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INTERNATIONAL RADIO CONSULTATIVE COMMITTEE

C.C.I.R.

DOCUMENTS OF THE VIIth PLENARY ASSEMBLY

LONDON 1953

VOLUME II

LIST OF PARTICIPANTS
REPORTS OF STUDY GROUP CHAIRMEN
REPORT OF THE DIRECTOR, C.C.I.R.
LIST OF DOCUMENTS
PLACE OF THE VIIth PLENARY ASSEMBLY



INTERNATIONAL TELECOMMUNICATION UNION
GENEVA

INTERNATIONAL RADIO CONSULTATIVE COMMITTEE

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INTERNATIONAL TELECOMMUNICATION UNION



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Study Groups Nos. I to III

REPORTS OF STUDY GROUP CHAIRMEN

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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)

Questions studied.

The Vith Plenary Assembly allocated the following questions and study programmes to Study Group No. I :

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

Question No. 18 : Telegraphic distortion;

Question No. 20 : Frequency-shift keying;

Question No. 46 : Arrangement of channels in multi-channel transmitters for long-range circuits;

Study Programme No. 1 : Bandwidth of emissions;

Study Programme No. 2 : Harmonics and parasitic emissions;

Study Programme No. 3 : Frequency stabilization of transmitters;

Study Programme No. 4 : Frequency-shift keying.

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

Membership of Study Group No. I.

Administrations :

Australia	Hungarian People's Republic	United Kingdom of Great Britain and Northern Ireland
Austria	Italy	Sweden
Belgium	Japan	Switzerland
Spain	Morocco	Czechoslovakia
United States of America	Norway	Union of Soviet Socialist Re- publics
Finland	Netherlands	Federal People's Republic of Yugoslavia
France	Federal German Republic	

Private operating agencies :

British Broadcasting Corporation (B.B.C.), London;
Cable & Wireless, Ltd., London;
Compañía Internacional de Radio S.A., Buenos Aires;
Compagnie Générale de Télégraphie sans fil, Paris;
Companhia Portuguesa Radio Marconi, Lisbon;
Italcable S.A., Rome;
Marconi International Marine Communication Co., 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.), Washington;
Transradio Española S.A., Madrid.

International Organizations :

International Radio-Maritime Committee (C.I.R.M.);
International Broadcasting Organization (I.B.O.);
European Broadcasting Union (E.B.U.).

* Doc. No. 101, London.

Scientific and Manufacturing Organizations :

Brown Boveri & Co., Ltd., Baden (Switzerland);
Marconi Española S.A., Madrid;
Hasler S.A., Berne;
Telefonaktiebolaget L. M. Ericsson, Stockholm.

Activities.

As the E.A.R.C., in its Recommendation No. 14, stated that the study of a number of points on their programme was a matter of urgency, a meeting of Study Groups Nos. I and III was held in The Hague, from 1-10 April, 1952, to supply an answer as quickly as possible to the requests of the E.A.R.C. concerning Study Programmes Nos. 1, 2, 3 and 4. All the members were invited to attend the meeting, at the end of which a final report was published (Doc. 22, The Hague), communicated to the C.C.I.R., and subsequently sent to Administrations. Apart from the U.S.S.R. reservation included in that report, the conclusions of The Hague Meeting were not questioned. They can consequently be regarded as having met with the general approval of the members which were not represented at the Meeting.

Following a request by the Director of the C.C.I.R., dated 29 July, 1952, concerning Recommendation No. 5, a circular (No. 596.0.80) was sent on 27th August, 1952 to the members of the group, requesting them to help in drawing up a list of terms and symbols used in the work of the Study Group. The following members sent contributions :

Administrations :

Belgium;
United Kingdom;
Switzerland;

Private Operating Agencies :

Brown Boveri & Co., Ltd., Baden (Switzerland) ;
Radio Austria A.G.;
Radio Corporation of America (R.C.A.).

A report sent to the C.C.I.R. assembling the results of the contributions, was despatched to all members on 21 October, 1952 (letter No. 596.0.122).

At the request of the Director of the C.C.I.R., and in preparation for the VIIth Plenary Assembly in London, Circular No. 596.0.75 was sent on 26 August 1952 to all the members of the Study Group, inviting them to follow the directives proposed by the Director for the presentation of their contributions, which were to be sent before 15 February 1953 to the Chairman of the Study Group, so that he could use them for preparing this present Report.

Since the VIth Plenary Assembly in Geneva, 6 new members have joined the Study Group, and have received working documents immediately upon registration.

General

The present Report has been designed as a working document for the Study Group meetings at the VIIth Plenary Assembly in London. It is intended :

- to summarize the basic points of the contributions;
- to give a progress report on each question;
- to propose draft replies where necessary;
- and to suggest further work wherever this seems possible, even if not absolutely necessary.

For each question the results obtained at The Hague are mentioned, preceded by a summary of the contributions on which they were based, and followed by summaries of the contributions intended for the VIIth Plenary Assembly in London. The state of present progress has been described under the title "Conclusions and Proposals"—a section which also contains certain proposals that seemed to be appropriate.

Thorough examination of the items on the agenda of Study Group No. I and the contributions received, leads us to a few practical considerations and suggestions that we should like to emphasize. It would be of great practical use if, at plenary assemblies, some of the equipment or devices described in the work of the reporters could be demonstrated to the representatives of Administrations. For instance, arrangements could be made in advance for apparatus such as spectrum analysers to be operated in a transmission centre near the Conference building.

The work of Study Group No. I is appreciably delayed by the absence of measurement results. *Progress in the work in hand and the practical value of the findings make it indispensable for administrations possessing the necessary equipment to communicate their observations.*

QUESTION No. 1a

Study Programme No. 1 : Bandwidth of Emissions

This question arises from Atlantic City Recommendation No. 4, para. 1. For the purpose of revising the Recommendation, the following had to be determined for the various classes of emission :

- (a) the bandwidth strictly necessary to ensure a service of the appropriate quality;
- (b) practical methods of measuring the bandwidth actually occupied by each emission.

A partial reply to this question was given in Recommendations Nos. 36 and 37 of the VIth Plenary Assembly in Geneva, and the E.A.R.C., in its Recommendation No. 14, stated that their continued study was a matter of urgency.

At the meeting of Study Groups Nos. I and III in The Hague, 1-10 April 1952, the attention of those taking part in Study Group No. I was concentrated on the above two problems.

A. Bandwidth of Emissions

Contributions submitted to the meeting at The Hague

Class A1 emissions.

Netherlands (Doc. 3, The Hague). — The bandwidth necessarily occupied by an emission is determined by the transmission spectrum sufficient to obtain a signal of required quality at the receiver output. To determine the bandwidth necessarily occupied, keying speed, keying system used, signal fluctuations caused by fading and the degree of stability of the oscillators and filters must be taken into account, as well as the time interval within which readjustment of the receiver by the operating staff is effected. The use of receivers with A.F.C. enables the bandwidth necessarily occupied to be reduced.

Netherlands (Doc. 4, The Hague). — Spectrum measurements of an A.M. telegraph transmitter. The premodulator A.F. passband is either 300-3,000 c/s or 1,000-2,000 c/s. The results are shown in two diagrams.

United Kingdom (Doc. 8, The Hague). — The existing relevant clause in Recommendation No. 36 should be considered to apply for frequency planning purposes.

Class A2 emissions.

United Kingdom (Doc. 8, The Hague). — It is not necessary to consider this class of emission in detail, on account of the E.A.R.C. separate recommendations referring to A2.

Class A9 emissions (all classes).

United Kingdom (Doc. 8, The Hague). — The minimum necessary bandwidth is adequately defined by the modulation characteristics and it need not be considered further in these meetings.

Class F1 emissions.

United Kingdom (Doc. 8, The Hague). — Clause 2.3 of Recommendation No. 36 recommends the minimum bandwidth necessarily occupied in terms of two parameters :

keying speed (B) and
deviation (D).

(B) will clearly be pre-determined by external conditions as in the previous classes of emissions. However, the operating agency, in present practice, has freedom of choice of the value for the second parameter (D). This is one of the matters to be studied in another question (Question No. 20) by this study group.

Class F4 emissions.

United Kingdom (Doc. 8, The Hague). — No data are yet available on the minimum bandwidth necessarily occupied by such emissions.

Conclusions of the meeting at The Hague.

Doc. 22, The Hague. — In view of the large number of emissions with A1 characteristics, an important contribution would be made to the improved utilization of the H.F. spectrum if such emissions were to conform with Recommendation No. 36 (paras. 2.1 and 2.2).

The Study Group feels that, for A1 transmitters, a substantial reduction of bandwidth occupied can be achieved if arrangements can be made for all stages of amplification following that in which keying takes place, and including this latter, to be operated as Class B amplifiers.

It seems desirable, in this respect, to consider modification of existing transmitters, as well as suitable design of future transmitters.

At The Hague, the U.S.S.R. maintained its Geneva reservation, and could not adopt, even as an approximation, the values given in Recommendation No. 36 of the VIth Plenary Assembly.

Contributions intended for the VIIth Plenary Assembly, London, 1953

Class A1 emissions.

Japan. — Measurements of the bandwidth actually occupied were made at a maximum speed of 70 bauds. For information, they were also made at higher speeds—100 and 160 bauds. The results give the percentage of total radiated power contained in the following bandwidths : 0.5; 1.0; 1.5; 2.0 kc/s. A table shows for different speeds (70, 100, 160 bauds) in what order of component 99 % of the total radiated power will be found. It also gives build-up and restoration times for a speed of 100 bauds as a percentage of the dot duration.

Italcable. — Measurements were made to find out how the classes of operation of the various stages constituting the transmitter influence the transmitted spectrum. These measurements show that appreciable improvements can be obtained as regards the bandwidth of A1 telegraph transmitters, chiefly by acting on the low power amplifying and multiplying stages.

Class A2 emissions.

Japan. — In view of the extensive use of this class of emission by ship telegraph stations, it is particularly important to study the out-of-band radiation caused by modulation distortion. Calculated values were checked up against experimental measurements. In the absence of parasitic radiation, the increase of bandwidth due to keying will be slight. Two tables show the measured values of out-of-band radiation with the corresponding percentage modulation, one for a continuous mark, the other for a keying speed of 25 bauds. The bandwidth of the measuring apparatus is 2.5 kc/s.

Class A3 emissions.

United States of America. — This document proposes values of bandwidth necessarily occupied and limits of out-of-band radiation for A3, A3a and A3b emissions. As regards out-of-band radiation of A3a and A3b emissions a distinction is drawn between old-fashioned transmitters and more recent ones. Requirements are stricter for the latter.

Class A4 emissions.

United States of America. — Radio photography. F.M. sub-carrier A.M. The instantaneous frequency of the sub-carrier is a function of the picture density. This sub-carrier amplitude-modulates a radio carrier. A formula is given for the bandwidth necessarily occupied.

Class F1 emissions.

Japan. — (a) For a build-up time of 8 %, as in Recommendation No. 36, para. 2.3.4, the values measured for the emitted F1 wave show that with modulation indices 3, 6 and 8 the bandwidth necessarily occupied and the out-of-band radiation spectrum are in accordance with the directives in 2.3.1 and 2.3.2 respectively of the Recommendation in question.

(b) For the same values of build-up time and modulation index, the calculated value of the F1 wave also confirms paras. 2.3.1 and 2.3.2 of the Recommendation.

Other measurement results give the percentage of the total radiated energy contained in bandwidths of 1.0; 1.5 and 2 kc/s for three keying speeds—70, 100 and 160 bauds, the deviation values being 690, 700 and 800 c/s. Lastly, these measurements permitted the drawing up of a table of values of K in the formula $BK + 2D$ given as a guide for the bandwidth necessarily occupied in the Radio Regulations, Atlantic City, 1947 (Appendix 5).

Class F4 emissions.

United States of America. — Two systems have been investigated :

(a) Radio photography — Frequency modulation ;

(b) Radio photography — A.M. sub-carrier F.M. ;

Two formulae are given for the bandwidth necessarily occupied.

Conclusions and proposals.

The information available is not sufficient, without previous discussion, for the drafting of a recommendation such as would have been the natural outcome and complement of Recommendation No. 36.

Japan, which submits the findings of practical bandwidth measurements, considers it difficult to apply the recommendations given for Class A1 emissions. It will therefore have to be decided whether the C.C.I.R. will amend Recommendation No. 36 in this connection.

The results of the measurements made by Italcable seem to confirm the conclusions reached by Japan concerning the application of the standards formulated in Recommendation No. 36 in connection with class A1 transmissions.

As regards the recommendations for Class F1 emissions, the calculations and measurements made by Japan confirm the established standards and it would seem advisable to propose that item 2.3 of Recommendation No. 36 be retained.

An investigation and discussion of the results of measurements of Class A2 emission bandwidths, submitted by Japan, might lead to conclusions on the application of the data supplied in this connection by Appendix 5 of the Atlantic City Radio Regulations. The United States proposal fixes standards for A3, A3a, A3b, A4 and F4 emissions. Study Group No. I will have to decide whether these standards should be incorporated in a new draft recommendation.

