reserving arabic numerals and the word "bands", unqualified, for general frequency classification.

TULLIO GORIO

Chairman, Study Group No. XIV

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REPORT OF THE DIRECTOR OF THE C.C.I.R.*

(COVERING THE PERIOD BETWEEN THE
VIIth AND VIIIth PLENARY ASSEMBLIES)

(Original language: English)

General.

The present Report records some of the major activities of the C.C.I.R. since the VIIth Plenary Assembly (London, 1953) and draws the attention of the forthcoming VIIIth Plenary Assembly to other points of importance. It is divided into three main parts:

1. Activities of the Study Groups;
2. Work of the Specialised Secretariat;
3. Organisation of the Specialised Secretariat.

1. Activities of the Study Groups.

(a) *Changes in the chairmanship of Study Groups.*

In October 1954, the Director of the C.C.I.R. learned with regret, from the Australian Administration, of the untimely death of Mr. A.H. Cannon, Chairman of C.C.I.R. Study Group No. VIII (International monitoring).

In accordance with Chapter 15, para. 3 of the General Regulations (Buenos Aires, 1952) the Chairmanship of this Study Group devolved upon its Vice-Chairman, Mr. J.D. Campbell (Australia). The members of Study Group No. VIII subsequently elected Mr. George S. Turner (USA) to replace him in the office of Vice-Chairman.

In April 1954 the Telecommunications Division of the Department of State in Washington, D.C., informed the Director that Mr. Neal McNaughten had resigned as Chairman of C.C.I.R. Study Group No. X (Broadcasting). In conformity with Chapter 15, para. 3, he was succeeded by the Vice-Chairman of the Study Group, Mr. A. Prose Walker (USA). The members of Study Group No. X subsequently elected Mr. Kenneth Miller (USA) to replace him in the office of Vice-Chairman.

(b) *Meetings of the Study Groups.*

Following the VIIth Plenary Assembly of the C.C.I.R., Study Group No. IX (General technical questions) met in Geneva from 10th - 22nd September 1954, under its Chairman, Mr. H. Stanesby (United Kingdom).

The main purpose of this meeting was to prepare data for the General Switching Programme, the experts of which were to meet at the end of 1954 in Karachi, as well as to prepare certain data for the XVIIth Plenary Assembly of the C.C.I.F., which met in September-October, 1954, in Geneva.

C.C.I.R. Study Groups Nos. I (Transmitters) and XI (Television) met in Brussels from 22nd March - 6th April 1955. The meeting was presided over by Dr. E. Metzler (Switzerland) and Mr. E. Esping (Sweden), Chairmen of the respective Study Groups.

As a result of that meeting:

— Study Group No. I issued a draft Report on "the frequency stabilisation of transmitters" (Addendum No. 3 to Vol. I of the Documents of the VIIth Plenary Assembly);

— Study Group No. XI issued a draft Report on "the requirements for the transmission of television over long distances" (Addendum No. 3);

* Doc. No. 115 (Warsaw, 1956)

— Study Group No. XI also adopted 5 new Questions and 2 new Study Programmes, which will be treated further on in this Report.

— In addition, Study Group No. XI made initial arrangements, in view of the interest evinced in colour television, for demonstrations to be given of the systems in various countries, and requested the Director, in cooperation with countries willing to give such demonstrations, to coordinate their schedules.

(c) *Colour television demonstrations.*

Following the initiative of the meeting of Study Group No. XI in Brussels, mentioned above, colour television demonstrations were arranged in the Spring of 1956, as follows:

- In the United States : 5th March - 16th March 1956,
- » France : 28th March - 30th March 1956,
- » the United Kingdom : 3rd April - 7th April, 1956,
- » the Netherlands : 9th April - 11th April 1956.

The result of these demonstrations forms the subject of a separate Report, prepared by the Chairman of Study Group No. XI, together with a Committee of Experts (see Doc. No. 417).

(d) *New items for study.*

During the period between the VIIth and VIIIth Plenary Assemblies, the C.C.I.R. adopted, by one or more of the methods foreseen in para. 2, of Article 7 of the Convention, the following new subjects for study:

— following the meeting of Study Group No. IX (Geneva, 1954):

- Question No. 113 (IX) : Procedure for international connections between radio relay systems with different characteristics.
- Question No. 114 (IX) : Frequency tolerances for transmitters used in wide-band radio relay systems operating at frequencies above about 30 Mc/s.
- Question No. 115 (IX) : Methods for the computation of intermodulation noise due to non-linearity in radio relay systems.

(These questions are included in Addendum No. 1 to Volume I of the documents of the VIIth Plenary Assembly (London, 1953));

— following the XVIIth Plenary Assembly of the C.C.I.F.:

- Question No. 116 (IX) : Operational characteristics of long distance radio relay systems.
- Question No. 117 (IX) : Single value of signal-to-noise ratio for different television systems.

(These questions to be studied in collaboration with the 3rd and 5th Study Groups of the C.C.I.F., respectively);

— upon the initiative of the Director of the C.C.I.R.:

- Study Programme No. 79 (V) : Tropospheric propagation across mountain ridges.

(The above three items, together with the Ground-wave Propagation Curves, below 300 kc/s, extended, in accordance with C.C.I.R. Resolution No. 10, para. (d), up to distances of 10,000 km, are the subject of Addendum No. 2);

— following the meeting of C.C.I.R. Study Group No. XI (Brussels, 1955):

- Question No. 118 (XI) : Colour television standards.
- Study Programme No. 80 (XI) : Standards for video colour television signals.
- Study Programme No. 81 (XI) : Standards for radiated colour television signals.
- Question No. 119 (XI) : Ratio of the wanted to the unwanted signal in television.
- Question No. 120 (XI) : Exchange of television programmes.

Question No. 121 (XI) : The transmission of monochrome and colour TV signals over long distances.

Question No. 122 (XI) : The gain of a TV transmission circuit.

(These 7 items, together with the two draft Reports mentioned in para. 1 (b), from the subject of Addendum No. 3).

(e) *The preparation of Study Group documents.*

The present arrangements for the preparation, and in particular the distribution of Study Group documents, as well as of the preparatory documentation of the Plenary Assembly, date back to the Vth Plenary Assembly of the C.C.I.R. (Stockholm, 1948), and are given in C.C.I.R. Recommendation No. 33.

Since that time, the number of participants in each of the C.C.I.R. Study Groups has grown greatly. This most welcome increase in the interest shown in the activities of the C.C.I.R. and its Study Groups has brought certain difficulties of an administrative nature for the Chairmen. In fact, the distribution within a given Study Group of contributions received for consideration by correspondence, has become practically impossible for those Chairmen who do not have sufficient office help available to arrange for translation (into English or French) and distribution of, in some cases, up to 160 copies of such contributions, particularly in the case of long documents.

In consequence, the Chairmen have naturally turned to the Specialised Secretariat, with the request that it undertake the necessary arrangements in this respect. Unfortunately, the present staff organisation within the Secretariat is not such that this additional work can generally be carried out in a reasonably short time.

The Director therefore wishes to place this problem before the Plenary Assembly and, in order to aid in coming to a decision on this subject, has prepared a draft Resolution, which is given in Annex I to this Report, as a basis for discussion.

2. Work of the specialised Secretariat.

(a) *In connexion with decisions of the VIIth Plenary Assembly (London, 1953)*

— *Documents of the VIIth Plenary Assembly*

The Specialised Secretariat, following the VIIth Plenary Assembly, undertook the editing and arrangements for publication of the following three volumes of the documents of that Assembly

Vol. I : Recommendations made by the Committee, Reports, Resolutions adopted by the Committee, Questions to be studied and Study Programmes.

Vol. II : List of Participants, Reports of Study Group Chairmen, Report of the Director, C.C.I.R., List of Documents Place of VIIIth Plenary Assembly.

Vol. III : Minutes of the Plenary Meetings.

The English and French editions of these volumes (as well as the Spanish edition of Vol. III) were produced locally in Geneva, while the printing of the Spanish editions of Vols. I and II was arranged in Madrid through the good offices of the Spanish Administration.

The total number sold (in the three languages) of each of these volumes, up to 1st April 1956, was: 2018, 1252 and 936 copies, respectively.

— *Extension of the ground-wave propagation curves for frequencies below 300 kc/s to distances up to 10 000 km*

In accordance with Resolution No. 10, para. d), these curves were prepared by the Specialised Secretariat and distributed with Addendum 2 to Volume I of the documents of the London Plenary Assembly.

— *Atlas of ground-wave propagation curves*

In accordance with C.C.I.R. Resolution No. 11, the Director of the C.C.I.R. undertook the publication of a comprehensive atlas, with introduction, of ground-wave propagation curves for the following parameters:

for frequencies of 30, 60, 100, 150, 200 and 300 Mc/s;

for distances up to 200 km;

for transmitting antenna heights of 10, 20, 50, 100, 200, 500 and 1000 m;

for receiving antenna heights of 0, 2, 5, 10, 20, 50, 100, 200, 500 and 1000 m;

- for vertical and horizontal polarisations;
- for land and sea paths;
- for field strengths between —20 db and 100 db for a radiated power of 1 kW.

The very complicated mathematical calculations involved were undertaken by contract by the Mathematical Centre at Amsterdam, while the actual publication was done in Geneva.

— *Prediction of solar index*

In accordance with C.C.I.R. Recommendation No. 117, the Director has continued the mathematical studies relating to the prediction of the occurrence of sunspots. As pointed out in his Report to the VIIth Plenary Assembly, this has proved to be a very difficult matter, in particular as the underlying physical phenomena causing sunspots are not fully known. The report on the advancement of this work is contained in Doc. No. 254.

— *Exchange of magnetic test tapes in accordance with Study Programme No. 74 (X)*

The Director of the C.C.I.R. received, during October 1954, four magnetic test tapes from the Japanese Administration. These tapes were distributed to Administrations which had expressed a desire to participate in this exchange. The accompanying Japanese Report, as well as the reports received on the comparative tests are reproduced in Doc. No. 374.

— *Organisation Committee*

In accordance with the desire expressed by the Plenary Assembly, the Director, on 29th June 1955, submitted a memorandum, containing proposals relative to the organisation of the C.C.I.R. Study Groups. The replies from the Chairmen to this first circular were circulated for further comment on 31st October 1955, to all Chairmen. The second series of comments made it evident that, rather than a convergence of opinion, a tendency to divergence existed.

A report on this matter is contained in Doc. No. 429.

(b) *Work in connection with Study Group activities*

One or more members of the C.C.I.R. staff attended all Study Group activities in a technical capacity. In addition, the secretarial help for the activities mentioned under points 1(b) and (c) was furnished, as far as possible, by the C.C.I.R. staff.

— *Following the meeting of Study Group No. I (Brussels, 1955)*, and at the request of that meeting, the Director circulated on 31st May 1955, to all Members of the C.C.I.R. a request for further information relative to Question No. 74 (I) (Arrangement of channels in multi-channel telegraph systems for long-range radio circuits operating on frequencies below about 30 Mc/s). This questionnaire, together with the replies received, are contained in Doc. No. 359.

— *Field strength measurements at C.C.I.R. headquarters*

The field-strength measurements undertaken for a number of years at the C.C.I.R. headquarters, with a view to aiding the work of Study Group No. V (Tropospheric propagation) have been continued, and the results obtained are given in Doc. No. 167.

— *Draft vocabulary*

At the request of the Chairman of C.C.I.R. Study Group No. XIV (Vocabulary), the Secretariat undertook the work of reproducing and distributing the draft edition of the C.C.I.R. Vocabulary, which had been prepared at the VIIth Plenary Assembly in London. The details of subsequent work in this connection will be found in the Report of the Chairman of Study Group No. XIV (Doc. No. 114).

(c) *Preparatory work for the VIIIth Plenary Assembly*

It will be recalled that, at the closing session of the VIIth Plenary Assembly in London, the invitation of the People's Republic of Poland to hold the VIIIth Plenary Assembly in Warsaw was accepted by acclamation. The Director would like to draw attention to the points which follow.

— *Agreement*

In order to facilitate the material arrangements for the Plenary Assembly, an agreement was drawn up between the Polish Administration and the C.C.I.R., and signed in Geneva in September 1955 by the Director General of the Polish Ministry of Telecommunications and Posts and the Director of the C.C.I.R. A copy of this agreement is attached as Annex II. The Administrative Council of the I.T.U. took note of this agreement at its 11th Session (April-May, 1956).

— *Preparatory documents*

It is with pleasure that the Director can report that the ever increasing interest in the activities of the C.C.I.R. is again very evident from the 450 or so preparatory documents submitted to date, which represents an increase of about 120 documents over the corresponding figure for the VIIIth Plenary Assembly. Naturally, this increase in the amount of contributions has also had staff repercussions, and in order to cope with some 3000 pages of text and figures (to be prepared in English, French and Spanish), it was necessary to engage about 30 additional staff on a supernumerary basis, so as to be able to meet the time limit set for the distribution of the preparatory documentation. The General Secretariat of the I.T.U. gave collaboration in providing the additional staff needed.

The Director would here like to express his appreciation for the generally early date by which contributions were submitted, which has greatly facilitated this task.

— *Languages*

As stated in the previous paragraph, and in accordance with Article 14, para, 2 (2) of the International Telecommunication Convention (Buenos Aires, 1952), the preparatory documents of the VIIIth Plenary Assembly are being published in English, French and Spanish, while arrangements have also been made for the use of these three languages at the Plenary Assembly.

In view of the extremely limited use made of the facilities for the Spanish language, the Director felt it incumbent upon himself to draw the attention of the Eleventh Session of the Administrative Council to this fact. The Council was of the opinion that the provisions of the Convention should be respected, so that the three working languages are used.

(d) *Participation in activities outside the C.C.I.R.*

— *I.T.U. activities*

The Director and the Vice-Director of the C.C.I.R. attended, ex officio, the 9th, 10th and 11th Sessions of the Administrative Council of the I.T.U., held respectively in the early part of 1954, 1955 and 1956.

As members of the Coordination Committee, the Director and Vice-Director also attended the meetings of this body, which treated, in addition to matters of internal I.T.U. interest, a number of subjects concerning Technical Assistance.

A considerable amount of the Director's time was also taken up by the Presidency of the Appeal Board of the I.T.U.

Moreover, one or more members of the C.C.I.R. staff attended the following I.T.U. meetings:

- the XVIIth Plenary Assembly of the C.C.I.F. (Geneva, 1954);
- various meetings of C.C.I.F. and C.C.I.T. Study Groups, where subjects of interest to the C.C.I.R. were treated;
- the meeting of the C.C.I.F. Sub-Commission for the Middle East and Southern Asia (Lahore, Pakistan, December 1953).

— *Non-I.T.U. activities*

The following is a list, in chronological order, of meetings and other manifestations, not organised by the I.T.U., in which one or more of the C.C.I.R. staff took part:

- October-November 1953 : a visit to the U.S.A. to study the latest advances in broadcasting and television in that country;
- November 1953 : a meeting of the technical commission of the E.B.U. (Monte-Carlo);
- December 1953 : meeting of the Swiss National U.R.S.I. Committee (Zürich);
- January 1954 : lectures on random series, a mathematical subject of interest to the work of the C.C.I.R. on the prediction of sunspot numbers (Amsterdam);

- April 1954 : International Congress on Sound Recording (Paris);
- May 1954 : opening of the new monitoring centre of the R.A.I. (Milan);
- June-August 1954 : a visit to the U.S.A. and Canada to attend the Symposium on global communications (Washington); to take up contact with the I.C.A.O. on certain matters of common interest (air-sea distress cooperation) (Montreal), and to visit certain laboratories and other installations in the U.S.A.;
- August-September 1954 : XIth General Assembly of the U.R.S.I. (The Hague);
- September 1954 : International Congress of Mathematicians (Amsterdam);
- September-October 1954 : Technical Commission of the E.B.U. (London);
- October 1954 : British colour TV demonstrations (London);
- December 1954 : Technical Commission of the O.I.R. (Prague);
- December 1954 : Swiss National U.R.S.I. Committee (Zürich);
- April 1955 : Exhibition of Scientific Instruments (London);
- July 1955 : Mathematical Colloquium (St. Andrew's, Scotland);
- September 1955 : British Radio & TV Exhibition (Earl's Court, London);
- September 1955 : Baltic and North Sea Radiotelephone Conference, Baltic and North Sea Telecommunications Meeting (Göteborg);
- September 1955 : Symposium on Information Theory (London);
- September 1955 : Committee on sky-wave propagation of E.B.U. (Paris);
- October 1955 : Technical Commission E.B.U. (Rome);
- November 1955 : Technical Commission O.I.R. (Leipzig);
- December 1955 : Swiss National U.R.S.I. Committee (Zürich);
- January 1956 : meeting with officials of the International Geophysical Year (Brussels).

(e) *Relations with International Organisations*

In addition to the summary list of activities outside the I.T.U. attended by members of the C.C.I.R. staff since the VIIth Plenary Assembly, the Director believes that the relations with the following international organisations are of particular interest, as they involve continuous cooperation with the C.C.I.R. throughout the period under review.

— *International Civil Aviation Organisation (I.C.A.O.)*

During the course of the 9th Session of the Administrative Council (1954), the Director of the C.C.I.R. was approached by the United Nations representative on behalf of the I.C.A.O. concerning the lack of communication possibilities between aircraft and ships at sea. The I.C.A.O. was of the opinion that an important link in the safety of human life in the air — as well as at sea — was missing, as the present Radio Regulations did not provide any call or working frequencies for radio telephony common to both aeronautical and maritime services. For this reason, the Director, during his visit to North America, mentioned in the preceding paragraph, visited the I.C.A.O. Headquarters at Montreal, where a fruitful discussion on this matter took place.

After considering various possibilities, the I.C.A.O. was of the opinion that most probably the maritime distress frequency of 2182 kc/s would be most suitable for aeronautical purposes, in making radiotelephony contact with ships at sea. In particular, the I.C.A.O. was interested in the possibility of auto-alarm systems for this frequency being installed on board ships and at coast stations. However, before committing itself, the I.C.A.O. felt that more data should be made available on the number of ships and coast stations equipped with this apparatus, and accordingly, the Director of the C.C.I.R. has undertaken steps both through the International Radio-Maritime Committee (C.I.R.M.) as well as directly with the Administrations, in order to assemble data on this subject.

It might be noted in this connection that the I.C.A.O. is of the opinion that an Administrative Radio Conference should be held as soon as possible, so as to bring the Radio Regulations into

line with the rapidly developing requirements of aeronautical services. In particular, the I.C.A.O. is interested in seeing certain C.C.I.R. Recommendations — some of which date back to Stockholm 1948 — incorporated in the Radio Regulations, so that they can become mandatory internationally.

— *International Geophysical Year (I.G.Y.)*

As is well-known, the International Geophysical Year, covering the period July 1957 to December 1958, has been decided upon by a great number of countries interested in the simultaneous observation over the entire earth of geophysical phenomena, with the purpose of correlating these observations in order to be able to determine the fundamental physical principles underlying a great number of phenomena of importance to life on the earth.

In so far as the C.C.I.R. is concerned, the I.G.Y. is, of course, of particular interest with regard to the observation of phenomena relating to radio-wave propagation. It was, therefore, very gratifying that the Director was requested by the Special Committee for the International Geophysical Year (C.S.A.G.I.) to appoint two members who could aid in organising the radio aspects of the I.G.Y.

As the organisation of the I.G.Y. is now well in hand, the Director felt that, if full mutual benefit was to be obtained, it would not be wise to await the VIIIth Plenary Assembly of the C.C.I.R., and he therefore, subject to the approval of the Plenary Assembly, nominated himself and the C.C.I.R. Counsellor as Members of C.S.A.G.I. for the C.C.I.R. Not wishing to place the Plenary Assembly before a *fait accompli*, the Director has made clear to the C.S.A.G.I. that these two nominations were temporary, until such time as the Plenary Assembly could pronounce itself, and the Director would hence request the Assembly to decide on the final arrangements in this matter.

— *International Radio Scientific Union (U.R.S.I.)*

Apart from various minor U.R.S.I. meetings, the Director and the Counsellor of the C.C.I.R. attended the XIIth General Assembly of the U.R.S.I. at The Hague in 1954, in line with the general policy of close cooperation between the two organisations on matters of common interest.

The Director can report that full U.R.S.I. collaboration was promised on that occasion on matters of joint interest, and, in particular, the cooperation of U.R.S.I. was guaranteed on these subjects on the programme of the C.C.I.R. on which the VIIth Plenary Assembly had requested such cooperation. In particular, a special U.R.S.I. Commission was set up to assure this collaboration, having as Chairman Dr. Dellinger, Chairman of C.C.I.R. Study Group No. VI.

On the other hand, certain requests for aid were made by the U.R.S.I. to the C.C.I.R., particularly in respect to the possibility of the reservation of frequencies for radio-astronomical observations.

— *World Meteorological Organisation (W.M.O.)*

It will be recalled that some time ago work was initiated in collaboration between the W.M.O. and the C.C.I.R. on the compilation of data concerning the frequency of thunderstorms over the whole earth, in connection with the study of atmospheric radio noise by C.C.I.R. Study Group No. VI.

The Director is happy to report that the W.M.O. has collected comparable data in tabular form on the world distribution of thunderstorms, and has, in addition, issued thunderstorm distribution charts. For their part, the C.C.I.R., through a sub-commission of Study Group No. VI, under the Chairmanship of Mr. Horner (U.K.), has undertaken the testing of various types of lightning-parts flash counters in various parts of the globe.

— *European Broadcasting Union (E.B.U.)*

Question (c) submitted by the I.F.R.B., as mentioned in C.C.I.R. Report No. 24, asked what modification, if any, should be made to C.C.I.R. long and medium wave propagation curves adopted at Cairo in 1938. Throughout the past several years the E.B.U. has carried out a series of measurements in an endeavour to provide evidence for modification, and the results have been made available in Doc. No. 418.

— *International Broadcasting Organisation (I.B.O.)*

Recent meetings of the Technical Commission of the I.B.O. were attended by the Vice-Director of the C.C.I.R., as shown in Section 2(d).

3. Organisation of the specialised Secretariat.

(a) *Election of a new Director.*

As already mentioned in the letter of invitation to the VIIIth Plenary Assembly (Circular letter VO/27 of 16th November 1955), this Plenary Assembly will have to elect a new Director of the C.C.I.R., to take office on 1st January 1957. In this connection, it should be pointed out that the Vice-Director is eligible for candidature and election, so that the possibility should not be precluded that the election of a new Vice-Director will also have to take place at the VIIIth Plenary Assembly. On this basis, and as mentioned in para. 3 (b) of VO/27, the Director has submitted, in Doc. No. 437, a proposed procedure for this election, as well as a draft time schedule for it, for consideration by the Plenary Assembly.

(b) *Staff:*

— *General.*

Due to economical staff management, the Director has up to the present been able to keep both the number of staff and the consequent expenses well within the limits of the C.C.I.R. Ordinary Budget. It should be noted, however, that although not all posts envisaged have yet been filled (see Annex III), this will most probably become necessary in the near future. Consequently, the staff establishment at present envisaged should not be construed as being capable of reduction.

It should be noted that, until the more definite consequences are known, the additional work foreseen on behalf of the Study Groups, in para. 1(e) of this Report and the relevant Annex, will be assigned to supernumerary staff to be engaged as the need arises, and the costs charged to the Extraordinary Budget of the C.C.I.R., as they in fact concern Study Group documentation, which may be considered to be preparatory to the Plenary Assembly.

(c) *C.C.I.R. estimates of expenditure:*

— *Ordinary Budget.*

Estimates of Ordinary C.C.I.R. Expenditure for the years 1957, 1958 and 1959 are given in Annex IV-A. In considering these figures, it should be borne in mind that, due to decision of the Administrative Council, the structure of the I.T.U. Budget has been modified in the sense that all expenses other than direct staff expenses are now grouped under the heading: "Miscellaneous Services" of the I.T.U. Budget.

Consequently, while every attempt has been made to present the figures in a comparable form to previous years, certain caution must be exercised when considering the figures in Annex IV-A.

— *Extraordinary Budget.*

In keeping with previous years, the estimates for the extraordinary expenses of the C.C.I.R. in 1957 and 1958 — i.e. years when no Plenary Assembly will take place — have been maintained at the figure of 100,000 Swiss francs per year (See Annex IV-B).

With regard to the estimate of extraordinary expenses for 1959, it is not possible to draw up an approximate estimate until such time as the place and duration of the IXth Plenary Assembly are known.

(d) *Office of the C.C.I.R.:*

The Director has nothing to report in addition to the information already given, concerning the advantages of the present location of the C.C.I.R. office, with regard to the low electrical noise level on the premises. As, furthermore, the present offices are quite adequate for the C.C.I.R. and the matter of a new I.T.U. building appears to be still under study, so that a new building cannot be ready for another two or three years, at least, it is considered that the C.C.I.R. is fortunate in having its present premises.

Conclusion.

In view of his imminent retirement, the present Director of the C.C.I.R. feels that it might be appropriate here to give a few figures on the development of the C.C.I.R. since the Permanent Secretariat was established at the Vth Plenary Assembly in Stockholm 1948, and perhaps some data on the Plenary Assemblies — which, after all, are the culmination of the work of the C.C.I.R. — would be most significant in this respect.

The attendance of 112 delegates in Stockholm, 1948, has grown via:
265 « in Geneva, 1951, and
359 « in London, 1953, to approximately
400 « in Warsaw, 1956.

These delegates studied a total of 334 documents in Stockholm,
695 « in Geneva,
839 « in London, while nearly
450 preparatory documents for Warsaw are a definite
indication that here, too, a new "high" will be attained.

As to results of the work, the number of Recommendations, Questions for study, etc., coming from these Plenary Assemblies, the following figures are also significant:

Stockholm	70
Geneva	138
London	169

More difficult to express in figures, but of at least equal importance, is the ever-increasing participation of the C.C.I.R. in the activities of other international organisations in radio matters, as outlined briefly in para. 2(e). It is this collaboration, in particular, which we may hope will contribute, in no minor measure, in:

"...facilitating relations between the peoples by means of efficient telecommunication services..."

as stated in the Preamble to the International Telecommunication Convention.

Finally, the present Director would like to take the opportunity to thank most warmly all those who have made this expansion of the work of the C.C.I.R. possible, by their helpful cooperation and to express the wish that this expansion may continue in the best interests of all concerned with radio communication.

ANNEX I

Subject: Work of the C.C.I.R. Study Groups.

DRAFT RESOLUTION

The C.C.I.R.,
considering

- (a) chapters 16 and 17 of the General Regulations annexed to the International Telecommunication Convention (Buenos Aires, 1952);
- (b) the great increase in participation in the work of the C.C.I.R. Study Groups since the Vth Plenary Assembly of the C.C.I.R. (Stockholm, 1948);
- (c) that the Chairmen of the Study Groups of the C.C.I.R. do not always have the necessary facilities available to translate, reproduce and distribute numerous contributions to the work of their Study Groups during the interval between Plenary Assemblies;
- (d) that the present staff of the Specialised Secretariat of the C.C.I.R. is not large enough to cope with this additional work within the time limits desirable;
- (e) that this additional work is likely to be irregular in volume;
- (f) that it is not desirable to increase the permanent staff of the C.C.I.R. at the present time;

resolves:

- 1. that during the interval between Plenary Assemblies, contributions to the work of a Study Group from the participants in the work thereof be sent:
— in one copy to the Chairman of the Study Group concerned, for his consideration;

- in three copies to the Director of the C.C.I.R., for translation, reproduction and distribution to the members of the Study Group concerned;
2. that the necessary credits for the engagement, on a supernumerary basis, of the required personnel be made available from the Extraordinary Budget of the C.C.I.R. for this purpose;
 3. that, as a trial, this procedure be instituted during the period between the VIIIth and IXth Plenary Assemblies of the C.C.I.R.;
 4. that the Director of the C.C.I.R. report on the experience acquired and make proposals, on the basis of this experience, to the IXth Plenary Assembly, for a definite arrangement on this matter.

ANNEX II

AGREEMENT between

THE ADMINISTRATION OF THE PEOPLE'S REPUBLIC OF POLAND
and

THE INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (C.C.I.R.)
OF THE INTERNATIONAL TELECOMMUNICATION UNION

Introduction.

The present agreement, concluded with reference to the I.T.U. Administrative Council Resolution No. 83 (amended), by the Administration of the People's Republic of Poland (hereinafter called "the inviting Administration") and by the International Telecommunication Union, represented by the Director of the International Radio Consultative Committee (hereinafter called the "I.T.U." or the "C.C.I.R.") is designed to facilitate the organisation of the VIIIth Plenary Assembly of the C.C.I.R. (hereinafter called the "Assembly"). This agreement is based on the relevant provisions of the International Telecommunication Convention and of its Annexes, and on the experience acquired at previous C.C.I.R. meetings.

Two copies of this agreement have been signed by the contracting parties. One copy has been kept by the inviting Administration, and the other by the C.C.I.R.

A. General provisions.

1. *Name of the Assembly.*

The Assembly shall be officially known as the VIIIth Plenary Assembly of the International Radio Consultative Committee (C.C.I.R.)

2. *Place and date of the Assembly.*

At the invitation of the Administration of the People's Republic of Poland, the Assembly shall meet in the Palace of Culture and Science, Warsaw.

The official opening will take place on *Thursday, August 9th, 1956*, at 11 o'clock a.m., and the closing meeting on *Thursday, September 13th, 1956*.

3. *Invitations.*

As soon as this agreement is signed, the Director of the C.C.I.R. shall, on behalf of the inviting Administration, invite all Members of the C.C.I.R. to attend the Assembly.

4. *Languages.*

In accordance with Article 14 of the International Telecommunication Convention (Buenos Aires, 1952), arrangements shall be made to ensure effective use of the working languages of the Union. Other languages may be used subject to Article 14, paragraph 6 (1) of the Convention. If possible, arrangements shall also be made for speakers to be heard directly.

5. *Cancellation of, or change in, the place and/or date of the Assembly.*

Should the Assembly be cancelled at the request of the inviting Administration, all expenses incurred by the inviting Administration for preparation of the Assembly shall be borne by that Administration. In case of a change in the place and/or date of the Assembly at the request of the inviting Administration, the expenses incurred by that Administration as a result of such a change or such changes shall be borne by that Administration.

Should the Assembly be cancelled, or should there be a change in place or date as a result of a decision taken by the I.T.U., the responsibilities undertaken by this latter vis-à-vis the inviting Administration shall be limited to the financial commitments incurred by that Administration, or to the sums actually disbursed by it, on preparations for the Assembly, and only in so far as the expenses incurred are indispensable and can be neither reduced nor annulled.

B. Financial provisions.

1. *Expenses borne by the inviting Administration.*

The *inviting Administration* hereby agrees to accept responsibility for expenses in connection with the following:

- a) the right to dispose of the furnished premises, including upkeep and cleaning; however, the inviting Administration shall bear no financial responsibility for any damage which might be caused to the premises by reason of the presence of the Assembly, apart from normal wear-and-tear.
- b) the staff exclusively at the service of the Chairman and/or of his representative or representatives;
- c) the official responsible for maintaining liaison between the Administration of the People's Republic of Poland and the C.C.I.R. and its staff;
- d) the Reception Committee;
- e) all excursions, shows and other events organised by the inviting Administration;
- f) the installation and operation of an internal telephone service in the premises of the Assembly.

2. *Expenses debited to the budget of the Assembly.*

All other expenses incurred by or for the Assembly shall be debited to the budget of the Assembly.

3. *Budget Supervision Committee.*

The Assembly shall be called upon to set up a Budget Supervision Committee, in accordance with Section C of Administrative Council Resolution No. 83 (amended).

4. *Limit on expenditure.*

No expenses exceeding the limits of the budget of the Assembly shall be incurred without the formal authorisation of the Plenary Assembly, on a recommendation by the Budget Supervision Committee and in accordance with Administrative Council Resolution No. 83 (amended).

5. *Advances of funds.*

The *inviting Administration* shall advance sufficient funds in local currency to meet bills for such office supplies as are essential for the Assembly and shall also advance the amounts owed to Secretariat staff recruited in Poland. It shall also make available to the Assembly the necessary funds in local currency to cover expenses payable in Poland, within the framework of paragraph B.2.

The I.T.U. shall refund these sums to the *inviting Administration* in Swiss francs, in accordance with the provisions of the payment agreements in force between Poland and Switzerland. The *inviting Administration* shall not claim interest from the I.T.U. on the sums it has advanced for 30 days after the final accounts of the Assembly have been received by the Secretary-General of the I.T.U. At the end of this period, if the account has not been paid, it shall bear interest at 4% in favour of the Administration of the People's Republic of Poland. The Secretary-General of the I.T.U. shall give instructions for the full refund of these monies by 31st December 1956, at the latest, provided he has received the final accounts at least one month before that date.

C. Staff.

1. *Staff required.*

Annex A gives a list of staff required for the Assembly. The periods for which this staff shall be engaged shall be decided on by agreement between the C.C.I.R. and the *inviting Administration*.

2. *Recruitment of staff.*

In the Annex hereinafter, staff in the categories marked with asterisks shall be supplied by the C.C.I.R., and the remainder shall be locally engaged by the *inviting Administration* on behalf

of the Assembly. Nevertheless, if the inviting Administration is unable to recruit all the staff it has agreed to recruit, it shall inform the C.C.I.R. to that effect in good time, and in no case later than 1st June, 1956, so that the C.C.I.R. may make arrangements for such recruitment.

3. *Scale of salaries and allowances; insurance, and working hours.*

- a) the provisions in force in the I.T.U. as regards the scale of salaries and per diem allowances, insurance, working hours and overtime shall be applicable to staff recruited by the I.T.U. for the Assembly.
- b) the relevant provisions of Polish legislation shall be applicable to staff recruited by the inviting Administration, allowance being made for local practices, it being understood that all sums under this heading will be paid by the inviting Administration in local currency. These amounts shall be refunded in Swiss francs in accordance with paragraph B.5., paragraph 2, it being understood that the amount of salaries which the inviting Administration may ask to be refunded shall not exceed the sum which would result from application of the salary scale in force in the I.T.U. for the corresponding categories of staff, the sums due under Polish law for insurance (15.5 %) and overtime (increase of 50 % for each of the two first hours and of 100 % for each additional hour and for every hour on public holidays and at night) being added.

D. **Premises.**

1. *Period during which premises will be available.*

The premises to be occupied by the Assembly, except those designed for general use (paragraph D, 2e) shall be exclusively available to it as from Thursday, August 9th, to Thursday, September 13th, 1956, it being understood that the plenary meeting room (paragraph D, 2a) can also be used for other purposes when the Assembly is not holding plenary meetings. The office premises for the Secretariat shall be available to it from *Wednesday, August 1st, to Friday, September 21st, 1956.*

Any person officially working for the Assembly shall have access to these premises at any hour of the day or night; other persons may be admitted if the needs of the Assembly so demand.

2. *Description of the premises.*

a) *Meeting rooms:*

- 1 hall for plenary meetings, equipped for simultaneous interpretation in at least four languages, and containing some 450 seats, without counting the Chairman's dais;
- 3 large committee rooms, each equipped for simultaneous interpretation in four languages, and each containing some 80 seats;
- 10 smaller committee rooms, not equipped for simultaneous interpretation, each containing from 10 to 20 seats.

b) *Offices for Chairman, Directors and their staff.*

- 1 office for the Chairman of the Assembly;
- 1 » » » Director of the C.C.I.R.;
- 1 » » » Vice-Director, C.C.I.R.;
- 1 » » » technical personnel of the C.C.I.R.;
- 2 offices » » secretaries of the above persons.

c) *Document distribution centre.*

The inviting Administration shall organise a document distribution centre in a place close to the main meeting hall. This centre shall have some 450 pigeon-holes, a distribution counter, and the necessary shelves for up to 50 copies of some 600 different documents to be stocked.

d) *Offices for the Secretariat.*

- 1 office for the Secretary of the Assembly;
- 1 » » » assistants to the Secretary of the Assembly;
- 1 » » » Assistant-Secretary (delegates);
- 1 » » » Assistant-Secretary (documents);
- 1 » » » Assistant-Secretary (finance and personnel);
- 1 » » » official supplied by the Polish Administration, responsible for liaison with the C.C.I.R.

N.B.: The above list does not include premises for minor personnel.

e) Premises for general use.

The inviting Administration shall equip the following premises, designed for general use:

- Writing room and salon for delegates;
- Cloakroom;
- Information counter;
- Reception office;
- First-aid post;
- Canteen and bar;
- Telephone booths;
- Post Office;
- Bank (exchange);
- Travel agency.

3. Security measures.

The inviting Administration shall be responsible for general security measures in the premises reserved for the Assembly.

4. Internal communication system.

Besides a messenger service, the inviting Administration shall install an internal telephone network with a set in each of the offices or rooms used for the Assembly (except for a few cases approved by the Director, C.C.I.R.). Outside the switchboard operators' working hours, the offices of the Chairman, the Director and Vice-Director of the C.C.I.R., the Secretary of the Assembly, the typing pool, and the documents section shall be directly connected to the general network.

5. Upkeep and cleaning.

The inviting Administration shall be responsible for the upkeep and cleaning of the premises and shall also arrange for such simple installations as may be requested by the Assembly.

6. Furniture.

The inviting Administration shall supply the necessary furniture in the Assembly building.

E. Technical equipment.

a) The inviting Administration shall supply:

1. 5 mimeograph machines, electrical if possible;
2. A device for reproducing designs which cannot be stencilled;
3. An electrical computing machine;
4. A machine for stapling bulky documents;
5. Two draftsmen's tables, fully equipped.

b) The simultaneous interpretation equipment in the three large committee rooms shall be supplied, assembled and operated by the inviting Administration at the Assembly's expense, should a tender submitted by a Polish concern be approved by the C.C.I.R. Otherwise the C.C.I.R. shall supply this equipment itself and shall ensure its operation.

The cost of operating the equipment already present in the plenary meeting hall shall be paid by the C.C.I.R., the conditions of such payment to be agreed on later.

F. Office supplies.

The inviting Administration shall be responsible for obtaining the following for the Assembly:

1. Miscellaneous office supplies.
2. Paper with the official heading of the Assembly.
3. Forms.
4. Supplies required for the publication of documents.

A decision as to what, and how much, will be required in each of the above classes shall be taken in due course.

The cost of these supplies shall be debited on the basis of world prices and the sums advanced shall be refunded in Swiss francs in accordance with paragraph B.5, paragraph 2.

G. Franking privileges.

The inviting Administration shall make all arrangements relative to the telegraph and telephone franking privileges mentioned in Opinion No. 1 of the International Telegraph and Telephone Conference (Paris, 1949). The extent of these privileges shall be communicated to participants before the Assembly begins, if possible.

H. Miscellaneous.

1. *Consular and customs formalities.*

The inviting Administration shall take the necessary steps, within the limits set by the law and the customs regulations of the People's Republic of Poland, to facilitate, as far as possible, for participants in the Assembly (including the Secretariat) and for the persons accompanying them, delivery of visas and customs formalities in connection with their personal effects, on both entering and leaving the People's Republic of Poland.

2. *Fiscal provisions.*

The salaries and emoluments paid to persons who, under the income tax law, are not considered as residing in the People's Republic of Poland, shall not be subject to income tax in that Republic.

3. *Insurance.*

The inviting Administration shall supply the necessary information to enable those interested to benefit from a system of insurance, with special reference to persons working for the Assembly (and their personal effects) in the premises of the Assembly. The I.T.U. shall undertake to insure such staff (and their belongings) as may be recruited, for the duration of the Assembly, outside the People's Republic of Poland.

4. *Lodging.*

The inviting Administration shall be responsible for reserving hotel rooms for all participants in the Assembly and for the persons accompanying them. To this end, Administrations and other probable participants are asked to acquaint the inviting Administration with the names of the persons who will be coming to Warsaw for the Assembly, and to state how long they will be staying. The C.C.I.R. shall supply similar information about members of the Secretariat not resident in the People's Republic of Poland.

I. Final clauses.

1. *Liaison.*

The inviting Administration and the C.C.I.R. shall each designate an official to agree on the necessary detailed arrangements within the framework of this agreement.

2. *Amendments to this agreement.*

Any amendment to this agreement must be signed in the same manner as the agreement itself and be annexed to it. However, since the figures quoted in this agreement, as regards the numbers of officials, the categories of staff, furniture and equipment, etc., have been based on experience acquired at previous meetings, and hence are liable to slight modification, such changes shall be made by common agreement, according to circumstances, without being considered as "amendments" in the sense given to the term above.

Done in Geneva, this third day of October, 1955.

*For the Administration of the People's
Republic of Poland:*
Konrad KOZŁOWSKI
Director-General, Ministry of Posts
and Telecommunications.

*For the International
Telecommunication Union:*
Balth. VAN DER POL
Director, C.C.I.R.

ANNEX A

Personnel required for the Assembly

a) *For the senior officials of the Assembly.*

Secretary * for the Director, C.C.I.R.
Secretary * for the Vice-Director, C.C.I.R.

b) *For the Secretariat of the Assembly.*

— *Administration.*

Secretary of the Assembly	1 *	
Assistants to the Secretary of Assembly	2 *	
Assistant-Secretary (delegates)	1	
Assistant	1	
Assistant-Secretary (documents)	1 *	
Assistant	1 *	
Assistant-Secretary (finance and personnel)	1 *	
Assistant	1	
Document supervision officer	1 *	
Assistants	2	
Supply officer	1	
Head of the document distribution section	1 *	
Document distribution officers	8	
Head messenger	1	
Messengers	10	33

— *Languages.*

Chief interpreter	1 *	
Interpreters (English 7, Spanish 5, French 7)	19 *	
Translator-revisers (minute-writers for plenary meetings)	3 *	
Translators (English 2, Spanish 4, French 3)	9 *	
Head of typing pool	1 *	
Senior typists (English 2, Spanish 2, French 2)	6 *	
Typists (shorthand-typists 6 *, typists 12)	18	57

— *Document reproduction.*

Head of mimeograph section	1 *	
Mimeograph operators	6	
Document assembly officers	6	
Draftsmen	2	15
		<u>105</u>

* To be supplied by the C.C.I.R.

ANNEX III

C.C.I.R.

(Posts filled and envisaged
as of 1st April 1956)

<i>Post No.</i>	<i>Grade</i>	<i>Class</i>	<i>Function</i>
C.C.I.R. No. 1	Counsellor	D	Technical Counsellor
C.C.I.R. No. 2	Senior Engineer	1	Engineer I
C.C.I.R. No. 3 *)	Senior Engineer	1	Engineer II
C.C.I.R. No. 4	Senior Secretary	1	Administrative Secretary
C.C.I.R. No. 5	Engineer	2	Technical Editor (F)
C.C.I.R. No. 6 *)	Engineer	2	Technical Editor (E)
C.C.I.R. No. 7	Technical Assistant	3	Technical Operator I
C.C.I.R. No. 8	Senior Office Assistant	4	Secretary to Director
C.C.I.R. No. 9	Senior Office Assistant	4	Secretary to Vice-Director
C.C.I.R. No. 10	Senior Office Assistant	4	Administrative Assistant
C.C.I.R. No. 11	Office Assistant	5	Shorthand-Typist
C.C.I.R. No. 12	Office Assistant	5	Administrative Assistant
C.C.I.R. No. 13 *)	Office Assistant	5	Technical Operator II
C.C.I.R. No. 14 **)	Clerk	7	Roneo Operator
C.C.I.R. No. 15	Clerk	7	Concierge

* Posts Nos. 3, 6 and 13 are vacant at present, although Post No. 6 will be filled temporarily throughout the VIIIth Plenary Assembly and for a few months afterwards.

** Post No. 14 is occupied, on a supernumerary basis, according to the needs of the C.C.I.R.

ANNEX IV-A

*C.C.I.R. ordinary budget for 1957, as submitted to the 11th session of the Administrative Council
Estimates of C.C.I.R. ordinary expenditures for 1958 And 1959*

	1957		1958		1959	
Section 5. C.C.I.R. Staff Expenses						
.10 Salaries	346,000.—		350,720.—		355,390.—	
.11 Cost of living allowances:						
.111 persons actively employed	16,300.—		16,600.—		16,900.—	
.112 retired staff	—		—		—	
.12 Allowances:						
.121 expatriation	8,000.—		7,500.—		7,500.—	
.122 family	8,800.—		10,400.—		10,400.—	
.123 Children's education:						
.123.1 allowance	2,000.—		2,000.—		2,000.—	
.123.2 travel expenses	400.—		400.—		400.—	
.13 Removal expenses	2,500.—		2,500.—		2,500.—	
.14 Home leave	26,200.—		3,800.—		26,200.—	
.15 Overtime	500.—		500.—		500.—	
.17 Insurance expenses:						
.171 regular contributions to S.S. and B. Fund (15%):	51,900.—		52,610.—		53,310.—	
.172.1 single contributions	22,900.—		3,500.—		4,000.—	
.172.2 buying-in fees	—		—		—	
.173 Survivors' insurance, retired staff .	7,750.—		7,750.—		7,750.—	
Totals: (to be carried forward) . . .		493,250.—		458,280.—		486,850.—

ANNEX IV-A (continued)

	1957		1958		1959	
Totals brought forward		493,250.—		458,280.—		486,850.—
Section 6. <i>I.T.U. Misc. Serv.</i> (C.C.I.R. share)						
.1 <i>Social welfare expenses</i>						
.10 Management expenses. S.S. and B. funds	1,500.—		1,500.—		1,500.—	
.11 Provident Fund.	15,000.—		15,000.—		15,000.—	
.12 Contrib. to joint med. service . . .	1,000.—		1,000.—		1,000.—	
.13 Contrib. Sickness Insur. Fund . . .	2,000.—		2,000.—		2,000.—	
.14 Collective accident insurance . . .	2,500.—		2,500.—		2,500.—	
.15 Language courses	700.—	22,700.—	700.—	22,700.—	700.—	22,700.—
.2 <i>Premises: rent and charges</i>						
.2033 Rent	18,000.—		18,000.—		18,000.—	
.213 Heating and lighting	6,500.—		6,500.—		6,500.—	
.223 Service (upkeep, cleaning, fire insurance, etc.)	1,000.—		1,000.—		1,000.—	
.23 Installations and repairs	500.—	26,000.—	500.—	26,000.—	500.—	26,000.—
.3 <i>Travel expenses</i>						
.31 Travel outside Switzerland	10,000.—		10,000.—		10,000.—	
.32 Travel inside Switzerland	400.—	10,400.—	400.—	10,400.—	400.—	10,400.—
.4 <i>Office expenses</i>						
.401 Maps, binding, journals	2,500.—		2,500.—		2,500.—	
.402 Furniture and office machinery . .	2,000.—		2,000.—		2,000.—	
.403 Office supplies	5,000.—	9,500.—	5,000.—	9,500.—	5,000.—	9,500.—
.5 <i>Technical equipment</i>		8,000.—		8,000.—		8,000.—
.6 <i>Stamps and telegraph charges</i>		3,000.—		3,000.—		3,000.—
.7 <i>Telephone</i> (subscrip. and calls) . . .		3,800.—		3,800.—		3,800.—
.8 <i>Central library</i> (purchase of books for all organs)		3,600.—		3,600.—		3,600.—
.9 <i>Offset workshop</i>		500.—		500.—		500.—
.10 <i>Miscellaneous and unforeseen</i>		1,000.—		970.—		1,150.—
<i>Totals</i>		581,750.—		546,750.—		575,500.—

ANNEX IV-B

*C.C.I.R. extraordinary budget for 1957, as submitted to the 11th session of the Administrative Council
Estimates of C.C.I.R. extraordinary expenditures for 1958 and 1959*

	1957	1958	1959
<i>Section 95. C.C.I.R.</i>			
<i>Art. I. Staff expenses</i>			
1. Administrative	10,000.—	10,000.—	
2. Linguistic	54,000.—	54,000.—	
3. Roneo	5,000.—	5,000.—	
4. Insurance	2,000.—	2,000.—	
<i>Art. II. Premises and equipment</i>			To be determined after place and du- ration of the IXth Plenary Assembly are known.
5. Premises, furniture, machines	5,000.—	5,000.—	
6. Document reproduction	10,000.—	10,000.—	
7. Office supplies and overheads	3,000.—	3,000.—	
8. Simultaneous interpretation and other technical equipment	—	—	
9. Unforeseen	3,000.—	3,000.—	
<i>Art. III. Cash expenses</i>			
10. Interest on advances	6,000.—	8,000.—	
<i>Expenses of an exceptional nature</i>			
11. Participation in meetings of C.C.I.T. or other International Organisations	6,000.—	6,000.—	6,000.—
	104,000.—	106,000.—	

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**REPORT OF THE CHAIRMAN OF THE
FINANCE COMMITTEE**

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FINANCE COMMITTEE
CHAIRMAN'S REPORT TO THE VIIIth PLENARY ASSEMBLY*

1. At the first meeting of the Plenary Assembly, the Finance Committee was formed with Mr. B.V. Baliga (India) as Chairman and Mr. Gasiorowski (Poland), Mr. de Groen (Netherlands), Mr. Bramel de Cléjoux (France), Capt. C. F. Booth (United Kingdom), Mrs. F.T. Dowling (United States of America) and Mr. R. Monnat (Switzerland).

1.1. The Finance Committee adopted the following terms of reference:

1.1.1. to examine:

- i) the budget and accounts of the VIIIth Plenary Assembly of the C.C.I.R. along with the agreement with the Polish Administration (Annex II to Doc. No. 115);
- ii) the Ordinary and Extraordinary Budgets of the C.C.I.R. for 1957, 1958 and 1959;
- iii) expenditure statement and revised estimates for 1956.

2. The Finance Committee held five meetings for the disposal of work and also formed a sub-committee to deal with item i) of the terms of reference.

3. *Agreement with the Polish Administration.*

The agreement with the Polish Administration (Annex II of Doc. No. 115), which had been examined by the Administrative Council of the I.T.U. at its 11th Session, was reviewed in connection with the examination of the accounts of the current Assembly and found to be in order. It is recommended that the agreement be approved; and the following text included in Volume II of the documents of this Assembly if it meets with the approval of the Plenary Assembly.

“Approval of agreement between the Polish Administration and the International Radio Consultative Committee of the I.T.U.

“The VIIIth Plenary Assembly (unanimously) approves the agreement between the Polish Administration and the International Radio Consultative Committee to facilitate material arrangements for the Assembly.”

3.1. The Finance Committee has noted with pleasure that the Polish Administration has provided spacious and well-appointed accommodation for the meetings of the Assembly and for the officials of the C.C.I.R. Secretariat, and of the Assembly, etc., without any charge. Private transport has also been placed at the disposal of the various officials, including the newly elected Director, at no expense to the Assembly. It has also assumed the burden of initially paying the salaries of locally recruited personnel, and other expenses which will be reimbursed by the C.C.I.R. at a subsequent date. This has simplified the accounting procedure.

3.2. It is strongly recommended that the Assembly express its appreciation and gratitude to the Polish Administration for its co-operation and the generosity of these facilities.

4. *Status of the expenditure of the VIIIth Plenary Assembly vis-à-vis the budget.*

The extraordinary budget estimates for the year 1956 were 850,000 Swiss francs. Out of this amount, an expenditure of 287,868.25 Swiss francs had been incurred in connexion with the preparatory work of the Assembly, television demonstrations, etc., as per Annex V-B, leaving a balance of 562,131.75 Swiss francs. The progress of expenditure against this balance up to 31st August 1956, and the financial position as on 13th September 1956, are given in Annex I. A brief explanation of the budgetary balances has been given in Section B of Doc. No. 829 (Report of the Finance Sub-Committee). The Finance Committee fully endorses the views expressed therein.

* Doc. N. 944 (Warsaw, 1956).

4.1. The final accounts of the VIIIth Plenary Assembly up to 13th September 1956 will have to be examined soon after the closure of the Assembly sessions. It is suggested that the Plenary Assembly may be pleased to authorise the Finance Sub-Committee to do the needful and submit its report direct to the C.C.I.R. Directorate for further action.*

5. *List of contributors to the extraordinary expenses.*

According to Article 19 of the Financial Regulations of the I.T.U., as amplified by Administrative Council Resolution No. 83 (amended), a complete list of the Members, Associate Members, Recognised Private Operating Agencies, International Organisations, etc., which are to contribute to the expenses of the conference, or meeting, is to be prepared. Such a list will be found in Annex II.

6. *C.C.I.R. Ordinary Budgets for 1957, 1958 and 1959.*

The ordinary budgets for 1957, 1958 and 1959 were compared with the budget for 1956 and are given in Annex III. The increases are due to:

- i) higher rates of cost-of-living allowances sanctioned by the Administrative Council from 1st July 1956;
- ii) the normal increments in salary provided for in the Staff Regulations of the I.T.U.;
- iii) slightly higher provision for family and other allowances which are normally to be expected.

6.1. The budget estimate for 1957 is higher than that for 1956 by 132,700 Swiss francs. This is mainly due to removal expenses and contributions to the Staff Superannuation and Benevolent Funds, on account of the election of the new Director of the C.C.I.R.

6.2. The Finance Committee has noted with satisfaction that no increase in staff was being contemplated during the years 1957 to 1959. Three technical posts had remained unfilled during the year 1955, but in view of the growing volume of work of the C.C.I.R., it was thought best to retain the possibility of filling these posts, if considered absolutely necessary to meet any eventuality. However, some savings would result under 12.1 — Expatriation — (approximately 5000 Swiss francs) and 13. — Removal expenses — on account of the Director-elect being of Swiss nationality.

6.3. There is a small provision of 8000 Swiss francs under Section 6.5. of Annex III. Whilst the Committee feels that this small sum may be allowed to be retained, it would like to reaffirm to the Plenary Assembly the inadvisability of establishing a laboratory in the C.C.I.R. and to request the Director-elect to review the item in question with a view to effecting a reduction.

7. *C.C.I.R. Extraordinary Budgets for 1957, 1958 and 1959.*

During the last few years the volume of work handled by the C.C.I.R. has grown from Plenary to Plenary on account of the increasing number of contributions received from administrations, private operating agencies, etc. Whilst this is indicative of the rapid development of radio communication during the last few years and the increasing interest shown by the administrations in the work of the C.C.I.R., the Finance Committee thought fit to make constructive suggestions to the Organisation Committee with a view to reducing the overall expenditure of the C.C.I.R. A note prepared in this connection is attached (Annex IV). The Finance Committee has been given to understand that the Organisation Committee is formulating proposals to improve the efficiency of work of the Study Groups and economise on the expenditure on documentation, which will be placed before the Plenary Assembly for consideration.

7.1. On the basis that these proposals may receive the approval of the Plenary Assembly, the Finance Committee suggests a provision of 20 000 Swiss francs for the year 1957, 230 000 Swiss francs for 1958 and 725 000 Swiss francs for 1959. A higher provision than indicated in Annex IV-B of Doc. No. 115 has been suggested for the year 1958, for meeting the expenditure of a larger number of study group meetings during the year, which will reduce the work load during the Plenary Assembly in 1959.

7.2. It is to be stated that the provisions suggested in paragraph 7.1. are only rough estimates; more accurate estimates could not be framed until the extent and scope of the proposals which the Organisation Committee intends to submit to the Plenary Assembly are known, and the place

* Doc. N. 1008 (Warsaw, 1956).

at which the next Plenary Assembly will meet is fixed. It has also not been possible to assess the extent of economy that can be effected by the new proposals for documentation until sufficient experience has been gained on the revised method of working of the Study Groups, etc. The provisions suggested may be approved by the Plenary.

8. *Expenditure statement and revised estimates for 1956.*

The budget and revised estimates of ordinary and extraordinary expenditure for 1956, as given in Annexes V-A and V-B, are brought to the notice of the Plenary Assembly. As these have been approved by the Administrative Council it is not necessary for the Plenary Assembly to act on these budgets.

9. In paragraph 2 of the "resolves" of Annex I to Doc. No. 115*, the method of financial adjustment of staff engaged on a supernumerary basis is covered as part of the draft resolution. The Finance Committee see no objection to this proposal.

B. V. BALIGA

Chairman, Finance Committee

* See page 212.

ANNEX I

VIIIth Plenary Assembly of the C.C.I.R., Warsaw 1956

Sections	Expenditure at 31 August 1956	Commitments and estimated expenses to 13 Sept. 1956	Total expenses	Budget: balance available	Difference	
					+	-
<i>Art. I. Staff expenses</i>						
1. Administration	82,200.—	43,700.—	125,900.—	126,172.80	272.80	
2. Languages	193,800.—	91,900.—	285,700.—	295,305.15	9,605.15	
3. Roneo	19,400.—	11,700.—	31,100.—	23,377.10		7,722.90
4. Insurance	2,800.—	2,150.—	4,950.—	4,038.15		911.85
<i>Art. II. Premises and equipment</i>						
5. Premises, furniture, machines	3,500.—	3,600.—	7,100.—	1,953.65		5,146.35
6. Document reproduction	35,200.—	12,200.—	47,400.—	27,990.05		19,409.95
7. Office supplies and overheads	10,900.—	6,700.—	17,600.—	32,994.85	15,394.85	
8. Simultaneous interpretation or other technical equipment	23,200.—	6,600.—	29,800.—	35,000.—	5,200.—	
9. Unforeseen	—	1,000.—	1,000.—	5,000.—	4,000.—	
<i>Art. III. Cash expenses</i>						
10. Interest on advances	7,000.—	3,300.—	10,300.—	10,300.—		
	378,000.—	182,850.—	560,850.—	562,131.75	34,472.80	33,191.05
					+ 1,281.75	
Expenses in connection with interpreta- tion into Russian	28,800.—	12,100.—	40,900.—			

ANNEX II

LIST OF PARTICIPANTS IN THE EXPENSES OF THE STUDY GROUPS 1954/55
AND OF THE VIIIth PLENARY ASSEMBLY OF THE C.C.I.R., WARSAW, 1956

	<i>Participant in the work of the VIIIth PA</i>	<i>Number of units</i>
<i>I. Members and Associate Members</i>		
P.R. of Albania	x	1/2
Argentine Republic	x	25
Commonwealth of Australia	x	20
Austria	x	1/2
Belgium	x	8
Bielorussian S.S.R.	x	3
P.R. of Bulgaria	x	1
Canada	x	20
Ceylon	x	1
China	x	15
Denmark	x	5
Egypt	x	5
Ecuador	x	1
Spain	x	3
United States of America	x	30
Finland	x	3
France	x	30
Hungarian P.R.	x	1
India	x	20
Ireland	x	3
State of Israël	x	1
Italy	x	20
Japan	x	25
Kingdom of Laos	x	1/2
Monaco	x	1/2
Norway	x	5
New Zealand	x	5
Pakistan	x	15
Netherlands, Surinam, Netherlands Antilles, New Guinea	x	10
Peru	x	2
P.R. of Poland	x	10
French Protectorates of Morocco and Tunisia	x	1+1
Federal German Republic	x	20
F.P.R. of Yougoslavia	x	1
Ukrainian S.S.R.	x	5
Roumanian P.R.	x	1
United Kingdom of Great Britain and Northern Ireland	x	30
Sweden	x	10
Swiss Confederation	x	10
Syrian Republic	x	1
Czechoslovakia	x	8
Overseas Territories of the French Republic and Territories administered as such	x	20
Turkey	x	5
Union of South Africa and Territory of South-West Africa	x	13
Union of Soviet Socialist Republics	x	30

	<i>Participant in the work of the VIIIth PA</i>	<i>Number of units</i>
<i>Members and Associate Members (continued)</i>		
Uruguay (Oriental Republic of)		3
Venezuela (Republic of)	x	10
British East Africa		½
II. <i>Recognised Private Operating Agencies</i>		
American Telephone and Telegraph Co.	x	½
British Broadcasting Corporation	x	½
Cable and Wireless Ltd	x	5
Compagnie générale de T.S.F.	x	½
Compania Internacional de Radio, S.A.		½
Companhia Portuguesa Radio Marconi		½
Empresa Torres Quevedo, S.A.		½
Independent Television Authority	x	½
International Marine Radio Company, Ltd.	x	½
Kokusai Denshin Denwa Company, Ltd	x	½
Marconi Intern. Marine Communication Company, Ltd.	x	½
Nippon Hoso Kyokai (Broadcasting Corporation of Japan)	x	½
Nippon Minka Hoso Remei (Nat. Ass. of Broadcasters)		½
Nippon Telegraph and Telephone Public Corporation	x	1
Radio Austria, A.G.	x	½
Radio Corporation of America		½
Radio Italiana (R.A.I.).	x	1
Redifon, Ltd.		5
Siemens Brothers & Co., Ltd.		½
Società Italcable	x	½
South African Broadcasting Corporation	x	½
Swedish Broadcasting Corporation	x	½
Transradio Española, S.A.	x	½
III. <i>Scientific and Industrial Organisations</i>		
Ateliers de constructions électriques de Charleroi	x	1
Brown, Boveri & Cie, Baden	x	½
Hasler, S.A. Berne.	x	1
Magneti Marelli, Rome	x	½
Manufacture belge de lampes et de matériel électronique, Bruxelles		½
Siemens & Halske A.G., München	x	3
Société Telettra, Milano	x	½
South African Council for Scientific and Industrial Research, Pretoria		½
Telefon A.B., L.M. Ericsson, Stockholm.	x	1
Telefunken G.m.b.H., Berlin.	x	1
IV. <i>International Organisations</i>		
Association internationale des intérêts radio-maritimes (A.I.I.R.M.)	x	½
International Time Bureau	x	*)
International Chamber of Shipping	x	½
Comité international radio-maritime (C.I.R.M.).	x	*)
Comité international spécial des perturbations radioélectriques (C.I.S.P.R.).	x	*)
International Electrotechnical Commission (I.E.C.)		*)
International Broadcasting Organisation (O.I.R.)	x	*)

	<i>Participant in the work of the VIIIth PA</i>	<i>Number of units</i>
World Meteorological Organisation (W.M.O.)	x	*)
International Civil Aviation Organisation (I.C.A.O.)	x	*)
European Broadcasting Union (E.B.U.)	x	*)
International Amateur Radio Union (I.A.R.U.)		*)
Union radio-scientifique internationale (U.R.S.I.) :	x	*)
		<hr/>
Total of units:		490½

* Exonerated from contribution in accordance with Resolution No. 222 (amended) of the Administrative Council.

ANNEX III

ORDINARY BUDGETS FOR THE YEARS 1956 TO 1957 AND ESTIMATED EXPENDITURE FOR THE YEARS
1958 AND 1959

	1956	1957	1958	1959
<i>Staff expenses</i>				
.10 Salaries				
.101 Salaries (permanent staff)	340,500.—	346,000.—	350,720.—	355,390.—
.102 Salaries (other staff)	—.—	—.—	—.—	—.—
.11 Cost-of-living allowances.				
.111 Cost-of-living allowance, staff actively employed	20,000.—	24,550.—	24,600.—	24,900.—
.112 Cost-of-living allowance, retired staff	—.—	1,400.—	1,400.—	1,400.—
.12 Allowances.				
.121 Expatriation	3,500.—	8,000.—	7,500.—	7,500.—
.122 Family	7,200.—	8,800.—	10,400.—	10,400.—
.123 Children's education				
.123.1 allowances	1,000.—	2,000.—	2,000.—	2,000.—
.123.2 travel expenses	500.—	400.—	400.—	400.—
.13 Removal expenses.	3,000.—	26,500.—	2,500.—	2,500.—
.14 Home leave	3,800.—	26,200.—	3,800.—	26,200.—
.15 Overtime.	500.—	500.—	500.—	500.—
.16 Gratuities for long service	—.—	—.—	—.—	—.—
.17 Insurance expenses				
.171 Reg. contr. to s.s. and b. funds	51,100.—	51,900.—	52,610.—	53,310.—
.172 Other contr. to s.s. and b. funds				
.172.1 Single contributions	3,100.—	22,900.—	3,500.—	4,000.—
.172.2 Entrance fees	—.—	40,000.—	—.—	—.—
.173 Insurance of survivors of retired staff	—.—	7,750.—	7,750.—	7,750.—
Totals : (to be carried forward)	434,200.—	566,900.—	467,680.—	496,250.—

Section 6. <i>General services of the I.T.U.*</i> (C.C.I.R. share)	1957		1958		1959	
Totals brought forward		566,900.—		467,680.—		496,250.—
.1 <i>Social services</i>						
.10 Administration of the S.S. and B. fund	1,500.— 15,000.—		1,500.— 15,000.—		1,500.— 15,000.—	
.11 Existing provident fund						
.12 Contrib. to joint medical service of U.N. and spec. agencies	1,000.—		1,000.—		1,000.—	
.13 Contrib. to sickness ins. fund	2,000.—		2,000.—		2,000.—	
.14 Coll. accident insurance	2,500.—		2,500.—		2,500.—	
.15 Language courses	700.—	22,700.—	700.—	22,700.—	700.—	22,700.—
.2 <i>Premises: rents and services</i>						
.2033 Rent	18,000.—		18,000.—		18,000.—	
.213 Lighting, heating	6,500.—		6,500.—		6,500.—	
.223 Serv. (cleaning, upkeep, fire insce. and concierge)	1,000.—		1,000.—		1,000.—	
.23 Instal. and repairs to premises	500.—	26,000.—	500.—	26,000.—	500.—	26,000.—
.3 <i>Travel</i>						
.31 Travel exp. outside Switzerland	10,000.—		10,000.—		10,000.—	
.32 Travel exp. in Switzerland	400.—	10,400.—	400.—	10,400.—	400.—	10,400.—
.4 <i>Office</i>						
.401 Maps, papers, bookbinding	2,500.—		2,500.—		2,500.—	
.402 Furniture, machines	2,000.—		2,000.—		2,000.—	
.403 Office supplies	5,000.—	9,500.—	5,000.—	9,500.—	5,000.—	9,500.—
.5 <i>Technical apparatus</i>		8,000.—		8,000.—		8,000.—
.6 <i>Postage and tel. charges</i>		3,000.—		3,000.—		3,000.—
.7 <i>Telephone service</i> (Subscriptions and calls)		3,800.—		3,800.—		3,800.—
.8 <i>Central library</i> (purchase of books for all the organs)		3,600.—		3,600.—		3,600.—
.9 <i>Offset workshop</i>		500.—		500.—		500.—
.10 <i>Miscellaneous and unforeseen</i>		1,000.—		970.—		1,150.—
<i>Total</i>		655,400.—		556,150.—		584,900.—

Note: The budget for 1956 has not been given in this statement as the method of presentation has changed since 1956, and comparative figures are not readily available.

ANNEX IV

FINANCE COMMITTEE

A NOTE ON THE DOCUMENTATION OF THE C.C.I.R.

1. In connection with the extraordinary budget of the C.C.I.R., the Finance Committee has noted with some concern the heavy increase in the documentation work handled by the C.C.I.R. and has made the following preliminary observations with a view to avoiding any appreciable increase in expenditure. It is recognised that in the present context of rapid developments of techniques and equipment used in the radiocommunication field, the work of the C.C.I.R. is bound to increase, and unless we take stock of the position at this stage and take effective measures to systematise the procedure and eliminate wasteful effort, the increase in expenditure is likely to be disproportionate to the results achieved.

2. *Documentation.*

The number of contributions received from various administrations and private organisations are increasing year by year. They mainly consist of:

- i) theoretical papers which are *not* of direct or immediate interest to the C.C.I.R.;
- ii) documents and papers which have a direct bearing on the Study Programmes, Questions etc.;
- iii) copies of published papers for reproduction as documents of the C.C.I.R.

It is considered that every contribution submitted to the C.C.I.R. should contain an abstract of the paper, and that in the case of theoretical papers or published papers, only the abstract should be documented in the working languages of the I.T.U. If any administration is interested in the original paper, it could be obtained direct from the administration which has sent the contributions.

3. In order to reduce the number and size of the documents, administrations may be requested to screen or sieve the documents so that only essential material of immediate or direct importance to the studies being undertaken by the C.C.I.R. are transmitted to the chairmen of the study groups. It would be of help if the documents could be classified according to their priority. It is also desirable that the chairmen of study groups and the Director of the C.C.I.R. should assist the administrations to reduce the size of the documents by making constructive suggestions before they are prepared for distribution.

4. *Presentation of documents.*

Considerable economy can be effected in the preparation of documents by the Secretariat of the C.C.I.R. if:

- i) the document is presented in a precise and concise form, and any annexes to the documents, such as curves, block schematic diagrams, illustrations etc. are kept to the minimum;
- ii) an abstract is given in every paper;
- iii) the documents are serially numbered according to study groups, when it is expected that the demand for a large number of copies will be reduced.

5. *Studies between Plenary Assemblies.*

According to the I.T.U. Convention, the study groups are required to conduct studies by correspondence as far as possible. However, the question of meetings of study groups between Plenary Assemblies is separately being considered by the Organisation Committee. In reaching any decisions on this point, the Finance Committee would like to urge the Organisation Committee to keep prominently in view the need for economy in expenditure, both from the point of view of the C.C.I.R., and Administrations participating in such meetings.