As regards Class A9 emissions, we propose that the following observation be included in a new draft recommendation :

“ The minimum bandwidth required for Class A9 emissions is defined by the modulation characteristics and the standards to be recommended should be established separately for each system in this class.”

It would be desirable for Administrations to carry out, before the London meeting, measurements of bandwidths occurring in practice which would confirm the existing standards or to draw up new and more suitable standards in the light of practical results.

B. Bandwidth measurements

Contributions submitted to the meeting at The Hague :

Austria (Doc. 2, The Hague). — This document gives a description of a recording equipment for monitoring the bandwidth of a transmitter by recordings effected in the direct radiation field. Two examples of bandwidth monitoring, one for a telegraph transmitter, the other for a television transmitter, show the possibilities of the apparatus.

Belgium (Doc. 1, The Hague). — This document submits a study of the response of a resonant circuit to an E.M.F. of which the frequency has a saw-tooth variation with time.

Japan (Doc. 5, The Hague). — In accordance with the definition of bandwidth given in the Atlantic City Radio Regulations, a bandmeter has been studied in Japan which shows the percentage ratio between the energy in a given bandwidth and the total energy of the emitted power.

Netherlands (Doc. 4, The Hague). — The transmitter spectrum to be analysed is reduced by means of a crystal oscillator to a 1 Mc/s spectrum, every component of which is consecutively transformed, by means of a variable frequency oscillator, to a 3000 kc/s frequency and then selected by a narrow-band filter. The amplitude measurement gives the relative value of the components. The difference between the oscillator frequency and the 1 Mc/s frequency (crystal) is determined with the aid of an audio-frequency generator and gives the frequency differences of components.

United Kingdom (Doc. 8, The Hague). — Since administrations are not yet agreed on bandwidth measuring equipment, the United Kingdom proposes that each administration should continue measurements with the apparatus it already possesses and that there should be a mutual exchange of information.

Conclusions of the meeting at The Hague :

Doc. 22. The Hague. — The various administrations are not yet agreed upon either the details of technique to be employed in the circuitry of spectrum analysers or the general conditions under which their use is admissible.

Although Recommendation No. 37 of the VIth Plenary Assembly (1951) recommended certain characteristics of measuring equipment, the development that has taken place in the interim period has revealed unsuspected problems in design whilst possible improvements in techniques are now apparent. It is therefore suggested that no specific or unique method of measurement should be defined at this stage.

However, since it is a matter of urgency to determine the bandwidths occupied by existing transmissions, it is desirable that administrations should make measurements as soon as possible, even if the measuring equipment at present available does not give all the precision that could be obtained in the future.

It is therefore suggested that when the administrations possess such equipment, they should exchange information on results obtained, in order that the desirable characteristics of measuring equipment can be agreed at the earliest possible date.

In the process of exchange of information it is considered desirable that there should be a correlation of results obtained by use of spectrum analysers and by point-to-point plotting methods.

Contributions intended for the VIIth Plenary Assembly, London, 1953

Belgium. — This contribution, which is a redraft of a similar paper submitted at The Hague, contains a succinct summary of the theoretical results obtained from the study of the response of a simple type of selective system that can be used in radio spectrum analysers and takes certain recent findings into account.

United States of America. — The advantages and drawbacks of bandwidth measurement methods are studied, first for the method consisting of successive measurements of each spectrum element, then for the method of scanning by automatic sweep. For a narrow spectrum, it is advisable to use narrow-band filters to obtain good resolving power, but for the exploration of a wider spectrum, much wider-band filters have to be used. Hence it is proposed to use two or more filters of different bandwidths with an automatic sweep. It would obviously be desirable at times to be able to deactivate the automatic sweep so that a sideband of interest could be observed continuously, utilizing the appropriate filter. On account of the disadvantages of automatic sweep, the use is also recommended of two or more filters of different bandwidths without automatic sweep. Lastly, the document considers the main problems arising from the measurement of bandwidths for frequencies above 30 Mc/s.

The use of spectrum analysers entails definition of the appropriate units of measurement.

Japan. — The equipment is connected to the intermediate frequency (100 kc/s) of a radio receiver and transforms the frequency of the received signal by the heterodyne method. The frequency of the local oscillator is displaced by an automatic sweep. Each component frequency is obtained in succession by feeding the frequency spectrum signal into a very narrow-band filter. The distribution of the intensities of the signal frequency spectrum is recorded on paper. Measurements have been made with Class F1 transmissions.

Another apparatus, with a bandwidth of 2.5 kc/s, has also been designed for Class A2 emissions.

Lastly, a bandmeter designed on the lines already described at The Hague, has been used for the measurement of Class A1 and Class F1 bandwidths.

United Kingdom. — The spectrum analyser described is basically a narrow band receiver which is repeatedly tuned through the signal under examination and arranged to give a display of the spectrum on a cathode-ray tube. The spectrum is automatically explored at a pre-selected repetition rate and a substantially continuous display is obtained by using a long-persistence screen. Measurements may be made over an amplitude range of 60 db and the maximum frequency range displayed is 30 kc/s.

Switzerland. — The frequency analyser developed for monitoring Swiss radio-telegraph emissions consists mainly of a special type of very high selectivity receiver (bandwidth approx. 20 c/s) with which the spectrum of an emission can be scanned and its various components successively measured. The apparatus also includes an oscilloscope for the direct observation and photography of the spectrum. In this way any kind of emission can be monitored and its bandwidth determined.

Netherlands. — A spectrum analyser has been designed for measuring bandwidths of transmitters. The apparatus was intended to be connected to the intermediate frequency stage of various types of receivers used in the Netherlands. The sweep of this analyser is automatic and extends from 100 kc/s to 2 Mc/s.

Austria. — A draft recommendation supplementing Recommendation No. 37 proposes the use of three types of spectrum analysers. It gives the characteristics of the three kinds of analysers as regards filter bandwidth, frequency sweep, amplitude limits, means of observation, frequency stability and sweep repetition rate (for the two systems using automatic sweep).

Conclusions and proposals.

Apparatus of various kinds for the measurement of bandwidth has been described but the lack of measurement results with such apparatus makes it impossible to decide in favour of any particular equipment.

Administrations seem to prefer repeated automatic sweep apparatus and manual scanning would thus be regarded as a complement of the first method. When a new draft recommendation is being drawn up, we propose the following addition to item 2 of Recommendation No. 37 :

“ Administrations are recommended to direct research on automatic sweep measuring apparatus to the design of devices for cutting off the automatic sweep to enable certain parts of the spectrum to be scanned by manual control.”

We propose the insertion in a new recommendation of directives aimed at furthering the progress of studies and the preparation of standards concerning measurement of bandwidth for *each emission specifically*. Considerable progress could be made if administrations could submit the results of measurements from which even provisional data could be proposed concerning

- (a) the sweep repetition rate
- (b) the filter pass-band
- (c) the frequency scanning

for each kind of emission.

Any advance in this subject is closely bound up with the results of measurements made by administrations. It is a matter of urgency that administrations should communicate these results to Study Group No. I if actual standards are to be prepared.

QUESTION NO. 1b

Study Programme No. 2 : Harmonics and parasitic emissions.

This Question is an outcome of Recommendation No. 4 in the Radio Regulations, Atlantic City, 1947 and is aimed at defining the effects of the limits mentioned in Appendix 4 of the Regulations.

Geneva Recommendation No. 38 is a preliminary reply to this question, the study of which was declared urgent by the E.A.R.C. in its Recommendation No. 14. At the meeting of Study Groups Nos. I and II at The Hague, from 1 to 10 April 1952, the study of the question was continued.

Contribution submitted to the meeting at The Hague.

Switzerland (Doc. 6, The Hague). — Measurements made on high-power medium-wave broadcasting stations show that it is possible to reduce harmonics to a considerable degree by means of filters without affecting to any great extent the operating economy of these stations by the use and installation of such filters.

Conclusions of the meeting at The Hague.

Doc. 22. The Hague.

1. Insufficient information has so far been received to permit re-evaluation of Appendix No. 4 of the Radio Regulations, 1947 for all fundamental frequencies between 10 and 30,000 kc/s.
2. The values mentioned in Appendix No. 4 of the Radio Regulations for fundamental frequencies below 3 Mc/s are confirmed.
3. For transmitters with fundamental frequencies between 3 and 30 Mc/s, administrations are recommended to undertake and pursue without delay studies and measurements connected with the measurement and suppression of harmonics and parasitic emissions which interfere with television transmissions. The problem of reducing interference to other classes of service will be solved more readily in view of the somewhat lower values of tolerable signal-to-noise ratio in these latter cases.
4. The Study Group draws administrations' attention to the importance of combination frequencies and their suppression.

Contributions intended for the VIIth Plenary Assembly, London, 1953.

Belgium. — Methods have been investigated of attenuating the direct radiation of harmonics by some 70 to 75 db in respect of the fundamental for high-power medium-wave transmitters. Higher order harmonics from high-power short-wave transmitters have also been attenuated. By the substitution method, measurements were made of the power of harmonics supplied to the symmetrical feeder of a high-power short-wave transmitter up to a frequency of 50 Mc/s.

Three kinds of combination wave were detected and it was possible to attenuate them either entirely or to a considerable degree (45 to 50 db).

Work is in progress on the origin of differential combination frequencies between distant stations.

United States of America. — Two methods of measurement are proposed :

- (a) tests of the transmitters, either individually or as to type, in the laboratory, based on power measurement, to determine the harmonic or parasitic power available for radiation by the substitution method;
- (b) field intensity measurement at a distance from the transmitter to determine the interfering possibilities of the complete installation.

Japan. — With apparatus designed in Japan, harmonic power can be measured while the transmitter is in operation even when it is one of a group of transmitters operating simultaneously. The method used is based on the measurement of the current, voltage and phase components of each harmonic with a frequency between 10 and 70 Mc/s.

Conclusions and proposals.

Since The Hague, as regards high-power medium-wave broadcast transmitters, experience has shown that the values in Appendix 4 are not too strict for the lower harmonics. For higher harmonics of high-power short-wave transmitters no measurement results are available, but it has proved possible to attenuate them by screening. More detailed information has been given on the substitution method and it has been observed that measurements cannot be made on low power, since the circuit voltages used in normal service must also be reproduced during the measurement.

Together with the substitution method advocated in Recommendation No. 38, para. 1, a further method based on field strength measurement is proposed. This method should provide practical means of measurement whenever leakage radiation is predominant.

We propose the insertion in a new draft recommendation of advice to administrations to adopt this additional method and to open discussion on the relevant measurement table given by the United States of America.

No new information has been received on antenna elements and feeder structure.

As regards combination frequencies, some of them have been attenuated by 45 to 50 db. We propose that administrations should continue to study this question.

QUESTION No. 1c

Study Programme No. 3: Frequency stabilization of transmitters

This Study Programme is the outcome of a desire to improve the conditions of spectrum utilization. It is very closely bound up with economic requirements.

Appendix 3 of the Atlantic City Radio Regulations gives a table of frequency tolerances for the various types of station. This study, declared urgent by the E.A.R.C. in its Recommendation No. 14, was put on the agenda of Study Group Nos. I and III, meeting at The Hague from 1 to 10 April, 1952.

Conclusions of the meeting at The Hague.

As no documents were submitted to the meeting at The Hague, the conclusions are based on the discussions.

Doc. 22, The Hague.

- (a) A large number of transmitters are at present in use, of which the frequency instability is the limiting factor in securing a reduction in spectrum space occupied. The additional cost necessary to enable many of these transmitters to comply with the Atlantic City table of tolerances or even to comply with more stringent tolerances is negligible in comparison with prime cost and operating expenses of the equipment.

- (b) All administrations and operating organizations are strongly recommended in their own interest to take all possible measures, consistent with economic considerations, to improve the degree of accuracy and stability of their transmitters in order that eventually the spectrum space occupied may tend towards the bandwidth necessarily occupied.

Contributions intended for the VIIth Plenary Assembly, London, 1953

United States of America. — In general, degrees of frequency stability in excess of that required by the Atlantic City Radio Regulations are readily attainable without excessive additional expense.

In the fixed services, using frequencies between 4 and 27 Mc/s, no serious problem of compliance as regards stability is presented by the 0.003 % requirement proposed by Atlantic City. This tightening of the tolerance requirement from the present 0.01 % does, however, present a problem as regards frequency *positioning*.

Equipment at present available for aviation and the maritime mobile service is capable of meeting the 0.02 % tolerance required by Atlantic City. At frequencies in the range of 500 to 10,000 Mc/s, the Atlantic City tolerance might be improved up to 0.05 % with the exception of certain types of equipment using magnetrons and ship-radar equipment for which a proposal is made. Television transmitters in the 470-890 Mc/s band are designed to operate within $\pm 1,000$ c/s. The stability of receiver oscillators can be equal to that attained in transmitters.

The data available at present are insufficient to warrant a revision of the tolerances so far admitted.

Japan. — The frequency tolerance of H.F. transmitters using 500 watts or more could be 2×10^{-5} .

The frequency stability will be determined by frequency measurements in monitoring stations and in this connection international collaboration would be desirable.

A thermostat designed in Japan and described in this document has eliminated risks of temperature variations for crystals and for all the smaller apparatus in communication circuits.

Three types of crystal have been investigated from the standpoint of compliance with the tolerances given in the table.

Netherlands. — This document determines three categories of frequency variation according to their origin. In studying frequency deviations, a distinction should be made between A.M. and F.M. transmitters. For the former, a degree of frequency stability much higher than that required by the Atlantic City Radio Regulations can be attained. Data are given on the results obtained with various crystal-controlled circuits.

Conclusions and proposals.

In view of the trend of the documents received since The Hague, we propose the insertion of paras. (a) and (b) of Doc. 22, The Hague, relative to Study Programme No. 3, as they stand, in a draft recommendation. We also propose the insertion in the recommendation of the following observations :

1. "An important step forward in the utilization of the spectrum would be achieved if administrations complied with the tolerance of 0.003 % for fixed service transmitters working on frequencies from 4 to 27.5 Mc/s used in international circuits."
2. "Practical experience having shown that it is in general possible to comply with the tolerance of 0.02 % prescribed in Appendix 3 of the Atlantic City Radio Regulations for ship and aircraft mobile stations, administrations are recommended, in the interest of a rational utilization of the spectrum, to take all necessary steps for such transmitters to comply with the required tolerance."

QUESTION No. 18

Telegraphic distortion

The object of studying this question is to establish a general definition of telegraphic distortion capable of being usefully applied to radio telegraphy. It was decided at the VIth Plenary Assembly

to continue the study of fortuitous distortion as an urgent question of interest to both the C.C.I.R. and the C.C.I.T.

It was subsequently proposed that the question of telegraphic distortion be studied by Study Group No. I of the C.C.I.T., jointly with C.C.I.R. reporters competent in the field of radio transmission. (Circ. CMT/1, 16 October 1951). Administrations were invited to inform the C.C.I.T. of the designation of C.C.I.R. reporters to cooperate in studying telegraphic distortion.

Study Group No. 1 of the C.C.I.T. met in Geneva from 14 to 18 October 1952 and studied *inter alia* Question No. 18 of the C.C.I.R. No C.C.I.R. representative from administrations in the sense of the circular quoted above was present at this meeting. The Director of the C.C.I.R. was represented and the chairman of Study Group No. I, absent on mission, also sent a representative.

At the meeting at The Hague, convened to deal with questions declared urgent by E.A.R.C. Recommendation No. 14, Question No. 18 was not examined for lack of time.

Contribution intended for the VIIth Plenary Assembly, London, 1953

United States of America. — Definitions are proposed for four different types of distortion. It is recommended that no action be taken on the question of telegraphic distortion measuring devices for use on radio services until such time as more practical experience can be had in the use of such devices and in the interpretation and application of data obtained therewith.

Conclusions and proposals.

Measurements of fortuitous distortion on telegraph circuits can act as a criterion of the quality of a circuit composed of a number of circuits in series. The method used is that of error counting, in which the errors that actually occur are counted during a period of time determined by the error probability factor selected. C.C.I.T. Study Group No. I was unable to draw up an entirely satisfactory answer but nevertheless proposed that the concept of probability be introduced into the definitions of degree of distortion so far adopted. The concept has already been introduced into the definition of "degree of service distortion" in the new draft recommendation annexed hereto (Annex II). In the case of a start-stop modulation or restitution, it appears that the concept of probability can be applied to the degree of distortion intuitively: it would suffice to note the degree of distortion of each successive signal and to reduce therefrom the frequency repetition of degrees of distortion, e.g. between 0 and 2%, 2 and 4%, etc.

In that case, if the observation is extended over a sufficiently long period for results to be regarded as representative of those that would be obtained over an infinite period of observation, it would be easy to calculate the probability that the degree of distortion would reach a certain value, and hence the probability of exceeding the value.

On the other hand, to apply the same method to an isochronous modulation (or restitution), it would have to be decided in advance over what elementary interval of time each observation of the degree of distortion was to be made. In any case it appears necessary to complete the fundamental definitions of degree of distortion by some indication of the length of observation, failing which the length of observation would be indefinite or would be equal to the entire duration of the modulation (or restitution) in question.

In addition to the definition of "distortion in time", a definition of "signal distortion" has proved necessary, since on radio circuits the original modulation is sometimes affected by fading or interference. The interval between two characteristic instants may be interrupted, broken up, or even, in some cases, entirely eliminated. These phenomena are designated by the term "signal distortion of a modulation or restitution".

Distortion on radio circuits may show such wide variations that the transmission quality cannot be assessed on a basis of maximum distortion. That is why the notion of "efficiency factor" has been introduced. It is the ratio of the number of correctly translated signals to the number of signals transmitted. It is realised, however, that this definition is not perfect. For instance, the factor is not determined solely by propagation conditions, but depends also on the receiver's own characteristics. The result can also be effected by the use of start-stop apparatus if, for instance, a mutilated signal caused the cylinder to rise, thus printing, instead of letters, a series of figures of which the signals correspond exactly to the letters which should have been reproduced. There are several such difficulties in the way of a satisfactory definition of the efficiency factor but, in spite of its inadequacy, the notion gives valuable indications of transmission quality.

The introduction of the notion of efficiency factor would thus seem useful. For the preparation of a definitive reply, data supplied by both the C.C.I.T. and the C.C.I.R. will have to be assembled and compared and studies should be continued on these lines. The notion of efficiency factor should thus be adopted and its study pursued in the two C.C.I.s. This conclusion, which will be proposed to the members of C.C.I.R. Study Group No. I, although it has not yet received their approval, will be brought to the attention of the Director of the C.C.I.R. who, if he deems fit, will communicate it to the chairman of C.C.I.T. Study Group No. I. The latter will then be able to take account of the conclusion, if he so desires, for the drafting of a future study programme at the C.C.I.T. Plenary Assembly which will be held before that of the C.C.I.R. In our opinion, the C.C.I.T. should also recommend administrations to take account of the definitions adopted in the study of apparatus for measuring telegraphic distortion on radio circuits. *

QUESTION NO. 20

Study Programme No. 4: Frequency-shift keying.

The main question is the fixation of one or more standard values of frequency shift for the fixed and mobile services in the various frequency bands. The task set by Study Programme No. 4 is to select the frequency-shift values for each type of service from the preferred values given in C.C.I.R. Recommendation No. 39 (Geneva, 1951).

Conclusions of the meeting at The Hague.

As no documents were submitted to the meeting at The Hague, the conclusions are based on the discussions.

Doc. 22. The Hague.

Particular attention should be given to the importance of using the lowest value of frequency shift compatible with the required keying speed. Propagation conditions, equipment, stability and receiving system must also be considered, but they are of secondary importance compared with the need for economy in spectrum.

In this connection recent experience, both laboratory and operational, suggests that, at least for fixed services, frequency shifts in excess of about 500 c/s are in general unnecessary and may, in fact, be detrimental to the overall grade of service.

The U.S.S.R. does not accept this conclusion. At the VIth Plenary Assembly the U.S.S.R. delegation considered that it was too early to standardize the values of frequency shift and reserved its opinion on Recommendation No. 39.

Contribution intended for the VIIth Plenary Assembly, London, 1953

United States of America. — Study of the existing situation and practical experience have made it possible to determine certain frequency-shift values. These values should be shown in any final list of recommended values.

Conclusions and proposals.

Insufficient information has been received since the meeting at The Hague to permit determination of the frequency shift values for the various types of services. The values suggested by the United States of America should be discussed.

In view of the reservation made by the U.S.S.R. at The Hague on the one hand, and the United States of America document recommending continued use of the shift value of 840 c/s by service utilizing equipment with a nominal shift of 850 c/s on the other, it would appear that discussion of the conclusions reached at The Hague on Study Programme No. 4 should be reopened.

* Note by the Director of the C.C.I.R. : After producing his report, the Chairman sent the following complementary note to the Secretariat of the C.C.I.R. :

"At the VIIth Plenary Assembly of the C.C.I.T., Arnhem (May-June 1953), Question No. 18 was dealt with in meetings of C.C.I.T. Study Group No. I at which the Chairman of C.C.I.R. Study Group No. I was present. As the conclusions of the work of the C.C.I.T. have not yet been published, the Chairman proposes to give a factual account of present progress in a document which will be distributed at the beginning of the C.C.I.R. Plenary Assembly in London."

The question of definitions and terminology was dealt with within the framework of Recommendation No. 5. A special report was forwarded to the Director of the C.C.I.R. on 21 October 1952, for transmission to the chairman of Study Group No. XIV and to the members of Study Group No. I.

QUESTION No. 46

*Arrangement of channels in multi-channel transmitters
for long-range circuits*

The C.C.I.R. agreed to study the best way of arranging and designating the channels in multi-channel transmitters for long-range circuits. Administrations were invited to exchange information for the establishment of standards.

Conclusions of the meeting at The Hague.

As no documents were submitted, the conclusions are based on the discussions.

Doc. 22. The Hague.

In the course of discussion at The Hague, it was observed that administrations could profitably examine the possibility of not using displacement equipment which is often used on one channel of twin-channel S.S.B. radiotelephone systems.

Experience shows in fact that the use of undisplaced channels would not generally result in an increase of cross-talk between the two channels and it considered that simplification of channel allocation procedure would result.

The above suggestion applies only to twin-channel operation where one channel is displaced and the space between that channel and the carrier is not occupied by another emission.

*Contributions intended for the VIIth Plenary Assembly,
London, 1953*

United States of America. — In addition to a summary of the transmission systems and channel designation used in telephony similar data are given for multi-channel telegraphy.

Japan. — Application of the general principles summarized in the document makes it possible to establish a channel designation based mainly on interference considerations.

United Kingdom. — The document contains information on the telephone transmission systems used in the United Kingdom as well as on channel arrangement and designation.

Federal German Republic. — This document proposes and justifies a certain channel arrangement, which takes various factors into account, especially spectrum economy.

Conclusions and proposals.

As regards channel designation, the views expressed by Japan differ from those of the United States of America and the United Kingdom. Since the difficulty is not, strictly speaking, a technical one but rather a matter of mutual agreement between administrations, the problem should be relatively easy to tackle provided more comprehensive information is made available to the C.C.I.R. before the Plenary Assembly in London. It is therefore advisable for any administration which has not already done so to submit its views on the matter.

The information received is insufficient for the formulation of a proposal for uniformity in the arrangement of the channels in multi-channel transmitters for long-range circuits. To enable the VIIth Plenary Assembly in London to prepare a recommendation, administrations should submit further information reflecting their practical experience.

From contributions received it would seem that countries are tending to adopt a four-channel equipment. The bandwidth of such emissions is 12 kc/s, while that of a three-channel system is 10 kc/s.

Bern, April 7th, 1953.*

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

* This report contains the additional items presented by the Chairman (Addendum to London Doc. No. 101).

ANNEX I

LIST OF CONTRIBUTIONS RECEIVED

QUESTION No. 1a

Study Programme No. 1

Country	Doc. No.*	
<i>Austria</i>	2.H	Report on the application of devices for radio reception recording of wave ranges in the radio control of the Austrian Posts and Telegraphs Administration.
	274	Draft Recommendation to replace Recommendation No.37.
<i>Belgium</i>	1.H	A note on the theory of repeated automatic-sweep radio-spectrum analysers.
	17	Re-draft of the above paper.
<i>United States of America</i>	78	Bandwidth of emissions.
	79	Report—Measurement of bandwidth of emissions.
<i>Italcable</i>	199	Analyses of A1 radiotelegraph emission spectra.
<i>Japan</i>	5.H	Bandmeters developed by the Radio Regulatory Commission.
	129	Report on bandwidth of Class A2 emissions.
	127	Report on bandwidth of Class F1 emissions.
	128	Report—Measurement of bandwidth of Class A1 and Class F1 emissions.
<i>Netherlands</i>	4.H	Spectrum measurements of a telegraph transmitter (F.M. and A.M.).
	136	Spectrum analyser.
<i>United Kingdom</i>	8.H	Bandwidth of emissions.
	168	A radio-frequency spectrum analyser for the H.F. band.
<i>Switzerland</i>	191	Description of a frequency analyser.

QUESTION No. 1b

Study Programme No. 2

<i>Belgium</i>	124	Reduction of harmonics and combined waves from high-power broadcasting transmitters.
<i>United States of America</i>	80	Recommendation—Harmonic and parasitic emission.
<i>Japan</i>	130	Report—Proposal for measurement of the power of the higher harmonics of a transmitter.
<i>Switzerland</i>	6.H	Report on the suppression of the harmonics of high-power medium-wave transmitters.

QUESTION No. 1c

Study Programme No. 3

<i>United States of America</i>	81	Report—Frequency stabilization of transmitters.
<i>Japan</i>	131	Frequency stabilization of transmitters.
<i>Netherlands</i>	193	Report—Frequency stabilization of transmitters.