B. V. BALIGA

Chairman, Finance Committee

ANNEX V-A

ORDINARY BUDGET FOR 1956

5 C.C.I.R.	Expenses Jan.-July	Expenses committed	Estimated expenses	Total revised estimates 1956	Budget	Budgetary balance
<i>Staff expenses</i>						
.101 Salaries	165,632.05	118,537.95	8,925.—	293,095.—	340,500.—	47,405.—
.111 Cost-of-living allowances	8,255.40	8,396.80		16,652.20	20,000.—	3,347.80
.121 Expatriation allowances	583.45	416.55		1,000.—	3,500.—	2,500.—
.122 Family allowances	3,799.75	2,666.90	300.—	6,766.65	7,200.—	433.35
.123 Children's education						
.1 Allowances	499.45	356.55		856.—	1,000.—	144.—
.2 Travel expenses	—.—	—.—		—.—	500.—	500.—
.13 Removal expenses	—.—	—.—	200.—	200.—	3,000.—	2,800.—
.14 Home leave	1,563.70	1,499.—		3,062.70	3,800.—	737.30
.15 Overtime	—.—	—.—		—.—	500.—	500.—
.171 Regular contributions to the staff superannuation and benevolent funds	30,891.75	11,733.75		42,625.50	51,100.—	8,474.50
.172 Other contributions to the staff superannuation and benevolent funds	1,496.25	1,293.75		2,790.—	3,100.—	310.—
<i>Total Art. 1.</i>	212,721.80	144,901.25	9,425.—	367,048.05	434,200.—	67,151.95
<i>Travel expenses</i>						
.21 Travel expenses outside Switzerland	53.10	500.—	8,500.—	9,053.10	10,000.—	946.90
.22 Travel expenses in Switzerland	—.—	120.—		120.—	500.—	380.—
<i>Total Art. 2.</i>	53.10	620.—	8,500.—	9,173.10	10,500.—	1,326.90
<i>Office expenses</i>						
.301 Maps, papers, bookbinding	2,277.35	153.70		2,431.05	2,500.—	68.95
.302 Furniture, office machines	1,408.20	155.70	300.—	1,863.90	2,000.—	136.10
.303 Office supplies	1,081.85	1,908.05	1,500.—	4,489.90	5,000.—	510.10
.312 Technical apparatus	1,160.40	3,389.05	2,000.—	6,549.45	8,000.—	1,450.55
<i>Total Art. 3.</i>	5,927.80	5,606.50	3,800.—	15,334.30	17,500.—	2,165.70
Miscellaneous and unforeseen	337.30	201.—		538.30	1,200.—	661.70
	219,040.—	151,328.75	21,725.—	392,093.75	463,400.—	71,306.25

ANNEX V-B •

EXTRAORDINARY BUDGET OF THE C.C.I.R., 1956

Sections	Budget 1956	Expenditure in connection with television demonstrations 1956	Expenditure in connection with preparatory work for VIIIth P.A.	Balance available
<i>Art. I. Staff expenses</i>				
1. Administration	168,000.—	34,560.10	7,267.10	126,172.80
2. Languages	437,000.—	—.—	141,694.85	295,305.15
3. Roneo	55,000.—	—.—	31,622.90	23,377.10
4. Insurance	5,000.—	—.—	961.85	4,038.15
<i>Art. II. Premises and equipment</i>				
5. Premises, furniture, machines	10,000.—	—.—	8,046.35	1,953.65
6. Document reproduction	65,000.—	—.—	37,009.95	27,990.05
7. Office supplies and overheads	50,000.—	—.—	17,005.15	32,994.85
8. Simultaneous interpretation or other technical equipment	35,000.—	—.—	—.—	35,000.—
9. Unforeseen	5,000.—	—.—	—.—	5,000.—
<i>Art III. Cash expenses</i>				
10. Interest on advances	20,000.—	1,000.—	8,700.—	10,300.—
	850,000.—	35,560.10	252,308.15	562,131.75

**LIST OF DOCUMENTS OF THE VIIIth PLENARY ASSEMBLY
OF THE C. C. I. R.**

- A. Classified in numerical order**
- B. Classified by Study Groups**

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LIST OF DOCUMENTS OF THE VIIIth PLENARY ASSEMBLY

Note. — The indices against the numbers of some of the documents have the following meaning:

- * documents mentioned in Volume I
- 1 documents having an corrigendum
- 2 documents having two corrigenda
- 3 documents having an addendum
- 4 documents which have been revised

A. Classified in numerical order

No.	Submitted by	Title	Subject	Study Group
1	Federal German Republic	Arrangement of channels in multi-channel telegraph systems for long-range radio circuits operating on frequencies below about 30 Mc/s.	Question 74	I
2 *	Netherlands	Protection against keyed interfering signals	Study Progs. 42 and 43	II
3 *	Federal German Republic	Frequency stability of receivers.	Question 77	II
4	U.R.S.I.	The responses of radio receivers to quasi-impulsive interference	Question 79	II
5	Federal German Republic	The responses of radio receivers to quasi-impulsive interference	Question 79	II
6 *	Federal German Republic	Choice of the intermediate frequency and protection against undesired responses of superheterodyne receivers	Question 78	II
7 *	Federal German Republic	Sensitivity and noise factor. Noise and sensitivity of receivers	Question 76 Rec. 94	II
8 *	Federal German Republic	Undesired emissions from receivers	Question 80	II
9 *	Belgium	Rounding of radiotelegraph signals and adjacent-channel interference	Study Progs. 39 and 43	I and II
10	Belgium	Note on the operation of radio spectrum analysers	Study Progs. 40	I

No.	Submitted by	Title	Subject	Study Group
11	Federal German Republic	The use of radio circuits in association with 5-unit start-stop telegraph apparatus	Question 83	III
12	Federal German Republic	The use of radio circuits in association with 5-unit start-stop telegraph apparatus	Study Prog. 50	III
13	U.R.S.I.	Communication theory	Study Prog. 47	III
14 *	U.R.S.I.	Communication theory	Question 44	III
15	U.R.S.I.	Communication theory	Rec. 107	III
16	Japan	Interim report on experiments on minimum signal-to-noise ratio necessary for various communication services	Study Progs. 44 and 45	III III
17	Federal German Republic	Improvement obtainable from the use of directional antennae	Study Prog. 48 (Item 1)	III
18	Federal German Republic	Determination of the maximum interference levels tolerable in complete systems	Question 84	III
19	Federal German Republic	Directivity of antennae at great distances	Question 81	III
20 *	United Kingdom	Extension of the C.C.I.R. propagation curves below 300 kc/s.	Res. 10	IV
21 *	Czechoslovakia	Diffraction of metric waves on mountain ranges, lengthy hills, and other obstacles	Study Progs. 54 and 79	IV and V
22 *	United Kingdom	Ground-wave propagation over irregular terrain	Study Prog. 54	IV
23	United Kingdom	Effects of tropospheric refraction on frequencies below 10 Mc/s.	Study Prog. 51 (Item 2)	IV
24 *	Federal German Republic	Temporal variation of ground-wave field strengths	Study Prog. 52	IV
25 *1	United Kingdom	Ground-wave propagation over mixed paths	Study Prog. 53	IV
26	U.R.S.I.	Standard-frequency transmissions and time signals	Rec. 122	VII
27	United States of America	Standard-frequency transmissions and time signals	Study Prog. 68	VII
28	U.R.S.I.	Tropospheric wave propagation	Study Prog. 56	V

No.	Submitted by	Title	Subject	Study Group
29	U.R.S.I.	Propagation data required for wide-band radio systems	Question 85	V
30 *	Federal German Republic	Tropospheric propagation across mountain ridges.	Study Prog. 79 (Item 1)	V
31	Federal German Republic	Tropospheric wave propagation	Study Prog. 56	V
32	Federal German Republic	Tropospheric propagation curves for distances well beyond the horizon.	Study Prog. 55	V
33	United Kingdom	Automatic monitoring of occupancy of the radio-frequency spectrum	Question 88	VIII
34 *	United States of America	Spectrum measurement by monitoring stations	Study Prog. 70	VIII
35 *	Japan	Report on frequency measurements above 50 Mc/s by monitoring stations	Question 89	VIII
36	Japan	Report on automatic monitoring of occupancy of the radio frequency - spectrum	Question 88	VIII
37 *	United States of America	Frequency measurements above 50 Mc/s by monitoring stations	Question 89	VIII
38 *	Federal German Republic	Spectrum measurement by monitoring stations	Study Prog. 70	VIII
39	United States of America	Automatic monitoring of occupancy of the radio-frequency spectrum	Question 88	VIII
40	United States of America	Accuracy of field strength measurements by monitoring stations	Study Prog. 69	VIII
41 *	Belgium	Frequency measurements above 50 Mc/s by monitoring stations	Question 89	VIII
42 *	Belgium	Spectrum measurement by monitoring stations	Study Prog. 70	VIII
43	Belgium	Accuracy of field strength measurements by monitoring stations	Study Prog. 69	VIII
44	United Kingdom	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above 30 Mc/s	Question 93	IX
45	Federal German Republic	Frequency tolerances for transmitters used in wide-band radio relay systems operating at frequencies above about 30 Mc/s	Question 114	IX

No.	Submitted by	Title	Subject	Study Group
46 ⁴	Czechoslovakia	Proposal about the title of Study Group XI	Proposal	XI
47	Federal German Republic	Television recording	Question 66	XI
48	Federal German Republic	Assessment of the quality of television pictures	Question 65	XI
49	United Kingdom	Proposal for dealing with conflicting systems of frequency naming	Rec. 142	XIV
50	C.C.I.R. Secretariat	List of documents issued (Nos. 1-50)	—	—
51	United Kingdom	Means of expression, terms, definitions, graphical and letter symbols and their conventional usage.	Rec. 144	XIV
52 ³	United Kingdom	Publication of service codes in use in the international telegraph service	Res. 18	XIII
53 *	United Kingdom	Marine identification device	Question 105	XIII
54	C.I.R.M.	Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships	Question 108	XIII
55	C.I.R.M.	Technical characteristics of frequency-modulated VHF maritime equipments	Question 107	XIII
56	United Kingdom	Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships	Question 108	XIII
57	Federal German Republic	Publication of the codes used in the international telegraph service. Proposal for the modification of the SINPO code	Res. 18	XIII
58	Federal German Republic	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	Question 107	XIII
59	Czechoslovakia	Characteristics of oscillation build-up in frequency-modulation systems	Question 99	X
60	United Kingdom	High frequency broadcasting. Use of synchronised transmitters	Study Prog. 72	X
61	United Kingdom	FM broadcasting in the VHF band	Question 99	X
62	Federal German Republic	Sound recording on films for the international exchange of television programmes	Question 100	X

No.	Submitted by	Title	Subject	Study Group
63	Federal German Republic	Frequency-modulation broadcasting in the V.H.F. (metric) band	Question 99	X
64	Federal German Republic	Standards of sound recording for the international exchange of programmes	Res. 16	X
65 *	Federal German Republic	Standards of sound recording for the international exchange of programmes	Study Prog. 74 (Part 1)	X
66	United States of America	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	Question 107	XIII
67 *	United States of America	Bearing and position classification for HF (decametric) and VHF (metric) direction-finding	Question 106	XIII
68	United States of America	Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships	Question 108	XIII
69	United States of America	Identification of radio stations	Rec. 132	XIII
70	United States of America	Identification of radio stations	Study Prog. 78 (Item 1)	XIII
71 *	United States of America	Marine radar identification device	Question 105	XIII
72	United Kingdom	Tropospheric wave propagation	Study Prog. 56	V
73	United Kingdom	Measurement of field strength of radio signals	Study Prog. 19	V
74 *	United Kingdom	Basic prediction information for ionospheric propagation	Study Prog. 60	VI
75	U.R.S.I.	Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings	Rec. 59	VI
76 *	Japan	Report on the general time distribution of amplitude and its practical uses in observation of rapid fading	Study Prog. 66	VI
77 *	Australia	Interim report on medium-frequency sky-wave measurements	Study Prog. 63	VI
78 *	Federal German Republic	Identification of a precursor indicative of short-term variations of ionospheric propagation conditions	Study Prog. 59	VI
79 *	United Kingdom	Identification of precursors indicative of short-term variations of ionospheric propagation conditions	Study Prog. 59	VI

No.	Submitted by	Title	Subject	Study Group
80	United Kingdom	Choice of a basic solar index for ionospheric propagation	Study Prog. 58	VI
81 *	Japan	Basic prediction information for ionospheric propagation	Study Prog. 60	VI
82 *	Federal German Republic	Study of fading	Study Prog. 66 (Item 1 to 3)	VI
83	Czechoslovakia	On the statistics of the occurrence of the sporadic E layer above central Europe	Study Prog. 60 (Item 3)	VI
84	U.R.S.I.	Protection of frequencies used for radio-astronomical measurements	Rec. 118	VI
85	U.R.S.I.	Radio propagation at frequencies—below 1500 kc/s.	Study Prog. 63	VI
86	U.R.S.I.	Basic prediction information for ionospheric propagation	Study Prog. 60	VI
87	U.R.S.I.	Identification of precursors indicative of short-term variations of ionospheric propagation conditions	Study Prog. 59	VI
88	U.R.S.I.	Choice of a basic solar index for ionospheric propagation	Study Prog. 58	VI
89 *	U.R.S.I.	Investigation of circularly polarised emitted waves propagated via the ionosphere	Res. 14	VI
90	U.R.S.I.	Usage and meaning of MUF	Res. 12	VI
91	U.R.S.I.	Pulse transmission tests at oblique incidence	Study Prog. 67	VI
92 *	U.R.S.I.	Study of fading	Study Prog. 66	VI
93	U.R.S.I.	Measurement of atmospheric radio noise	Study Prog. 65	VI
94	United Kingdom	Non-linear effects in the ionosphere	Study Prog. 61	VI
95	U.R.S.I.	Revision of atmospheric radio noise data	Rec. 120	VI
96 *	Federal German Republic	The effect of hills and other obstacles in diffracting waves in either the horizontal or the vertical plane	Question 6 (§ 2) Study Prog. 54 (§ 1 and 5)	IV
97	Czechoslovakia	Transmission of standard frequencies in the H.F. bands	New Question	VII
98	United States of America	Pulse transmission tests at oblique incidence	Study Prog. 67	VI
99	Federal German Republic	Harmonics and parasitic emissions	Study Prog. 2	I

No.	Submitted by	Title	Subject	Study Group
100	C.C.I.R. Secretariat	List of documents issued (Nos. 51-100)	—	—
101 ³	Chairman, Study Group I	Report of Chairman of Study Group No. I	—	I
102	Chairman, Study Group II	Report of Chairman of Study Group No. II	—	II
103	Chairman, Study Group III	Report of Chairman of Study Group No. III	—	III
104* ²	Chairman, Study Group IV	Report of Chairman of Study Group No. IV	—	IV
105	Chairman, Study Group V	Report of Chairman of Study Group No. V	—	V
106	Chairman, Study Group VI	Report of Chairman of Study Group No. VI	—	VI
107	Chairman, Study Group VII	Report of Chairman of Study Group No. VII	—	VII
108	Chairman, Study Group VIII	Report of Chairman of Study Group No. VIII	—	VIII
109	Chairman, Study Group IX	Report of Chairman of Study Group No. IX	—	IX
110	Chairman, Study Group X	Report of Chairman of Study Group No. X	—	X
111	Chairman, Study Group XI	Report of Chairman of Study Group No. XI	—	XI
112 ^{1,3}	Chairman, Study Group XII	Report of Chairman of Study Group No. XII	—	XII
113	Chairman, Study Group XIII	Report of Chairman of Study Group No. XIII	—	XIII
114	Chairman, Study Group XIV	Report of Chairman of Study Group No. XIV	—	XIV
115 ¹	C.C.I.R. Director,	Report of the Director, C.C.I.R.	—	—
116	Federal German Republic	Automatic monitoring of occupancy of the radio-frequency spectrum	Question 88	VIII
117*	Federal German Republic	Frequency measurements above 50 Mc/s by monitoring stations	Question 89	VIII

No.	Submitted by	Title	Subject	Study Group
118	Czechoslovakia	Conditions required for the transmission of a television signal over a radio relay system	Question 91 (Item 2)	IX
119*	Czechoslovakia	Frequency stability of receivers	Question 77	II
120	Czechoslovakia	Frequency stabilisation of flexible oscillators	Question 1 Study Prog. 3	I
121	U.S.S.R.	Twinplex radiotelegraphy	Question 20	I
122*	Czechoslovakia	Possibility of long-duration propagation of radio waves around the earth on the lower boundary of the F-layer	Study Progs. 63 and 64	VI
123*	Czechoslovakia	Index for activity of solar flares and sudden ionospheric disturbances (S.I.D.)	Study Prog. 59	VI
124*	Czechoslovakia	The relationship between the daily sum of the geomagnetic K-indices and a certain coefficient characterising the state of the F2 layer on certain days	Study Prog. 59	VI
125	Federal German Republic	Pulse transmission tests at oblique incidence	Study Prog. 67	VI
126	Netherlands	Frequency stabilisation of transmitters (a)	Study Prog. 3 Question 1 (Item (c))	I
127	Netherlands	Frequency stabilisation of transmitters (b)	Study Prog. 3 Question 1 (Item (c))	I
128	French Overseas Territories	Tropical broadcasting. Provisional power limits in Rec. 84	Study Prog. 38 (Item 2)	XII
129	United Kingdom	The gain of a television transmission circuit	Question 122	XI
130	United Kingdom	Hypothetical reference circuit for wide-band radio relay systems. Maintenance procedure for wide-band radio relay systems	Questions 96 and 97	IX
131	United Kingdom	Investigation of multipath transmission through the troposphere	Study Prog. 57	V
132	Finland	Oscillator of a long-wave transmitter	Study Prog. 3	I
133	United Kingdom	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Question 93	IX

No.	Submitted by	Title	Subject	Study Group
134	United Kingdom	Principles of provision of standby plant in multi-channel radio-relay systems	Questions 93 and 96	IX
135	United Kingdom	Standardisation of multi-channel radio relay systems using frequency - division multiplex and operating at frequencies above about 30 Mc/s. Maintenance procedure for wide-band radio relay systems	Questions 93 and 96	IX
136*	United Kingdom	Undesired emissions from receivers	Question 80	II
137*	United Kingdom	Selectivity of receivers	Study Prog. 42	II
138	United Kingdom	The use of radio circuits in association with 5-unit start-stop telegraph apparatus	Study Prog. 50	III
139	United Kingdom	Directivity of aerials	Study Prog. 45 Rec. 103	III
140*	United Kingdom	Temporal variation of ground-wave field strength	Study Prog. 52	IV
141	United Kingdom	Tropospheric propagation curves for distances well beyond the horizon	Study Prog. 55	V
142*1	United Kingdom	Propagation data required for wide-band radio systems	Question 85	V
143	India	Measurement of atmospheric radio noise	Study Prog. 65	VI
144	Union of South Africa	Report on standard-frequency and time signal transmissions from ZUO—Johannesburg	Study Prog. 68	VII
145	United Kingdom	Radio propagation at frequencies below 1500 kc/s	Study Prog. 63	VI
146	United Kingdom	Use of special modulation on the standard-frequency transmissions for assessing the reliability of propagation forecasts	Study Prog. 62	VI
147*	United Kingdom	Study of fading	Study Prog. 66	VI
148*	United Kingdom	Basic prediction information for ionospheric propagation	Study Prog. 60 (Part 2)	VI
149	United Kingdom	Report on standard-frequency transmissions	Study Prog. 68	VII
150	C.C.I.R. Secretariat	List of documents issued (Nos. 101-150)	—	—
151*	United Kingdom	Standard-frequency transmissions and time signals	Question 87	VII

No.	Submitted by	Title	Subject	Study Group
152*	United Kingdom	Standards of sound recording for the international exchange of programmes	Study Prog. 74	X
153*	United Kingdom	Proposals for amending the draft report (Doc. 91-rev., Brussels) on the requirements for the transmission of television over long distances	Study Prog. 32	XI
154*	United Kingdom	The requirements for the transmission of television over long distances	Study Prog. 32	XI
155*	United Kingdom	Ionospheric propagation of waves in the band 30 to 300 Mc/s	Study Prog. 64	VI
156	United Kingdom	The responses of radio receivers to quasi-impulsive interference	Question 79	II
157*	United Kingdom	Choice of intermediate frequency and protection against undesired responses of super-heterodyne receivers	Question 78	II
158*	United Kingdom	Frequency stability of receivers	Question 77 (Item 1)	II
159*	United Kingdom	Frequency stability of receivers	Question 77 (Item 2)	II
160*	United Kingdom	Frequency stability of receivers	Question 77 (Item 3)	II
161*	United Kingdom	Sensitivity and noise factor	Question 76	II
162	United Kingdom	Sensitivity and noise factor of receivers	Question 76	II
163	United Kingdom	Four-frequency duplex	Study Prog. 41	I
164	United Kingdom	Four-frequency duplex	Study Prog. 41	I
165	United Kingdom	Frequency stabilisation of transmitters	Question I (c) Study Prog. 3	I
166	Union of South Africa	Frequency stabilisation of transmitters	Study Prog. 3	I
167*	C.C.I.R. Secretariat	Observations on two signal paths across mountain ridges	Study Prog. 79	V
168	France	Measurement of field strength in the neighbourhood of obstacles	Question 86	V
169	France	Measurement of field strength of radio signals	Study Prog. 19	V
170*	France	Propagation data required for wide-band radio systems	Question 85	V
171	France	Tropospheric propagation curves for distances well beyond the horizon	Study Prog. 55	V

No.	Submitted by	Title	Subject	Study Group
172*	France	Report on presentation of data in studies of tropospheric wave propagation	Rec. 110	V
173	France	Tropospheric wave propagation	Study Prog. 56	V
174*	France	Theoretical and experimental study of mutual interference of radio systems	Questions 1 and 3 Study Progs. 39, 43 and 45	I, II, III
175	France	Protection from interference obtained in practice with directional rhombic antennae	Question 81 Study Prog. 48	III
176	France	Channel separation achieved in practice	Rec. 98	III
177	France	Statistical measurements of telegraph distortion in the presence of noise	Questions 3 and 18	I, III
178	France	Description of a statistical distortion measuring set	Questions 3 and 18	I, III
179	France	Standard-frequency transmissions and time signals	Rec. 122 Question 54 Study Prog. 68	VII
180	France	The responses of radio receivers to quasi-impulsive interference	Question 79	II
181*	France	Undesired emissions from receivers	Question 80	II
182*	France	Temporal variation of ground-wave field strengths	Study Prog. 52	IV
183*	France	Ground-wave propagation over irregular terrain	Study Prog. 54	IV
184	France	Frequency stabilisation of transmitters	Question 1 (c) Study Prog. 3	I
185	France	Limitation of unwanted radiation from industrial installations	Question 75	I
186	France	Sound recording on films for the international exchange of television programmes	Question 100	X
187*	France	Standards of sound recording for the international exchange of programmes	Rec. 135 Study Prog. 74	X
188	France	Study of absorption in the ionosphere	Rec. 115	VI
189	France	Maintenance procedure for wide-band radio relay systems	Question 96	IX

No.	Submitted by	Title	Subject	Study Group
190	France	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s	Question 93	IX
191	France	Standardisation of multi-channel radiotelephone systems using time-division multiplex and operating on frequencies above about 30 Mc/s	Question 92	IX
192	France	Frequency tolerances for transmitters used in wide-band radio relay systems operating at frequencies above about 30 Mc/s	Question 114	IX
193*	France	Methods for the computation of inter-modulation noise due to non-linearity in radio relay systems	Question 115	IX
194	France	Average power gain obtainable through use of a directional antenna as opposed to a dipole	Study Prog. 48	III
195	France	Procedure for international connexions between radio relay systems with different characteristics	Question 113	IX
196*	France	Effects of tropospheric refraction on frequencies below 10 Mc/s	Question 6 Study Prog. 51	IV
197	France	Standards of sound recording for the international exchange of programmes	Res. 16	X
198*	France	Standards of sound recording for the international exchange of programmes	Study Prog. 74	X
199*	France	Sensitivity and noise factor	Question 76	II
200	C.C.I.R. Secretariat	List of documents issued (Nos. 151-200)	—	—
201	France	Technical characteristics of frequency-modulated VHF (metric) maritime equipment	Question 107	XIII
202	France	Identification of radio stations	Study Prog. 78	XIII
203	P. R. of Poland	Frequency stabilisation of transmitters	Question 1 Study Prog. 3	I
204	P. R. of Poland	Quality measure of Chebyshev filters	Study Prog. 45	III
205	P. R. of Poland	Improvement in accuracy of field strength measurements due to the use of various secondary voltage standards	Study Prog. 69	VIII

No.	Submitted by	Title	Subject	Study Group
206*	P. R. of Poland	Directional antennae for high-frequency broadcasting	New Question	X
207	P. R. of Poland	Apparatus for measuring the level of unwanted radiation from industrial installations	Question 75	I
208* ¹	P. R. of Poland	Reduction of subsidiary lobes in the radiation pattern of directional antennae	Question 23	X
209*	P. R. of Poland	Ratio of the wanted to the unwanted signal in television	Question 119	XI
210	P. R. of Poland	Communication theory. The concept of entropy in continuous distributions	Study Prog. 47	III
211	P. R. of Poland	Communication theory. The problem of communication when signals and noise are non-stationary Gaussian processes	Study Prog. 47	III
212	P. R. of Poland	Minimum signal distortion and noise power in linear filters	Question 3 Study Prog. 45	III
213* ¹	P. R. of Poland	Doppler effect in ionospheric propagation	Question 87 Study Prog. 68	VII
214*	P. R. of Poland	Programme meters in Polish Broadcasting	Report 33 Question 14 (C.C.I.F.)	X
215*	P. R. of Poland	Definition and measurement of the usable sensitivity of the vision channel of television receivers	Question 76	II
216*	P. R. of Poland	Measurement of bandwidth of radiotelegraph emissions	Study Prog. 40	I
217	P. R. of Poland	Results of measurements and calculations of ground-wave field strengths in the vicinity of the Szczecin coast-lakes	Study Prog. 53	IV
218	Czechoslovakia	Predictions of relative sunspot number R	Study Prog. 60	VI
219*	Czechoslovakia	Predictions of the diurnal curves of critical frequencies $f_F^C(t)$ and $f_E^C(t)$, of MUF and LUF	Study Prog. 60	VI
220*	F.P.R. of Yugoslavia	Temporal variation of ground-wave field strengths	Study Prog 52.	IV

No.	Submitted by	Title	Subject	Study Group
221*	F. P. R. of Yugoslavia	Ground-wave propagation over mixed paths	Study Prog. 53	IV
222	F. P. R. of Yugoslavia	Calculation of the ground-wave phase constant	Study Prog. 53	IV
223	Czechoslovakia	The Doppler effect in ionospheric propagation. Influence on communications using frequency-shift keying	New Question	VI
224*	Czechoslovakia	Ratio of the wanted to the unwanted signal in television	Report 34	XI
225	Czechoslovakia	Determination of the electrical characteristics of the surface of the earth	New Question	IV
226	United Kingdom	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	Question 107	XIII
227*	United Kingdom	Sensitivity and noise factor	Question 76	II
228	United Kingdom	Hypothetical reference circuit for wide-band radio relay systems	Question 97	IX
229*	United Kingdom	Best method for calculating the field strength produced by a tropical broadcasting transmitter	Question 69	XII
230	United Kingdom	Ground-wave propagation over mixed paths	Study Prog. 53	IV
231*	United Kingdom	Selectivity of receivers	Study Prog. 42	II
232*	United Kingdom	Bearing and position classification for HF (decametric) and VHF (metric) direction finding	Question 106	XIII
233	United Kingdom	Standards of sound recording for the international exchange of programmes	Rec. 134	X
234	United Kingdom	Standards of sound recording for the international exchange of programmes	Rec. 135	X
235*	United Kingdom	Standards of sound recording for the international exchange of programmes	Rec. 135	X
236	Federal German Republic	Assesment of the quality of television pictures	Question 65	XI
237	Federal German Republic	Hypothetical reference circuit for wide-band radio relay systems	Question 97	IX
238	Federal German Republic	Procedure for international connexions between radio relay systems with different characteristics	Question 113	IX

No.	Submitted by	Title	Subject	Study Group
239	Federal German Republic	International wide-band radio relay systems operating on frequencies above about 30 Mc/s	Question 90 (Item 3)	IX
240	Federal German Republic	Ratio of the wanted to the unwanted signal in television	Question 119	XI
241	Federal German Republic	Pulse transmission tests at oblique incidence	Study Prog. 67	VI
242	Federal German Republic	Basic prediction information for ionospheric propagation	Study Prog. 60	VI
243	Federal German Republic	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s	Question 93	IX
244	Federal German Republic	Standardisation of international multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s	Question 93	IX
245	United States of America	Ionospheric propagation data	Report 23	VI
246	United States of America	Basic prediction information for ionospheric propagation	Study Prog. 60	VI
247	United States of America	Improvements in standard frequencies broadcast by radio stations WWV and WWVH	Rec. 112 Study Prog. 68	VII
248	United States of America	Multipath propagation effects and their reduction	Study Prog. 59	VI
249	Spain	Basic prediction information for ionospheric propagation	Study Prog. 60	VI
250	C.C.I.R. Secretariat	List of documents issued (Nos. 201-250)	—	—
251*	Switzerland	Basic prediction information for ionospheric propagation	Study Prog. 60 Report 23	VI
252	New Zealand	Standard-frequency transmissions	Study Prog. 68	VII
253	Italy	Use of cymomotive force as a measure of radiation at frequencies above 30 Mc/s	Question 49 Rec. 108 (§ 3)	IV
254	C.C.I.R. Secretariat	Prediction of solar index	Rec. 117	VI
255	Japan	Propagation of electro-magnetic waves over the earth across boundaries separating different earth media and coastal refraction	Study Prog. 53	IV

No.	Submitted by	Title	Subject	Study Group
256*	Netherlands	Measurement of the polarisation of radio waves reflected by the ionosphere	Res. 14	VI
257*	Netherlands	Measurement of group-delay / frequency characteristics	Study Prog. 42 (Point 3)	II
258	Netherlands	International wide-band radio-relay systems operating on frequencies above about 30 Mc/s. Interconnexion of multiplex systems	Question 90	IX
259	Netherlands	International wide-band radio-relay systems operating on frequencies above about 30 Mc/s. Transmission of telephony and television on the same system	Question 91	IX
260	Netherlands	International wide-band radio-relay systems operating on frequencies above about 30 Mc/s. Transmission of telephony and television on the same system	Question 91	IX
261	Netherlands	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s.	Question 93	IX
262	Netherlands	Hypothetical reference circuit for wide-band radio relay systems	Question 97	IX
263	Netherlands	Hypothetical reference circuit for wide-band radio relay systems	Question 97	IX
264	Netherlands	Procedure for international corrections between radio relay systems with different characteristics	Question 113	IX
265	Netherlands	Directivity of antennae used in the frequency band 3-30 Mc/s.	Study Prog. 48 Rec. 103	III
266	Netherlands	Phase linearity of television systems	Question 64	XI
267*	Netherlands	Tropospheric propagation curves for distances well beyond the horizon	Study Prog. 55 Question 101	V, XI
268*	Netherlands	Methods for the computation of intermodulation noise due to non-linearity in radio relay systems	Question 115	IX
269	Netherlands	Frequency tolerance for transmitters used in wide-band radio relay systems operating on frequencies above about 30 Mc/s.	Question 114	IX
270	Netherlands	Maintenance procedure for wide-band radio relay systems	Question 96	IX

No.	Submitted by	Title	Subject	Study Group
271	Netherlands	Maintenance procedure for wide-band radio relay systems	Question 96	IX
272	Netherlands	Transmission and reception of standard frequencies and time signals	Question 87 Study Prog. 68	VII
273	Netherlands	Frequency stabilisation of transmitters	Study Prog. 3	I
274*	Netherlands	Ground-wave propagation over irregular terrain	Study Progs. 52 and 54	IV
275	United Kingdom	Harmonics and parasitic emissions	Study Prog. 2	I
276	United States of America	Harmonics and parasitic emissions	Question 1 (b) Study Prog. 2	I
277	United States of America	Frequency stabilisation of transmitters	Question 1 (c) Study Prog. 3	I
278	United States of America	Limitation of unwanted radiation from industrial installations	Question 75	I
279	Federal German Republic	Limitation of unwanted radiation from industrial installations	Question 75	I
280	Belgium	A brief description of the spectrum analyser	Study Prog. 40	I
281	United States of America	Prediction of solar index	Rec. 117	VI
282	United States of America	Comparison of short-term forecasts with observed results	Rec. 59	VI
283	United States of America	Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings	Report 26	VI
284*	United States of America	Modification of master FOT curves used by the 1948 H.F. Broadcasting Conference (Mexico)	Report 24 (Annex: Question a)	VI
285*	United States of America	Calculation of field strength above 1500 kc/s.	Report 24 (Annex: Question b)	VI
286	New Zealand	Choice of a basic index for ionospheric propagation	Report 25	VI
287	Chairmen of Study Groups VI and VII	Draft Recommendation	Study Prog. 62 Study Prog. 68 (Section 6)	VI, VII
288	Chairman of Working Group VI A	Report on pulse transmissions between Radio-Kootwijk and Casablanca (B.I.F.)	Study Prog. 67	VI
289*	United States of America	Night field strengths, 540 to 1600 kc/s.	Study Prog. 63 (Section 7)	VI

No.	Submitted by	Title	Subject	Study Group
290	Denmark	Television standards	Question 64	XI
291	European Broadcasting Union (E.B.U.)	Standards of sound recording for the international exchange of programmes	Res. 16	X
292*	European Broadcasting Union (E.B.U.)	Standards of sound recording for the international exchange of programmes	Study Prog. 74	X
293*	European Broadcasting Union (E.B.U.)	Standards of sound recording for the international exchange of programmes	Rec. 135	X
294	European Broadcasting Union (E.B.U.)	Sound recording on film for the international exchange of television programmes	Question 100	X
295	Federal German Republic	Standardisation of multi-channel radiotelephone systems using time-division multiplex and operating on frequencies above about 30 Mc/s.	Question 92	IX
296	Federal German Republic	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s.	Question 93	IX
297*	United States of America	Frequency-shift keying	Question 20 Rec. 92	I
298*	P. R. of Poland	Remarks on fading	Study Prog. 66	VI
299	P. R. of Poland	Limitation of the parameters of directional antennae in ionospheric and tropospheric radiocommunication	New Question	III
300	C.C.I.R. Secretariat	List of documents issued (Nos. 251-300)	—	—
301*	P. R. of Poland	Study of the possibilities of reception of short-wave radio signals at long distances in derogation of MUF	Study Prog. 60	VI
302*	P. R. of Poland	Radiation from radio receivers in the frequency range below 30 Mc/s	Question 80	II
303	P. R. of Poland	Some methods for the prediction of sunspot numbers	Rec. 117	VI
304	Chairman of C.C.I.R. S.G. I	Conclusions of the Brussels Meeting, 1955	Study Prog. 40	I
305	Chairman of C.C.I.R. S.G. I	Conclusions of the Brussels Meeting, 1955 (Brussels Doc. 86)	Study Prog. 39	I
306	Chairman of C.C.I.R. S.G. I	Conclusions of the Brussels Meeting, 1955 (Brussels Doc. 100)	Study Prog. 3	I

No.	Submitted by	Title	Subject	Study Group
307	Chairman of C.C.I.R. S.G. I	Conclusions of the Brussels Meeting, 1955 (Brussels Doc. 89)	Study Prog. 2	I
308	Chairman of C.C.I.R. S.G. I	Report on the work of C.C.I.T. Study Group I. Definition of "Telegraph channel"	Question 74	I
309*	Chairman of C.C.I.R. S.G. I	Report on the Meeting of C.C.I.T. Study Group I (June, 1955)	Question 18	I
310	Chairman of C.C.I.R. S.G. I	United Kingdom Rapporteur, C.C.I.T. Study Group I: Report on questions under study by C.C.I.T. Study Group I	Question 18	I
311	Chairman of C.C.I.R. S.G. I	Report by the Chairman of C.C.I.T. Study Group I: Comments and proposals on telegraph modulation and distortion	Question 18	I
312*	Japan	Bandwidth of emissions and methods of measuring emitted spectra in actual traffic	Study Progs. 39 and 40	I
313	Japan	Harmonics and parasitic emissions	Study Prog. 2	I
314	Japan	Proposal on frequency-shift keying	Question 20 Study Prog. 41 Rec. 92	I
315	Japan	Proposal on arrangement of channels in multi-channel telegraph systems for long- range radio circuits operating on frequencies below about 30 Mc/s	Question 74	I
316	Japan	Limitation of unwanted radiation from industrial installations	Question 75	I
317*	Japan	Sensitivity and noise factor	Question 76	II
318*	Japan	Selectivity of receivers	Study Prog. 42	II
319* ¹	Japan	Protection against keyed interfering signals	Study Prog. 43 (Point 4)	II
320	Japan	Directivity of antennae at great distances	Question 81	III
321	Japan	Use of directional antennae	Rec. 103	III
322*	Japan	Ground-wave propagation over mixed paths	Study Prog. 53	IV
323*	Japan	Ground-wave propagation over irregular terrain	Study Prog. 54	IV
324*	Japan	VHF propagation tests on over-mountain paths	Study Prog. 79	V
325*	Japan	Tropospheric propagation across mountain ridges	Study Prog. 79	V

No.	Submitted by	Title	Subject	Study Group
326*	Japan	Basic prediction information for ionospheric propagation	Study Prog. 60	VI
327	Japan	Radio propagation at frequencies below about 1500 kc/s	Study Prog. 63	VI
328	Japan	Measurement of atmospheric radio noise	Study Prog. 65	VI
329	Japan	Measurement of atmospheric radio noise	Study Prog. 65	VI
330*	Japan	A simplified method of observation of intensity distribution by measuring fading parameters	Study Prog. 57 (Point 3) Study Prog. 66 (Points 1 to 5)	V & VI
331*	Japan	Study of fading. A simple graphical method of estimating fading statistics in diversity reception	Study Prog. 66	VI
332	Japan	Standard frequency transmissions and time signals	Study Prog. 68	VII
333	Japan	Procedure for international connexions between radio relay systems with different characteristics	Question 113	IX
334	Japan	Standardisation of multi-channel radiotelephone systems using time-division multiplex and operating on frequencies above about 30 Mc/s	Question 92	IX
335	Japan	Maintenance procedure for wide-band radio relay systems	Question 96	IX
336	Japan	Hypothetical reference circuit for wide-band radio relay systems	Question 97	IX
337	Japan	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s	Question 93	IX
338	Japan	Report on technical characteristics of frequency modulated VHF (metric) maritime equipments	Question 107	XIII
339	Japan	International wide-band radio relay systems operating on frequencies above about 30 Mc/s	Question 90	IX
340	Japan	Ground-wave propagation over mixed paths	Study Prog. 53 (§ 1 and 2)	IV
341	Italy	Standard-frequency transmissions and time signals	Rec. 122 Question 54 Study Prog. 68	VII

No.	Submitted by	Title	Subject	Study Group
342	Netherlands	Reception of standard-frequency and time-signal transmissions from WWV in the Netherlands and in Surinam	Question 54 Study Prog. 68	VII
343	Belgium	Provisional note on harmonic measurements	Study Prog. 2	I
344	C.C.I.R. Working Group on bandwidth measurement apparatus	Report on comparative tests carried out from 14th-22nd March, 1955	Study Prog. 40	I
345*	United States of America	Measurement of atmospheric radio noise	Study Prog. 65	VI
346*	United States of America	Basic prediction information for ionospheric propagation	Study Prog. 60	VI
347*	United States of America	Identification of precursors indicative of short-term variations of ionospheric propagation conditions	Study Prog. 59	VI
348	Netherlands	Communication theory	Question 44 Study Prog. 47	III
349	Netherlands	Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships	Question 108	XIII
350	C.C.I.R. Secretariat	List of documents issued (Nos. 301-350)	—	—
351*	Italy	Radio links during atmospheric super-refraction	Study Prog. 57	V
352*	Italy	Propagation curves for ultra-short waves over optical paths	Study Prog. 56	V
353*	Italy	Propagation tests at a frequency of 4000 Mc/s on the Rome-Mt. S. Pancrazio section of the Rome-Pescara wide-band radio relay link	Question 85	V
354*	Italy	Propagation data required for wide-band radio systems	Question 85	V
355*	Belgium	Bandwidth occupied by a class A1 emission	Study Progs. 39 and 40	I
356*	India	Interference in the bands shared with broadcasting. Determination of the protection required for a broadcast signal in the presence of interference	Question 102 Study Prog. 77	XII
357*	India	Best method for calculating the skywave field produced by a tropical broadcasting transmitter	Question 69	XII
358	India	Maximum power for short-distance high-frequency broadcasting in the tropical zone	Study Prog. 38	XII

No.	Submitted by	Title	Subject	Study Group
359*	C.C.I.R. Secretariat	Note: Replies to C.C.I.R. circular letter G.I/129 and questionnaire (Annexes A to R)	Question 74	I
360	United States of America	Characteristics of facsimile apparatus	Question 94	IX
361	Netherlands	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	Question 107	XIII
362	Japan	Standards of sound recording for the international exchange of programmes. Cine type spools	Res. 16	X
363	New Zealand	Standards of sound recording for the international exchange of programmes. Cine type spools	Res. 16	X
364*	Japan	Standards of sound recording for the international exchange of programmes	Study Prog. 74	X
365	Japan	Proposal for the modification of Rec. 134: standards of sound recording for the international exchange of programmes	Rec. 134 Study Prog. 74	X
366*	Japan	Investigation of multipath transmission through the troposphere	Study Prog. 57	V
367*	Japan	Propagation data required for wide-band radio systems	Question 85	V
368	Japan	The responses of radio receivers to quasi-impulsive interference	Question 79	II
369	Japan	Frequency stabilisation of transmitters	Study Prog. 3	I
370	New Zealand	Ionospheric absorption at low and medium frequencies	Rec. 115	VI
371	Australia	Frequency stabilisation of transmitters	Study Prog. 3	I
372	Netherlands	Limitation of unwanted radiation from industrial installations	Question 75	I
373	Belgium	Comments. (Contributions by Japan, New Zealand and France)	Study Prog. 74 Res. 16 Question 100	X
374*	Japan	Exchange of magnetic test tapes (Annexes A to D)	Study Prog. 74 (§ 3)	X
375	Belgium	Comments on Brussels Docs. Nos. 9 and 28	Study Progs. 2 and 3	I
376 ³	Czechoslovakia	Determination of the relative deviations of standard frequencies	Study Prog. 68 Question 87	VII
377	International Radio-Maritime Committee	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	Question 107	XIII

No.	Submitted by	Title	Subject	Study Group
378*	Netherlands	Ionospheric scatter propagation	Draft Rec.	VI
379	Chairman of Study Group XIV	Provisional Report	Provisional Report	XIV
380*	International Federation of Documentation	Report by the S.C.I.C.T. on decimal classification as applicable to the C.C.I.R.	Question 72	XIV
381	Spain	Use of the 26 Mc/s broadcasting band	Res. 17	X
382	Switzerland	Standard-frequency transmissions and time signals	Question 87 Study Prog. 68	VII
383	United States of America	Measurement of the quality of television pictures	Question 65 Study Prog. 75	XI
384	Federal German Republic	Frequency stabilisation of transmitters	Study Prog. 3	I
385	Italcable	Frequency stabilisation of transmitters	Study Prog. 3	I
386	Italy	Definition of cymomotive force	Rec. 108 (§ 3)	IV
387*	Federal German Republic	Radio propagation at frequencies below 1500 kc/s	Study Prog. 63	VI
388*	Federal German Republic	Methods for the calculation of distortion noise due to non-linearity in radio relay systems	Question 115	IX
389 ¹	United States of America	Colour television standards. A comparison of NTSC colour television and C.C.I.R. criteria	Question 118	XI
390	United States of America	Standards for video color television signals	Study Prog. 80	XI
391	United States of America	Co-channel and adjacent-channel interference in television	Question 119	XI
392	P. R. of Poland	Reply to the Chairman's questionnaire	Question 75	I
393*	Compagnie Générale de T.S.F.	The various theories on the propagation of ultra-short waves beyond the horizon	Question 6	IV
394*	France	Frequency stability of receivers	Question 77	II
395	Federal German Republic	Reply to the Chairman's questionnaire	Question 75	I

No.	Submitted by	Title	Subject	Study Group
396	Argentine Rep.	Service of standard frequencies and time signals	Study Prog. 68 Rec. 122	VII
397	United States of America	Reduction of the bandwidth for television	Study Prog. 35	XI
398*	Italy	Data on sensitivity, selectivity, stability and spurious radiation for sound and vision receivers	Questions 76 and 80 Rec. 94, 95, 96 Study Prog. 42	II, XI
399 ³	Italy	Undesired emissions from receivers	Question 80	II, XI
400	C.C.I.R. Secretariat	List of documents issued (Nos. 351-400).	—	—
401	U.S.S.R.	Protection from interference in systems with correcting codes	Question 44 Study Prog. 47	III
402	U.S.S.R.	Probability of interference to broadcast reception when the U.S.S.R. standards for man-made interference are observed	Question 84	III
403	U.S.S.R.	The theory of ideal coding in binary transmission	Question 44	III
404	U.S.S.R.	Apparatus for measuring frequency deviation in the channels of FSK radiotelegraph systems	Question 20	I
405*	U.S.S.R.	Measurements of bandwidths of emission of radiotelegraph transmitters made in the U.S.S.R.	Study Prog. 40	I
406	U.S.S.R.	A high-frequency wattmeter	—	I
407*	U.S.S.R.	Non-linear distortion due to multi-path propagation and mismatching of antenna waveguides in FM multi-channel systems	Question 115	IX
408	U.S.S.R.	The influence of limiters on the operation of radio relay links	Study Prog. 28	IX
409	U.S.S.R.	Reliability of systems comprising numerous component elements	Question 96	IX
410	U.S.S.R.	Ways of calculating the reliability of systems comprising numerous component elements	Question 96	IX
411	U.S.S.R.	Means of improving short-wave phototelegraphy	—	IX
412	U.S.S.R.	Characteristics relative to the measurement of details in television systems	Question 65	XI

No.	Submitted by	Title	Subject	Study Group
413	U.S.S.R.	The effect of impulsive interference on FM receivers	Question 79	II
414	U.S.S.R.	Suppression of impulsive interference by the compensation method	—	II
415	U.S.S.R.	The theory of methods of measuring fluctuating noise	—	II
416	Czechoslovakia	Diffraction of metric waves at mountain ridges, elongated hills and other obstacles	Study Prog. 54	IV
417	Chairman of Study Group XI	Report by the Chairman of C.C.I.R. Study Group No. XI on the colour television demonstrations given for C.C.I.R. Study Group No. XI	Colour TV demonstrations	XI
418*	European Broadcasting Union	Results of a measurement campaign carried out under the auspices of the E.B.U.	Study Prog. 63	VI
419	United States of America	Limitation of unwanted radiation from industrial installations	Question 75	I
420	France	Hypothetical reference circuit for wide-band radio relay systems	Question 97	IX
421	France	Measurement of atmospheric radio noise	Study Prog. 65	VI
422	Italy and the Netherlands	Frequency-division multiplex radiotelegraphy system with reduced bandwidth	Study Prog. 46	III
423	South African Broadcasting Corporation	Interim Report of the activities of Study Group No. XII	Questions 69, 71 and 103 Study Progs. 38 and 77	XII
424	France	Pulse transmission tests at oblique incidence	Study Prog. 67	VI
425	Chairman of Working Group of S.G. VI	Report of the chairman of the Working Group of Study Group No. VI. Pulse transmission tests	Study Prog. 67	VI
426	United Kingdom	Determination of noise level for tropical broadcasting	Question 71	XII
427*	United Kingdom	Frequency measurements above 50 Mc/s by monitoring stations	Question 89	VIII
428	United Kingdom	Interference in the bands shared with broadcasting	Question 102	XII
429	Director of the C.C.I.R.	Report by the Director of the C.C.I.R.	Organisation Committee	I to XIV

No.	Submitted by	Title	Subject	Study Group
430*	Spain	Practical application and utility of ionospheric propagation data	Report 23	VI
431*	Federal German Republic	Extension of the C.C.I.R. propagation curves below 300 kc/s	Res. 10 (Item 2)	IV & VI
432	Netherlands	Limitation of unwanted radiation from industrial installations	Question 75	I
433	U.R.S.I.	Reception of standard time signals on the occasion of U.R.S.I. experiments for determination of propagation time of signals	Study Prog. 68	VII
434	United Kingdom	Measurement of atmospheric radio noise	Study Prog. 65	VI
435*	United Kingdom	Advantages to be obtained from consideration of polarisation in the planning of broadcasting services in the VHF (metric) and UHF (decimetric) bands	Question 101	XI
436	Federal German Republic	Telegraph distortion	Question 18 Rec. 93	I
437	C.C.I.R. Secretariat	Election of Director and, if necessary, Vice-Director of the C.C.I.R.	Election	Plenary Assembly
438*	C.C.I.T. Study Group VII	Transmission over radio circuits of supplementary signals required, for example, in the international Telex service	Question 109 (C.C.I.T. Question 82)	III
439*1	International Broadcasting Organisation	A measurement method for precision comparison of quasi-harmonically related frequencies	Rec. 122 (§ 7, 8 & 9)	VII
440	International Broadcasting Organisation	On a theory of long-range VHF propagation (For supplement see Doc. 519)	Study Prog. 56	V
441	Sweden	Limitation of unwanted radiation from industrial installations	Question 75	I
442*	I.F.R.B.	Communication to the C.C.I.R.	Information requested by the I.F.R.B.	I, II, III & VI
443	C.C.I.R. Secretariat	Note by the Secretariat: Documents of Study Group No. IX Meeting, Geneva, 1954	Documents of Study Group IX Meeting	IX
444*	Federal German Republic (Siemens & Halske AG)	Demands on the linearity of multi-channel radio link systems with frequency modulation	Questions 93 and 115	IX

No.	Submitted by	Title	Subject	Study Group
445*	Sweden	Sensitivity and noise factor	Question 76	II
446*	Sweden	Selectivity of receivers	Study Prog. 42	II
447	Chairman of U.R.S.I. Com. V	Proposals concerning Rec. 118 of the C.C.I.R.	Rec. 118	VI
448	European Broadcasting Union	Frequency stabilisation of broadcasting transmitters	Question 1 (c) Study Prog. 3	I
449*	Sweden	Undesired emissions from receivers	Question 80	II
450	C.C.I.R. Secretariat	List of documents issued (Nos. 401-450)	—	—
451*	Sweden	Amendments of some definitions in the International Telecommunication Convention	—	XIV
452*	C.C.I.T.	Summary of the report of C.C.I.T. Study Group III	C.C.I.T. Ques. 42 and 43 (C.C.I.R. Q. 83)	III
453	C.C.I.T.	Report of the joint C.C.I.T./C.C.I.R. Study Group on phototelegraphy	Joint C.C.I.T./C.C.I.R. S.G.	Plenary Assembly
454*	P. R. of Poland	Extension of Feinberg's theory to the case of electromagnetic wave propagation over an unhomogeneous spherical earth and introduction of an approximate method of computation based on equivalent second- ary sources	Question 6 Study Prog. 53	IV
455	Spain (Transradio Española)	Contribution to the improvement of auto- matic-sweep (panoramic) spectroscopes	Study Prog. 40 Rec. 88	I
456	Chairman of Study Group XIV	Memorandum for the Study Groups	C.C.I.R. provisional list of terms and definitions	I to XIV
457	European Broadcasting Union	Broadcast transmitters: Harmonics and par- asitic emissions	Question 1(b) Study Prog. 2	I
458	C.C.I.T.	Extract from the preliminary report of Study Group No. IX of the C.C.I.T.	C.C.I.T. Question 83 (C.C.I.R. Question 110)	III
459	United States of America	Standards of sound recording for the inter- national exchange of programmes. Cine type spools	Res. 16	X
460	Federal German Republic	Hypothetical reference circuit for wide-band radio relay systems	Question 97	IX
461	Federal German Republic	Operational characteristics of long-distance radio relay systems	Question 116	IX

No.	Submitted by	Title	Subject	Study Group
462	Netherlands Fed. German Rep. Switzerland	Test signals for international television transmission circuits	Questions 96 and 40 Study Prog. 32	IX,XI
463	United States of America	Tropospheric propagation curves for distances well beyond the horizon	Study Prog. 55	V
464*	United States of America	Methods for the computation of intermodulation noise due to non-linearity in radio relay systems	Question 115	IX
465	United States of America	Frequency tolerances for transmitters used in wide-band radio relay systems operating at frequencies above about 30 Mc/s	Question 114	IX
466	United States of America	Procedure for international connexions between radio relay systems with different characteristics	Question 113	IX
467	United States of America	Identification of radio stations	Res. 19	XIII
468*	United States of America	Identification system for complex FSK emissions	Study Prog. 78 Res. 19	XIII
469	United States of America	Pulse transmission tests at oblique incidence	Study Prog. 67	VI
470*	United Kingdom	Design of transmitting aerials for tropical broadcasting	Question 103	XII
471*	C.C.I.T.	Report of C.C.I.T. Study Group IX relative to C.C.I.R. Res. 18	C.C.I.T. Question 61 (C.C.I.R. Res. 18)	XIII
472	France	Distortion observed on radiotelegraph circuits	Question 83	III
473	U.S.S.R.	On the theory of accumulation of noise and fading in major radio relay links	Question 97	IX
474*	U.S.S.R.	Approximate methods for the computation of the field strengths of ultra-short waves taking into consideration the influence of geographical relief	—	IV
475*	U.S.S.R.	Study of fading	Study Prog. 66	VI
476	U.S.S.R.	A comparative study of several interference-resistant codes	Question 83 Study Prog. 50	III
477	U.S.S.R.	Measurement of the field strength of atmospheric interference	Study Prog. 49	III
478	Switzerland	Draft Recommendation	Question 65	XI

No.	Submitted by	Title	Subject	Study Group
479*1	Italy	Reception of standard frequencies at the Istituto Superiore delle Poste e Telecomunicazioni. Interference between transmissions	Study Prog. 68	VII
480	Sweden	The responses of radio receivers to quasi-impulsive interference	Question 79	II
481	Sweden	Requirements concerning transmitters and receivers for the land mobile radio service on VHF and UHF	Proposed New Question	I & II
482	Sweden	Principles of allocation of very high frequencies to the fixed and land mobile VHF service	Proposed New Question	XIII
483	Federal German Republic	Maintenance procedure for wide-band radio relay systems	Question 96	IX
484	South African Broadcasting Corporation	Comments on contributions circulated by the Chairman of Study Group No. X	Res. 16	X
485	South African Broadcasting Corporation	Comments on contributions circulated by the Chairman of Study Group No. X	Study Prog. 74	X
486	South African Broadcasting Corporation	Comments on contributions circulated by the Chairman of Study Group No. X	Question 100	X
487	Working Group on local lightning-flash counters	Report of the Working Group	Rec. 121	VI
488*	Federal German Republic	Selectivity of receivers	Study Prog. 42	II
489	Italy	Electronic computer for the statistical measurement of the electromagnetic field strength	Study Prog. 19	V
490	Study Group VI	Revision of atmospheric radio noise data	Rec. 120	VI
491*	C.C.I.R. Secretariat	Technical Assistance	Technical Assistance	Plenary Meeting
492	Austria	Automatic monitoring of occupancy of the radio-frequency spectrum	Question 88	VIII
493	U.S.S.R. Ukrainian SSR & Bielorussian SSR	Statement	—	—
494	Chairman of Study Group IV	Note by the Chairman of Study Group No. IV	—	IV

No.	Submitted by	Title	Subject	Study Group
495	I.F.R.B.	Comments on some questions related to Study Groups Nos. I, II and III	—	I, II and III
496	Czechoslovakia	Proposal	—	Organisation Committee
497	Sweden	Tropospheric propagation curves for distances well beyond the horizon	Study Prog. 55	V
498	U.S.S.R.	Draft New Question	Question 85	V
499	P. R. of Bulgaria	Letter to the Chairman of the VIIIth Plenary Assembly	—	—
500	C.C.I.R. Secretariat	List of documents issued (Nos. 451-500)	—	—
501*	U.S.S.R.	Ground-wave propagation over mixed paths	Rec. 109	IV
502	F. P. R. of Yugoslavia	International standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s.	Question 93	IX
503	Spain	Publication of service codes in use in the international telegraph service	Res. 18	XIII
504	C.C.I.R. Secretariat	Election of Director. Voting procedure	—	—
505	United States of America	Measurement of atmospheric radio noise	Rec. 119 Study Prog. 65 (Section 3)	VI
506*	United States of America	Very low frequency long-distance propagation	Res. 10	VI
507*	I.F.R.B.	Letter to the Chairman of Study Group VI	—	VI
508	France	Multi-channel radiotelephone systems using time-division multiplex and operating on frequencies above about 30 Mc/s.	Question 92	IX
509*	United Kingdom	MSF standard frequencies expressed in terms of the caesium resonance	—	VII
510	Study Group IX	Summary record of the 1st meeting (10th August 1956)	—	IX
511	Study Group XI	Summary record of the 1st meeting (10th August 1956)	—	XI
512*	France	Note on polarisation discrimination on VHF (175 Mc/s)	Question 101	XI

No.	Submitted by	Title	Subject	Study Group
513	Study Group VI	Summary record of the 1st meeting (10th August 1956)	—	VI
514	I.F.R.B.	Comments on high-frequency broadcasting	—	X
515	Roumanian People's Rep.	Statement	—	—
516	World Meteorological Organization	Radio transmission by facsimile of meteorological charts	Question 94	IX
517	Election Committee	Report of the Committee on the election of a Director of the C.C.I.R.	—	—
518	Czechoslovakia	Prediction of solar activity	Rec. 117	VI
519	O.I.R.	Supplement to Doc. No. 440	Study Prog. 56	V
520	Denmark	Draft Recommendation	—	XI
521	Denmark	Draft Study Programmes	—	XI
522	C.C.I.R. Secretariat	Recent findings of the C.I.S.P.R.	—	I, III
523	U.S.S.R.	Hypothetical reference circuit for wide-band radio relay systems	Question 97	IX
524	C.C.I.R. Secretariat	Minutes of the inaugural meeting of the VIIIth Plenary Assembly of the C.C.I.R. (9th August, 1956)	—	Plenary Assembly
525	C.C.I.R. Secretariat	Minutes of the first plenary meeting (9th August, 1956)	—	Plenary Assembly
526	C.C.I.R. Secretariat	Election of Director. Voting procedure	—	—
527	—	First list of terms and definitions on which the Study Groups are consulted	—	I to XIV
528	Italy	Cooperation between the C.C.I.R. and the S.C. 12-1 of the I.E.C. in the field of spurious radiations from receivers	Question 80	II, XI
529	Sub-Group IX-A	First meeting of Sub-Group IX-A (13th August 1956)	—	IX
530	United States of America	Technical characteristics of single-sideband aeronautical mobile and maritime mobile radiotelephone equipments	Proposed New Question	—
531	Study Group V	Summary record of the first meeting (13th August 1956)	—	V
532	United States of America	Improvement obtainable from the use of directional antennae	Question 81	III

No.	Submitted by	Title	Subject	Study Group
533	United States of America	Communication theory	Study Prog. 47	III
534	United States of America	Standard frequencies and time signals from WWV and WWVH	Study Prog. 68	VII
535	United States of America	Frequency-modulation broadcasting in the VHF (metric) band	Question 99	X
536	Study Group VII	Summary record of the first meeting (10th August 1956)	—	VII
537	Study Group X	Summary record of the first meeting (13th August 1956)	—	X
538	Study Group XIV	Summary record of the first meeting (10th August 1956)	—	XIV
539	Sub-Group IX-A	Preferred characteristics of radio relay systems for the transmission of monochrome television	Draft Question	IX
540	Study Group XII	Summary record of the first meeting (13th August 1956)	—	XII
541	Study Group VI	Summary record of the second meeting (14th August 1956)	—	VI
542	Study Group I	Summary record of the first meeting (10th August 1956)	—	I
543	Study Group IV	Summary record of the first meeting (13th August 1956)	—	IV
544	Study Group III	Summary record of the first meeting (13th August 1956)	—	III
545	Study Group XI	Summary record of the second meeting (14th August 1956)	—	XI
546 ³	Sub-Group IX-A	Summary record of the second meeting (14th August 1956)	—	IX
547	Study Group II	Summary record of the first meeting (13th August 1956)	—	II
548	Study Group XIII	Summary record of the first meeting (14th August 1956)	—	XIII
549	Joint C.C.I.T./C.C.I.R. Study Group on phototelegraphy	Transmission of meteorological charts over radio circuits by direct frequency-modulation of the carrier	Draft New Question	—
550	C.C.I.R. Secretariat	List of documents issued (Nos. 501-550)	—	—
551	Joint C.C.I.T./C.C.I.R. Study Group on phototelegraphy	Facsimile transmission of meteorological charts over radio circuits	Draft Rec.	—

No.	Submitted by	Title	Subject	Study Group
552	Joint C.C.I.T./C.C.I.R. Study Group on phototelegraphy	Standardisation of phototelegraph apparatus for use on combined radio and metallic circuits	Draft revision of C.C.I.R. Rec. 127	—
553*	Federal German Republic	Selectivity of receivers	Study Prog. 42	II
554	Study Group V	Tropospheric-wave propagation curves	Draft Res.	V
555	Study Group VIII	Summary record of the first meeting (14th August 1956)	—	VIII
556	Sub-Group VII-A	Standard-frequency transmissions and time signals in additional frequency bands	Draft new Question	VII
557*	United States of America	Experimental standard-frequency broadcast on 60 kc/s	Study Prog. 68	VII
558	W.M.O.	Tropospheric-wave propagation	Study Prog. 56	V
559	—	Draft letter of appointment of a Director of the C.C.I.R.	—	—
560	Study Group IV	Summary record of the second meeting (16th August 1956)	—	IV
561	Italy	Arrangement of channels in multichannel telegraph systems for long-range radio circuits operating on frequencies below about 30 Mc/s	Question 74	I
562	Sub-Group IX-B	Summary record of the first meeting (14th August 1956)	—	IX
563*	U.S.S.R.	Theory of mixed path propagation of radio- waves and engineering methods of calcula- tion	—	IV
564	Sub-Group IX-B	Summary record of the second meeting (16th August 1956)	—	IX
565 ⁴	Study Group V	Draft Report on Study Prog. 79: Tropo- spheric propagation across mountain ridges	Draft Report	V
566	Study Group V	Draft Report on Study Prog. 57: Investiga- tion on multipath transmission through the troposphere	Draft Report	V
567	Study Group III	Summary record of the second meeting (16th August 1956)	—	III
568	Sub-Group IX-A	Summary record of the third meeting (16th August 1956)	—	IX
569	Study Group XII	Summary record of the second meeting (16th August 1956)	—	XII

No.	Submitted by	Title	Subject	Study Group
570	I.F.R.B.	Comments on the tests carried out for the determination of the protection required by a broadcasting service in the presence of interference	—	II, III, VI, X and XII
571	Study Group IV	Summary record of the third meeting (21st August 1956)	—	IV
572*	United Kingdom	Report on bandwidth measurements carried out by the British Post Office at Banbury radio measuring station	Study Prog. 70	VIII
573	Study Group XII	Summary record of the third meeting (20th August 1956)	—	XII
574	C.C.I.R. Secretariat	Minutes of the second plenary meeting (15th August 1956)	—	Plenary Assembly
575	Sub-Group IX-C	Draft Recommendation concerning Question No. 113	Draft Rec.	IX
576	Sub-Group IX-C	Draft Recommendation concerning Question No. 90	Draft Rec.	IX
577 ⁴	Study Group VIII	Automatic monitoring of occupancy of the radio frequency spectrum	Draft Rec. (Question 88)	VIII
578	Sub-Group IX-D	Operational characteristics of long-distance radio relay systems	Draft Res. (Question 116)	IX
579	Sub-Group IX-D	Preferred characteristics of multi-channel radiotelephone systems using time-division multiplex and operating at frequencies above about 30 Mc/s	Draft Rec. (Question 92)	IX
580	Sub-Group IX-D	Preferred characteristics of multi-channel radiotelephone systems using time-division multiplex and operating at frequencies above about 30 Mc/s	Draft Report (Question 92)	IX
581	Study Group XIII	Summary record of the second meeting (21st August 1956)	—	XIII
582	Sub-Group IX-A	Preferred characteristics for multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Draft Report	IX
583	Sub-Group VI-A	Prediction of the solar index	—	VI
584	Sub-Group VI-A	Prediction of the solar index	Draft Study Prog.	VI
585	Study Group XIV	Summary record of the second meeting (17th August 1956)	—	XIV
586	United Kingdom	Proposed new Question	Proposed new Question	II

No.	Submitted by	Title	Subject	Study Group
587	Study Group II	Summary record of the second meeting (17th August 1956)	—	II
588	Study Group VII	Summary record of the second meeting (20th August 1956)	—	VII
589	Study Group III	Summary record of the third meeting (20th August 1956)	—	III
590	Study Group VI	New Report to replace Report No. 26	Report 58	VI
591	Study Group VI	Identification of precursors indicative of short-term variations of ionospheric propagation conditions	Revision of Study Prog. 59	VI
592	Study Group VI	Choice of a basic index for ionospheric propagation	Revision of Report 25	VI
593 ^a	Sub-Group XIII-A	Report to Study Group No. XIII	—	XIII
594	Study Group VIII	Summary record of the second meeting (21st August 1956)	—	VIII
595	Study Group VIII	Automatic monitoring of occupancy of the radio-frequency spectrum	Draft Question	VIII
596	—	Second list of terms and definitions on which the Study Groups are consulted	—	I to XIV
597	Sub-Group XIII-C	Spurious emissions from frequency-modulated VHF (metric) maritime equipment	Draft new Study Prog.	XIII
598	Sub-Group XIII-C	Selective calling devices for use in the international VHF maritime mobile service	Draft new Question	XIII
599	Sub-Group XIII-C	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	Draft Rec.	XIII
600	C.C.I.R. Secretariat	List of documents issued (Nos. 551-600)	—	—
601	Study Group II	Undesired emissions from broadcast and television receivers	Draft Rec.	II
602	Study Group II	Undesired emissions from receivers	Draft Question	II
603	Study Group VI	Summary record of the third meeting (20th August 1956)	—	VI
604	F. P. R. of Yugoslavia	International cooperation in the sphere of radio communication	Draft Res.	—

No.	Submitted by	Title	Subject	Study Group
605 ³	United Kingdom	A comparison of C.W. interference effects on the reception of monochrome and N.T.S.C.-type colour-television signals	Question 119	XI
606	Study Group II	The response of broadcast and television receivers to quasi-impulsive interference	Draft Rec.	II
607	Study Group II	The usable sensitivity of radio receivers in the presence of quasi-impulsive interference	Draft Question	II
608 ³	Study Group II	Selectivity of receivers	Draft Rec.	II
609	Study Group II	Selectivity of receivers	Draft Question	II
610	Sub-Group IX-C	Service channels	Draft Report	IX
611	Sub-Group IX-C	Service channels	Draft Question	IX
612	Sub-Group IX-C	Transmission of pilot waves over circuits consisting of cable paths and radio relay links	Draft Report	IX
613	Sub-Group XIII-B	Inter-ship radar identification	Draft Rec.	XIII
614	Sub-Group XIII-B	Draft new Question to replace Question 105	Draft new Question	XIII
615	Sub-Group XIII-B	Draft Question to replace Question 106	Draft Question	XIII
616	Sub-Group XIII-B	Revision of Recs. Nos. 72, 78, 124 and 125	Recs. 72, 78, 124 and 125	XIII
617	Sub-Group XIII-B	Marine radar identification	Draft Report	XIII
618	Sub-Group XIII-B	Draft Report on HF and VHF direction finding	Draft Report	XIII
619	Sub-Group XIII-B	Technical characteristics of single-sideband aeronautical mobile and maritime radio-telephone equipments	Proposed new Question	XIII
620	C.C.I.R. Secretariat	Organisation of C.C.I.R. work	—	—
621	Study Group XIII	Testing of 500 kc/s radio telegraphic auto-alarm receiving equipment on board ships	Draft Rec.	XIII