* The numbers of documents submitted to the meeting of S.G. No. I at The Hague (April 1952), are followed by the letter "H".

Country	Doc. No.	
		QUESTION No. 18 <i>Study Programme No. 3</i>
<i>United States of America</i>	82	Recommended definition—telegraph distortion.
		QUESTION No. 20 <i>Study Programme No. 4</i>
<i>United States of America</i>	83	Frequency-shift keying.
		QUESTION No. 46 <i>Study Programme No. 4</i>
<i>United States of America</i>	84	Report—Arrangement of channels in multi-channel transmitters for long-range circuits.
<i>Japan</i>	126	Proposal—Arrangement of channels in multi-channel S.S.B. transmitters.
<i>Federal German Republic</i>	228	Arrangement of channels in multi-channel transmitters for long-range circuits.
<i>United Kingdom</i>	120	Arrangement and designation of channels on multi-channel radiotelephone systems.
		RESOLUTION No. 5
<i>Federal German Republic</i>	254	List of technical terms used in the work of Study Group No. I for which a definition is felt to be necessary.

ANNEX II

DRAFT RECOMMENDATION TO REPLACE C.C.I.T. RECOMMENDATION No. 301

Definitions

1. *Telegraph modulation.*

The process performed at the sending end of a telegraph channel causing the appropriate device in the transmitting apparatus to assume successive conditions prescribed by the telegraph code and corresponding to the text to be transmitted.

2. *Restitution.*

The series of conditions assumed by the appropriate device in the receiving apparatus (for example : the series of positions assumed by the armature of a receiving relay) as a result of a telegraph modulation.

3. *Significant conditions of a restitution.*

Conditions assumed by the appropriate device in the receiving apparatus having such characteristics that their succession enables the transmitted text to be reconstituted.

4. *Significant conditions of a modulation.*

Conditions assumed by the appropriate device in the transmitting apparatus which are intended to direct the appropriate device in the receiving apparatus into the corresponding significant conditions.

5. *Characteristic instants of a modulation or of a restitution.*

Instants at which the significant conditions of a modulation or of a restitution begin.

6. *Significant interval and unit interval of a modulation or of a restitution.*

A significant interval is the interval of time between two successive characteristic instants, to which a theoretical duration is attributed in a standardized telegraph system, and which is equal to, or a multiple of, a value called the *unit interval*.

Example of an interval which is not significant :

An interval separating two consecutive characteristic instants belonging to two different characters in the case of manual operation of a start-stop apparatus.

7. *Modulation rate : telegraph speed (deprecated).*

Reciprocal of the unit interval measured in seconds. It is expressed in bauds.

Example : if the unit interval is 20 milliseconds, the modulation rate is 50 bauds.

8. *Restitution delay.*

The delay between a characteristic instant of modulation and the corresponding characteristic instant of restitution.

9. *Isochronous modulation or restitution.*

Modulation or restitution in which all the intervals between two successive characteristic instants are significant.

10. *Arythmic (start-stop) modulation or restitution.*

Modulation or restitution comprising trains of isochronous modulation separated by non-significant intervals.

11. *Perfect modulation or restitution.*

Modulation or restitution in which all the intervals separating consecutive characteristic instants are occupied by the correct significant conditions and conform accurately to their theoretical durations.

12. *Degree of individual distortion of a particular characteristic instant of a modulation or of a restitution.*

It is sometimes necessary to take into consideration the displacement of a particular characteristic instant of a modulation or of a restitution from the instant with which it would have coincided under certain ideal conditions.

It will be necessary to indicate in each particular case the basis on which that ideal instant is determined.

The degree of individual distortion of a characteristic instant is the ratio to the unit interval of the displacement taken algebraically (i.e. early or late) of that characteristic instant from the ideal instant.

13. *Distortion of a modulation or restitution.*

Distortion of a modulation or restitution occurs when not all the characteristics are those of a perfect modulation.

14. *Telegraph distortion.*

Telegraph distortion (in time) occurs when an interval between two consecutive characteristic instants of a modulation or restitution has not exactly its theoretical duration.

15. *Signal distortion of a modulation or restitution.*

Signal distortion occurs when certain intervals separating successive characteristic instants of a modulation or restitution are, partly or wholly, occupied by conditions prescribed by the code and corresponding to the text to be transmitted.

16. *Efficiency factor of a telegraph communication (provisional definition).*

The efficiency factor of a telegraph communication is the ratio of the number of correctly translated signals to the number of signals transmitted, the keying being correct.

17. *Degree of distortion of an isochronous modulation or restitution.*

Ratio to the unit interval of the maximum difference, irrespective of sign, between the actual and the theoretical intervals separating any two characteristic instants of modulation or restitution, these instants being not necessarily consecutive.

Note : The result of the measurement would be completed by an indication of the period of the observation.

Measurements made under appropriate conditions would permit the establishment of the probability of a certain predetermined degree of distortion being exceeded.

18. *Degree of distortion of a start-stop modulation or restitution.*

Ratio to the interval of the maximum difference, irrespective of sign, between the actual and theoretical intervals separating any characteristic instant of modulation or restitution from the characteristic instant of the start element immediately preceding it.

Note : as for definition No. 17.

(a) *Degree of gross start-stop distortion.*

Degree of distortion determined when the unit interval and the theoretical intervals assumed are those appropriate to the standardized modulation rate.

Note : as for definition No. 17.

(b) *Degree of synchronous start-stop distortion.*

Degree of distortion determined when the unit interval and the theoretical intervals assumed are those appropriate to the actual mean modulation rate of the signals under consideration.

Note : as for definition No. 17.

19. *Degree of service distortion.*

Degree of distortion of a modulation or of a restitution, measured when the telegraph apparatus is in service.

Note : The duration of the measurement may be quoted in each particular case.

20. *Degree of standardized test distortion.*

Degree of distortion of a modulation or restitution measured during a specified period of time when the modulation is perfect and corresponds to a specific text.

21. *Quality factor of a modulation or of a restitution (provisional definition).*

The probability that an assigned value of distortion will be exceeded.

22. *Various types of distortion.*

It is useful, for certain applications, to distinguish various types of distortion which may appear separately or in combination.

They are as follows :

(a) *Characteristic distortion.*

Distortion caused by transients which, as a result of the modulation, are present in the transmission channel and depend on its transmission qualities.

(b) *Fortuitous distortion.*

Distortion resulting from causes generally subject to random laws (accidental irregularities in the operation of the apparatus and moving parts, disturbances affecting the transmission channel, etc.).

(c) *Bias or asymmetrical distortion.*

Distortion affecting a two-condition (or binary) modulation or restitution in which all the significant intervals corresponding to one of the two significant conditions have longer or shorter duration than the corresponding theoretical durations.

REPORT BY THE CHAIRMAN OF STUDY GROUP No. II*

(Receivers)

(Original language : French)

1. Work of the Group.

Study Group No. II (Receivers), set up at Stockholm in 1948, prepared Recommendations Nos. 41 and 42 at Geneva in 1951. It was then given a new programme of work in the shape of :

Question No. 47 — Sensitivity and noise figure;
Study Programmes

No. 5 — Stability of receivers;

No. 6 — Selectivity of receivers;

No. 7 — Protection against keyed interfering signals.

Subsequently, the programme was further extended :

1.1. By Circular AC/9 the Director of the C.C.I.R. communicated to the Group Recommendation No. 14 of the Extraordinary Administrative Radio Conference, stressing the urgent need for technical data on the 3.95-27.5 Mc/s band, particularly as regards the selectivity and stability of receivers.

1.2. Each group was requested by Study Group No. XIV (Vocabulary) (Resolution No. 5) to establish a list of definitions of the principal terms and symbols used in the branch of radio-communication with which it is concerned.

1.3. Finally, specific points were submitted by various members of the Group :

- amendment of the *noise figure* formula in Recommendation No. 41 (France);
- *standardization of the intermediate frequencies* of ship receivers and their protection from interference (C.I.R.M.);
- standardization of "*list of performances*" for receivers (Radio-Austria).

Members were informed of these proposals by the Chairman's Circulars Nos. 5, 6 and 7, dated December, 1951, November, 1952, and January, 1953, respectively. Circular No. 7 also requested members to reply before 20th February, 1953.

Meanwhile, membership had risen to 36 : 17 administrations, 16 operating agencies, scientific and industrial organizations, and 3 international organizations.

By 8th March, 1953, the following replies had been received :

Completed reports.

Japan (Doc. Nos. 132 and 133);

United States of America (September, 1952, and February, 1953);

United Kingdom (February, 1953);

Compagnie Radio-Maritime (November, 1952).

* Doc. No. 102, London.

Partial Reports, to be completed.

France — Report on Question No. 47 (February, 1953);
Italy — Report on Question No. 47, Study Programme No. 6 (February, 1953);
Comité International Radio-Maritime — Letter (December, 1952);
Federal German Republic — Letter (February, 1953);
Netherlands — Letter (February, 1953).

Unofficial contribution.

European Broadcasting Union — Choice of the intermediate frequency for superheterodyne receivers (July and December, 1953).

These reports are summarized below, in subject order.

2. Sensitivity and noise figure.

2.1. Study of this problem was provided for in Geneva Recommendation No. 41 and Question No. 47.

Recommendation No. 41 contained the following provisions which might be regarded as final for most receivers :

- definitions of *usable sensitivity*, *reference sensitivity* and *noise figure*;
- a formula for calculating the reference sensitivity from the noise figure, and vice versa;
- recommended *methods of measurement*, for A.M. telegraphy and telephony receivers only;
- two tables, one showing the best noise figure attainable for various frequency ranges, the other giving sensitivity and noise figures for 15 specimen receivers.

Question No. 47 stated, however, that the information given was incomplete. Insufficient data were available for frequencies above 10 Mc/s and additional figures were asked for. The definitions and methods of measurement for television receivers and pulse code modulation systems could not be described with accuracy and further information was required.

2.2. Bearing this in mind, it is interesting to note that Recommendation No. 41 as a whole has been accepted. No basic criticism of the definitions and methods has been made. Some administrations (the United Kingdom—Docs. 116, 117, 118, 119; and the United States of America—Doc. No. 121) have had no difficulty in carrying out the measurements prescribed. Others (Italy—Doc. 178) have made use of slightly different methods which, however, can be easily brought into line. Finally, as will be seen subsequently, the values shown in the tables have received satisfactory confirmation.

However, specific details have been questioned and additions and improvements to Recommendation No. 41 suggested.

2.2.1. Various comments have been made on the *formula* giving the *noise figure* F as a function of reference sensitivity E , bandwidth B and resistance of dummy aerial R

$$(1) \quad F = \frac{E^2}{400 k T B R}$$

Firstly, the formula seems to be applicable only to keyed or fully modulated signals. If the depth of modulation m is less than one ($1 = 100\%$), E must be replaced by the corresponding fraction $m.E$. Thus :

$$(1a) \quad F = \frac{(m.E)^2}{400 k T B R} *$$

* French proposal approved by Australia and accepted with a reservation by the Federal German Republic. See para 2.4.2. possible extension to frequency modulation.

Secondly, the value of F , thus calculated, seems somewhat unreliable because of possible errors in E (squared), B ("noise bandwidth" which in theory should be calculated by integration, but which is often expressed approximately as "width at 3 db" or "at 6 db down"), and even in R . France (Doc. 197) considers that the actual measured values of F should always be used. Japan (Doc. 133) likewise believes that F can be more accurately and conveniently measured than E .*

2.2.2. Operational procedure for measuring reference sensitivity and noise figures should be further defined, since various details and numerical values have been questioned.

In this connection, see the following documents :

France : (Doc. No. 197, Annex) Sensitivity and noise figure of receivers; United Kingdom : (Doc. No. 116, para. 3.2) Measurement of sensitivity and noise figure of television receivers; and United Kingdom : (Doc. No. 117) Measurement of noise figure of receivers above 30 Mc/s, (the last two for the use of noise-diodes and gas-discharge sources).

These differences of views should not, however, be regarded as serious, since the actual figures supplied by administrations on the whole show quite satisfactory agreement.

2.2.3. It would be interesting to obtain statistics of the way values vary from one receiver to another of the same type, or between new receivers and used or re-trimmed receivers, etc.

A statistical method of this kind is discussed in the Annex to the French contribution (Doc. 197). Examples of the degree of dispersion may be obtained by comparing the figures given for various receivers in the United Kingdom, Japanese and Italian contributions (Docs. 118, 133 and 178), the latter giving statistics for 170 broadcasting receivers—see para. 2.3.1 below. The dispersion is considerable.

2.2.4. To improve the noise figure, alterations may be made in some parts of the receiver (e.g. input circuit coupling) in a way which increases the risk of *cross-modulation*. In assessing the former, some indication of the latter should also be given. (Annex to Doc. 197, France).

2.2.5. Recommendation No. 41 (Consideration 6) created a fundamental restriction, which it would be desirable to eliminate, by assuming that *linear* receivers only are used. The French contribution suggests the use of an additional carrier at the maximum usable sensitivity level or at several pre-agreed levels for showing any variation in the noise figure. Such a solution would make formulae 1 and 1(a), given in para. 2.2.1, applicable one way only, since F cannot be measured unless E is known.