No.	Submitted by	Title	Subject	Study Group
622	Sub-Group XIII-E	Report to the Chairman of Study Group No. XIII	C.C.I.T. Question 61 C.C.I.R. Res. 18	XIII
623	Study Group IX	Summary record of the second meeting (21st August 1956)	—	IX
624	Sub-Group IX-D	Summary notes of 2nd, 3rd and 4th meetings (14th, 20th and 21st August 1956)	—	IX
625	Study Group I	Summary record of the second meeting (23rd August 1956)	—	I
626	Study Group VI	Summary record of the fourth meeting (22nd August 1956)	—	VI
627	New Zealand	Draft Resolution regarding the method of handling reports and their submission to the Plenary Assembly	Draft Res.	—
628	Federal German Republic	High-frequency broadcasting. Justification for use of more than one frequency per programme	Question 37 Study Prog. 71	X
629	Federal German Republic	Basic prediction information for ionospheric propagation. Allowance for ionospheric scattering in calculating radio propagation predictions	Study Prog. 60 (Item 1)	VI
630 ³	Study Group II	Frequency stability of receivers	Draft Rec.	II
631	C.C.I.T.	Possible amalgamation of the C.C.I.T. Study Group for phototelegraphy and facsimile and the joint C.C.I.R./C.C.I.T. Study Group for phototelegraphy	—	—
632	Study Group VIII	Summary record of the third meeting (24th August 1956)	—	VIII
633	Study Group V	Summary record of the third meeting (24th August 1956)	—	V
634	Study Group VIII	Measurements by mobile monitoring stations	Draft Question	VIII
635	Study Group VIII	Frequency measurements above 50 Mc/s by monitoring stations	Draft Report	VIII
636	Study Group VIII	Proposed revision of Study Programme No. 70. Spectrum measurement by monitoring stations	Study Prog. 70	VIII
637	Study Group VIII	Draft replacement of Study Programme No. 69. Field-strength measurements by monitoring stations	Study Prog. 69	VIII
638	Study Group VIII	Draft amendment to Rec. No. 123. Accuracy of field-strength measurements by monitoring stations	Rec. 123	VIII

No.	Submitted by	Title	Subject	Study Group
639	Study Group VIII	Automatic monitoring of occupancy of the radio-frequency spectrum	Draft Question	VIII
640	Study Group VIII	Spectrum measurement by monitoring stations	Draft Report	VIII
641	Study Group IX	Summary record of the third meeting (24th August 1956)	—	IX
642	Drafting Committee	Facsimile transmission of meteorological charts over radio circuits	Rec. 226	CCIT/CCIR
643	Drafting Committee	Standardisation of phototelegraph apparatus for use on combined radio and metallic circuits	Rec. 227	CCIT/CCIR
644	Drafting Committee	Prediction of the solar index	Rec. 172	VI
645	Drafting Committee	Transmission of meteorological charts over radio circuits by direct frequency-modulation of the carrier	Question 130	CCIT/CCIR
646	Study Group IV	Summary record of the fourth meeting (24th August 1956)	—	IV
647	Study Groups IV and VI	Extension of the C.C.I.R. propagation curves below 300 kc/s	Draft Report	IV, VI
648	Sub-Group IV-A	Determination of the electrical characteristics of the surface of the earth	Draft Question	IV
649	India	Fading allowances for tropical broadcast transmissions	Draft Question	XII
650	C.C.I.R. Secretariat	List of documents issued (Nos. 601-650)	—	—
651	India	Interference in the bands shared with broadcasting	Draft Study Prog.	XII
652	Sweden	Collaboration between aeronautical and maritime mobile services for safety of life at sea	—	XIII
653	Study Group XII	Summary record of the fourth meeting (23rd August 1956)	—	XII
654	Study Group III	Summary record of the fourth meeting (27th August 1956)	—	III
655	C.C.I.R. Secretariat	Minutes of the third plenary meeting (24th August 1956)	—	Plenary Assembly
656	Drafting Committee	Prediction of solar index	Study Prog. 100	VI
657	Chairman of Study Group XIII	Letter from the Chairman of Study Group No. XIII	—	XIII

No.	Submitted by	Title	Subject	Study Group
658	Sub-Group X-B	Organisations qualified to take action on questions of sound recording	Draft Res.	X
659	Sub-Group IX-B	Hypothetical reference circuit for wide-band frequency-division multiplex radio relay systems with a capacity of more than 60 telephone channels	Draft Rec.	IX
660	Sub-Group IX-B	Hypothetical reference circuit for wide-band frequency-division multiplex radio relay systems with a capacity of 12 to 60 telephone channels	Draft Rec.	IX
661	Sub-Group IX-B	Methods for the computation of intermodulation noise due to non-linearity in radio relay systems	Draft Report	IX
662	Study Group XIII	Summary record of the third meeting (27th August 1956)	—	XIII
663	Sub-Group IX-B	Summary record of the third meeting	—	IX
664	Study Group XIII	Characteristics of equipments and principles governing the allocation of channels in the VHF and UHF land mobile services	Draft Question	XIII
665	Study Group I	Summary record of the third meeting (28th August 1956)	—	I
666	Sub-Group IX-A	Wide-band radio relay systems. Frequency deviation for television	Draft Rec.	IX
667	Sub-Group VII-A	Standard-frequency transmissions and time signals	Draft Report	VII
668	Sub-Group X-A	High-frequency broadcasting. Directional aerial systems for reception areas of unusual size or shape	Draft Study Prog.	X
669	Sub-Group X-A	Frequency-modulation broadcasting in the VHF (metric) band	Draft new Question	X
670	Sub-Group X-A	HF broadcasting: Directional antenna systems	Draft Study Prog.	X
671	Sub-Group X-A	Draft revision of Question 98. HF broadcasting: Effects of closer spacing between carrier frequencies	Question 98	X
672	Sub-Group X-A	Draft revised Rec. No. 137	Rec. 137	X
673	Sub-Group X-A	FM broadcasting in the VHF band	Draft Report	X
674	Sub-Group X-A	Standards for FM sound broadcasting in the VHF band	Draft Rec.	X

No.	Submitted by	Title	Subject	Study Group
675	Drafting Committee	Modification to Rec. No. 87	Rec. 145	I
676 ⁴	Drafting Committee	Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings	Report 58	VI
677	Drafting Committee	Identification of precursors indicative of short-term variations of ionospheric propagation conditions	Study Prog. 93	VI
678	Drafting Committee	Choice of a basic index for ionospheric propagation	Report 57	VI
679	Drafting Committee	Modification to Study Prog. No. 58	Study Prog. 92	VI
680	F. P. R. of Yugoslavia	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Draft Study Prog.	IX
681	Study Group VI	Draft Rec. replacing Rec. No. 118	Draft Rec.	VI
682	Study Group VIII	Frequency measurements at monitoring stations	Draft new Question	VIII
683	Study Group VIII	Draft replacement of Rec. No. 20. Accuracy of frequency measurements at monitoring stations	Draft Rec.	VIII
684	Study Group IV	Summary record of the fifth meeting (29th August 1956)	—	IV
685	Sub-Group IX-A	Standardisation of multi-channel radio relay systems. Radio-frequency interconnexion of 240-channel telephony systems	Draft Rec.	IX
686	Sub-Group IX-A	Standardisation of multi-channel radio relay systems. Radio-frequency interconnexion of radio relay systems transmitting television alone or television and multi-channel telephony at frequencies above about 1000 Mc/s	Draft Rec.	IX
687	Sub-Group IX-A	Standardisation of multi-channel radio relay systems using frequency-division multiplex	Draft Rec.	IX
688	Sub-Group III-C	Draft Question (formerly Question No. 83)	Draft Question	III
689	Sub-Group III-C	Use of radio circuits in association with 5-unit start-stop telegraph apparatus	Draft Rec.	III

No.	Submitted by	Title	Subject	Study Group
690	C.C.I.T.	Comments on the Recommendation entitled "Standardisation of phototelegraph apparatus for use on combined radio and metallic circuits"	—	Plenary Assembly
691	Study Group VI	Summary record of the fifth meeting (27th August 1956)	—	VI
692	Study Group II	Summary record of the third meeting (27th August 1956)	—	II
693	Sub-Group IX-C	Use of special pilot frequencies on wide-band radio relay links for 600 telephone channels	Draft Rec.	IX
694	Sub-Group IX-C	Use of special pilot frequencies on wide-band radio relay links for monochrome television of 625 lines and less	Draft Rec.	IX
695	Sub-Group IX-A	Interconnexion of wide-band radio relay systems at radio frequencies	Draft Rec.	IX
696	Study Group III	Determination of the required interference protection ratios between various classes of emissions	Draft Question	III
697	Study Group III	Revision of Recommendation No. 105. Fading allowances for the various classes of service	Rec. 105	III
698	Study Group III	Revision of Recommendation No. 99. Bandwidth and signal to noise ratio in complete systems	Rec. 99	III
699	Sub-Group X-B	Draft amendment to Rec. No. 135. Single track recording on magnetic tape	Rec. 135	X
700	C.C.I.R. Secretariat	List of documents issued (Nos. 651-700)	—	—
701	Drafting Committee	Tropospheric wave propagation curves	Res. 23	V
702	Drafting Committee	Investigation on multipath transmission through the troposphere	Report 51	V
703	Drafting Committee	Standard-frequency transmissions and time signals in additional frequency bands	Question 142	VII
704	Drafting Committee	International wide-band radio relay systems operating on frequencies above about 30 Mc/s	Report 69	IX
705	Drafting Committee	International wide-band radio relay systems operating on frequencies above about 30 Mc/s	Rec. 187	IX

No.	Submitted by	Title	Subject	Study Group
706	Drafting Committee	Interconnexion at audio frequencies of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Rec. 188	IX
707	Drafting Committee	Interconnexion at audio frequencies of multi-channel radiotelephone systems using time-division multiplex and operating at frequencies above about 30 Mc/s	Rec. 186	IX
708	Drafting Committee	Preferred characteristics of radio relay systems for the transmission of monochrome television	Question 146	IX
709	Drafting Committee	Interconnexion at baseband frequencies of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Rec. 189	IX
710	Drafting Committee	Frequency tolerances for transmitters used in wide-band radio relay systems operating at frequencies above about 30 Mc/s	Draft Rec.	IX
711	Drafting Committee	Operational characteristics of long-distance radio relay systems	Res. 29	IX
712	Sub-Group X-B	Measurement of "wow" and "flutter"	Draft Report	X
713	Sub-Group X-B	Measurement of programme level	Draft Question	X
714	Sub-Group X-B	Measurement of programme level	Draft Study Prog.	X
715	Sub-Group X-B	Measurements of "wow" and "flutter"	Draft Rec.	X
716	Sub-Group X-B	Recommendation No. 134 (London)	Rec. 134	X
717 ^a	Sub-Group X-B	Sound recording on film for the international exchange of television programmes	Draft Rec.	X
718	Sub-Group X-B	Sound recording on film for the international exchange of television programmes	Draft Report	X
719	Sub-Group X-B	Proposed Report concerning Study Programme No. 74 (Point 3)	Draft Report	X
720	Sub-Group X-B	Draft Resolution concerning the width of magnetic tape	Draft Res.	X
721	Sub-Group X-B	Draft Report concerning the width of magnetic tape	Draft Report	X

No.	Submitted by	Title	Subject	Study Group
722	Study Group II	Sensitivity and noise factor	Draft Question	II
723 ³	Study Group II	Noise and sensitivity of receivers	Draft Rec.	II
724	Study Group VI	Fading of HF and MF signals propagated by the ionosphere	Draft Report	VI
725	Study Group I	Summary record of the fourth meeting (29th August 1956)	—	I
726	Sub-Group IX-C	Control of the performance of multi-channel telephone circuits on radio relay systems with the help of a signal with continuous uniform spectrum	Draft Rec.	IX
727	Sub-Group IX-C	Draft Recommendation on Question No. 96	Draft. Rec.	IX
728	Sub-Group III-C	Use of radio circuits in association with 5-unit start-stop telegraph apparatus	Draft Report	III
729	Drafting Committee	Preferred characteristics for multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Report 71	IX
730	Drafting Committee	Interconnexion at intermediate and radio frequencies of frequency-modulated multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Rec. 191	IX
731	Drafting Committee	Interconnexion at intermediate frequencies of multi-channel radio-relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Rec. 190	IX
732	Drafting Committee	Procedure for international connexions between radio relay systems with different characteristics	Rec. 204	IX
733	Drafting Committee	Preferred characteristics of multi-channel radiotelephone systems using time-division multiplex and operating on frequencies above about 30 Mc/s	Report 70	IX
734	Study Group I	Spurious radiation	Draft Rec.	I
735	Study Group VI	Questions submitted by the I.F.R.B.	Draft revision	VI
736	Sub-Group VI-E	Report by Sub-Group VI-E to Study Group VI	Study Prog. 60	VI
737	Study Group XI	Summary record of the third meeting (23rd August 1956)	—	XI

No.	Submitted by	Title	Subject	Study Group
738	Drafting Committee	International wide-band radio relay systems operating on frequencies above about 30 Mc/s	Rec. 183	IX
739	Drafting Committee	Identification of radio stations. Modification to Rec. No. 132	Rec. 220	XIII
740	Drafting Committee	Modification of Study Programme No. 78	Study Prog. 115	XIII
741	Study Group VIII	Summary record of the fourth meeting (28th August 1956)	—	VIII
742	Study Group IX	Allowable noise power in the hypothetical reference circuit	Draft Rec.	IX
743*	U.S.S.R.	Intermodulation noise in radio relay links	Question 115	IX
744	U.S.S.R.	Basic data for the calculation of ionospheric propagation phenomena	Study Prog. 60	VI
745	Sub-Group I-B	Draft amendment of Recommendation No. 92	Rec. 92	I
746	Sub-Group I-B	Report on paragraph 6 of Rec. No. 92	Rec. 92	I
747	Study Group IX	Summary record of the fourth meeting (29th August 1956)	—	IX
748	Drafting Committee	Inter-ship radar identification. Question No. 105	Rec. 222	XIII
749	Drafting Committee	Marine identification devices	Question 158	XIII
750	C.C.I.R. Secretariat	List of documents issued (Nos. 701-750)	—	—
751	Drafting Committee	Bearing and position classification for direction finding in the VHF, HF and 2 Mc/s bands	Question 159	XIII
752	Drafting Committee	HF and VHF direction finding	Report 93	XIII
753	Drafting Committee	Revision of Recommendations Nos. 72, 78 and 125	Rec. 217, 218 and 219	XIII
754	Study Group II	Frequency stability of receivers	Draft Question	II
755	Study Group V	Radio transmission caused by inhomogeneities in the troposphere (commonly termed "scattering")	Draft Rec.	V

No.	Submitted by	Title	Subject	Study Group
756	Study Group V	Radio transmission caused by inhomogeneities in the troposphere (commonly termed "scattering")	Draft Study Prog.	V
757	Drafting Committee	Identification of radio stations	Report 91	XIII
758	Drafting Committee	Technical characteristics of single-sideband aeronautical mobile and maritime radiotelephone equipments	Question 162	XIII
759	Drafting Committee	Spurious emissions from frequency-modulated VHF (metric) maritime equipment	Question 161	XIII
760	Drafting Committee	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	Rec. 223	XIII
761	Drafting Committee	Selective calling device for use in the international VHF (metric) maritime mobile service	Question 160	XIII
762	Drafting Committee	Testing of 500 kc/s radiotelegraphic auto-alarm receiving equipment on board ships	Rec. 224	XIII
763	Drafting Committee	Modification to Rec. 141	Rec. 221	XIII
764	Drafting Committee	Modification to Resolution 18	Res. 33	XIII
765	Study Group II	Sensitivity, selectivity and stability of frequency-modulation sound-broadcasting receivers and television receivers	Draft Rec.	II
766	Study Group II	Sensitivity, selectivity and stability of amplitude-modulation sound-broadcasting receivers	Draft Rec.	II
767	Study Group V	Summary record of the fourth and last meeting (30th August 1956)	—	V
768	Study Group X	The minimum number of frequencies necessary for the transmission of a high-frequency broadcasting programme	Report 13	X
769	Study Group X	HF broadcasting. Justification for the use of more than one frequency per programme. Conditions for satisfactory reception	Study Progs. 71 and 73	X
770 ⁴	Drafting Committee	Measurement of field strength in the neighbourhood of obstacles	Question 137	V

No.	Submitted by	Title	Subject	Study Group
771	Drafting Committee	Field strength measurement. Influence of local conditions on interpretation and accuracy of measurements of field strength	Rec. 171	V
772	Drafting Committee	Measurement of field strengths for VHF and UHF broadcast services, including television	Question 138	V
773	Drafting Committee	Tropospheric wave propagation	Study Prog. 90	V
774	Drafting Committee	Modifications to the titles of the following reports: Reports Nos. 4, 5 and 22	Reports 48, 49 and 50	V
775	Drafting Committee	Four-frequency duplex systems	Rec. 152	I
776	Drafting Committee	Four-frequency duplex systems	Study Prog. 83	I
777	France	Comments by the French Delegation on Doc. 676	Doc. 676	VI
778	Drafting Committee	Arrangement of channels in multi-channel radio telegraph systems for long-range circuits operating on frequencies below about 30 Mc/s	Report 39	I
779	Drafting Committee	Arrangement of channels in multi-channel radio telegraph systems for long-range circuits operating on frequencies below about 30 Mc/s	Rec. 153	I
780	Drafting Committee	Amendment to Recommendation 91	Rec. 149	I
781	Drafting Committee	Selectivity of receivers	Question 128	II
782	Drafting Committee	Extension of the C.C.I.R. propagation curves below 300 kc/s	Report 61	IV, VI
783 ³	Drafting Committee	Hypothetical reference circuit for wide-band frequency-division multiplex radio relay systems with capacity of 12 to 60 telephone channels	Rec. 202	IX
784	Drafting Committee	Methods for the computation of intermodulation noise due to non-linearity in radio relay systems	Report 74	IX
785	Study Group III	Summary record of the fifth meeting (28th August 1956)	—	III
786	Study Group III	Summary record of the sixth meeting (30th August 1956)	—	III
787	Drafting Committee	Automatic monitoring of occupancy of the radio-frequency spectrum	Rec. 182	VIII

No.	Submitted by	Title	Subject	Study Group
788	Drafting Committee	Automatic monitoring of occupancy of the radio-frequency spectrum	Question 143	VIII
789	Drafting Committee	Frequency measurements above 50 Mc/s at monitoring stations	Report 67	VIII
790	Drafting Committee	Field-strength measurements at monitoring stations	Study Prog. 102	VIII
791	Drafting Committee	Spectrum measurement at monitoring stations	Report 68	VIII
792	Study Group IX	Wide-band radio relay systems. Noise tolerable during very short period of time	Draft Study Prog.	IX
793	Study Group VI	Summary record of the sixth meeting (28th August 1956)	—	VI
794	Drafting Committee	Spectrum measurement at monitoring stations	Study Prog. 103	VIII
795	Drafting Committee	Measurements at mobile monitoring stations	Question 144	VIII
796	Drafting Committee	Accuracy of field-strength measurements at monitoring stations	Rec. 181	VIII
797	Drafting Committee	Revision of atmospheric radio noise data	Report 65	VI
798	Drafting Committee	Maintenance procedure for wide-band radio relay systems. Service channels	Report 72	IX
799	Drafting Committee	Service channels for wide-band radio relay systems	Question 147	IX
800	C.C.I.R. Secretariat	List of documents issued (Nos. 751-800)	—	—
801	Drafting Committee	Preferred characteristics of multi-channel radiotelephone systems using time-division multiplex and operating at frequencies above about 30 Mc/s	Rec. 185	IX
802 ^a	Drafting Committee	Hypothetical reference circuit for wide-band frequency-division multiplex radio relay systems with a capacity of more than 60 telephone channels	Rec. 203	IX
803	Drafting Committee	Determination of the electrical characteristics of the surface of the earth	Question 135	IV
804	Drafting Committee	Fading allowances for tropical broadcast transmissions	Question 157	XII
805	Drafting Committee	Protection of frequencies used for radio astronomical measurements	Rec. 173	VI
806	Drafting Committee	Local lightning-flash counters	Res. 25	VI

No.	Submitted by	Title	Subject	Study Group
807	Drafting Committee	World-wide atmospheric radio noise measurements	Rec. 174	VI
808	Drafting Committee	Interconnexion of wide-band radio relay systems at radio frequencies	Rec. 192	IX
809	Drafting Committee	Standardisation of multi-channel radio relay systems. Radio-frequency interconnexion of radio relay systems transmitting television alone or television and multi-channel telephony at frequencies above about 1000 Mc/s	Rec. 195	IX
810	Drafting Committee	Wide-band radio relay systems. Frequency deviation for television	Rec. 184	IX
811	Drafting Committee	Measurement of the performance of multi-channel telephone circuits on radio relay systems with the help of a signal with continuous uniform spectrum	Rec. 197	IX
812	Drafting Committee	Tropospheric propagation across mountain ridges	Report 52	V
813	Drafting Committee	Stability of standard-frequency transmissions and time signals as received	Question 141	VII
814	Drafting Committee	Marine identification device	Report 92	XIII
815	Sub-Group XII-A	Interference in the bands shared with broadcasting	Draft Report	XII
816	Study Group XIII	Summary record of the fourth meeting (31st August 1956)	—	XIII
817	Drafting Committee	Standardisation of multi-channel radio relay systems using frequency-division multiplex	Rec. 194	IX
818	Drafting Committee	The use of radio circuits in association with 5-unit start-stop telegraph apparatus	Question 129	III
819	Drafting Committee	Frequency-shift keying	Report 40	I
820	Drafting Committee	Amendment of Recommendation No. 92. Frequency-shift keying	Rec. 150	I
821	Drafting Committee	Standby arrangements for wideband radio relay systems	Rec. 196	IX
822	Study Group XI	Summary record of the fourth meeting (29th August 1956)	—	XI
823	Study Group XI	Summary record of the fifth and last meeting (31st August 1956)	—	XI

No.	Submitted by	Title	Subject	Study Group
824	Study Group IV	Summary record of the sixth and last meeting (3rd September 1956)	—	IV
825	Study Group IX	Summary record of the fifth and last meeting (31st August 1956)	—	IX
826	Drafting Committee	Ground-wave propagation	Question 134	IV
827	Drafting Committee	Maintenance procedure for wide-band radio relay systems. Use of special pilot frequencies on wide-band radio relay links for 600 telephone channels	Rec. 198	IX
828	Drafting Committee	Maintenance procedure for wide-band radio relay systems. Use of special pilot frequencies on wide-band radio relay links for monochrome television of 625 lines and less	Rec. 199	IX
829 ¹	Finance Sub-Committee	Report of the Finance Sub-Committee.	—	—
830	Study Group XII	Summary record of the fifth meeting (29th August 1956)	—	XII
831	Study Group III	Signal-to-interference protection ratios	Draft Rec.	III
832	Study Group III	Determination of the required interference protection ratios between various classes of emissions	Draft Question	III
833	C.C.I.R. Secretariat	Minutes of the fourth plenary meeting (3rd September 1956)	—	Plenary Assembly
834	Drafting Committee	Temporal variations of ground-wave field strength	Report 46	IV
835	Drafting Committee	Standard-frequency transmissions and time signals	Study Prog. 101	VII
836	Drafting Committee	Standard-frequency transmissions and time signals	Question 140	VII
837	Drafting Committee	Best method for calculating the skywave field intensity produced by a tropical broadcasting transmitter	Report 88	XII
838	Drafting Committee	Atmospheric radio noise data	Rec. 175	VI
839	Drafting Committee	Measurement of atmospheric radio noise	Study Prog. 96	VI
840	Drafting Committee	Use of special modulation on the standard-frequency transmissions for assessing the reliability of propagation forecasts	Study Prog. 94	VI

No.	Submitted by	Title	Subject	Study Group
841	Drafting Committee	Presentation of data in studies of tropospheric-wave propagation (Modification to Rec. No. 110)	Rec. 170	V
842	Drafting Committee	Propagation data required for wide-band radio systems	Report 53	V
843	Drafting Committee	Propagation data required for wide-band radio systems	Question 136	V
844	Drafting Committee	Frequency-shift keying (Amendment to Rec. No. 92)	Rec. 150	I
845	Drafting Committee	Telegraph distortion (Modification to Rec. No. 93)	Rec. 151	I
846	Drafting Committee	Bandwidth of emissions (Modification to Study Prog. No. 39)	Study Prog. 82	I
847	Drafting Committee	Definition of the bandwidth of emissions	Rec. 146	I
848	Drafting Committee	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Study Prog. 104	IX
849	Drafting Committee	Characteristics of equipments and principles governing the allocation of channels in the VHF (metric) and UHF (decimetric) land mobile services	Question 163	XIII
850	C.C.I.R. Secretariat	List of documents issued (Nos. 801-850)	—	—
851	Study Group II	Distortion in frequency-modulation receivers due to multipath propagation	Draft Question	II
852	Study Group XIV	Summary record of the 3rd and last meeting (31st August 1956)	—	XIV
853	Drafting Committee	Transmission of pilot frequencies over circuits consisting of cable paths and radio relay links	Report 73	IX
854	Drafting Committee	Standardisation of multi-channel radio relay systems. Radio-frequency interconnexion of 240-channel telephony systems	Rec. 193	IX
855	Drafting Committee	Hypothetical reference circuit for time-division multiplex radio relay systems with 60 or less telephone channels	Rec. 201	IX
856	Drafting Committee	Fading of HF (decametric) and MF (hectometric) signals propagated by the ionosphere	Report 59	VI
857	Drafting Committee	Determination of the type of emission producing minimum interference	Report 38	I

No.	Submitted by	Title	Subject	Study Group
858	Study Group II	Choice of intermediate frequency and protection against undesired responses of super-heterodyne receivers	Draft Report	II
859	Drafting Committee	Standard-frequency transmissions and time signals	Rec. 179	VII
860	Drafting Committee	Spurious radiation	Rec. 147	I
861	Drafting Committee	Frequency measurements at monitoring stations	Question 145	VIII
862	Drafting Committee	Accuracy of frequency measurements at monitoring stations	Rec. 180	VIII
863	Drafting Committee	High-frequency broadcasting	Study Prog. 107	X
864	Drafting Committee	Organisations qualified to take action on questions of recording	Res. 31	X
865	Drafting Committee	Frequency-modulation broadcasting in the VHF (metric) band	Question 150	X
866	Drafting Committee	HF (decametric) broadcasting. Effects of closer spacing between carrier frequencies	Question 149	X
867	Drafting Committee	Frequency - modulation sound broadcasting in the VHF (metric) band	Report 77	X
868	Drafting Committee	Standards for frequency-modulation sound broadcasting in the VHF (metric) band	Rec. 206	X
869	Drafting Committee	Modification to Report No. 13. The minimum number of frequencies necessary for the transmission of a high-frequency broadcasting programme	Report 76	X
870	Drafting Committee	Standards of sound recording for the international exchange of programmes	Report 79	X
871	Drafting Committee	Modification to Recommendation No. 134. Standards of sound recording for the international exchange of programmes. Lateral-cut recording on discs	Rec. 208	X
872	Drafting Committee	Ratio of the wanted to the unwanted signal in television	Study Prog. 111	XI
873	Study Group X	Summary record of the 2nd meeting (30th August 1956)	—	X
874	Study Group II	Summary record of the 4th meeting (30th August 1956)	—	II
875	C.C.I.R. Secretariat	Minutes of the fifth plenary meeting (4th September 1956)	—	Plenary Assembly
876	Study Group II	Summary record of the 5th and last meeting (3th September 1956)	—	II

No.	Submitted by	Title	Subject	Study Group
877	Study Group VII	Summary record of the 3rd and last meeting (30th August 1956)	—	VII
878	Study Group I	Summary record of the 5th and last meeting (31st August 1956)	—	I
879	Drafting Committee	HF (decametric) broadcasting. Directional antenna systems	Study Prog. 106	X
880	Drafting Committee	Measurements of "wow" and "flutter"	Rec. 210	X
881	Drafting Committee	Measurement of programme level	Study Prog. 109	X
882	Drafting Committee	Measurement of programme level	Question 151	X
883	Drafting Committee	Amendment to Recommendation No. 135. Standards of sound recording for the international exchange of programmes	Rec. 209	X
884	Drafting Committee	Width of magnetic tape	Report 80	X
885	Drafting Committee	Presentation of antenna radiation data	Rec. 168	IV
886	Drafting Committee	Communication theory	Question 133	III
887	Drafting Committee	Communication theory	Rec. 165	III
888	Drafting Committee	Communication theory	Study Prog. 86	III
889	Drafting Committee	Radio transmission utilising inhomogeneities in the troposphere (commonly termed "scattering")	Study Prog. 91	V
890	Drafting Committee	Width of magnetic tape	Res. 30	X
891	Drafting Committee	Modification to Recommendation No. 137. Use of synchronised transmitters in HF (decametric) broadcasting	Rec. 205	X
892	Drafting Committee	Modification to Study Programme No. 72. High-frequency broadcasting. Use of synchronised transmitters	Study Prog. 108	X
893	Study Group XIV	Draft amendment to Recommendation No. 142. Nomenclature of the frequency and wavelength bands used in radiocommunication	Rec. 142	XIV
894	Study Group XIV	Means of expression	Draft Report	XIV
895	Drafting Committee	Unit of quantity of information	Rec. 166	III

No.	Submitted by	Title	Subject	Study Group
896	Study Group IX	Summary notes of additional meeting (5th September 1956)	—	IX
897	Study Group XIV	Definitions of certain basic words used in the International Telecommunication Convention	Draft Res.	XIV
898	Study Group XIV	Decimal classification	Draft Report	XIV
899	Drafting Committee	Frequency stabilisation of transmitters	Rec. 148	I
900	C.C.I.R. Secretariat	List of documents issued (Nos. 851-900)	—	—
901	Drafting Committee	Measurement of "wow" and "flutter"	Report 78	X
902	Drafting Committee	Revision of Question No. 65. Assessment of the quality of television pictures	Question 152	XI
903	Drafting Committee	Standard-frequency transmissions and time signals	Report 66	VII
904	Drafting Committee	Measurement of unwanted radiations from industrial installations	Res. 20	I
905	Drafting Committee	High-frequency broadcasting. Directional antennae with reduced subsidiary lobes	Report 75	X
906	Study Group VI	Summary record of the seventh meeting (30th August 1956)	—	VI
907	Drafting Committee	Requirements for the transmission of television over long distances	Report 84	XI
908	Drafting Committee	Investigation of circularly polarised emitted waves propagated via the ionosphere	Report 62	VI
909	Drafting Committee	Regular long-distance transmission in the VHF (metric) band by means of scattering from inhomogeneities in the lower ionosphere	Report 64	VI
910	Drafting Committee	The transmission of monochrome and colour-television signals over long distances	Res. 32	XI
911	Drafting Committee	Maximum power for short-distance high-frequency broadcasting in the tropical zone	Rec. 215	XII
912	Drafting Committee	Undesired emissions from receivers excluding sound broadcast and television	Question 126	II
913	Drafting Committee	Undesired emissions from broadcast and television receivers	Rec. 160	II

No.	Submitted by	Title	Subject	Study Group
914	Drafting Committee	Revision of Question No. 68. Resolving power and differential sensitivity of the human eye	Question 153	XI
915	Drafting Committee	Revision of Report No. 35. Television systems	Report 83	XI
916	Drafting Committee	Radio relay systems employing tropospheric scatter propagation	Question 148	IX
917	Drafting Committee	Revision of Report No. 34. Ratio of the wanted to the unwanted signal in monochrome television	Report 82	XI
918	Drafting Committee	Wide-band radio relay systems. Noise tolerable during very short periods of time	Study Prog. 105	IX
919	Drafting Committee	Sound recording on film for the international exchange of television programmes	Rec. 211	X
920	Drafting Committee	Modification to Rec. No. 103. Use of directional antennae	Rec. 162	III
921	Drafting Committee	Modification to Study Prog. No. 48. Improvement obtainable from the use of directional antennae	Study Prog. 85	III
922	Drafting Committee	Revision of Report No. 7. Long-distance propagation of waves of 30-300 Mc/s by way of ionisation in the E and F regions of the ionosphere	Report 54	VI
923	Drafting Committee	Sensitivity, selectivity and stability of amplitude-modulation sound-broadcasting receivers	Rec. 157	II
924	Drafting Committee	Sensitivity and noise factor	Question 123	II
925	Drafting Committee	Sensitivity, selectivity and stability of frequency-modulation sound-broadcasting receivers and television receivers	Rec. 158	II
926	Drafting Committee	Response of broadcast and television receivers to quasi-impulsive interference	Rec. 159	II
927	Drafting Committee	The usable sensitivity of radio receivers in the presence of quasi-impulsive interference	Question 125	II
928	Drafting Committee	Distortion in frequency-modulation receivers due to multipath propagation	Question 127	II
929	Drafting Committee	Interference in the bands shared with broadcasting	Report 89	XII

No.	Submitted by	Title	Subject	Study Group
930	Drafting Committee	Determination of the required interference protection ratios between various classes of emissions	Question 131	III
931	Drafting Committee	Revision of Rec. No. 105. Fading allowances for the various classes of service	Rec. 164	III
932	Drafting Committee	Modification to Rec. No. 99. Bandwidth and signal-to-noise ratio in complete systems	Rec. 161	III
933	C.C.I.R. Secretariat	Minutes of the sixth plenary meeting (6th September 1956)	—	Plenary Assembly
934	Drafting Committee	Pulse transmission tests at oblique incidence	Study Prog. 97	VI
935	Drafting Committee	The influence of Doppler shifts on long-distance high-frequency communication using frequency-shift keying	Question 137	VI
936	Drafting Committee	Effects of tropospheric refraction on frequencies below 10 Mc/s	Report 45	IV
937	Drafting Committee	Ground-wave propagation over irregular terrain	Study Prog. 89	IV
938	Drafting Committee	Amendment to Rec. No. 82. Television standards	Rec. 212	XI
939	Drafting Committee	Use of radio circuits in association with 5-unit start-stop telegraph apparatus	Report 42	III
940	Drafting Committee	The use of radio circuits in association with 5-unit start-stop telegraph apparatus	Rec. 167	III
941	Drafting Committee	Signal-to-interference protection ratios	Rec. 163	III
942	Study Group III	Summary record of the seventh and last meeting (7th September 1956)	—	III
943	Drafting Committee	Sound recording on film for the international exchange of television programmes	Report 81	X
944	Finance Committee	Chairman's report to the VIIIth Plenary Assembly	Report	—
945	Drafting Committee	The estimation of sky-wave field strengths on frequencies above 1500 kc/s	Rec. 178	VI
946	Drafting Committee	The estimation of sky-wave field strengths on frequencies above 1500 kc/s	Study Prog. 99	VI
947	Drafting Committee	Allowable noise power in the hypothetical reference circuit	Rec. 200	IX