2.2.6. In view of these comments, Recommendation No. 41 might be revised. A much more detailed text is proposed in the Annex to the French contribution (Doc. 197).

2.3. As requested, the 1953 contributions contain many new sensitivity and noise figures, particularly for the decametric wave range (3 to 30 Mc/s).

To facilitate rapid approximate comparison of these values, the chairman has regrouped them to the best of his ability ** in the annexed table (fig. 1), the ordinates denoting reference sensitivity in the upper part of the table and noise figures in the lower part. To differentiate between the effect of the various factors, the data have been set out as follows :

- the 0.1 to 3 Mc/s, 3 to 30 Mc/s, 40 to 50 Mc/s, 100 to 160 Mc/s and 225 to 400 Mc/s frequency bands have been arranged in columns;
- whenever necessary, the various types of receivers are shown in each group, i.e., general purpose or communication (or unspecified) receivers, fixed services, mobile services, broadcast, and, for television, "vision" and "sound" sections;
- the origin of the information is shown by the shape of the symbols (see legend, Fig. 1).

It will be seen that most of the values given are for individual receivers. The values given by Italy and Japan are means or limits for receivers too numerous to permit individual plotting.

* The Chairman is of the opinion that some of the causes of error mentioned also occur, though to a lesser degree, in the direct measurement of F (uncertain signal strength, bandwidth and antenna resistance).

** The Chairman has occasionally had to give his own interpretation or translation of the data submitted, which are not always very full or very clear. He apologizes for any errors that may have crept in, and would be grateful to have them pointed out. He trusts that they have not affected the conclusions.

The value shown in Geneva Recommendation No. 41 are also given for comparison.

Examination of the data shows that :

2.3.1. Receivers of the same type and sometimes of the same make, tested by the same operators, show marked differences in performance.

This is clearly shown in the individual entries in the table, e.g. United Kingdom, frequencies 0.1 to 3 Mc/s, broadcast receivers (column 4), the sensitivities vary by approximately 40 db and by approximately 20 db for television (columns 9 and 10).

Reference to the Japanese and Italian documents confirms this dispersion. The table on page 2 of Doc. 133 (Japan) gives sensitivity ranges varying from 11 to 41 db for 6 types of receiver (all of which appear to be fixed service professional equipment); Fig. 3 of Doc. 178 (Italy) shows, for instance, that for 170 broadcast receivers on 1 Mc/s sensitivity varies between 4 and 170 μ V, i.e. 32 db, while in 80 % of the receivers there is a variation of 9 to 50 μ V, i.e. 15 db.

Thus, no great accuracy can be expected in statistical information of interest to the C.C.I.R., and even the averages values can only be computed to the nearest few decibels. Moreover, the information furnished is based on tests of new ex-factory receivers. Tests on receivers which have been in service for some time would reveal even greater dispersion.

2.3.2. Compared with these variations, the remaining causes of discrepancy are relatively insignificant.

The figures submitted by members for receivers of the same type operating in the same frequency band are sufficiently consistent and correspond fairly well with those shown in Geneva Recommendation No. 41. The influence of the frequency range proper, at least up to 30 Mc/s, is slight.

In all cases, *the reference sensitivity* is approximately :

- 0.1 to 1 μ V for best quality very narrow band (1 kc/s or under) receivers,
- 5 to 10 μ V for most telegraph and telephone service receivers,
- 10 to 1000 μ V for sound broadcasting and television.

The actual *noise figures* are approximately :

- 5 to 10 db for good quality receivers, in which noise has been reduced to a minimum,
- 10 to 20 db, sometimes as much as 30 db, for broadcast type receivers where the noise factor is less important.

These figures are not so good as those given in the first table in Recommendation No. 41. This is not surprising since the latter were intended to be the best obtainable. The figures thus show the difference between record performance and mass production.

It would appear, therefore, that the C.C.I.R. could continue along the lines of Recommendation No. 41—which, incidentally, are on the safe side—without being unduly hampered by the operational difficulties described in para. 2.2.

2.4. The 1953 contributions also contain partial replies to some of the unsolved points in Question No. 47.

2.4.1. *Television.*

The following measurement details are suggested by the United Kingdom in Doc. 116 :

- use of a 50 % sine-wave modulated signal for measuring the sensitivity of the vision channel,
- in the same measurement, choice of an output level of 20 volts and a signal-to-noise ratio of 12 db at the output,
- assessment of bandwidth for the calculation of the noise figure,
- use for noise figure measurements of diode generators and gas-discharge sources (up to approximately 30,000 Mc/s, to the nearest db).

2.4.2. *F.S.K. and F.M.*

A United Kingdom contribution (Doc. 119) contains a proposal for measuring the sensitivity of *frequency-shift* receivers by a 1/1000 probability of 20 % distortion.

A United States report (Doc. 121) offers a proposal for calculating the noise figure from the reference sensitivity for *F.M. receivers*. This question is likewise broached in a short note submitted by the Netherlands. The formulae arrived at are similar to formula 1 (a) in paragraph 2.2.1 above, with the depth of modulation m replaced by another numerical quantity containing the square of the "modulation index".

It will be necessary to decide whether Recommendation No. 41 should be amended to include television and frequency modulation.

3. Stability.

3.1. Study Programme No. 5 provided for :

3.1.1. Measurements to determine :

3.1.1.1. — drift after the receiver has been switched on (the room temperature and power supply being stable);

3.1.1.2. — after equilibrium is attained, frequency variation with ambient temperature; and

3.1.1.3. — frequency variation with power supply;

3.1.2. study of *circuits, compensating devices and manufacturing processes* likely to improve stability;

3.1.3. special study of *automatic frequency control*.

Examples of variations for various types of receivers were given in the annex.

Most of the replies received have emanated from Japan, the United Kingdom and the United States of America. Although no serious objection to the programme as a whole has been raised, specific points have been commented on.

3.2. *Comments.*

3.2.1. *Drift.* The following points must be specified :

3.2.1.1. — the duration of the "warming up" period which is intentionally or unintentionally "neutralized" at the start of the test. The United Kingdom suggests 5 minutes;

3.2.1.2. — the duration of the test, if it is discontinued before final stabilization (which is sometimes difficult to achieve). The United Kingdom tables show that a period of 1 hour is usually insufficient, since during that period drift may reach a maximum point, decrease and even change direction (see Doc. 167, Table, broadcast receivers Nos. 8 and 11).

3.2.2. The Chairman has assembled the figures furnished, reduced to *relative* values, in a table similar to that for sensitivity (Fig. 2). To separate the various types of receivers, distinction has been made between (adjacent columns) :

— "ordinary" receivers, with no indication of special compensation; (lack of indication does not preclude intentional or even fortuitous compensation);

— receivers fitted with supply voltage *stabilizers* or temperature compensation;

— receivers with a first oscillator, with or without crystal filter.

Examination of the diagram reveals that :

— for "ordinary" receivers, or even "stabilized or compensated" non-crystal receivers, the figures obtained are of the order of those given in Geneva in 1951;

— for crystal receivers, the drift values (24×10^{-6} to 255×10^{-6}) are considerably higher than the Geneva figure (10×10^{-6}) obviously applicable only to exceptionally high grade receivers;

— in this case, too, the dispersion is considerable. According to the United Kingdom document (Doc. 167, Table 1, Nos. 8 and 4), drift in sound-broadcast receivers varies between 15×10^{-6} and 2600×10^{-6} . It can therefore be deduced that compensation, whether intentional or fortuitous, can be very effective. It would be interesting to make a detailed analysis of the causes of these differences.

3.2.3. *Instability due to changes in ambient temperature.*

No general comments and very little measurement data have been received.

In plotting the three values quoted (one submitted by the United Kingdom and two by the United States of America) on the diagram, an indoor temperature variation of 10°C. , which would appear to be both reasonable and practical, was assumed. The figure in the Annex to Geneva Study Programme No. 5 are less favourable; they are, however, based on data obtained from tests on about 40 receivers and are not invalidated by the three new, perhaps exceptional, values.

3.2.4. *Instability due to supply voltage variation.*

A voltage drop of 10 % is generally assumed here. The figures in the diagram are of the order of those shown in Geneva Study Programme No. 5.

3.2.5. *Other causes of variation.*

The United Kingdom report (Doc. 167, para. 2.4) draws attention to two other causes of instability, i.e.

— *humidity*, which is capable of producing frequency variation of from 1600×10^{-6} to 1700×10^{-6} , i.e. greater than that produced by changes in temperature, partially attenuated by correction.

— *mechanical shock and vibration*, which have a very varied effect, sometimes producing a variation of up to 150×10^{-6} (columns on the righthand side of the diagram).

3.3. *Circuitry, precautions and devices for improving stability.*

Several contributions enumerate the usual technical precautions to be taken.

3.3.1. Japan maintains that to attenuate the absolute effect of relative variations in the selective systems, it is advisable to lower the intermediate frequency. This, however, would also lower the degree of image rejection *, e.g. with a variation of 25 to 50°C. , an intermediate frequency of 455 kc/s produces a drift of 1.2 kc/s , while the drift with an I.F. of 45 kc/s is only 0.2 kc/s .

3.3.2. Against variations in ambient temperature, the choice of components with low cyclic variation is recommended, but it is difficult in practice to obtain less than 1×10^{-4} per degree **; compensation between inversely varying components is also recommended (but their time constants must be equal and it is difficult to obtain more than a reduction of $1/10$ in this way); lastly, the use of thermostats is an obvious safeguard.

3.3.3. Against supply voltage changes, in the first instance, use may be made of *regulating devices* such as barretters, saturated transformers, gas discharge tubes, etc. . . . , between the line feed and the receiver. Then the (first) frequency change oscillator may be designed with special care to include high-Q coils, anode-tuning (Japan), bridge-stabilization, negative feed-back, etc.

3.3.4. Against changes in humidity, protection can be afforded by means of suitably lacquered coils, block-moulded components, etc. Lastly, to maintain temperature equilibrium, the use of anti-condensation heaters during stand-by periods is advocated (see examples and results, Doc. 167—United Kingdom).

3.3.5. The harmful effects of shock and vibration can be lessened by mounting the receiver on a rigid chassis (which, however, must not be stressed in assembly), with flexibly mounted compartments, vibration-absorbing sockets, tube padding, etc. (some mountings may do more harm than good). The wiring should be rigid and great care should be taken in the correct placing of switches, variable condensers, tuning-drive mechanisms, etc.

3.4. *Automatic frequency controls (A.F.C.).*

Some of the examples given show that excellent results are obtained by the use of automatic frequency controls provided their action is sufficiently stable, reliable and rapid; their use in S.S.B. receivers is particularly recommended.

* Neither does the method give any protection from variations in the first F.C. oscillator, which are usually the most serious.

** In this connection, the French proposal submitted to the Geneva Conference, 1951, might be consulted (Geneva Doc. 170).

Japan describes the results obtained with a mechanical control. The frequency remains stable to within a few c/s, while a local oscillator drift of 800 c/s is corrected within two seconds.

The United States of America report quotes a receiver (No. 3) in the 4.8 to 28 Mc/s range, with A.F.C. which holds the received signal to within ± 1 c/s average and within ± 6 c/s maximum over a variation interval of ± 1400 to 7000 c/s (Doc. 122).

The United Kingdom describes an A.F.C. broadcasting receiver (the last in the list), but the drift and instability figures are apparently given for receivers not fitted with A.F.C.

4. Selectivity.

4.1. The question of selectivity is covered in Geneva Recommendation No. 42 and Study Programme No. 6.

Comparison of the two texts shows that the problem was considered to be solved as regards single-signal selectivity for standard receivers intended for class A1, A2 and A3 emissions. Bandwidths and attenuation slopes for about 50 receivers are given (in db/kc/s and db/octave) in the annex to Recommendation No. 42.

Study Programme No. 6 provides for additional study of :

4.1.1. Selectivity of receivers intended for other classes of emission;

4.1.2. Effective selectivity by the two-signal method in accordance with the suggestions in Recommendation No. 42, para. 1.1-1.3;

4.1.3. The phase response versus frequency relationship and methods for measuring it.

Single-signal selectivity of standard receivers is dealt with in the Italian, United Kingdom and United States of America contributions for 1953. Some information is furnished on items 4.1.1 (receivers for other classes of emission) and 4.1.2 (two-signal method), but *no data* are given for 4.1.3 (phase characteristics). The information is summarized below.

4.2. *Single-signal selectivity of standard receivers.*

Italy has submitted statistics for 170 broadcast receivers, the United Kingdom individual results for 25 receivers of various types, and the United States of America of tests on three mobile service receivers operating on frequencies up to 400 Mc/s. All the data have been submitted, without adverse comment, in the form specified in Recommendation No. 42.

Comparison of these three sets of results and the Geneva figures leads to different conclusions for different types of receiver.

For *broadcast receivers* the following table may be set up :

	Pass band kc/s	Attenuation slope	
		in db/kc/s	ultimate in db/octave
Geneva Recommendation No. 42 .	4.4 to 8.5	2.4 to 8.9	19 to 46
Italy 1953	(average) 5.3	(average) 4.3	(average) 30
United Kingdom 1953	4.0 to 13.3	2.0 to 5.2	18 to 27

Considering the inevitable lack of uniformity in the manufacture of receivers, the results obtained are sufficiently consistent. They also confirm the Geneva figures to a satisfactory degree.

For *receivers of other types*, however, dispersion is so great that the new figures are practically valueless. The pass bands range from 0.1 to 20 kc/s for medium and short waves and reach 43, 129 and 135 kc/s for metric waves (V.H.F.) (this does not, of course, apply to television or radar). The attenuation slopes, in db/kc/s, range from 0.2 to 240 and 296, more or less in inverse proportion to the bandwidth; the ultimate slopes, in db/octave, for which dispersion is a little less marked, are generally of the order of 40 to 60, with a minimum of 11 and a maximum of 270.

In view of this confusion, no distinction according to the type of receiver can be made. Particulars of the *selective system* employed, which are not usually given, would provide the only useful information.

On the other hand, as will be seen subsequently, the incongruity of some of these figures may be due to non-linearity. It should also be noted that :

— protection against *spurious responses* ranges from 9' to over 110 db, with an average of 35 db (from 20 to 44), for Italian broadcast receivers, while the figure given for British service receivers in most cases exceed 50 db.

— protection against *I.F. interference* ranges from 23 to over 125 db. The figures are generally high.

4.3. *Receivers for other classes of emission.*

The only information received (Doc. 99) relates to 4 British television receivers (vision : 45 Mc/s, sound : 41.5 Mc/s). Only the lower vision sideband, i.e. the sideband on the " sound " side, is retained. To separate the latter, the selectivity curve must fall by about 50 db in a frequency interval of 0.8 to 1.1 Mc/s, which requires a slope of 50-80 db per *megacycle/s*. The bandwidth ratios at 40 db and 6 db are then only 1.5 and 1.6 respectively.

No figures have been submitted for F.M. or P.M. receivers.

4.4. *Two-signal selectivity.*

Despite the insistence of Recommendation No. 42 on the superiority of this method—confirming the numerous comments and prior recommendations of Lisbon, Bucharest and Stockholm—the United Kingdom report is the only 1953 contribution to mention this system (Doc. 98 and 99). As in all the preceding cases, the results obtained furnish convincing evidence of the unreliability of the single signal method. In practice, as the frequency difference increases, interference decreases at a *much slower rate* than the single-signal selectivity curve would lead one to suppose.

Receiver No. 2 shown in Table 1, " Communication receivers, general purpose ", of the United Kingdom report (Doc. 98) may be cited as an example. The single-signal selectivity given for 5 different bandwidths (cols. 8a to 8d) shows a slope consistently above 6 or 7 db/kc/s. It would be natural to assume that if an interfering signal at a distance of 10 kc/s produces a certain effect, the same effect will be produced at a distance of 20 kc/s if the signal level is raised by $(6 \text{ to } 7) \times (20 - 10) = 60 \text{ to } 70 \text{ db}$.

However, double-signal tests show that the difference in level actually obtained when the distance apart increases from 10 to 20 kc/s is *nil* for blocking (cols. 15a to 15c) and *at most 20 db* for cross modulation (cols. 16b to 16d).

Similar remarks hold good for receiver No. 8. The attenuation slope is of the order of 8 to 10 db/octave (cols. 8a, 8b). When the distance of the interfering signal passes from 10 to 20 or even to 30 kc/s (col. 14), its level for cross modulation is increased only by 12.19 and 11db respectively (cols. 16b to 16d) instead of the 160 to 200 db to be expected.

A probable explanation of this anomaly is that for interference considered at a high level (61 to over 120 db above 1 microvolt, i.e., from 1 millivolt to over 1 volt at the receiver input), blocking or cross modulation phenomena are produced in the R.F. and mixer stages where selectivity is much lower than that measured by the single-signal method, and, in practice, almost the same as the I.F. selectivity.

No similar check can be effected for the " fixed service " receivers Nos 2, 3, and 4 on which two-signal tests have been made for only one distance of the interfering signal (10 kc/s, col. 14). It is possible, however, that the attenuation-slope figures, i.e. 100 to 240 db/kc/s, which are extraordinarily high for the bandwidth (even though highly selective systems were probably used after two frequency changes), merely indicate saturation of the first stages. In any case, they should not be used for calculating the interference, since (col. 15 and 16) two-signal interference phenomena begin to appear at levels of from 64 to 90 db ref. 1 μV , when the interfering frequency is already at a distance of 10 kc/s.

It is, therefore, clear that the very high slopes obtained from single-signal curves are extremely unreliable and should not be used in calculating protection from interference caused by near-by signals superimposed on the wanted signal.

5. Protection from keyed interference.

No replies relating to Study Programme No. 7 have been received. This is to be regretted since the Programme seemed to offer a possible new means of reducing interference.

If Study Group No. II considers that the problem is now outside its competence and that voluntary rounding of keyed dots by the *transmitters* themselves is the solution, then the Study Programme should be officially taken over by Study Group No. I (Transmitters) as part of Study Programme No. I (Bandwidth of emissions).

6. Miscellaneous.

Few comments have been received on the remaining questions mentioned in para. 1.

As regards *vocabulary*, a letter from the Federal German Republic suggests that a better definition of "frequency instability" would be desirable.

Italy (Doc. 178, Annex IV) and the United Kingdom (letter to the chairman, dated 12th February, 1953) consider that the Radio Austria proposal for a *standard list of performances* might be discussed and extended*.

Two comments have been received on the suggestion by the C.I.R.M. for the standardization and special protection of one or several intermediate frequencies used by ship receivers. Italy (Doc. 178, Annex 3) is in favour of a detailed study of the problem, while the United Kingdom has already submitted figures on protection from interference in this connection. As shown in para. 4.2, these figures are rather high. In a letter to the chairman dated 12th February, 1953, the United Kingdom adds that protection can be easily improved still further by the insertion of a wave-trap at a suitable point before the mixer stage.

Lastly, a rather similar new question bearing on the protection ratio for the intermediate frequencies of *television* receivers is submitted by Italy (Doc. 178, Annex 2).

7. Conclusions.

The tasks of Study Group No. II for the London meeting may be summarized as follows :

7.1. *Points for which sufficient information has been received to permit preparation of a draft recommendation.*

Sensitivity and background noise of A.M. receivers. Definitions, methods of measurement, values obtained, divergence.

Stability. Drift, effect of temperature, effect of voltage variations. Average values. Dispersion. Methods of reducing instability. Automatic frequency control.

Selectivity. Single-signal method. Average values for broadcast and television receivers. Protection against spurious responses and I.F. interference.

7.2. *Points for which replies or information are insufficient and require completion.*

Sensitivity : details for the determination of the noise figure for non-linear, television and F.M. receivers.

Stability : drift, the initial neutralization period, duration of tests. Variations due to humidity and mechanical shock and vibration.

Selectivity : service receiver attenuation slope dispersion. Results obtained by the two-signal method and their interpretation.

Vocabulary.

List of performances.

7.3. *Points on which no information has been received.*

Sensitivity, stability and selectivity of P.M. receivers.

Causes of the very high divergences in "drift" values for receivers of the same type.

* The question of *receiver classification* in the manner adopted by the United Kingdom (Appendix A) seems pertinent here.

Study Programme No. 6, para. 3 : phase response versus frequency relationship; methods of measurement.

Study Programme No. 7 : protection from keyed interference.

7.4. *Texts proposed for consideration.*

Re-draft of Recommendation No. 41.

Protection of the intermediate frequencies of ship receivers.

Protection of the intermediate frequencies of television receivers.

The chairman would like to draw attention to the gaps mentioned in paras. 7.2 and 7.3. He hopes that further contributions which will enable him to complete the report will be made available before the conference opens in London.

Pierre DAVID

Chairman of Study Group No. II

Paris, 31st March 1953.

ANNEX

PREPARATORY DOCUMENTS RELATIVE TO STUDY GROUP No. II

(Receivers)

Question No. 47. — (Sensitivity and noise figure).

United Kingdom	Docs. 116, 117, 118, 119	
United States of America	Doc. 121	
Japan	Doc. 133	
France	Doc. 197	
Netherlands	Doc. 235	
Federal German Republic	Doc. 238	
Italy	Doc. 178	(refers also to Study Programmes Nos. 5 and 6 and Recommendations Nos. 41 and 42).

Study Programme No. 5. — (Stability of receivers).

United Kingdom	Doc. 167	
United States of America	Doc. 122	
Japan	Doc. 132	
Netherlands	Doc. 237	
Federal German Republic	Doc. 240	
Italy	Doc. 178	(refers also to Question No. 47, Study Programme No. 6 and Recommendations Nos. 41 and 42).

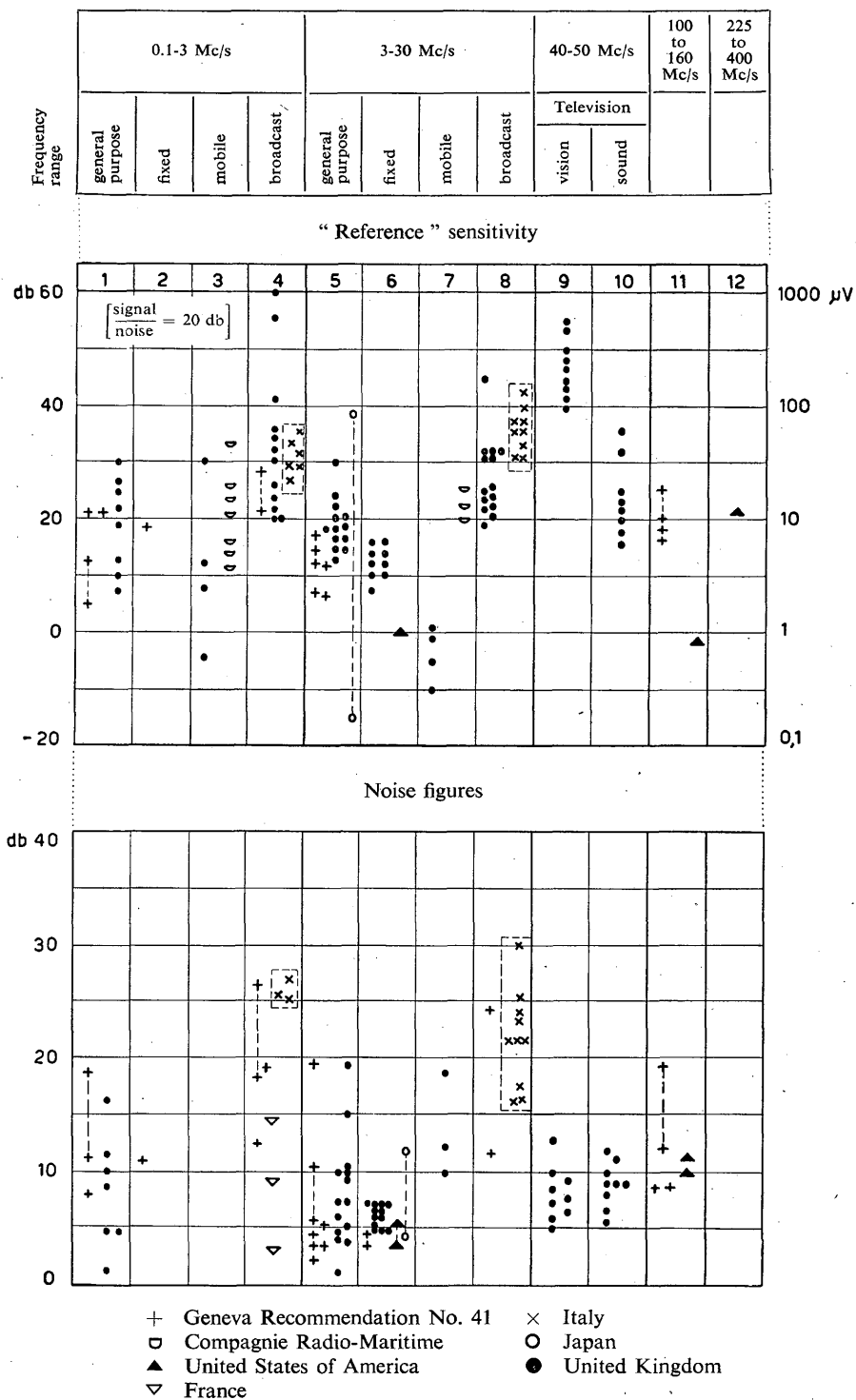
Study Programme No. 6. — (Selectivity of receivers).

United Kingdom	Docs. 98, 99, 166	
United States of America	Doc. 123	
Netherlands	Doc. 236	(refers also to Study Programme No. 7).
Federal German Republic	Doc. 239	
Italy	Doc. 178	(refers also to Question No. 47, Study Programme No. 5 and Recommendations Nos. 41 and 42).