No.	Submitted by	Title	Subject	Study Group
948	Drafting Committee	Distortion of television signals due to the use of vestigial-sideband transmission	Study Prog. 110	XI
949	Drafting Committee	Advantages to be obtained from consideration of polarisation in the planning of broadcasting services in the VHF (metric) and UHF (decimetric) bands	Report 85	XI
950	C.C.I.R. Secretariat	List of documents issued (Nos. 901-950)	—	—
951	Drafting Committee	Amendment to Report No. 28. Centralising agencies for the rapid exchange of information on propagation	Report 60	VI
952	Drafting Committee	Ionospheric scatter propagation	Study Prog. 95	VI
953	Drafting Committee	Radio propagation at frequencies below 1500 kc/s	Report 63	VI
954	Drafting Committee	Back-scattering	Study Prog. 98	VI
955	Drafting Committee	Ionospheric scatter propagation	Rec. 28	VI
956	Drafting Committee	Amendment to Study Prog. No. 51. Effects of tropospheric refraction on frequencies below 10 Mc/s	Study Prog. 87	IV
957	Drafting Committee	Ionospheric sounding stations	Res. 26	VI
958	Denmark	Spurious radiation	—	I
959	Study Group X	Summary record of the third and last meeting (4th September 1956)	—	X
960	Drafting Committee	Supplement to the C.C.I.R. Atlas of Propagation Curves	Res. 21	IV
961	Drafting Committee	Limitation of unwanted radiation from industrial installations	Study Prog. 84	I
962	Drafting Committee	Ground-wave propagation over mixed paths	Study Prog. 88	IV
963	Drafting Committee	Ground-wave propagation over mixed paths	Report 47	IV
964	Drafting Committee	Ground-wave propagation over mixed paths	Rec. 169	IV
965	Technical Assistance Committee	Minutes of the first meeting of the Technical Assistance Committee (3rd September 1956)	—	—

No.	Submitted by	Title	Subject	Study Group
966	Technical Assistance Committee	Minutes of the second meeting of the Technical Assistance Committee (5th September 1956)	—	—
967	Organisation Committee	Organisation Committee	—	—
968	Study Group VI	Summary record of the eighth and last meeting (31st August 1956)	—	VI
969	Drafting Committee	I.F.R.B. topics	Rec. 177	VI
970	Drafting Committee	Basic prediction information for ionospheric propagation	Rec. 176	VI
971	Drafting Committee	Publication of service codes in use in the international telegraph service	Report 90	XIII
972	Drafting Committee	Choice of intermediate frequency and protection against undesired responses of superheterodyne receivers	Report 41	II
973	Drafting Committee	Frequency stability of receivers	Question 124	II
974	Drafting Committee	The gain of a television transmission circuit	Rec. 213	XI
975 ⁴	Drafting Committee	Non-linear effects in the troposphere	Res. 27	VI
976	Drafting Committee	Ground-wave propagation over irregular terrain	Report 44	IV
977	Drafting Committee	Modification to Report No. 23	Report 55	VI
978	Drafting Committee	Publication of new ground-wave propagation curves	Res. 22	IV
979	Drafting Committee	Selectivity of receivers	Rec. 155	II
980	Drafting Committee	Questions submitted by the I.F.R.B.	Report 56	VI
981	Drafting Committee	Frequency stability of receivers	Rec. 156	II
982	Drafting Committee	Interference in the frequency bands used for tropical broadcasting	Study Prog. 114	XII
983	Drafting Committee	Design of transmitting aerials for tropical broadcasting	Report 87	XII
984	Drafting Committee	Radio transmission caused by inhomogeneities in the troposphere (commonly termed "scattering")	Rec. 24	V

No.	Submitted by	Title	Subject	Study Group
985	C.C.I.R. Secretariat	Minutes of the seventh plenary meeting (7th September 1956)	—	Plenary Assembly
986	C.C.I.R. Secretariat	Minutes of the eighth plenary meeting (10th September 1956)	—	Plenary Assembly
987	Drafting Committee	Modification to Rec. No. 142. Nomenclature of the frequency and wavelength bands used in radio communication	Rec. 225	XIV
988	Drafting Committee	Means of expression	Report 94	XIV
989	Drafting Committee	Definitions of certain basic words used in the International Telecommunication Convention	Res. 34	XIV
990	Drafting Committee	Decimal classification	Report 95	XIV
991	Study Group XII	Summary record of the sixth meeting (5th September 1956)	—	XII
992	Denmark	Radio relay systems employing ionospheric scatter propagation	Draft New Question	Plenary Assembly
993	C.C.I.R. Secretariat	Minutes of the ninth plenary meeting (10th September 1956)	—	Plenary Assembly
994	Drafting Committee	Noise and sensitivity of receivers	Rec. 154	II
995	Drafting Committee	Terms of reference of the C.C.I.R. Study Groups	—	I to XIV
996	Drafting Committee	Reduction of preparatory documentation	Res. 35	—
997	Drafting Committee	Organisation of C.C.I.R. work	Res. 36	—
998	Drafting Committee	Work of C.C.I.R. Study Groups	Res. 37	—
999	C.C.I.R. Secretariat	Minutes of the tenth plenary meeting (11th September 1956)	—	Plenary Assembly
1000	C.C.I.R. Secretariat	List of documents issued (Nos. 951-1009)	—	—
1001	Drafting Committee	Technical Assistance	Res. 38	—
1002	C.C.I.R. Secretariat	Proposed assignment to the Study Groups of the findings of the VIIIth Plenary Assembly	—	—
1003	Technical Assistance Committee	Minutes of the third meeting of the Technical Assistance Committee (11th September 1956)	—	—

No.	Submitted by	Title	Subject	Study Group
1004	C.C.I.R. Secretariat	Minutes of the eleventh plenary meeting (12th September 1956)	—	Plenary Assembly
1005	C.C.I.R. Secretariat	Minutes of the twelfth plenary meeting (12th September 1956)	—	Plenary Assembly
1006	C.C.I.R. Secretariat	Minutes of the thirteenth plenary meeting (13th September 1956)	—	Plenary Assembly
1007	C.C.I.R. Secretariat	Minutes of the fourteenth and last plenary meeting (13th September 1956)	—	Plenary Assembly
1008	Finance Sub-Committee	Final report of the Finance Sub-Committee	—	—
1009	C.C.I.R. Secretariat	List of addenda, corrigenda and revised documents	—	—

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LIST OF DOCUMENTS OF THE VIIIth PLENARY ASSEMBLY

Note — The indices against the numbers of some of the documents have the following meaning:

- * documents mentioned in Vol. I
- 1 documents having one corrigendum
- 2 documents having two corrigenda
- 3 documents having an addendum
- 4 documents which have been revised

B. Classified by Study Groups

No.	Subject	Submitted by	Reference	Other Study Group concerned
STUDY GROUP No. I				
1	Arrangement of channels in multi-channel telegraph systems for long-range radio circuits operating on frequencies below about 30 Mc/s	Federal German Republic	Question 74	—
9*1	Rounding of radiotelegraph signals and adjacent-channel interference	Belgium	Study Progs. 39 and 43	II
10	Note on the operation of radio spectrum analysers	Belgium	Study Prog. 40	—
99	Harmonics and parasitic emissions	Federal German Republic	Study Prog. 2	—
101 ³	Report of Chairman of Study Group No. I	Chairman, Study Group I	—	—
120	Frequency stabilisation of flexible oscillators	Czechoslovakia	Question 1 Study Prog. 3	—
121	Twinplex radiotelegraphy	U.S.S.R.	Question 20	—
126	Frequency stabilisation of transmitters (a)	Netherlands	Study Prog. 3 Question 1 (Item c)	—
127	Frequency stabilisation of transmitters (b)	Netherlands	Study Prog. 3 Question 1 (Item c)	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
132	Oscillator of a long-wave transmitter	Finland	Study Prog. 3	—
163	Four-frequency diplex	United Kingdom	Study Prog. 41	—
164	Four-frequency diplex	United Kingdom	Study Prog. 41	—
165	Frequency stabilisation of transmitters	United Kingdom	Question 1 c) Study Prog. 3	—
166	Frequency stabilisation of transmitters	Union of South Africa	Study Prog. 3	—
174*	Theoretical and experimental study of mutual interference of radio systems	France	Questions 1 and 3 Study Prog. 39, 43 and 45	II, III
177	Statistical measurements of telegraph distortion in the presence of noise	France	Questions 3 and 18	III
178	Description of a statistical distortion measuring set	France	Questions 3 and 18	III
184	Frequency stabilisation of transmitters	France	Question 1 c) Study Prog. 3	—
185	Limitation of unwanted radiation from industrial installations	France	Question 75	—
203	Frequency stabilisation of transmitters	P. R. of Poland	Question 1 Study Prog. 3	—
207	Apparatus for measuring the level of unwanted radiation from industrial installations	P. R. of Poland	Question 75	—
216*	Measurement of bandwidth of radiotelegraph emissions	P. R. of Poland	Study Prog. 40	—
273	Frequency stabilisation of transmitters	Netherlands	Study Prog. 3	—
275	Harmonics and parasitic emissions	United Kingdom	Study Prog. 2	—
276	Harmonics and parasitic emissions	United States of America	Question 1 (b) Study Prog. 2	—
277	Frequency stabilisation of transmitters	United States of America	Question 1 (c) Study Prog. 3	—
278	Limitation of unwanted radiation from industrial installations	United States of America	Question 75	—
279	Limitation of unwanted radiation from industrial installations	Federal German Republic	Question 75	—
280	A brief description of the spectrum analyser	Belgium	Study Prog. 40	—
297*	Frequency-shift keying	United States of America	Question 20 Rec. 92	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
304	Conclusions of the Brussels meeting, 1955	Chairman, Study Group I	Study Prog. 40	—
305	Conclusions of the Brussels meeting, 1955 (Brussels Doc. 86)	Chairman, Study Group I	Study Prog. 39	—
306	Conclusions of the Brussels meeting, 1955 (Brussels Doc. 100)	Chairman, Study Group I	Study Prog. 3	—
307	Conclusions of the Brussels meeting, 1955 (Brussels Doc. 89)	Chairman, Study Group I	Study Prog. 2	—
308	Report on the work of C.C.I.T. Study Group I. Definition of "Telegraph channel"	Chairman, Study Group I	Question 74	—
309*	Report on the Meeting of C.C.I.T. Study Group I (June, 1955)	Chairman, Study Group I	Question 18	—
310	United Kingdom Rapporteur, C.C.I.T. Study Group I: Report on questions under study by C.C.I.T. Study Group I	Chairman, Study Group I	Question 18	—
311	Report by the Chairman of C.C.I.T. Study Group I: Comments and proposals on telegraph modulation and distortion	Chairman, Study Group I	Question 18	—
312*	Bandwidth of emissions and methods of measuring emitted spectre in actual traffic	Japan	Study Progs. 39 and 40	—
313	Harmonics and parasitic emissions	Japan	Study Prog. 2	—
314	Proposal on frequency-shift keying	Japan	Question 20 Study Prog. 41 Rec. 92	—
315	Proposal on arrangement of channels in multi-channel telegraph systems for long-range radio circuits operating on frequencies below about 30 Mc/s	Japan	Question 74	—
316	Limitation of unwanted radiation from industrial installations	Japan	Question 75	—
343	Provisional note on harmonic measurements	Belgium	Study Prog. 2	—
344	Report on comparative tests carried out from 14th-22nd March, 1955	C.C.I.R. Working Group on bandwidth measurement apparatus	Study Prog. 40	—
355*	Bandwidth occupied by a class A1 emission	Belgium	Study Progs. 39 and 40	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
359*	Note: Replies to C.C.I.R. circular letter G.I/129 and questionnaire (Annexes A to R)	C.C.I.R. Secretariat	Question 74	—
369	Frequency stabilisation of transmitters	Japan	Study Prog. 3	—
371	Frequency stabilisation of transmitters	Australia	Study Prog. 3	—
372	Limitation of unwanted radiation from industrial installations	Netherlands	Question 75	—
375	Comments on Brussels Doc. Nos. 9 and 28	Belgium	Study Progs. 2 and 3	—
384	Frequency stabilisation of transmitters	Federal German Republic	Study Prog. 3	—
385	Frequency stabilisation of transmitters	Italcable	Study Prog. 3	—
392	Reply to the Chairman's questionnaire	P. R. of Poland	Question 75	—
395	Reply to the Chairman's questionnaire	Federal German Republic	Question 75	—
404	Apparatus for measuring frequency deviation in the channels of FSK radiotelegraph systems	U.S.S.R.	Question 20	—
405*	Measurements of emission bandwidths of radiotelegraph transmitters made in the U.S.S.R.	U.S.S.R.	Study Prog. 40	—
406	A high-frequency wattmeter	U.S.S.R.	—	—
419	Limitation of unwanted radiation from industrial installations	United States of America	Question 75	—
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
432	Limitation of unwanted radiation from industrial installations	Netherlands	Question 75	—
436	Telegraph distortion	Federal German Republic	Question 18 Rec. 93	—
441	Limitation of unwanted radiation from industrial installations	Sweden	Question 75	—
442*	Communication to the C.C.I.R.	I.F.R.B.	Information requested by the I.F.R.B.	II, III, VI
448	Frequency stabilisation of broadcasting transmitters	European Broadcasting Union	Question 1 (c) Study Prog. 3	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
455	Contribution to the improvement of automatic-sweep (panoramic) spectroscopes	Spain (Transradio Española)	Study Prog. 40 Rec. 88	—
456	Memorandum for the Study Groups	Chairman, Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV
457	Broadcast transmitters: Harmonics and parasitic emissions	European Broadcasting Union	Question 1 (c) Study Prog. 2	—
481	Requirements concerning transmitters and receivers for the land mobile radio service on VHF and UHF	Sweden	Proposed New Question	II
495	Comments on some questions related to Study Groups I, II and III	I.F.R.B.	—	II, III
522	Recent findings of the C.I.S.P.R.	C.C.I.R. Secretariat	—	III
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
542	Summary record of the first meeting (10th August 1956)	Study Group I	—	—
561	Arrangement of channels in multi-channel telegraph systems for long range radio circuits operating on frequencies below about 30 Mc/s	Italy	Question 74	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
625	Summary record of the second meeting (23rd August 1956)	Study Group I	—	—
665	Summary record of the third meeting (28th August 1956)	Study Group I	—	—
675	Modification to Rec. 87	Drafting Committee	Rec. 145	—
725	Summary record of the fourth meeting (29th August 1956)	Study Group I	—	—
734	Spurious radiation	Study Group I	Draft Rec.	—
745	Draft amendment of Recommendation No. 92	Sub-Group I-B	Recommendation 92	—
746	Report on paragraph 6 of Recommendation 92	Sub-Group I-B	Recommendation 92	—
775	Four-frequency duplex systems	Drafting Committee	Rec. 152	—
776	Four-frequency duplex systems	Drafting Committee	Study Prog. 83	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
778	Arrangement of channels in multi-channel radio telegraph systems for long-range circuits operating on frequencies below about 30 Mc/s	Drafting Committee	Report 39	—
779	Arrangements of channels in multi-channel radio telegraph systems for long-range circuits operating on frequencies below about 30 Mc/s	Drafting Committee	Rec. 153	—
780	Amendment to Recommendation 91	Drafting Committee	Rec. 149	—
819	Frequency-shift keying	Drafting Committee	Report 40	—
820	Amendment of Recommendation 92. Frequency-shift keying	Drafting Committee	Rec. 150	—
844	Frequency-shift keying (Amendment to Rec. 92)	Drafting Committee	Rec. 150	—
845	Telegraph distortion (Modification to Rec. No. 93)	Drafting Committee	Rec. 151	—
846	Bandwith of emissions (Modification to Study Prog. 39)	Drafting Committee	Study Prog. 82	—
847	Definition of the bandwidth of emissions	Drafting Committee	Rec. 146	—
857	Determination of the type of emission producing minimum interference	Drafting Committee	Report 38	—
860	Spurious radiation	Drafting Committee	Rec. 147	—
878	Summary record of the 5th and last meeting (31st August 1956)	Study Group I	—	—
899	Frequency stabilisation of transmitters	Drafting Committee	Rec. 148	—
904	Measurement of unwanted radiations from industrial installations	Drafting Committee	Res. 20	—
958	Spurious radiation	Denmark	—	—
961	Limitation of unwanted radiation from industrial installations	Drafting Committee	Study Prog. 84	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV

No.	Subject	Submitted by	Reference	Other Study Group concerned
STUDY GROUP No. II				
2*	Protection against keyed interfering signals	Netherlands	Study Progs. 42 and 43	—
3*	Frequency stability of receivers	Federal German Republic	Question 77	—
4	The responses of radio receivers to quasi-impulsive interference	U.R.S.I.	Question 79	—
5	The responses of radio receivers to quasi-impulsive interference	Federal German Republic	Question 79	—
6*	Choice of the intermediate frequency and protection against undesired responses of super-heterodyne receivers	Federal German Republic	Question 78	—
7*	Sensitivity and noise factor. Noise and sensitivity of receivers	Federal German Republic	Question 76 Rec. 94	—
8*	Undesired emissions from receivers	Federal German Republic	Question 80	—
9*1	Rounding of radiotelegraph signals and adjacent channel interference	Belgium	Study Progs. 39 and 43	I
102	Report of Chairman of Study Group No. II	Chairman, Study Group II	—	—
119*	Frequency stability of receivers	Czechoslovakia	Question 77	—
136*	Undesired emissions from receivers	United Kingdom	Question 80	—
137*	Selectivity of receivers	United Kingdom	Study Prog. 42	—
156	The responses of radio receivers to quasi-impulsive interference	United Kingdom	Question 79	—
157*	Choice of intermediate frequency and protection against undesired responses of super-heterodyne receivers	United Kingdom	Question 78	—
158*	Frequency stability of receivers	United Kingdom	Question 77 (Item 1)	—
159*	Frequency stability of receivers	United Kingdom	Question 77 (Item 2)	—
160*	Frequency stability of receivers	United Kingdom	Question 77 (Item 3)	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
161*	Sensitivity and noise factor	United Kingdom	Question 76	—
162	Sensitivity and noise factor of receivers	United Kingdom	Question 76	—
174*	Theoretical and experimental study of mutual interference of radio systems	France	Questions 1 and 3 Study Progs. 39, 43 and 45	I, III
180	The responses of radio receivers to quasi-impulsive interference	France	Question 79	—
181*	Undesired emissions from receivers	France	Question 80	—
199*	Sensitivity and noise factor	France	Question 76	—
215*	Definition and measurement of the usable sensitivity of the vision channel of television receivers	P. R. of Poland	Question 76	—
227*	Sensitivity and noise factor	United Kingdom	Question 76	—
231*	Selectivity of receivers	United Kingdom	Study Prog. 42	—
257*	Measurement of group-delay/frequency characteristics	Netherlands	Study Prog. 42 (Point 3)	—
302*	Radiation from radio receivers in the frequency range below 30 Mc/s	P. R. of Poland	Question 80	—
317*	Sensitivity and noise factor	Japan	Question 76	—
318*	Selectivity of receivers	Japan	Study Prog. 42	—
319* ¹	Protection against keyed interfering signals	Japan	Study Prog. 43 (Point 4)	—
368	The responses of radio receivers to quasi-impulsive interference	Japan	Question 79	—
394*	Frequency stability of receivers	France	Question 77	—
398*	Data on sensitivity, selectivity, stability and spurious radiation for sound and vision receivers	Italy	Questions 76 & 80 Recs. 94, 95 & 96 Study Prog. 42	XI
399 ³	Undesired emissions from receivers	Italy	Question 80	XI
413	The effect of impulsive interference on FM receivers	U.S.S.R.	Question 79	—
414	Suppression of impulsive interference by the compensation method	U.S.S.R.	—	—
415	The theory of methods of measuring fluctuating noise	U.S.S.R.	—	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
442*	Communication to the C.C.I.R.	I.F.R.B.	Information requested by the I.F.R.B.	I, III, VI
445*	Sensitivity and noise factor	Sweden	Question 76	—
446*	Selectivity of receivers	Sweden	Study Prog. 42	—
449*	Undesired emissions from receivers	Sweden	Question 80	—
456	Memorandum for the Study Groups	Chairman, Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV
480	The response of radio receivers to quasi-impulsive interference	Sweden	Question 79	—
481	Requirements concerning transmitters and receivers for the land mobile radio service on VHF and UHF	Sweden	Proposed new Question	I
488*	Selectivity of receivers	Federal German Republic	Study Prog. 42	—
495	Comments on some questions related to Study Groups I, II and III	I.F.R.B.	—	I, III
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
528	Cooperation between the C.C.I.R. and S.C. 12-1 of the I.E.C. in the field of spurious radiations from receivers	Italy	Question 80	XI
547	Summary record of the first meeting (13th August 1956)	Study Group II	—	—
553*	Selectivity of receivers	Federal German Republic	Study Prog. 42	—
570	Comments on the tests carried out for the determination of the protection required by a broadcasting service in the presence of interference	I.F.R.B.	—	III, VI, X and XIII
586	Proposed new Question	United Kingdom	Proposed new Question	—
587	Summary record of the second meeting (17th August 1956)	Study Group II	—	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV

No.	Subject	Submitted by	Reference	Other Study Group concerned
601	Undesired emissions from broadcast and television receivers	Study Group II	Draft Rec.	—
602	Undesired emissions from receivers	Study Group II	Draft Question	—
606	The response of broadcast and television receivers to quasi-impulsive interference	Study Group II	Draft Rec.	—
607	The usable sensitivity of radio receivers in the presence of quasi-impulsive interference	Study Group II	Draft Question	—
608 ³	Selectivity of receivers	Study Group II	Draft Rec.	—
609	Selectivity of receivers	Study Group II	Draft Question	—
630 ³	Frequency stability of receivers	Study Group II	Draft Rec.	—
692	Summary record of the third meeting (27th August 1956)	Study Group II	—	—
722	Sensitivity and noise factor	Study Group II	Draft Question	—
723 ³	Noise and sensitivity of receivers	Study Group II	Draft Rec.	—
754	Frequency stability of receivers	Study Group II	Draft Question	—
765	Sensitivity, selectivity and stability of frequency-modulation sound-broadcasting receivers and television receivers	Study Group II	Draft Rec.	—
766	Sensitivity, selectivity and stability of amplitude-modulation sound-broadcasting receivers	Study Group II	Draft Rec.	—
781	Selectivity of receivers	Drafting Committee	Question 128	—
851	Distortion in frequency-modulation receivers due to multi-path propagation	Study Group II	Draft Question	—
858	Choice of intermediate frequency and protection against undesired responses of superheterodyne receivers	Study Group II	Draft Report	—
874	Summary record of the 4th meeting (30th August 1956)	Study Group II	—	—
876	Summary record of the 5th and last meeting (3rd September 1956)	Study Group II	—	—
912	Undesired emissions from receivers excluding sound broadcast and television	Drafting Committee	Question 126	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
913	Undesired emissions from broadcast and television receivers	Drafting Committee	Rec. 160	—
923	Sensitivity, selectivity and stability of amplitude-modulation sound-broadcasting receivers	Drafting Committee	Rec. 157	—
924	Sensitivity and noise factor	Drafting Committee	Question 123	—
925	Sensitivity, selectivity and stability of frequency-modulation sound-broadcasting receivers and television receivers	Drafting Committee	Rec. 158	—
926	Response of broadcast and television receivers to quasi-impulsive interference	Drafting Committee	Rec. 159	—
927	The usable sensitivity of radio receivers in the presence of quasi-impulsive interference	Drafting Committee	Question 125	—
928	Distortion in frequency-modulation receivers due to multipath propagation	Drafting Committee	Question 127	—
972	Choice of intermediate frequency and protection against undesired responses of superheterodyne receivers	Drafting Committee	Report 41	—
973	Frequency stability of receivers	Drafting Committee	Question 124	—
979	Selectivity of receivers	Drafting Committee	Rec. 155	—
981	Frequency stability of receivers	Drafting Committee	Rec. 156	—
994	Noise and sensitivity of receivers	Drafting Committee	Rec. 154	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV
STUDY GROUP No. III				
11	The use of radio circuits in association with 5-unit start-stop telegraph apparatus	Federal German Republic	Question 83	—
12	The use of radio-circuits in association with 5-unit start-stop telegraph apparatus	Federal German Republic	Study Prog. 50	—
13	Communication theory	U.R.S.I.	Study Prog. 47	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
14*	Communication theory	U.R.S.I.	Question 44	—
15	Communication theory	U.R.S.I.	Rec. 107	—
16	Interim report on experiments on minimum signal-to-noise ratio necessary for various communication services	Japan	Study Progs. 44 and 45	—
17	Improvement obtainable from the use of directional antennae	Federal German Republic	Study Prog. 48 (Item 1)	—
18	Determination of the maximum interference levels tolerable in complete systems	Federal German Republic	Question 84	—
19	Directivity of antennae at great distances	Federal German Republic	Question 81	—
103	Report of Chairman of Study Group No. III	Chairman, Study Group III	—	—
138	The use of radio circuits in association with 5-unit start-stop telegraph apparatus	United Kingdom	Study Prog. 50	—
139	Directivity of aerials	United Kingdom	Study Prog. 45 Rec. 103	—
174*	Theoretical and experimental study of the mutual interference of radio systems	France	Questions 1 and 3 Study Progs. 43 and 45	I, II
175	Protection from interference obtained in practice with directional rhombic antennae	France	Question 81 Study Prog. 48	—
176	Channel separation achieved in practice	France	Rec. 98	—
177	Statistical measurements of telegraph distortion in the presence of noise	France	Questions 3 and 18	I
178	Description of a statistical distortion measuring set	France	Questions 3 and 18	I
194	Average power gain obtainable through use of a directional antenna as opposed to a dipole	France	Study Prog. 48	—
204	Quality measure of Chebyshev filters	P. R. of Poland	Study Prog. 45	—
210	Communication theory. The concept of entropy in continuous distributions	R. P. of Poland	Study Prog. 47	—
211	Communication theory. The problem of communication when signals and noise are non-stationary Gaussian	P. R. of Poland	Study Prog. 47	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
212	Minimum signal distortion and noise power in linear filters	P. R. of Poland	Question 3 Study Prog. 45	—
265	Directivity of antennae used in the frequency band 3-30 Mc/s	Netherlands	Study Prog. 48 Rec. 103	—
299	Limitation of the parameters of directional antennae in ionospheric and tropospheric radio-communication	P. R. of Poland	New Question	—
320	Directivity of antennae at great distances	Japan	Question 81	—
321	Use of directional antennae	Japan	Rec. 103	—
348	Communication theory	Netherlands	Question 44 Study Prog. 47	—
401	Protection from interference in systems with correcting codes	U.S.S.R.	Question 44 Study Prog. 47	—
402	Probability of interference to broadcast reception when the U.S.S.R. standards for man-made interference are observed	U.S.S.R.	Question 84	—
403	The theory of ideal coding in binary transmission	U.S.S.R.	Question 44	—
422	Frequency-division multiplex radiotelegraphy systems with reduced bandwidth	Italy and the Netherlands	Study Prog. 46	—
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
438*	Transmission over radio circuits of supplementary signals required, for example, in the international Telex service	C.C.I.T. Study Group VII	Question 109 (C.C.I.T. Question 82)	—
442*	Communication to the C.C.I.R.	I.F.R.B.	Information required by the I.F.R.B.	I, II, VI
452*	Summary of the report of C.C.I.T. Study Group III	C.C.I.T.	C.C.I.T. Ques. 42 and 43 (C.C.I.R. Ques. 83)	—
456	Memorandum for the Study Groups	Chairman, Study Group XIV	C.C.I.R. pro- visional list of terms and definitions	I to XIV
458	Extract from the preliminary report of Study Group IX of the C.C.I.T.	C.C.I.T.	C.C.I.T. Question 83 (C.C.I.R. Question 110)	—
472	Distortion observed on radiotelegraph circuits	France	Question 83	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
476	A comparative study of several interference-resistant codes	U.S.S.R.	Question 83 Study Prog. 50	—
477	Measurement of the field strength of atmospheric interference	U.S.S.R.	Study Prog. 49	—
495	Comments on some questions related to Study Groups I, II and III	I.F.R.B.	—	I, II
522	Recent findings of the C.I.S.P.R.	C.C.I.R. Secretariat	—	I
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
532	Improvement obtainable from the use of directional antennae	United States of America	Question 81	—
533	Communication theory	United States of America	Study Prog. 47	—
544	Summary record of the first meeting (13th August 1956)	Study Group III	—	—
567	Summary record of the second meeting (16th August 1956)	Study Group III	—	—
570	Comments on the tests carried out for the determination of the protection required by a broadcasting service in the presence of interference	I.F.R.B.	—	II, VI, X, XII
589	Summary record of the third meeting (20th August 1956)	Study Group III	—	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
654	Summary record of the fourth meeting (27th August 1956)	Study Group III	—	—
688	Draft Question (formerly Question 83)	Sub-Group III-C	Draft Question	—
689	Use of radio circuits in association with 5-unit start-stop telegraph apparatus	Sub-Group III-C	Draft Rec.	—
696	Determination of the required interference protection ratios between various classes of emissions	Study Group III	Draft Question	—
697 ⁴	Revision of Recommendation No. 105. Fading allowances for the various classes of service	Rec. 105	—	—
698 ⁴	Revision of Recommendation No. 99. Bandwidths and signal-to-noise ratios in complete systems	Rec. 99	—	—
728	Use of radio circuits in association with 5-units start-stop telegraph apparatus	Sub-Group III-C	Draft Report	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
785	Summary record of the fifth meeting (28th August 1956)	Study Group III	—	—
786	Summary record of the sixth meeting (30th August 1956)	Study Group III	—	—
818	The use of radio circuits in association with 5-unit start-stop telegraph apparatus	Drafting Committee	Question 129	—
831	Signal-to-interference protection ratios	Study Group III	Draft Rec.	—
832	Determination of the required interference protection ratios between various classes of emission	Study Group III	Draft Question	—
886	Communication theory	Drafting Committee	Question 133	—
887	Communication theory	Drafting Committee	Rec. 165	—
888	Communication theory	Drafting Committee	Study Prog. 86	—
895	Unit of quantity of information	Drafting Committee	Rec. 166	—
920	Modification to Rec. No. 103. Use of directional antennae	Drafting Committee	Rec. 162	—
921	Modification to Study Prog. No. 48. Improvement obtainable from the use of directional antennae	Drafting Committee	Study Prog. 85	—
930	Determination of the required interference protection ratios between various classes of emission	Drafting Committee	Question 131	—
931	Revision of Rec. No. 105. Fading allowances for the various classes of service	Drafting Committee	Rec. 164	—
932	Modification to Rec. No. 99. Bandwidth and signal-to-noise ratio in complete systems	Drafting Committee	Rec. 161	—
939	Use of radio circuits in association with 5-unit start-stop telegraph apparatus	Drafting Committee	Report 42	—
940	The use of radio circuits in association with 5-unit start-stop telegraph apparatus	Drafting Committee	Rec. 167	—
941	Signal-to-interference protection ratios	Drafting Committee	Rec. 163	—
942	Summary record of the seventh and last meeting (7th September 1956)	Study Group III	—	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV

No.	Subject	Submitted by	Reference	Other Study Group concerned
STUDY GROUP No. IV				
20*	Extension of the C.C.I.R. propagation curves below 300 kc/s	United Kingdom	Res. 10	—
21*	Diffraction of metric waves on mountain ranges, lengthy hills, and other obstacles	Czechoslovakia	Study Progs. 54 and 79	V
22*	Ground-wave propagation over irregular terrain	United Kingdom	Study Prog. 54	—
23	Effects of tropospheric refraction on frequencies below 10 Mc/s	United Kingdom	Study Prog. 51 (Item 2)	—
24*	Temporal variation of ground-wave field strengths	Federal German Republic	Study Prog. 52	—
25*1	Ground-wave propagation over mixed paths	United Kingdom	Study Prog. 53	—
96*	The effect of hills and other obstacles in diffracting waves in either the horizontal or the vertical plane	Federal German Republic	Question 6 (Para. 2) Study Prog. 54 (Paras 1 & 5)	—
104*1	Report of Chairman of Study Group No. IV	Chairman, Study Group IV	—	—
140*	Temporal variation of ground-wave field strength	United Kingdom	Study Prog. 52	—
182*	Temporal variation of ground-wave field strength	France	Study Prog. 52	—
183*	Ground-wave propagation over irregular terrain	France	Study Prog. 54	—
196*	Effects of tropospheric refraction on frequencies below 10 Mc/s	France	Question 6 Study Prog. 51	—
217	Results of measurements and calculations of ground-wave field strengths in the vicinity of the Szczecin coast-lakes	P. R. of Poland	Study Prog. 53	—
220*	Temporal variation of ground-wave field strength	F. P. R. of Yugoslavia	Study Prog. 52	—
221*	Ground-wave propagation over mixed paths	F. P. R. of Yugoslavia	Study Prog. 53	—
222	Calculation of the ground-wave phase constant	F. P. R. of Yugoslavia	Study Prog. 53	—
225	Determination of the electrical characteristics of the surface of the earth	Czechoslovakia	New Question	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
230	Ground-wave propagation over mixed paths	United Kingdom	Study Prog. 53	—
253	Use of cymomotive force as a measure of radiation at frequencies above 30 Mc/s	Italy	Question 49 Rec. 108 (Para. 3)	—
255	Propagation of electro-magnetic waves over the earth across boundaries separating different earth media and coastal refraction	Japan	Study Prog. 53	—
274*	Ground-wave propagation over irregular terrain	Netherlands	Study Progs. 52 and 54	—
322*	Ground-wave propagation over mixed paths	Japan	Study Prog. 53	—
323*	Ground-wave propagation over irregular terrain	Japan	Study Prog. 54	—
340	Ground-wave propagation over mixed paths	Japan	Study Prog. 53 (Paras. 1 & 2)	—
386	Definition of cymomotive force	Italy	Rec. 108 (Para. 3)	—
393*	The various theories on the propagation of ultra-short waves beyond the horizon	Compagnie Générale de T.S.F.	Question 6	—
416	Diffraction of metric waves at mountain ridges, elongated hills and other obstacles	Czechoslovakia	Study Prog. 54	—
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
431*	Extension of the C.C.I.R. propagation curves below 300 kc/s	Federal German Republic	Res. 10 (Item 2)	VI
454*	Extension of Feinberg's theory to the case of electromagnetic wave propagation over an un-homogeneous spherical earth and introduction of an approximate method of computation based on equivalent secondary sources	P. R. of Poland	Question 6 Study Prog. 53	—
456	Memorandum for the Study Groups	Chairman, Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV
474*	Approximate methods for the computation of the field strengths of ultra-short waves taking into consideration the influence of geographical relief	U.S.S.R.	—	—
494	Note by the Chairman of Study Group IV	Chairman, Study Group IV	—	—
501*	Ground-wave propagation over mixed paths	U.S.S.R.	Rec. 109	—
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV

No.	Subject	Submitted by	Reference	Other Study Group concerned
543	Summary record of the first meeting (13th August 1956)	Study Group IV	—	—
560	Summary record of the second meeting (16th August 1956)	Study Group IV	—	—
563*	Theory of mixed path propagation of radio-waves and engineering methods of calculation	U.S.S.R.	—	—
571	Summary record of the third meeting (21th August 1956)	Study Group IV	—	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
646	Summary record of the fourth meeting (24th August 1956)	Study Group IV	—	—
647	Extension of the C.C.I.R. propagation curves below 300 kc/s	Study Groups IV and VI	Draft Report	VI
648	Determination of the electrical characteristics of the surface of the earth	Sub-Group IV-A	Draft Question	—
684	Summary record of the fifth meeting (29th August 1956)	Study Group IV	—	—
782	Extension of the C.C.I.R. propagation curves below 300 kc/s	Drafting Committee	Report 61	VI
803	Determination of the electrical characteristics of the surface of the earth	Drafting Committee	Question 135	—
824	Summary record of the sixth and last meeting (3rd September 1956)	Study Group IV	—	—
826	Ground-wave propagation	Drafting Committee	Question 134	—
834	Temporal variations of ground-wave field strength	Drafting Committee	Report 46	—
885	Presentation of antenna radiation data	Drafting Committee	Rec. 168	—
936	Effects of tropospheric refraction on frequencies below 10 Mc/s	Drafting Committee	Report 45	—
937	Ground-wave propagation over irregular terrain	Drafting Committee	Study Prog. 89	—
956	Amendment to Study Prog. No. 51. Effects of tropospheric refraction on frequencies below 10 Mc/s	Drafting Committee	Study Prog. 87	—
960	Supplement to C.C.I.R. Atlas of propagation curves	Drafting Committee	Res. 21	—
962	Ground-wave propagation over mixed paths	Drafting Committee	Study Prog. 88	—
963	Ground-wave propagation over mixed paths	Drafting Committee	Report 47	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
964	Ground-wave propagation over mixed paths	Drafting Committee	Rec. 169	—
976	Ground-wave propagation over irregular terrain	Drafting Committee	Report 44	—
978	Publication of new ground-wave propagation curves	Drafting Committee	Res. 22	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV
STUDY GROUP No. V				
21*	Diffraction of metric waves on mountain ranges, lengthy hills, and other obstacles	Czechoslovakia	Study Progs. 54 and 79	IV
28	Tropospheric wave propagation	U.R.S.I.	Study Prog. 56	—
29	Propagation data required for wide-band radio systems	U.R.S.I.	Question 85	—
30*	Tropospheric propagation across mountain ridges	Federal German Republic	Study Prog. 79 (Item 1)	—
31	Tropospheric wave propagation	Federal German Republic	Study Prog. 56	—
32	Tropospheric propagation curves for distances well beyond the horizon	Federal German Republic	Study Prog. 55	—
72	Tropospheric wave propagation	United Kingdom	Study Prog. 56	—
73	Measurement of field strength of radio signals	United Kingdom	Study Prog. 19	—
105	Report of Chairman of Study Group No. V	Chairman, Study Group V	—	—
131	Investigation of multipath transmission through the troposphere	United Kingdom	Study Prog. 57	—
141	Tropospheric propagation curves for distances well beyond the horizon	United Kingdom	Study Prog. 55	—
142* ¹	Propagation data required for wide-band radio systems	United Kingdom	Question 85	—
167*	Observations on two signal paths across mountain ridges	C.C.I.R. Secretariat	Study Prog. 79	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
168	Measurement of field strength in the neighbourhood of obstacles	France	Question 86	—
169	Measurement of field strength of radio signals	France	Study Prog. 19	—
170*	Propagation data required for wide-band radio systems	France	Question 85	—
171	Tropospheric propagation curves for distances well beyond the horizon	France	Study Prog. 55	—
172*	Report on the presentation of data in studies of tropospheric-wave propagation	France	Rec. 110	—
173	Tropospheric-wave propagation	France	Study Prog. 56	—
267*	Tropospheric propagation curves for distances well beyond the horizon	Netherlands	Question 101 Study Prog. 55	XI
324*	VHF propagation tests on over-mountain paths	Japan	Study Prog. 79	—
325*	Tropospheric propagation across mountain ridges	Japan	Study Prog. 79	—
330*	A simplified method of observation of intensity distribution by measuring fading parameter	Japan	Study Prog. 57 (Point 3) Study Prog. 66 (Points 1 to 5)	VI
351*	Radio links during atmospheric super-refraction	Italy	Study Prog. 57	—
352*	Propagation curves for ultra-short waves over optical paths	Italy	Study Prog. 56	—
353*	Propagation tests at a frequency of 4000 Mc/s on the Rome-Mt. S. Pancrazio section of the Rome-Pescara wide-band radio relay link	Italy	Question 85	—
354*	Propagation data required for wide-band radio systems	Italy	Question 85	—
366*	Investigation of multipath transmission through the troposphere	Japan	Study Prog. 57	—
367*	Propagation data required for wide-band radio systems	Japan	Question 85	—
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
440	On a theory of long-range VHF propagation (for supplement see Doc. 519)	International Broadcasting Organisation	Study Prog. 56	—
456	Memorandum for the Study Groups	Chairman, Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV

No.	Subject	Submitted by	Reference	Other Study Group concerned
463	Tropospheric propagation curves for distances well beyond the horizon	United States of America	Study Prog. 55	—
489	Electronic computer for the statistical measurement of electromagnetic field strength	Italy	Study Prog. 19	—
497	Tropospheric propagation curves for distances well beyond the horizon	Sweden	Study Prog. 55	—
498	Draft new Question	U.S.S.R.	Question 85	—
519	Supplement to Doc. 440	O.I.R.	Study Prog. 56	—
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
531	Summary record of the first meeting (13th August 1956)	Study Group V	—	—
554	Tropospheric-wave propagation curves	Study Group V	Draft Res.	—
558	Tropospheric-wave propagation	W.M.O.	Study Prog. 56	—
565 ⁴	Draft Report on Study Prog. 79: Tropospheric propagation across mountain ridges	Study Group V	Draft Report	—
566	Draft Report on Study Prog. 57: Investigation on multipath transmission through the troposphere	Study Group V	Draft Report	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
633	Summary record of the third meeting (24th August 1956)	Study Group V	—	—
701	Tropospheric wave propagation	Drafting Committee	—	—
702	Investigation on multipath transmission through the troposphere	Drafting Committee	Report 51	—
755	Radio transmission caused by inhomogeneities in the troposphere (commonly termed "scattering")	Study Group V	Draft Rec.	—
756	Radio transmission caused by inhomogeneities in the troposphere (commonly termed "scattering")	Study Group V	Draft Study Prog.	—
767	Summary record of the fourth and last meeting (30th August 1956)	Study Group V	—	—
770 ⁴	Measurement of field strength in the neighbourhood of obstacles	Drafting Committee	Question 137	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
771	Field-strength measurement. Influence of local conditions on interpretation and accuracy of measurements of field strength	Drafting Committee	Rec. 171	—
772	Measurement of field strength for VHF and UHF broadcast services, including television	Drafting Committee	Question 138	—
773	Tropospheric-wave propagation	Drafting Committee	Study Prog. 90	—
774	Modifications to the titles of the following reports: Reports Nos. 4, 5 and 22	Drafting Committee	Reports 48, 49 and 50	—
812	Tropospheric propagation across mountain ridges	Drafting Committee	Report 52	—
841	Presentation of data in studies of tropospheric-wave propagation. (Modification to Rec. No. 110)	Drafting Committee	Rec. 170	—
842	Propagation data required for wide-band radio systems	Drafting Committee	Report 53	—
843	Propagation data required for wide-band radio systems	Drafting Committee	Question 136	—
889	Radio transmission utilising inhomogeneities in the troposphere (commonly termed "scattering")	Drafting Committee	Study Prog. 91	—
984	Radio transmission caused by inhomogeneities in the troposphere (commonly termed "scattering")	Drafting Committee	Res. 24	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV

STUDY GROUP No. VI

74*	Basic prediction information for ionospheric propagation	United Kingdom	Study Prog. 60	—
75	Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings	U.R.S.I.	Rec. 59	—
76*	Report on the general time distribution of amplitude and its practical uses in observation of rapid fading	Japan	Study Prog. 66	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
77*	Interim report on medium frequency sky-wave measurements	Australia	Study Prog. 63	—
78*	Identification of a precursor indicative of short-term variations of ionospheric propagation conditions	Federal German Republic	Study Prog. 59	—
79*	Identification of precursors indicative of short-term variations of ionospheric propagation conditions	United Kingdom	Study Prog. 59	—
80	Choice of a basic solar index for ionospheric propagation	United Kingdom	Study Prog. 58	—
81*	Basic prediction information for ionospheric propagation	Japan	Study Prog. 60	—
82*	Study of fading	Federal German Republic	Study Prog. 66 (Items 1 to 3)	—
83	On the statistics of the occurrence of the sporadic E layer above central Europe	Czechoslovakia	Study Prog. 60 (Item 3)	—
84	Protection of frequencies used for radio-astronomical measurements	U.R.S.I.	Rec. 118	—
85	Radio propagation at frequencies below 1500 kc/s	U.R.S.I.	Study Prog. 63	—
86	Basic prediction information for ionospheric propagation	U.R.S.I.	Study Prog. 60	—
87	Identification of precursors indicative of short-term variations of ionospheric propagation conditions	U.R.S.I.	Study Prog. 59	—
88	Choice of a basic solar index for ionospheric propagation	U.R.S.I.	Study Prog. 58	—
89*	Investigation of circularly polarised emitted waves propagated via the ionosphere	U.R.S.I.	Res. 14	—
90	Usage and meaning of MUF	U.R.S.I.	Res. 12	—
91	Pulse transmission tests at oblique incidence	U.R.S.I.	Study Prog. 67	—
92*	Study of fading	U.R.S.I.	Study Prog. 66	—
93	Measurement of atmospheric radio noise	U.R.S.I.	Study Prog. 65	—
94	Non-linear effects in the ionosphere	United Kingdom	Study Prog. 61	—
95	Revision of atmospheric radio noise data	U.R.S.I.	Rec. 120	—
98	Pulse transmission tests at oblique incidence	United States of America	Study Prog. 67	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
106	Report of Chairman of Study Group No. VI	Chairman, Study Group VI	—	—
122*	Possibility of long-duration propagation of radio waves around the earth on the lower boundary of the F-layer	Czechoslovakia	Study Progs. 63 and 64	—
123*	Index for activity of solar flares and sudden ionospheric disturbances (SID)	Czechoslovakia	Study Prog. 59	—
124*	The relationship between the daily sum of the geomagnetic K-indices and a certain coefficient characterising the state of the F2 layer on certain days	Czechoslovakia	Study Prog. 59	—
125	Pulse transmission tests at oblique incidence	Federal German Republic	Study Prog. 67	—
143	Measurement of atmospheric radio noise	India	Study Prog. 65	—
145	Radio propagation at frequencies below 1500 kc/s	United Kingdom	Study Prog. 63	—
146	Use of special modulation on the standard-frequency transmissions for assessing the reliability of propagation forecasts	United Kingdom	Study Prog. 62	—
147*	Study of fading	United Kingdom	Study Prog. 66	—
148*	Basic prediction information for ionospheric propagation	United Kingdom	Study Prog. 60 (Part 2)	—
155*	Ionospheric propagation of waves in the band 30 to 300 Mc/s	United Kingdom	Study Prog. 64	—
188	Study of absorption in the ionosphere	France	Rec. 115	—
218	Predictions of relative sunspot number R	Czechoslovakia	Study Prog. 60	—
219*	Predictions of the diurnal curves of critical frequencies $f_F^c(t)$ and $f_E^c(t)$, of MUF and LUF	Czechoslovakia	Study Prog. 60	—
223	The Doppler effect in ionospheric propagation. Influence on communications using frequency-shift keying	Czechoslovakia	New Question	—
241	Pulse transmission tests at oblique incidence	Federal German Republic	Study Prog. 67	—
242	Basic prediction information for ionospheric propagation	Federal German Republic	Study Prog. 60	—
245	Ionospheric propagation data	United States of America	Report 23	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
246	Basic prediction information for ionospheric propagation	United States of America	Study Prog. 60	—
248	Multipath propagation effects and their reduction	United States of America	Study Prog. 59	—
249	Basic prediction information for ionospheric propagation	Spain	Study Prog. 60	—
251*	Basic prediction information for ionospheric propagation	Switzerland	Study Prog. 60 Report 23	—
254	Prediction of solar index	C.C.I.R. Secretariat	Rec. 117	—
256*	Measurement of the polarisation of radio waves reflected by the ionosphere	Netherlands	Res. 14	—
281	Prediction of solar index	United States of America	Rec. 117	—
282	Comparison of short-term forecasts with observed results	United States of America	Rec. 59	—
283	Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings	United States of America	Report 26	—
284*	Modification of master FOT curves used by the 1948 H.F. Broadcasting Conference (Mexico)	United States of America	Report 24 (Annex: Question (a))	—
285*	Calculation of field strength above 1500 kc/s	United States of America	Report 24 (Annex: Question (b))	—
286	Choice of a basic index for ionospheric propagation	New Zealand	Report 25	—
287	Draft Recommendation	Chairmen of Study Groups VI and VII	Study Prog. 62 Study Prog. 68 (Section 6)	VII
288	Report on pulse transmissions between Radio-Kootwijk and Casablanca (B.I.F.)	Chairman of Sub-Group VI-A	Study Prog. 67	—
289*	Night field strengths, 540 to 1600 kc/s	United States of America	Study Prog. 63 (Section 7)	—
298*	Remarks on fading	P. R. of Poland	Study Prog. 66	—
301*	Study of the possibilities of reception of short-wave radio signals at long distances in derogation of MUF	P. R. of Poland	Study Prog. 60	—
303	Some methods for the prediction of sunspot numbers	P. R. of Poland	Rec. 117	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
326*	Basic prediction information for ionospheric propagation	Japan	Study Prog. 60	—
327	Radio propagation at frequencies below about 1500 kc/s	Japan	Study Prog. 63	—
328	Measurement of atmospheric radio noise	Japan	Study Prog. 65	—
329	Measurement of atmospheric radio noise	Japan	Study Prog. 65	—
330*	A simplified method of observation of intensity distribution by measuring fading parameters	Japan	Study Prog. 57 (Point 3) Study Prog. 66 (Points 1 to 5)	V
331*	Study of fading. A simple graphical method of estimating fading statistics in diversity reception	Japan	Study Prog. 66	—
345*	Measurement of atmospheric radio noise	United States of America	Study Prog. 65	—
346*	Basic prediction information for ionospheric propagation	United States of America	Study Prog. 60	—
347*	Identification of precursors indicative of short-term variations of ionospheric propagation conditions	United States of America	Study Prog. 59	—
370	Ionospheric absorption at low and medium frequencies	New Zealand	Rec. 115	—
378*	Ionospheric scatter propagation	Netherlands	Draft Rec.	—
387*	Radio propagation at frequencies below 1500 kc/s	Federal German Republic	Study Prog. 63	—
418*	Results of a measurement campaign carried out under the auspices of the E.B.U.	European Broadcasting Union	Study Prog. 63	—
421	Measurement of atmospheric radio noise	France	Study Prog. 65	—
424	Pulse transmission tests at oblique incidence	France	Study Prog. 67	—
425	Report of the Chairman of the Working Group of Study Group VI. Pulse transmission tests	Chairman of Working Group of Study Group VI	Study Prog. 67	—
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
430*	Practical application and utility of ionospheric propagation data	Spain	Report 23	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
431*	Extension of the C.C.I.R. propagation curves below 300 kc/s	Federal German Republic	Res. 10 (Item 2)	IV
434	Measurement of atmospheric radio noise	United Kingdom	Study Prog. 65	—
442*	Communication to the C.C.I.R.	I.F.R.B.	Information requested by the I.F.R.B.	I, II, III
447	Proposals concerning Rec. No. 118 of the C.C.I.R.	Chairman of U.R.S.I. Com. V	Rec. 118	—
456	Memorandum for the Study Groups	Chairman, Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV
469	Pulse transmission tests at oblique incidence	United States of America	Draft new Study Programme	—
475*	Study of fading	U.S.S.R.	Study Prog. 66	—
487	Report of the Working Group	Working Group on local lightning-flash counters	Rec. 121	—
490	Revision of atmospheric radio noise data	Study Group VI	Rec. 120	—
505	Measurement of atmospheric radio noise	United States of America	Rec. 119 Study Prog. 65 (Section 3)	—
506*	Very-low-frequency long-distance propagation	United States of America	Res. 10	—
507*	Letter to the Chairman of Study Group VI	I.F.R.B.	—	—
513	Summary record of the 1st meeting (10th August 1956)	Study Group VI	—	—
518	Prediction of solar activity	Czechoslovakia	Rec. 117	—
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
541	Summary record of the second meeting (14th August 1956)	Study Group VI	—	—
570	Comments on the tests carried out for the determination of the protection required by a broadcasting service in the presence of interference	I.F.R.B.	—	II, III, X, XII
583	Prediction of the solar index	Sub-Group VI-A	—	—
584	Prediction of the solar index	Sub-Group VI-A	Draft Study Prog.	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
590	New Report to replace Report No. 26	Study Group VI	Draft Report	—
591	Identification of precursors indicative of short-term variations of ionospheric propagation conditions	Study Group VI	Revision of Study Prog. 59	—
592	Choice of a basic index for ionospheric propagation	Study Group VI	Revision of Report 25	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
603	Summary record of the third meeting (20th August 1956)	Study Group VI	—	—
626	Summary record of the fourth meeting (22nd August 1956)	Study Group VI	—	—
629	Basic prediction information for ionospheric propagation. Allowance for ionospheric scattering in calculating radio propagation predictions	Federal German Republic	Study Prog. 60 (Item 1)	—
664	Prediction of the solar index	Drafting Committee	Rec. 172	—
647	Extension of the C.C.I.R. propagation curves below 300 kc/s	Study Groups IV and VI	Draft Report	IV
656	Prediction of solar index	Drafting Committee	Study Prog. 100	—
676 ⁴	Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings	Drafting Committee	Report 58	—
677	Identification of precursors indicative of short-term variations of ionospheric propagation conditions	Drafting Committee	Study Prog. 93	—
678	Choice of a basic index for ionospheric propagation	Drafting Committee	Report 57	—
679	Modification to Study Prog. No. 58	Drafting Committee	Study Prog. 92	—
681	Draft Rec. replacing Rec. No. 118	Study Group VI	Draft Rec.	—
691	Summary record of the fifth meeting (27th August 1956)	Study Group VI	—	—
724	Fading of HF and MF signals propagated by the ionosphere	Study Group VI	Draft Report	—
735	Questions submitted by the I.F.R.B.	Study Group VI	Draft revision	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
736	Report by Sub-Group VI-E to Study Group VI	Sub-Group VI-E	Study Prog. 60	—
744	Basic data for the calculation of ionospheric propagation phenomena	U.S.S.R.	Study Prog. 60	—
777	Comments by the French Delegation on Doc. 676	France	Doc. 676	—
782	Extension of the C.C.I.R. propagation curves below 300 kc/s	Drafting Committee	Report 61	IV
793	Summary record of the sixth meeting (28th August 1956)	Study Group VI	—	—
797	Revision of atmospheric radio noise data	Drafting Committee	Report 65	—
805	Protection of frequencies used for radio astronomical measurements	Drafting Committee	Rec. 173	—
806	Local lightning flash counters	Drafting Committee	Res. 25	—
807	World-wide atmospheric radio noise measurements	Drafting Committee	Rec. 174	—
838	Atmospheric radio noise data	Drafting Committee	Rec. 175	—
839	Measurement of atmospheric radio noise	Drafting Committee	Study Prog. 96	—
840	Use of special modulation on standard frequency transmissions for assessing the reliability of propagation forecasts	Drafting Committee	Study Prog. 94	—
856	Fading of HF (decametric) and MF (hectometric) signals propagated by the ionosphere	Drafting Committee	Report 59	—
906	Summary record of the seventh meeting (30th August 1956)	Study Group VI	—	—
908	Investigation of circularly polarised emitted waves propagated via the ionosphere	Drafting Committee	Report 62	—
909	Regular long-distance transmission in the VHF (metric) band by means of scattering from inhomogeneities in the lower ionosphere	Drafting Committee	Report 64	—
922	Revision of Report No. 7. Long distance propagation of waves of 30 to 300 Mc/s by way of ionisation in the E and F regions of the ionosphere	Drafting Committee	Report 54	—
934	Pulse transmission tests at oblique incidence	Drafting Committee	Study Prog. 97	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
935	The influence of Doppler shifts on long-distance high frequency communication using frequency-shift keying	Drafting Committee	Question 137	—
945	The estimation of sky-wave field strengths on frequencies above about 1500 kc/s	Drafting Committee	Rec. 178	—
946	The estimation of sky-wave field strengths on frequencies above 1500 kc/s	Drafting Committee	Study Prog. 99	—
951	Amendment to Report No. 28. Centralising agencies for the rapid exchange of information on propagation	Drafting Committee	Report 60	—
952	Ionospheric scatter propagation	Drafting Committee	Study Prog. 95	—
953	Radio propagation at frequencies below 1500 kc/s	Drafting Committee	Report 63	—
954	Back-scattering	Drafting Committee	Study Prog. 98	—
955	Ionospheric scatter propagation	Drafting Committee	Rec. 28	—
957	Ionospheric sounding stations	Drafting Committee	Res. 26	—
968	Summary record of the eighth and last meeting (31st August 1956)	Study Group VI	—	—
969	I.F.R.B. topics	Drafting Committee	Rec. 177	—
970	Basic prediction information for ionospheric propagation	Drafting Committee	Rec. 176	—
975 ⁴	Non-linear effects in the troposphere	Drafting Committee	Res. 27	—
977	Modification to Report No. 23	Drafting Committee	Report 55	—
980	Questions submitted by the I.F.R.B.	Drafting Committee	Report 56	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV

No.	Subject	Submitted by	Reference	Other Study Group concerned
STUDY GROUP No. VII				
26	Standard - frequency transmissions and time signals	U.R.S.I.	Rec. 122	—
27	Standard - frequency transmissions and time signals	United States of America	Study Prog. 68	—
97	Transmission of standard frequencies in the HF bands	Czechoslovakia	New Question	—
107	Report of Chairman of Study Group No. VII	Chairman, Study Group VII	—	—
144	Report on standard-frequency and time-signal transmissions from ZUO - Johannesburg	Union of South Africa	Study Prog. 68	—
149	Report on standard-frequency transmissions	United Kingdom	Study Prog. 68	—
151*	Standard - frequency transmissions and time signals	United Kingdom	Question 87	—
179	Standard - frequency transmissions and time signals	France	Rec. 122 Question 54 Study Prog. 68	—
213* ⁴	Doppler effect in ionospheric propagation	P. R. of Poland	Question 87 Study Prog. 68	—
247	Improvements in standard frequencies broadcast by radio stations WWV and WWVH	United States of America	Rec. 122 Study Prog. 68	—
252	Standard - frequency transmissions	New Zealand	Study Prog. 68	—
272	Transmission and reception of standard frequencies and time signals	Netherlands	Question 87 Study Prog. 68	—
287	Draft Recommendation	Chairmen of Study Groups VI and VII	Study Progs. 62 and 68 (Section 6)	VI
332	Standard - frequency transmissions and time signals	Japan	Study Prog. 68	—
341	Standard - frequency transmissions and time signals	Italy	Rec. 122 Question 54 Study Prog. 68	—
342	Reception of standard-frequency and time-signal transmissions from WWV in the Netherlands and in Surinam	Netherlands	Question 54 Study Prog. 68	—
376 ³	Determination of the relative deviations of standard frequencies	Czechoslovakia	Study Prog. 68 Question 87	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
382	Standard-frequency transmissions and time signals	Switzerland	Question 87 Study Prog. 68	—
396	Service of standard frequencies and time signals	Argentine Republic	Study Prog. 68 Rec. 122	—
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
433	Reception of standard time signals on the occasion of U.R.S.I. experiments for determination of propagation time of signals	U.R.S.I.	Study Prog. 68	—
439*1	A measurement method for precision comparison of quasi-harmonically related frequencies	International Broadcasting Organisation	Rec. 122 (Paras 7, 8 and 9)	—
456	Memorandum for the Study Groups	Chairman, Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV
479*1	Reception of standard frequencies at the Istituto Superiore delle Poste e Telecomunicazioni. Interference between transmissions	Italy	Study Prog. 68	—
509*	MSF standard frequencies expressed in terms of the caesium resonance	United Kingdom	—	—
527	First list of terms and definitions on which the Study Groups are consulted	—	—	—
534	Standard frequencies and time signals from WWV and WWVH	United States of America	Study Prog. 68	—
536	Summary record of the first meeting (10th August 1956)	Study Group VII	—	—
556	Standard-frequency transmissions and time signals in additional frequency bands	Sub-Group VII-A	Draft new Question	—
557*	Experimental standard-frequency broadcast on 60 kc/s	United States of America	Study Prog. 68	—
588	Summary record of the second meeting (20th August 1956)	Study Group VII	—	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
667	Standard-frequency transmissions and time signals	Sub-Group VII-A	Draft Report	—
703	Standard-frequency transmissions and time signals in additional frequency bands	Drafting Committee	Question 142	—
813	Stability and standard-frequency transmissions and time signals as received	Drafting Committee	Question 141	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
835	Standard - frequency transmissions and time signals	Drafting Committee	Study Prog. 101	—
836	Standard - frequency transmissions and time signals	Drafting Committee	Question 140	—
859	Standard - frequency transmissions and time signals	Drafting Committee	Rec. 179	—
877	Summary record of the 3rd and last meeting (30th August 1956)	Study Group VII	—	—
903	Standard - frequency transmissions and time signals	Drafting Committee	Report 66	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV
STUDY GROUP No. VIII				
33	Automatic monitoring of occupancy of the radio-frequency spectrum	United Kingdom	Question 88	—
34*	Spectrum measurement by monitoring stations	United States of America	Study Prog. 70	—
35*	Report on frequency measurements above 50 Mc/s by monitoring stations	Japan	Question 89	—
36	Report on automatic monitoring of occupancy of the radio-frequency spectrum	Japan	Question 88	—
37*	Frequency measurements above 50 Mc/s by monitoring stations	United States of America	Question 89	—
38*	Spectrum measurement by monitoring stations	Federal German Republic	Study Prog. 70	—
39	Automatic monitoring of occupancy of the radio-frequency spectrum	United States of America	Question 88	—
40	Accuracy of field-strength measurements by monitoring stations	United States of America	Study Prog. 69	—
41*	Frequency measurements above 50 Mc/s by monitoring stations	Belgium	Question 89	—
42*	Spectrum measurement by monitoring stations	Belgium	Study Prog. 70	—
43	Accuracy of field-strength measurements by monitoring stations	Belgium	Study Prog. 69	—
108	Report of Chairman of Study Group No. VIII	Chairman, Study Group VIII	—	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
116	Automatic monitoring of occupancy of the radio frequency spectrum	Federal German Republic	Question 88	—
117*	Frequency measurements above 50 Mc/s by monitoring stations	Federal German Republic	Question 89	—
205	Improvement in accuracy of field-strength measurements due to the use of various secondary voltage standards	P. R. of Poland	Study Prog. 69	—
427*	Frequency measurements above 50 Mc/s by monitoring stations	United Kingdom	Question 89	—
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
456	Memorandum for the Study Groups	Chairman of Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV
492	Automatic monitoring of occupancy of the radio-frequency spectrum	Austria	Question 88	—
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
555	Summary record of the first meeting (14th August 1956)	Study Group VIII	—	—
572*	Report on bandwidth measurements carried out by the British Post Office at Banbury radio measuring station	United Kingdom	Study Prog. 70	—
577 ⁴	Automatic monitoring of occupancy of the radio-frequency spectrum	Study Group VIII	Draft Rec. (Question 88)	—
594	Summary record of the second meeting (21st August 1956)	Study Group VIII	—	—
595	Automatic monitoring of occupancy of the radio-frequency spectrum	Study Group VIII	Draft Question	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
632	Summary record of the third meeting (24th August 1956)	Study Group VIII	—	—
634	Measurements by mobile monitoring stations	Study Group VIII	Draft Question	—
635	Frequency measurements above 50 Mc/s by monitoring stations	Study Group VIII	Draft Report	—
636	Proposed revision of Study Programme No. 70. Spectrum measurement by monitoring stations	Study Group VIII	Study Prog. 70	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
637	Draft replacement of Study Programme No. 69. Field strength measurements by monitoring stations	Study Group VIII	Study Prog. 69	—
638	Draft amendment to Rec. No. 123. Accuracy of field strength measurements by monitoring stations	Study Group VIII	Rec. 123	—
639	Automatic monitoring of occupancy of the radio frequency spectrum	Study Group VIII	Draft Question	—
640	Spectrum measurement by monitoring stations	Study Group VIII	Draft Report	—
682	Frequency measurements at monitoring stations	Study Group VIII	Draft new Question	—
683	Draft replacement of Rec. No. 20. Accuracy of frequency measurements at monitoring stations	Study Group VIII	Draft Rec.	—
741	Summary record of the fourth meeting (28th August 1956)	Study Group VIII	—	—
787	Automatic monitoring of occupancy of the radio-frequency spectrum	Drafting Committee	Rec. 182	—
788	Automatic monitoring of occupancy of the radio-frequency spectrum	Drafting Committee	Question 143	—
789	Frequency measurements above 50 Mc/s at monitoring stations	Drafting Committee	Report 67	—
790	Field-strength measurements at monitoring stations	Drafting Committee	Study Prog. 102	—
791	Spectrum measurement at monitoring stations	Drafting Committee	Report 68	—
794	Spectrum measurement at monitoring stations	Drafting Committee	Study Prog. 103	—
795	Measurements at mobile monitoring stations	Drafting Committee	Question 144	—
796	Accuracy of field-strength measurements at monitoring stations	Drafting Committee	Rec. 181	—
861	Frequency measurements at monitoring stations	Drafting Committee	Question 145	—
862	Accuracy of frequency measurements at monitoring stations	Drafting Committee	Rec. 180	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV

No.	Subject	Submitted by	Reference	Other Study Group concerned
STUDY GROUP No. IX				
44	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above 30 Mc/s	United Kingdom	Question 93	—
45	Frequency tolerances for transmitters used in wide-band radio relay systems operating at frequencies above about 30 Mc/s	Federal German Republic	Question 114	—
109	Report of Chairman of Study Group No. IX	Chairman, Study Group IX	—	—
118	Conditions required for the transmission of television signal over a radio relay system	Czechoslovakia	Question 91 (Item 2)	—
130	Hypothetical reference circuit for wide-band radio relay systems. Maintenance procedure for wide-band radio relay systems	United Kingdom	Questions 96 and 97	—
133	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	United Kingdom	Question 93	—
134	Principles of provision of standby plant in multi-channel radio relay systems	United Kingdom	Questions 93 and 96	—
135	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s. Maintenance procedure for wide-band radio relay systems	United Kingdom	Questions 93 and 96	—
189	Maintenance procedure for wide-band radio relay systems	France	Question 96	—
190	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s	France	Question 93	—
191	Standardisation of multi-channel radiotelephone systems using time-division multiplex and operating on frequencies above about 30 Mc/s	France	Question 92	—
192	Frequency tolerances for transmitters used in wide-band radio relay systems operating at frequencies above about 30 Mc/s	France	Question 114	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
193*	Methods for the computation of intermodulation noise due to non-linearity in radio relay systems	France	Question 115	—
195	Procedure for international connexions between radio relay systems with different characteristics	France	Question 113	—
228	Hypothetical reference circuit for wide-band radio relay systems	United Kingdom	Question 97	—
237	Hypothetical reference circuit for wide-band radio relay systems	Federal German Republic	Question 97	—
238	Procedure for international connexions between radio relay systems with different characteristics	Federal German Republic	Question 113	—
239	International wide-band radio relay systems operating on frequencies above about 30 Mc/s	Federal German Republic	Question 90 (Item 3)	—
243	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s	Federal German Republic	Question 93	—
244	Standardisation of international multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s	Federal German Republic	Question 93	—
258	International wide-band radio relay systems operating on frequencies above about 30 Mc/s. Interconnexion of multiplex systems	Netherlands	Question 90	—
259	International wide-band radio relay systems operating on frequencies above about 30 Mc/s. Transmission of telephony and television on the same system	Netherlands	Question 91	—
260	International wide-band radio relay systems operating on frequencies above about 30 Mc/s. Transmission of telephony and television on the same system	Netherlands	Question 91	—
261	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s	Netherlands	Question 93	—
262	Hypothetical reference circuit for wide-band radio relay systems	Netherlands	Question 97	—
263	Hypothetical reference circuit for wide-band radio relay systems	Netherlands	Question 97	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
264	Procedure for international connexions between radio relay systems with different characteristics	Netherlands	Question 113	—
268*	Methods for the computation of intermodulation noise due to non-linearity in radio relay systems	Netherlands	Question 115	—
269	Frequency tolerances for transmitters used in wide-band radio relay systems operating at frequencies above about 30 Mc/s	Netherlands	Question 114	—
270	Maintenance procedure for wide-band radio relay systems	Netherlands	Question 96	—
271	Maintenance procedure for wide-band radio relay systems	Netherlands	Question 96	—
295	Standardisation of multi-channel radiotelephone systems using time-division multiplex and operating on frequencies above about 30 Mc/s	Federal German Republic	Question 92	—
296	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s	Federal German Republic	Question 93	—
333	Procedure for international connexions between radio relay systems with different characteristics	Japan	Question 113	—
334	Standardisation of multi-channel radiotelephone systems using time-division multiplex and operating on frequencies above about 30 Mc/s	Japan	Question 92	—
335	Maintenance procedure for wide-band radio relay systems	Japan	Question 96	—
336	Hypothetical reference circuit for wide-band radio relay systems	Japan	Question 97	—
337	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s	Japan	Question 93	—
339	International wide-band radio relay systems operating on frequencies above about 30 Mc/s	Japan	Question 90	—
360	Characteristics of facsimile apparatus	United States of America	Question 94	—
388*	Methods for the calculation of distortion noise due to non-linearity in radio relay systems	Federal German Republic	Question 115	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
407*	Non-linear distortion due to multipath propagation and mismatching of antenna waveguides in FM multi-channel systems	U.S.S.R.	Question 115	—
408	The influence of limiters on the operation of radio relay links	U.S.S.R.	Study Prog. 28	—
409	Reliability of systems comprising numerous component elements	U.S.S.R.	Question 96	—
410	Ways of calculating the reliability of systems comprising numerous component elements	U.S.S.R.	Question 96	—
411	Means of improving short-wave phototelegraphy	U.S.S.R.	—	—
420	Hypothetical reference circuit for wide-band radio relay systems	France	Question 97	—
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
443	Note by the Secretariat: Documents of Study Group IX meeting, Geneva, 1954	C.C.I.R. Secretariat	Documents of Study Group IX Meeting	—
444*	Demands on the linearity of multi-channel radio link systems with frequency modulation	Federal German Republic (Siemens & Halske A.G.)	Questions 93 and 115	—
456	Memorandum for the Study Groups	Chairman, Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV
460	Hypothetical reference circuit for wide-band radio relay systems	Federal German Republic	Question 97	—
461	Operational characteristics of long distance radio relay systems	Federal German Republic	Question 116	—
462	Test signals for international television transmission circuits	Netherlands Federal German Republic Switzerland	Questions 96 and 40 Study Prog. 32	XI
464*	Methods for the computation of intermodulation noise due to non-linearity in radio relay systems	United States of America	Question 115	—
465	Frequency tolerances for transmitters used in wide-band radio relay systems operating at frequencies above about 30 Mc/s	United States of America	Question 114	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
466	Procedure for international connexions between radio relay systems with different characteristics	United States of America	Question 113	—
473	On the theory of accumulation of noise and fading in major radio relay links	U.S.S.R.	Question 97	—
483	Maintenance procedure for wide-band radio relay systems	Federal German Republic	Question 96	—
502	International standardisation of multi-channel radio relay systems using frequency-division multiplex and operating on frequencies above about 30 Mc/s	F. P. R. of Yugoslavia	Question 93	—
508	Multi-channel radiotelephone systems using time-division multiplex and operating on frequencies above about 30 Mc/s	France	Question 92	—
510	Summary record of the first meeting (10th August 1956)	Study Group IX	—	—
516	Radio transmission by facsimile of meteorological charts	World Meteorological Organisation	Question 94	—
523	Hypothetical reference circuit for wide-band radio relay systems	U.S.S.R.	Question 97	—
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
529	Summary record of the first meeting (13th August 1956)	Sub-Group IX-A	—	—
539	Preferred characteristics of radio relay systems for the transmission of monochrome television	Sub-Group IX-A	Draft Question	—
546 ^a	Summary record of the second meeting (14th August 1956)	Sub-Group IX-A	—	—
562	Summary record of the first meeting (14th August 1956)	Sub-Group IX-B	—	—
564	Summary record of the second meeting (16th August 1956)	Sub-Group IX-B	—	—
568	Summary record of the third meeting (16th August 1956)	Sub-Group IX-A	—	—
575	Draft Recommendation concerning Question No. 113	Sub-Group IX-C	Draft Rec.	—
576	Draft Recommendation concerning Question No. 90	Sub-Group IX-C	Draft Rec.	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
578	Operational characteristics of long-distance radio relay systems	Sub-Group IX-D	Draft Res. (Question 116)	—
579	Preferred characteristics of multi-channel radio-telephone systems using time-division multiplex and operating at frequencies above about 30 Mc/s	Sub-Group IX-D	Draft Rec. (Question 92)	—
580	Preferred characteristics of multi-channel radio-telephone systems using time division multiplex and operating at frequencies above about 30 Mc/s	Sub-Group IX-D	Draft Report (Question 92)	—
582	Preferred characteristics for multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Sub-Group IX-A	Draft Report	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
610	Service channels	Sub-Group IX-C	Draft Report	—
611	Service channels	Sub-Group IX-C	Draft Question	—
612	Transmission of pilot waves over circuits consisting of cable paths and radio relay links	Sub-Group IX-C	Draft Report	—
623	Summary record of the second meeting (21st August 1956)	Study Group IX	—	—
624	Summary notes of second, third and fourth meetings (14st, 20th and 21th, August 1956)	Sub-Group IX-D	—	—
641	Summary record of the third meeting (24th August 1956)	Study Group IX	—	—
659	Hypothetical reference circuit for wide-band frequency-division multiplex radio relay systems with capacity of more than 60 telephone channels	Sub-Group IX-B	Draft Rec.	—
660	Hypothetical reference circuit for wide-band frequency-division multiplex radio relay systems with capacity of 12 to 60 telephone channels	Sub-Group IX-B	Draft Rec.	—
661	Methods for the computation of intermodulation noise due to non-linearity in radio relay systems	Sub-Group IX-B	Draft Report	—
663	Summary record of the third meeting	Sub-Group IX-B	—	—
666	Wide-band radio relay systems. Frequency deviation for television	Sub-Group IX-A	Draft Rec.	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
680	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	F. P. R. of Yugoslavia	Draft Study Prog.	—
685	Standardisation of multi-channel radio relay systems. Radio-frequency interconnexion of 240-channel systems	Sub-Group IX-A	Draft Rec.	—
686	Standardisation of multi-channel relay radio systems. Radio-frequency interconnexion of radio relay systems transmitting television alone or television and multi-channel telephony at frequencies above about 1000 Mc/s	Sub-Group IX-A	Draft Rec.	—
687	Standardisation of multi-channel radio relay systems using frequency-division multiplex	Sub-Group IX-A	Draft Rec.	—
693	Use of special pilot frequencies on wide-band radio relay links for 600 telephone channels	Sub-Group IX-C	Draft Rec.	—
694	Use of special pilot frequencies on wide-band radio relay links for monochrome television of 625 lines and less	Sub-Group IX-C	Draft Rec.	—
695	Interconnexion of wide-band radio relay systems at radio frequencies	Sub-Group IX-A	Draft Rec.	—
704	International wide-band radio relay systems operating on frequencies above about 30 Mc/s	Drafting Committee	Report 69	—
705	International wide-band radio relay systems operating on frequencies above about 30 Mc/s	Drafting Committee	Rec. 187	—
706	Interconnexion at audio frequencies of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Drafting Committee	Rec. 188	—
707	Interconnexion at audio frequencies of multi-channel radiotelephone systems using time-division multiplex and operating at frequencies above about 30 Mc/s	Drafting Committee	Rec. 186	—
708	Preferred characteristics of radio relay systems for the transmission of monochrome television	Drafting Committee	Question 146	—
709	Interconnexion at baseband frequencies of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Drafting Committee	Rec. 189	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
710	Frequency tolerances for transmitters used in wide-band radio relay systems operating at frequencies above about 30 Mc/s	Drafting Committee	Draft Rec.	—
711	Operational characteristics of long-distance radio relay systems	Drafting Committee	Res. 29	—
726	Control of the performance of multi-channel telephone circuits on radio relay systems with the help of a signal with continuous uniform spectrum	Sub-Group IX-C	Draft Rec.	—
727	Draft Recommendation on Question No. 96	Sub-Group IX-C	Draft Rec.	—
729	Preferred characteristics for multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Drafting Committee	Report 71	—
730	Interconnexion at intermediate and radio frequencies of frequency-modulated multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Drafting Committee	Rec. 191	—
731	Interconnexion at intermediate frequencies of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Drafting Committee	Rec. 190	—
732	Procedure for international connexions between radio relay systems with different characteristics	Drafting Committee	Rec. 204	—
733	Preferred characteristics of multi-channel radio-telephone systems using time-division multiplex and operating on frequencies above about 30 Mc/s	Drafting Committee	Report 70	—
738	International wide-band radio-relay systems operating on frequencies above about 30 Mc/s	Drafting Committee	Rec. 183	—
742	Allowable noise power in the hypothetical reference circuit	Study Group IX	Draft Rec.	—
743*	Intermodulation noise in radio relay links	U.S.S.R.	Question 115	—
747	Summary record of the fourth meeting (29th August 1956)	Study-Group IX	—	—
783 ³	Hypothetical reference circuit for wide-band frequency-division multiplex radio relay systems with capacity of 12 to 60 telephone channels	Drafting Committee	Rec. 202	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
784	Methods for the computation of intermodulation noise due to non-linearity in radio relay systems	Drafting Committee	Report 74	—
792	Wide-band radio relay systems. Noise tolerable during very short period of time	Study Group IX	Draft Study Prog.	—
798	Maintenance procedure for wide-band radio relay systems. Service channels	Drafting Committee	Report 72	—
799	Service channels for wide-band radio relay systems	Drafting Committee	Question 147	—
801	Preferred characteristics of multi-channel radio-telephone systems using time-division multiplex and operating at frequencies above about 30 Mc/s	Drafting Committee	Rec. 185	—
802 ³	Hypothetical reference circuit for wide-band frequency-division multiplex radio relay systems with capacity of more than 60 telephone channels	Drafting Committee	Rec. 203	—
808	Interconnexion of wide-band radio relay systems at radio frequencies	Drafting Committee	Rec. 192	—
809	Standardisation of multi-channel radio relay systems. Radio-frequency interconnexion of radio relay systems transmitting television alone or television and multi-channel telephony at frequencies above about 1000 Mc/s	Drafting Committee	Rec. 195	—
810	Wide-band radio relay systems. Frequency deviation for television	Drafting Committee	Rec. 184	—
811	Measurement of the performance of multi-channel telephone circuits on radio relay systems with the help of a signal with continuous uniform spectrum	Drafting Committee	Rec. 197	—
817	Standardisation of multi-channel radio relay systems using frequency-division multiplex	Drafting Committee	Rec. 194	—
821	Standby arrangements for wide-band radio relay systems	Drafting Committee	Rec. 196	—
825	Summary record of the fifth and last meeting (31st August 1956)	Study Group IX	—	—
827	Maintenance procedure for wide-band radio relay systems. Use of special pilot frequencies on wide-band radio relay links for 600 telephone channels	Drafting Committee	Rec. 198	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
828	Maintenance procedure for wide-band radio relay systems. Use of special pilot frequencies on wide-band radio relay links for monochrome television of 625 lines or less	Drafting Committee	Rec. 199	—
848	Standardisation of multi-channel radio relay systems using frequency-division multiplex and operating at frequencies above about 30 Mc/s	Drafting Committee	Study Prog. 104	—
853	Transmission of pilot frequencies over circuits consisting of cable paths and radio relay links	Drafting Committee	Report 73	—
854	Standardisation of multi-channel radio relay systems. Radio-frequency interconnexion of 240-channel telephony system	Drafting Committee	Rec. 193	—
855	Hypothetical reference circuit for time-division multiplex radio relay systems with 60 or less telephone channels	Drafting Committee	Rec. 201	—
896	Summary notes of additional meeting (5th September 1956)	Study Group IX	—	—
916	Radio relay systems employing tropospheric scatter propagation	Drafting Committee	Question 148	—
918	Wide-band radio relay systems. Noise tolerable during very short periods of time	Drafting Committee	Study Prog. 105	—
947	Allowable noise power in the hypothetical reference circuit	Drafting Committee	Rec. 200	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV
STUDY GROUP No. X				
59	Characteristics of oscillation build-up in frequency-modulation systems	Czechoslovakia	Question 99	—
60	High-frequency broadcasting. Use of synchronised transmitters	United Kingdom	Study Prog. 72	—
61	FM broadcasting in the VHF band	United Kingdom	Question 99	—
62	Sound recording on films for the international exchange of television programmes	Federal German Republic	Question 100	—
63	Frequency-modulation broadcasting in the VHF (metric) band	Federal German Republic	Question 99	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
64	Standards of sound recording for the international exchange of programmes	Federal German Republic	Res. 16	—
65*	Standards of sound recording for the international exchange of programmes	Federal German Republic	Study Prog. 74 (Part 1)	—
110	Report of Chairman of Study Group No. X	Chairman, Study Group X	—	—
152*	Standards of sound recording for the international exchange of programmes	United Kingdom	Study Prog. 74	—
186	Sound recording on films for the international exchange of television programmes	France	Question 100	—
187*	Standards of sound recording for the international exchange of programmes	France	Rec. 135 Study Prog. 74	—
197	Standards of sound recording for the international exchange of programmes	France	Res. 16	—
198*	Standards of sound recording for the international exchange of programmes	France	Study Prog. 74	—
206*	Directional antennae for high-frequency broadcasting	P. R. of Poland	New Question	—
208* ¹	Reduction of subsidiary lobes in the radiation pattern of directional antennae	P. R. of Poland	Question 23	—
214*	Programme meters in Polish broadcasting	P. R. of Poland	Report 33 Question 14 (C.C.I.F.)	—
233	Standards of sound recording for the international exchange of programmes	United Kingdom	Rec. 134	—
234	Standards of sound recording for the international exchange of programmes	United Kingdom	Rec. 135	—
235*	Standards of sound recording for the international exchange of programmes	United Kingdom	Rec. 135	—
291	Standards of sound recording for the international exchange of programmes	European Broadcasting Union (E.B.U.)	Res. 16	—
292*	Standards of sound recording for the international exchange of programmes	European Broadcasting Union (E.B.U.)	Study Prog. 74	—
293*	Standards of sound recording for the international exchange of programmes	European Broadcasting Union (E.B.U.)	Rec. 135	—
294	Sound recording on film for the international exchange of television programmes	European Broadcasting Union (E.B.U.)	Question 100	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
362	Standards of sound recording for the international exchange of programmes. Cine type spools	Japan	Res. 16	—
363	Standards of sound recording for the international exchange of programmes. Cine type spools	New Zealand	Res. 16	—
364*	Standards of sound recording for the international exchange of programmes	Japan	Study Prog. 74	—
365	Proposal for the modification of Rec. No. 134: standards of sound recording for the international exchange of programmes	Japan	Rec. 134 Study Prog. 74	—
373	Comments. (Contributions by Japan, New Zealand and France)	Belgium	Study Prog. 74 Res. 16 Question 100	—
374*	Exchange of magnetic test tapes (Annexes A to D)	Japan	Study Prog. 74 (Para. 3)	—
381	Use of the 26 Mc/s broadcasting band	Spain	Res. 17	—
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
456	Memorandum for the Study Groups	Chairman, Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV
459	Standards of sound recording for the international exchange of programmes. Cine type spools	United States of America	Res. 16	—
484	Comments on contributions circulated by the Chairman of the Study Group No. X	South African Broadcasting Corporation	Res. 16	—
485	Comments on contributions circulated by the Chairman of Study Group No. X	South African Broadcasting Corporation	Study Prog. 74	—
486	Comments on contributions circulated by the Chairman of Study Group No. X	South African Broadcasting Corporation	Question 100	—
514	Comments on high-frequency broadcasting	I.F.R.B.	—	—
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
535	Frequency-modulation broadcasting in the VHF (metric) band	United States of America	Question 99	—
537	Summary record of the first meeting (13th August 1956)	Study Group X	—	—
570	Comments on the tests carried out for the determination of the protection required by a broadcasting service in the presence of interference	I.F.R.B.	—	II, III, VI, XII

No.	Subject	Submitted by	Reference	Other Study Group concerned
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
628	High-frequency broadcasting. Justification for use of more than one frequency per programme	Federal German Republic	Study Prog. 37 Question 71	—
658	Organisations qualified to take action on questions of sound recording	Sub-Group X-B	Draft Res.	—
668	High-frequency broadcasting. Directional aerial systems for reception areas of unusual size or shape	Sub-Group X-A	Draft Study Prog.	—
669	Frequency-modulation broadcasting in the VHF (metric) band	Sub-Group X-A	Draft new Question	—
670	HF broadcasting: directional antenna systems	Sub-Group X-A	Draft Study Prog.	—
671	Draft revision of Question No. 98. HF broadcasting: effects of closer spacing between carrier frequencies	Sub-Group X-A	Question 98	—
672	Draft revised Rec. No. 137	Sub-Group X-A	Rec. 137	—
673	FM broadcasting in the VHF band	Sub-Group X-A	Draft Report	—
674	Standards for FM sound broadcasting in the VHF band	Sub-Group A	Draft Rec.	—
699	Draft amendment to Rec. No. 135. Single-track recording on magnetic tape	Sub-Group X-B	Rec. 135	—
712	Measurement of "wow" and "flutter"	Sub-Group X-B	Draft Report	—
713	Measurement of programme level	Sub-Group X-B	Draft Question	—
714	Measurement of programme level	Sub-Group X-B	Draft Study Prog.	—
715	Measurements of "wow" and "flutter"	Sub-Group X-B	Draft Rec.	—
716	Recommendation No. 134 (London)	Sub-Group X-B	Rec. 134	—
717 ⁴	Sound recording on film for the international exchange of television programmes	Sub-Group X-B	Draft Rec.	—
718	Sound recording on film for the international exchange of television programmes	Sub-Group X-B	Draft Report	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
719	Proposed Report concerning Study Programme No. 74 (Point 3)	Sub-Group X-B	Draft Report	—
720	Draft Resolution concerning the width of magnetic tape	Sub-Group X-B	Draft Res.	—
721	Draft Report concerning the width of magnetic tape	Sub-Group X-B	Draft Report	—
768	The minimum number of frequencies necessary for the transmission of a high-frequency broadcasting programme	Study Group X	Report 13	—
769	HF broadcasting. Justification for the use of more than one frequency per programme. — Conditions for satisfactory reception	Study Group X	Study Progs. 71 and 73	—
863	High-frequency broadcasting	Drafting Committee	Study Prog. 107	—
864	Organisations qualified to take action on questions of recording	Drafting Committee	Res. 31	—
865	Frequency-modulation broadcasting in the VHF (metric) band	Drafting Committee	Question 150	—
866	HF (decametric) broadcasting. Effects of closer spacing between carrier frequencies	Drafting Committee	Question 149	—
867	Frequency-modulation sound broadcasting in the VHF (metric) band	Drafting Committee	Report 77	—
868	Standards for frequency-modulation sound broadcasting in the VHF (metric) band	Drafting Committee	Rec. 206	—
869	Modification to Report No. 13. The minimum number of frequencies necessary for the transmission of a high-frequency broadcasting programme	Drafting Committee	Report 76	—
870	Standards of sound recording for the international exchange of programmes	Drafting Committee	Report 79	—
871	Modification to Recommendation No. 134. Standards of sound recording for the international exchange of programmes. Lateral cut recording on discs	Drafting Committee	Rec. 208	—
873	Summary record of the second meeting (30th August 1956)	Study Group X	—	—
879	HF (decametric) broadcasting directional antenna systems	Drafting Committee	Study Prog. 106	—
880	Measurements of "wow" and "flutter"	Drafting Committee	Rec. 210	—
881	Measurement of programme level	Drafting Committee	Study Prog. 109	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
882	Measurement of programme level	Drafting Committee	Question 151	—
883	Amendment to Recommendation No. 135. Standards of sound recording for the international exchange of programmes	Drafting Committee	Rec. 209	—
884	Width of magnetic tape	Drafting Committee	Report 80	—
890	Width of magnetic tape	Drafting Committee	Res. 30	—
891	Modification to Recommendation No. 137. Use of synchronised transmitters in HF (deca-metric) broadcasting	Drafting Committee	Rec. 205	—
892	Modification to Study Programme No. 72. High frequency broadcasting. Use of synchronised transmitters	Drafting Committee	Study Prog.108	—
901	Measurement of "wow" and "flutter"	Drafting Committee	Report 78	—
905	High-frequency broadcasting. Directional antennae with reduced subsidiary lobes	Drafting Committee	Report 75	—
919	Sound recording on film for the international exchange of television programmes	Drafting Committee	Rec. 211	—
943	Sound recording on film for the international exchange of television programmes	Drafting Committee	Report 81	—
959	Summary record of the third and last meeting (4th September 1956)	Study Group X	—	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV
STUDY GROUP No. XI				
46 ⁴	Proposal about the title of Study Group No. XI	Czechoslovakia	Proposal	—
47	Television recording	Federal German Republic	Question 66	—
48	Assessment of the quality of television pictures	Federal German Republic	Question 65	—
111	Report of Chairman of Study Group No. XI	Chairman, Study Group XI	—	—
129	The gain of a television transmission circuit	United Kingdom	Question 122	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
153*	Proposals for amending the draft report (Doc. No. 91 rev., Brussels) on the requirements for the transmission of television over long distances	United Kingdom	Study Prog. 32	—
154*	The requirements for the transmission of television over long distances	United Kingdom	Study Prog. 32	—
209*	Ratio of the wanted to the unwanted signal in television	P. R. of Poland	Question 119	—
224*	Ratio of the wanted to the unwanted signal in television	Czechoslovakia	Report 34	—
236	Assessment of the quality of television pictures	Federal German Republic	Question 65	—
240	Ratio of the wanted to the unwanted signal in television	Federal German Republic	Question 119	—
266	Phase linearity of television systems	Netherlands	Question 64	—
267*	Tropospheric propagation curves for distances well beyond the horizon	Netherlands	Study Prog. 55 Question 101	V
290	Television standards	Denmark	Question 64	—
383	Measurement of the quality of television pictures	United States of America	Question 65 Study Prog. 75	—
389 ¹	Colour television standards. A comparison of N.T.S.C. colour television and C.C.I.R. criteria	United States of America	Question 118	—
390	Standards for video colour television signals	United States of America	Study Prog. 80	—
391	Co-channel and adjacent-channel interference in television	United States of America	Question 119	—
397	Reduction of the bandwidth for television	United States of America	Study Prog. 35	—
398*	Data on sensitivity, selectivity, stability and spurious radiation for sound and vision receivers	Italy	Questions 76 and 80 Recs. 94, 95 and 96 Study Prog. 42	II
399 ³	Undesired emissions from receivers	Italy	Question 80	II
412	Characteristics relative to the measurement of details in television systems	U.S.S.R.	Question 65	—
417	Report by the Chairman of C.C.I.R. Study Group No. XI on the colour television demonstrations given for C.C.I.R. Study Group No. XI	Chairman, Study Group XI	Colour TV demonstrations	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
435*	Advantages to be obtained from consideration of polarisation in the planning of broadcasting services in the VHF (metric) and UHF (decimetric) bands	United Kingdom	Question 101	—
456	Memorandum for the Study Groups	Chairman of Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV
462	Test signals for international television transmission circuits	Netherlands Fed. German Republic Switzerland	Questions 96 and 40 Study Prog. 32	IX
478	Draft Recommendation	Switzerland	Question 65	—
511	Summary record of the first meeting (10th August 1956)	Study Group XI	—	—
512*	Note on polarisation discrimination on VHF (175 Mc/s)	France	Question 101	—
520	Draft Recommendation	Denmark	—	—
521	Draft Study Programmes	Denmark	—	—
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
528	Cooperation between the C.C.I.R. and the S.C. 12-1 of the I.E.C. in the field of spurious radiations from receivers	Italy	Question 80	II
545	Summary record of the second meeting (14th August 1956)	Study Group XI	—	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
605 ³	A comparison of CW interference effects on the reception of monochrome and N.T.S.C.-type colour television signals	United Kingdom	Question 119	—
737	Summary record of the third meeting (23rd August 1956)	Study Group XI	—	—
822	Summary record of the fourth meeting (29th August 1956)	Study Group XI	—	—
823	Summary record of the fifth and last meeting (31st August 1956)	Study Group XI	—	—
872	Ratio of the wanted to the unwanted signal in television	Drafting Committee	Study Prog. 111	—
902	Revision of Question No. 65. Assessment of the quality of television pictures	Drafting Committee	Question 152	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
907	Requirements for the transmission of television over long distances	Drafting Committee	Report 84	—
910	The transmission of monochrome and colour television signals over long distances	Drafting Committee	Res. 32	—
914	Revision of Question No. 68. Resolving power and differential sensitivity of the human eye	Drafting Committee	Question 153	—
915	Revision of Report No. 35. Television systems	Drafting Committee	Report 83	—
917	Revision of Report No. 34. Ratio of the wanted to the unwanted signal in monochrome television	Drafting Committee	Report 82	—
938	Amendment to Rec. No. 82. Television standards	Drafting Committee	Rec. 212	—
948	Distortion of television signals due to the use of vestigial-sideband transmission	Drafting Committee	Study Prog. 110	—
949	Advantages to be obtained from consideration of polarisation in the planning of broadcasting services in the VHF (metric) and UHF (decimetric) bands	Drafting Committee	Report 85	—
974	The gain of a television transmission circuit	Drafting Committee	Rec. 213	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV

STUDY GROUP No. XII

112 ^{1,3}	Report of Chairman of Study Group No. XII	Chairman, Study Group XII	—	—
128	Tropical broadcasting. Provisional power limits in Rec. No. 84	French Overseas Territories	Study Prog. 38 (Item 2)	—
229 *	Best method for calculating the field strength produced by a tropical broadcasting transmitter	United Kingdom	Question 69	—
356 *	Interference in the bands shared with broadcasting. Determination of the protection required for a broadcast signal in the presence of interference	India	Question 102 Study Prog. 77	—
357 *	Best method for calculating the skywave field produced by a tropical broadcasting transmitter	India	Question 69	—
358	Maximum power for short-distance high-frequency broadcasting in the tropical zone	India	Study Prog. 38	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
423	Interim Report on the activities of Study Group No. XII	South African Broadcasting Corporation	Questions 69, 71 and 103 Study Progs. 38 and 77	—
426	Determination of noise level for tropical broadcasting	United Kingdom	Question 71	—
428	Interference in the bands shared with broadcasting	United Kingdom	Question 102	—
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
456	Memorandum for the Study Groups	Chairman, Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV
470 *	Design of transmitting aerials for tropical broadcasting	United Kingdom	Question 103	—
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
540	Summary record of the first meeting (13th August 1956)	Study Group XII	—	—
569	Summary record of the second meeting (16th August 1956)	Study Group XII	—	—
570	Comments on the tests carried out for the determination of the protection required by a broadcasting service in the presence of interference	I.F.R.B.	—	II, III, VI, X
573	Summary record of the third meeting (20th August 1956)	Study Group XII	—	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
649	Fading allowances for tropical broadcast transmissions	India	Question 157	—
651	Interference in the bands shared with broadcasting	India	Draft Study Prog.	—
653	Summary record of the fourth meeting (23rd August 1956)	Study Group XII	—	—
804	Fading allowances for tropical broadcast transmissions	Drafting Committee	Question 157	—
815	Interference in the band shared with broadcasting	Sub-Group XII-A	Draft Report	—
830	Summary record of the fifth meeting (29th August 1956)	Study Group XII	—	—
837	Best method for calculating the sky-wave field intensity produced by a tropical broadcasting transmitter	Drafting Committee	Report 88	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
911	Maximum power for short distance high frequency broadcasting in the tropical zone	Drafting Committee	Rec. 215	—
929	Interference in the bands shared with broadcasting	Drafting Committee	Report 89	—
982	Interference in the frequency bands used for tropical broadcasting	Drafting Committee	Study Prog.114	—
983	Design of transmitting aerials for tropical broadcasting	Drafting Committee	Report 87	—
991	Summary record of the sixth meeting (5th September 1956)	Study Group XII	—	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV

STUDY GROUP No. XIII

52 ³	Publication of service codes in use in the international telegraph service	United Kingdom	Res. 18	—
53*	Marine identification device	United Kingdom	Question 105	—
54	Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships	C.I.R.M.	Question 108	—
55	Technical characteristics of frequency-modulated VHF maritime equipments	C.I.R.M.	Question 107	—
56	Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships	United Kingdom	Question 108	—
57	Publication of the codes used in the international telegraph service. Proposal for the modification of the SINPO code	Federal German Republic	Res. 18	—
58	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	Federal German Republic	Question 107	—
66	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	United States of America	Question 107	—
67*	Bearing and position classification for HF (decimetric) and VHF (metric) direction-finding	United States of America	Question 106	—
68	Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships	United States of America	Question 108	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
69	Identification of radio stations	United States of America	Rec. 132	—
70	Identification of radio stations	United States of America	Study Prog. 78 (Item 1)	—
71*	Marine radar identification device	United States of America	Question 105	—
113	Report of Chairman of Study Group No. XIII	Chairman, Study Group XIII	—	—
201	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	France	Question 107	—
202	Identification of radio stations	France	Study Prog. 78	—
226	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	United Kingdom	Question 107	—
232* ³	Bearing and position classification for HF (decametric) and VHF (metric) direction-finding	United Kingdom	Question 106	—
338	Report on technical characteristics of frequency-modulated VHF (metric) maritime equipments	Japan	Question 107	—
349	Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships	Netherlands	Question 108	—
361	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	Netherlands	Question 170	—
377	Technical characteristics of frequency-modulated VHF (metric) maritime equipment	C.I.R.M.	Question 107	—
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
456	Memorandum for the Study Groups	Chairman, Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV
467	Identification of radio stations	United States of America	Res. 19	—
468*	Identification system for complex FSK emissions	United States of America	Study Prog. 78 Res. 19	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
471*	Report of C.C.I.T. Study Group IX relative to C.C.I.R. Res. No. 18	C.C.I.T.	C.C.I.T. Question 61 (C.C.I.R. Res. 18)	—
482	Principles of allocation of very high frequencies to the fixed and land mobile VHF service	Sweden	Proposed new Question	—
503	Publication of service codes in use in the international telegraph service	Spain	Res. 18	—
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
548	Summary record of the first meeting (14th August 1956)	Study Group XIII	—	—
581	Summary record of the second meeting (21st August 1956)	Study Group XIII	—	—
593 ³	Report to Study Group XIII	Sub-Group XIII-A	—	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
597	Spurious emissions from frequency-modulated VHF (metric) maritime equipment	Sub-Group XIII-C	Draft new Study Prog.	—
598	Selective calling devices for use in the international VHF maritime mobile service	Sub-Group XIII-C	Draft new Question	—
599	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	Sub-Group XIII-C	Draft Rec.	—
613	Inter-ship radar identification	Sub-Group XIII-B	Draft Rec.	—
614	Draft new Question to replace Question No. 105	Sub-Group XIII-B	Draft new Question	—
615	Draft Question to replace Question No. 106	Sub-Group XIII-B	Draft Question	—
616	Revision of Recs. Nos. 72, 78, 124 and 125	Sub-Group XIII-B	Recs. 72, 78, 124 and 125	—
617	Marine radar identification	Sub-Group XIII-B	Draft Report	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
618	Draft Report on HF and VHF direction finding	Sub-Group XIII-B	Draft Report	—
619	Technical characteristics of single-sideband aeronautical mobile and maritime radiotelephone equipments	Sub-Group XIII-B	Proposed new Question	—
621	Testing of 500 kc/s radiotelegraphic auto-alarm receiving equipment on board ships	Study Group XIII	Draft Rec.	—
622	Report to the Chairman of Study Group No. XIII	Sub-Group XIII-E	C.C.I.T. Question 61 C.C.I.R. Res. 18	—
652	Collaboration between aeronautical and maritime mobile services for safety of life at sea	Sweden	—	—
657	Letter from the Chairman of Study Group No. XIII	Chairman of Study Group XIII	—	—
662	Summary record of the third meeting (27th August 1956)	Study Group XIII	—	—
664	Characteristics of equipments and principles governing the allocation of channels in the VHF and UHF land mobile services	Study Group XIII	Draft Question	—
739	Identification of radio stations. Modification to Rec. No. 132	Drafting Committee	Rec. 220	—
740	Modification of Study Programme No. 78	Drafting Committee	Study Prog. 115	—
748	Inter-ship radar identification. Question No. 105	Drafting Committee	Rec. 222	—
749	Marine identification devices	Drafting Committee	Question 158	—
751	Bearing and position classification for direction finding in the VHF, HF and 2 Mc/s bands	Drafting Committee	Question 159	—
752	HF and VHF direction finding	Drafting Committee	Report 93	—
753	Revision of Recommendations Nos. 72, 78 and 125	Drafting Committee	Recs. 217, 218 and 219	—
757	Identification of radio stations	Drafting Committee	Report 91	—
758	Technical characteristics of single-sideband aeronautical mobile and maritime radiotelephone equipments	Drafting Committee	Question 162	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
759	Spurious emissions from frequency-modulated VHF (metric) maritime equipment	Drafting Committee	Question 161	—
760	Technical characteristics of frequency-modulated VHF (metric) maritime equipments	Drafting Committee	Rec. 223	—
761	Selective calling device for use in the international VHF (metric) maritime mobile service	Drafting Committee	Question 160	—
762	Testing of 500 kc/s radiotelegraphic auto-alarm receiving equipment on board ships	Drafting Committee	Rec. 224	—
763	Modification to Rec. No. 141	Drafting Committee	Rec. 221	—
764	Modification to Resolution No. 18	Drafting Committee	Res. 33	—
814	Marine identification device	Drafting Committee	Report 92	—
816	Summary record of the fourth meeting (31st August 1956)	Study Group XIII	—	—
849	Characteristics of equipments and principles governing the allocation of channels in the VHF (metric) and UHF (decimetric) land mobile services	Drafting Committee	Question 163	—
971	Publication of service codes in use in the international telegraph service	Drafting Committee	Report 90	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV

STUDY GROUP No. XIV

49	Proposal for dealing with conflicting systems of frequency naming	United Kingdom	Rec. 142	—
51	Means of expression, terms, definitions, graphical and letter symbols and their conventional usage	United Kingdom	Rec. 144	—
114	Report of Chairman of Study Group No. XIV	Chairman, Study Group XIV	—	—
379	Provisional Report	Chairman, Study Group XIV	Provisional Report	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
380*	Report by the S.C.I.C.T. on decimal classification as applicable to the C.C.I.R.	International Federation of Documentation	Question 72	—
429	Report by the Director of the C.C.I.R.	Director of the C.C.I.R.	Organisation Committee	I to XIV
451*	Amendments of some definitions in the International Telecommunication Convention	Sweden	—	—
456	Mémorandum for the Study Groups	Chairman, Study Group XIV	C.C.I.R. provisional list of terms and definitions	I to XIV
527	First list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
538	Summary record of the first meeting (10th August 1956)	Study Group XIV	—	—
585	Summary record of the second meeting (17th August 1956)	Study Group XIV	—	—
596	Second list of terms and definitions on which the Study Groups are consulted	—	—	I to XIV
852	Summary record of the 3rd and last meeting (31st August 1956)	Study Group XIV	Draft Question	—
893	Draft amendment to Recommendation No. 142. Nomenclature of the frequency and wavelength bands used in radio communication	Drafting Committee	Rec. 225	—
894	Means of expression	Study Group XIV	Draft Report	—
897	Definitions of certain basic words used in the International Telecommunication Convention	Study Group XIV	Draft Res.	—
898	Decimal classification	Study Group XIV	Draft Report	—
987	Modification to Rec. No. 142. Nomenclature of the frequency and wavelength bands used in radio communication	Drafting Committee	Rec. 225	—
988	Means of expression	Drafting Committee	Report 94	—
989	Definitions of certain basic words used in the International Telecommunication Convention	Drafting Committee	Res. 34	—
990	Decimal classification	Drafting Committee	Report 95	—
995	Terms of reference of the C.C.I.R. Study Groups	Drafting Committee	—	I to XIV

PLACE OF THE IXth PLENARY ASSEMBLY

During its fourteenth and last session, the C.C.I.R. VIIIth Plenary Assembly accepted unanimously and by acclamation the invitation of the United States of America to hold the IXth Plenary Assembly of the C.C.I.R. in that country.