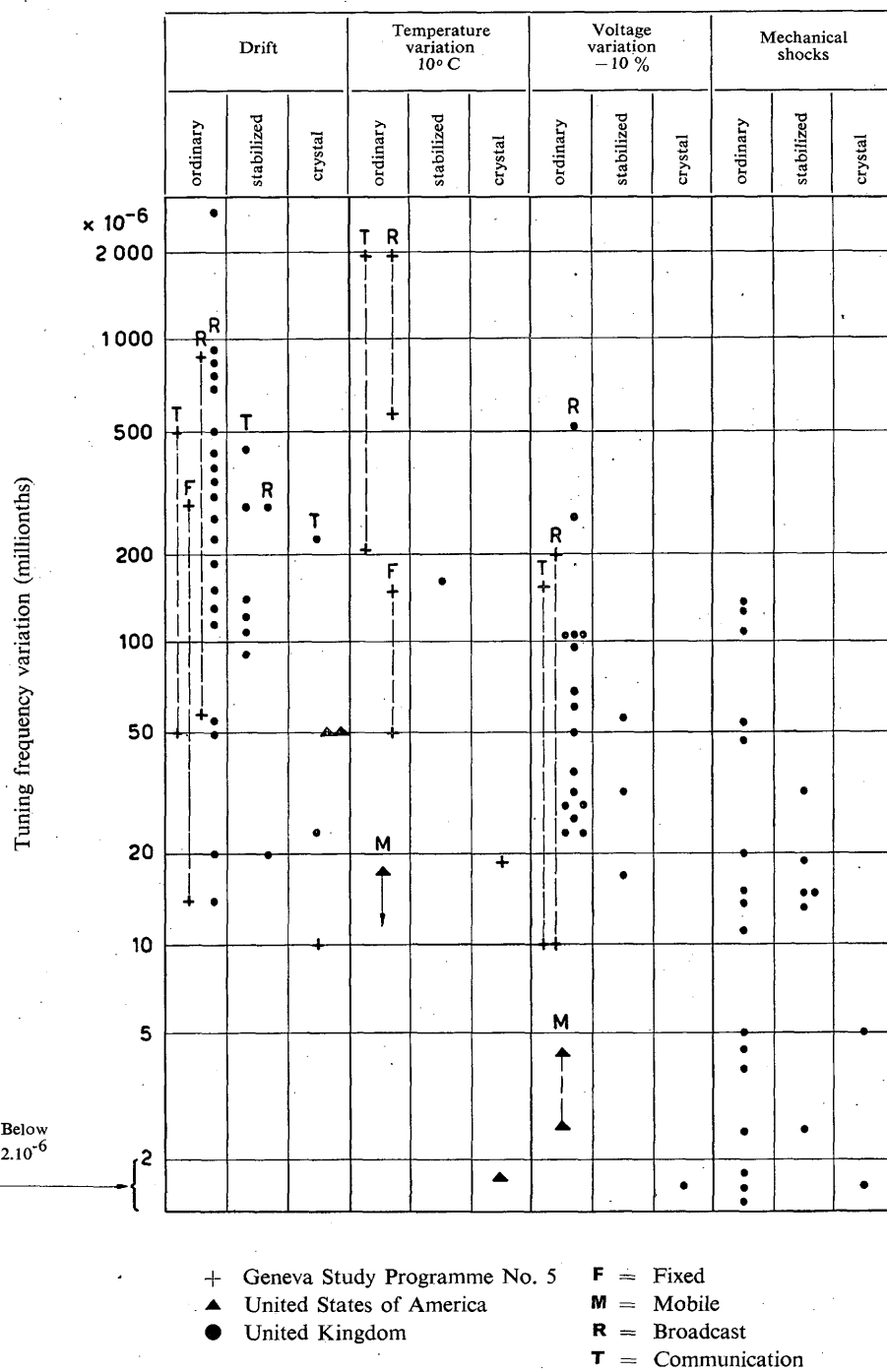
Study Programme No. 7. — (Protection against keyed interfering signals).

Netherlands	Doc. 236	(refers also to Study Programme No. 6).
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FIGURE 1



Instability



REPORT BY THE CHAIRMAN OF STUDY GROUP No. III *

(Complete radio systems employed by different services)

(Original language : English)

Study objects.

To Study Group No. III have been assigned :

1. Question No. 3 and Study Programme No. 8 ;
2. Question No. 11 ;
3. Question No. 43 and Study Programme No. 9 ;
4. Question No. 44 and Study Programme No. 10 ;
5. Question No. 48.

Working method.

The Group has held a meeting at The Hague in April 1952. The object of this meeting was the preparation of a reply with respect to Recommendation No. 14 of the E.A.R.C. The result of the meeting is contained in Doc. 23 (final) of the meeting of Study Group No. III, The Hague, 1952, annexed to this report.

The United States did not participate in the meeting but reported that the report of The Hague meeting is considered to be acceptable to them for the most part. Some clarification is requested in Section 1.1, Telephony, paragraphs *b* and *c*. Attention is drawn to Geneva Doc. No. 112, and to Doc. No. 138 of the meeting of Study Groups No. VI and No. X in Washington, 1950.

Contributions.

The United States (Docs. 2, 3, 4, 5, 6, 7) prepared preliminary responses to all five items mentioned above. These responses were forwarded to the members of the Study Group.

Italy expressed complete agreement with these responses.

French Overseas Territories pointed out that as yet no remarks could be made, but expressed the view that final adoption is premature and that the questions will have to be discussed in detail at the London meeting.

France (Docs. 204, 205, 206) made three very valuable contributions. Docs. No. 206 deals with the directivity of antennae at great distances. Doc. No. 205 relates to Question No. 43 and Doc. No. 204 describes an equipment for measuring the order of magnitude of the margin to be foreseen against fading.

Comments on the responses of the United States of America will be supplied soon, but these comments have not been received before issuing this report.

The Federal German Republic agrees to the responses to :

- Question No. 3, Study Programme No. 8 ;
- Question No. 43, Study Programme No. 9 ;
- Question No. 44, Study Programme No. 10 ;
- Question No. 48.

As far as Question No. 11 is concerned, the Federal German Republic points out that problem 3 constitutes a problem in which are also interested the U.R.S.I. and the World Meteorological Organization. A proposal for a rewording of points 3 and 4 of the Study Programme is given.

* Doc. No. 103, London.

The *United Kingdom* (Doc. 179) made a statement of the position regarding study of Question No. 11. A large amount of experimental results of noise measurements were presented to Study Group No. VI.

Japan (Docs. 134, 137) made an extensive contribution concerning Question No. 44 and Study Programme No. 10.

The contributions are entitled :

- Report on communication theory and its practical application (Doc. 134) ;
- References of communication theory in Japan (Doc. 137) ;
- Report on coding of discrete information ;
- Report on calculation of capacity of discrete channels.

The last two papers are both long and theoretical. The Director requested the author of the documents to supply a relatively short abstract of the papers for submission to Study Group No. III (see Annexes I and II to Doc. No. 137). In this way the members of Study Group III will be in a better position to study the problem.

Contributions for definitions and vocabulary.

As a result of Resolution No. 5 of the VIth Plenary Assembly of the C.C.I.R. the members of Study Group No. III were requested to send in contributions. The object is to establish a list of definitions of the principal terms and symbols used in the branch of radiocommunications with which Study Group No. III is concerned.

As Study Group No. III is concerned with complete systems, the result has been, as could be expected, viz. that the general feeling is that there is little or no need of a separate list of definitions and symbols as far as Study Group III is concerned, but that all the needs can be covered in the list on a more general basis.

There is one exception : a contribution from *Austria* contains a proposal to introduce the term "Radio-frequency band analyser" as a collective name for bandwidth measuring equipment with the definition :

"device for showing the components in frequencies of the temporarily variable high-frequency oscillations".

Furthermore, it is proposed to define the analysing capacity of such devices as :

"distance measured in cycles between two neighbouring oscillations, which can be recognized separately by means of the device concerned".

Switzerland and *Marconi Española* reported not to be able to make contributions.

The *United States* sent a set of standards issued by the Institute of Radio Engineers and a set of definitions presently being prepared under the auspices of the American Standard Association.

Australia submitted a copy of "Drafting Engineering Instructions (Graphical Symbols)" and a copy of the Melbourne Technical College publication entitled "Radio Draughting and Circuit Reading".

Both contributions have to be considered as informative about what in these countries has already been done in this respect on a national basis.

Dr. Ir. H. C. A. VAN DUUREN
Chairman of Study Group No. III

ANNEX

STUDY GROUP NO. III

REPORT OF THE MEETING AT THE HAGUE *

1. *Preamble.*

The terms of reference of the Study Group are contained in Recommendation No. 14 of the E.A.R.C.

The results of the studies are summarized in the following paragraphs in respect of Study Programme No. 8.

2. *Study Programme No. 8.*

Considering the documentation received and the discussions held, the following considerations should be taken into account :

Section 1.1 (Telephony).

Paras. 1.1.1.

1.1.2.

(a) In the text of Study Programme No. 8 and in the table of Annex I of Recommendation No. 44, for A3 telephony, the use of the terms "qualité courante" in the French text and "low grade" in the English text was noted. Although as a general rule in the I.T.U., the French text was the reference text, it appeared from the Geneva documents that in this instance the English text was correct and that the French text might better have read "qualité inférieure".

The Study Group agreed that in the course of this study the meaning to be given to these terms should be "juste utilisable" and "just usable" respectively.

The group noted further that the value of 3db for audio signal-to-noise ratio given in the table appeared to be an error and should be replaced by 13 db. The error appeared in both English and French published texts and in the relative Geneva documents.

(b) In the same table, the figure 33 db for audio signal-to-noise ratio for A3 double-sideband commercial telephony is substantially confirmed by the documentation received.

(c) In the same table and for A3 double-sideband telephony, the audio signal-to-noise ratio for just usable quality is 13 db; this figure is also substantially confirmed by the documentation received.

(d) As a compromise between intelligibility and economy of bandwidth, the upper frequency of the audio band can be reduced to 2600 c/s as mentioned in Recommendation No. 40, para. 2.1. However, it may be more practicable not to reduce the upper frequency below 2700 c/s particularly in the case of equipment using privacy devices.

(e) The minimum value of signal-to-noise ratio necessary at the output of the receiver for excellent service is understood to be the same as the audio signal-to-noise ratio given in Annex 1 of Recommendation No. 44 for A3 double sideband commercial telephony, i.e. 33 db.

Para. 1.1.9.

(a) Directional antennae

The use of directional antennae at the transmitter can also contribute to improved reception, not only by increasing the wanted field at the receiver but also by reducing echo and multipath effects. This is quite distinct from the value of transmitter directional antennae in reducing interference to adjacent channels.

Despite the non-uniformity of the transmission medium it is possible to employ transmitting and receiving antennae with appreciably greater directivity than that of antennae in general use.

Antennae with great directivity can be constructed, using known techniques, but the possibility of employing them depends on consideration of cost. Consequently, it is desirable to specify the minimum gain of the antennae that should be provided in the various frequency bands.

* Doc. No. 23, Meetings C.C.I.R. Study Groups Nos. I & III, The Hague, 1952.

(b) *Diversity reception*

At the present stage of development it is not yet definite that improvement results from the use of diversity reception on single-sideband telephony circuits.

However, from the point of view of economy of bandwidth, it should be borne in mind that space diversity is preferable to frequency diversity.

(c) *Noise reducers*

In addition to the use of a noise reducer at the receiver, reception can be improved by peak clipping at the transmitter, thereby enabling the average percentage of modulation to be maintained at a high level. However, to avoid out-of-band radiation, peak clipping must be followed by a low-pass filter having a suitable cut-off frequency and a substantially linear phase characteristic.

Note.

In the case of commercial radio telephony it is emphasized that the greatest improvement in the utilisation of the spectrum will arise from the replacement of double-sideband by single-sideband technique (see Recommendation No. 40, paras. 2.1 and 2.2).

Section 1.2 (Telegraphy).

Para. 1.2.1.

Although the permissible degree of telegraph distortion is not yet defined for radiotelegraph circuits, it is considered that the bandwidth in cycles per second at the output of the receiver (i.e. after the last detector) should be 2.5 times the baud speed for A1 emissions.

In the case of F1 emissions in the presence of fading the requirements are different because the receiver comprises a system of limiting and symmetrical frequency discrimination in which the instants of change-over from space to mark and vice-versa are less dependent on the presence of the higher keying harmonics.

It follows that the value of the highest frequency present in the keying spectrum can be lowered and the value of deviation can be reduced to the limit imposed by the preservation of signal-to-noise ratio. This limit varies directly with the highest frequency present in the keying spectrum.

Therefore, it is possible in F1 :

- to use a restricted bandwidth after the receiving discriminator, down to a value in cycles per second about the same as the keying speed in bauds;
- to reduce correspondingly the bandwidth occupied at the transmitter by diminishing the keying sidebands.

The extent to which these considerations can be applied to permit closer spacing of adjacent channels depends upon the degree and speed of amplitude variations due to fading and upon the differential fading of the mark and space frequencies.

It is important, therefore, that administrations carry out tests to determine the value of the foregoing considerations for the more economic use of the spectrum.

Para. 1.2.2.

The documentation received and discussed confirms the figure of audio signal-to-noise ratio given in Annex I of Recommendation No. 44 in the case of F1.

Para. 1.2.9.

(a) *Directional antennae*

The remarks under 1.1.9 (a) apply.

(b) *Diversity reception*

Some evidence indicates that an improvement of at least 6 db in signal-to-noise ratio can be expected from the use of double space-diversity in the case of A1 telegraphy.

To minimise the telegraph distortion due to multipath effects, it is desirable for the polar diagrams of the diversity receiving antennae to be similar.

Section 2 (Separation between frequencies of adjacent channels).

2.1.1. It is confirmed that the factors to be taken into account should be those given in Annex II of Recommendation No. 44.

2.1.2.

- (a) In the case of machine telegraphy it is useful to express the effect of interference as either:
- the percentage of faulty telegraph characters; or
 - the percentage of signal elements which suffer distortion in excess of specified values; or
 - the ratio in db by which the wanted signal, in the presence of interference, must be increased to have the same percentage of errors as without interference.

All these methods of expression can be used for assessing the effects of noise, fading and adjacent channel interference.

(b) In telephony, the effect of interference may be expressed as the ratio of signal to interference powers, as in the case of noise.

2.1.7. See remarks under 1.1.9 (a).

2.1.8.

(a) In the case of telegraphy using A1 and F1 emissions, it is common knowledge that a large number of machine telegraph circuits are operating successfully on nominal separations of 2.5 kc/s, particularly in the frequency bands below 12 Mc/s.

(b) The documentation received and discussed (in particular Doc. 457 of the VIth Plenary Assembly of the C.C.I.R. (Geneva, 1951) in which tests were carried out over a single circuit) indicates that with F1 reception at a speed of 50 bauds a separation of about 1.5 kc/s is satisfactory when the two signals have the same median values at the input to the receiver. Some of the tests described show that a fairly satisfactory operation at a channel separation of 2 kc/s is possible when the median value of the wanted signal is 6 db below that of the unwanted signal at the input to the receiver. It is particularly interesting to note that the quality of reception of the wanted signal was markedly reduced when the keying waveform of the unwanted transmitter was such that components due to higher harmonics of the keying frequency were being radiated.

When allowance is made for frequency tolerance, these figures indicate the possibility of a channel separation of about 2.5 kc/s under the particular conditions of the tests.

(c) It is recommended that administrations :

- collect data relating to transmitters at present working in adjacent channels, indicating the channel separations observed in practice, the field strengths of the signals on adjacent channels received at the same location and the effect of interference;
- carry out similar tests to those referred to above.

3. *Study Programme No. 10.*

Question No. 44.

Considering the documentation received and the discussions held at The Hague on Question No. 44, para. 1, Study Programme No. 10 should include the following :

In radiotelephony the determination of the relation between the amount of useful information (intelligibility) and the shape and width of the pass band for signal-to-noise ratios consistent with :

- (a) just usable service ;
- (b) excellent service.

taking into account that :

1. Radiotelephone circuits have in many cases to take into consideration signal-to-noise ratios lower than those of 33 db recommended in Recommendation No. 44 (Annex 1) for excellent service, this value itself being already less stringent than that recommended by the C.C.I.F. for international land-line circuits, viz. 52 db.

2. In many cases the noise energy is equally distributed over the audio frequency spectrum, while speech energy is distributed unevenly in this spectrum.

3. When high noise levels are present in a communication system and the signal-to-noise ratio is constant, the intelligibility might show a maximum as a function of the bandwidth and the distribution of the energy corresponding to the various frequencies it contains.

This distribution of the energy may vary with the fading.

STATEMENT BY THE DELEGATION OF THE U.S.S.R.

(Original language : French)

Following the decisions adopted by Study Group No. III, relative to the question of bandwidth and of signal-to-noise ratio in complete systems, the Delegation of the U.S.S.R. considers it necessary to make the following declaration :

Study Group No. III confirms the standards relative to the signal-to-noise ratio for telegraphy and telephony which are contained in Recommendation No. 44 of the VIth Plenary Assembly of the C.C.I.R.

The Delegation of the U.S.S.R. did not accept Recommendation No. 44, for it was of the opinion that it is necessary to study the questions relative to bandwidth and the signal-to-noise ratio in close connection with the question of the quality of the emission, and further considers that, at present, the C.C.I.R. has an insufficient amount of experimental and scientific data available to permit it to draw any definite conclusions at all. Since the closing of the VIth Plenary Assembly of the C.C.I.R., Study Group No. III has not received any new data concerning bandwidth and the signal-to-noise ratio, which would allow confirmation of the values given in Recommendation No. 44. For this reason the opinion of our Delegation has not changed since the VIth Plenary Assembly of the C.C.I.R.

We are of the opinion that the standards for bandwidth and those for the signal-to-noise ratio, contained in Recommendation No. 44, are unfounded and that they cannot be adopted, even for approximative calculations, in the field of telegraphy and telephony.

We are also of the opinion that, as long as the question of telegraphic distortion has not been studied, and the standards for telegraphic distortion have not been fixed, it would be premature to adopt any standards concerning the bandwidth, and, in particular, audio standards for A1 and F1 telegraphy, as has been done in the final report of Study Group No. III. We do not agree with the limitations laid down for the audio bandwidth in telegraphy, a limitation which goes as low as $2\frac{1}{2}$ times the speed in bauds for A1 and would be equal to the speed in bauds for F1.

It is also premature to draw a conclusion relative to the reduction of bandwidth for telephony, which would be as great as 2600 c/s. We are opposed to this opinion.

Studies should be continued on the question of bandwidth, as well as of that of the signal-to-noise ratio, both for telegraphy and telephony, in close connection with the question of the quality required for emissions pertaining to different systems.

10th April 1952.

(Signed) OUSPENSKY.

REPORT BY THE CHAIRMAN OF STUDY GROUP No. IV*

Ground-wave propagation

(Original language : French)

1. General.

1.1. Since none of the questions entrusted to Study Group No. IV was urgent and since no problems were referred to it by any I.T.U. authority, no meetings of the Group have been held since the VIth Plenary Assembly.

1.2. Seven administrations have taken part by correspondence in the work of the Study Group. 25 contributions have been submitted.

1.3. A list of definitions and symbols used by the Study Group has been circulated to members with a view to reaching agreement on a contribution to be submitted to Study Group No. XIV in accordance with paragraph 1 of Resolution No. 5 (Means of Expression).

1.4. The present report deals with :

- Questions Nos. 6 and 49 ;
- Study Programmes Nos. 11, 12, 13, 14, 15 and 16 ;
- Reports Nos. 2 and 3.

2. Question No. 6 : *Ground-wave propagation.*

2.1. A summary of the study made of Stockholm (1948) Question No. 6 is contained in the report by the Chairman of Study Group No. IV given on pages 44 to 49, Volume II, of the Documents of the VIth Plenary Assembly. Although various points of the question had already been dealt with in five special study programmes and in Report No. 2, the Assembly, considering the matter open to further discussion, decided that additional study should be made.

2.2. A very detailed contribution dealing with Question No. 6 in its entirety has been submitted by the United Kingdom (Doc. 154). Two contributions from the United States, furnished by K. A. Norton (Doc. 11) and G. A. Hufford (Doc. 10), respectively, deal with propagation over irregular ground, provided for in Point 2 of Question No. 6 and in Study Programme No. 14. Since the distinction between the purposes of the two sets of study is not very clear, the questions could be dealt with together. However, it has seemed preferable to carry out the studies entrusted to us in subject order.

2.3. The United Kingdom Report (Doc. 154) deals with all the aspects of Question No. 6, with particular reference to the revision of the propagation curves, likewise provided for in Study Programme No. 16. The report contains interesting suggestions for the presentation of data, the subdivision of frequency bands, range, and height, and for formulae and methods of calculation.

Doc. 154 states that the methods of calculation should in all cases involve the use of the fundamental results of propagation theory for a smooth homogeneous earth. After reviewing the five best known methods, the document expresses a preference for the method of Domb and Pryce, which makes use of different nomograms for different propagation conditions. It is noted, however, that as a rule the use of nomograms has its disadvantages. Suggestions are made for the construction of the new curves.

* Doc. No. 104, London.

2.3.1. As regards the calculation of attenuation required for the construction of the propagation curves, an interesting contribution to Study Programme No. 16 (Doc. 162) has been received from Dr. Bremmer. It is discussed in section 9 of the present report.

2.3.2. Italy has likewise submitted a proposal by the author of the present report, based on the "residue series" described by Dr. Bremmer in his well-known work.* It is also discussed in section 9.

2.3.3. The Italian contribution for Question No. 49 (Doc. 1), in so far as it concerns either the source of emission (cymomotive force or reference antenna radiating 1 kW) or the presentation of results (field in $\mu\text{V/m}$ versus distance or attenuation—or virtual distance—versus actual distance), should be deemed to extend to that part of Question No. 6 which bears on the revision of the propagation curves.

The matter has also been discussed by Study Group No. X (Resolution No. 3) which, at its meeting in Geneva in September 1952, agreed that the final decision for the presentation of data on antenna radiation should be deferred until a decision had been reached on Question No. 49.

2.3.4. The proposal regarding the virtual distance is well within the framework of that part of Question No. 6 which concerns the revision of the curves. The curves should be made independent of any reference antenna and of any radiated power, since these quantities are not physically related to the properties of the transmission media and consequently give rise to confusion whenever the antenna used differs from the reference antenna.

Since the attenuation of the path with distance is the operative characteristic, it seems perfectly natural that the propagation curves should show the attenuation itself, or at least the virtual distance with which it is directly connected, without reference to any extraneous factor. Since attenuation varies with each mode of propagation, a separate curve must be drawn for each mode. The existence of such curves would facilitate the choice of the mode most suitable for a given circuit.

2.3.5. A comment which is in principle in agreement with the Italian statement is contained in the contribution from the Radiodiffusion - Télévision Française (Doc. 207, Remark III) It reads :

"For the use of cymomotive force to take on its full value as an expression of the radiation of an antenna, it would be useful to draw up propagation curves or tables showing the field for the unit of cymomotive force. In this way, for a given emission of total radiated power P the field at the point with coordinates (φ, ψ, D) will be immediately deduced from knowledge of :

1. the diagram of specific cymomotive forces of the antenna $F(\varphi, \psi)$,
2. the total power radiated by the antenna P ,
3. the propagation curve giving the attenuation $A(D)$ by the formula

$$E = F(\varphi, \psi) \cdot \sqrt{P} \frac{A(D)}{D} \dots \dots "$$

The last member, which represents the field deduced from the curves for a c.m.f. of 1 volt is, in actual fact, the inverse of the virtual distance $D/A(D)$.

2.4. The United States of America has submitted a contribution (Doc. 10) to Question No. 6, point 2 (the effect of hills and other obstacles in diffracting the waves in either the horizontal or vertical plane, compiled by G. A. Hufford for C.R.P.L. Report No. 6.2 of the N.B.S. (19 February 1951).

In the report, the problem is examined from the mathematical point of view and reduced to the solution of an integral equation which can be numerically calculated. Because of the approximations used, the author does not consider his solution as final, even though it has been successfully applied to standard cases already solved by other methods, i.e. propagation over a plane earth with raised antennae and propagation over a spherical earth. The concordance of the results obtained shows that some consideration should be given to the equation evolved by Hufford, who, by examining propagation over irregular and inhomogeneous terrain, tackled

* Terrestrial Radio Waves, 1949.

the problem in its most general aspect. It might be interesting likewise to apply the equation to specific cases, e.g. propagation over a smooth and inhomogeneous spherical earth (mixed paths) or over reasonably regular terrain for which a smooth surface could serve as an approximation in accordance with, for example, the method proposed by K. A. Norton (Doc. 11) and examined in connection with Study Programme No. 14.

3. Question No. 49 : *Presentation of antenna radiation data.*

3.1. The most detailed contribution received is the report submitted by Italy (Doc. 1), which develops the arguments contained in Doc. 313 of the VIth Plenary Assembly. In Doc. 1 it is proposed that the concept of *virtual distance* (defined as the actual distance divided by the attenuation due to that distance) be adopted together with that of *cymomotive force* for the designation of more or less established concepts, with a view to standardizing and finally clarifying the notions on which the problems of propagation are based, particularly as regards the frequency bands used internationally.

3.2. It has already been pointed out that the concept of c.m.f. bears on Question No. 6, as regards propagation curves, and on Resolution No. 3 (S.G. No. X) as regards the publication of antenna radiation charts. The concept of virtual distance also falls within the scope of Question No. 6. Moreover, it is considered that the adoption of the two concepts would greatly simplify the calculation of propagation, since with a known c.m.f. for the transmitting antenna, in the direction of propagation, and with a given virtual path distance and a given mode of propagation, the calculation of the field boils down to a simple division of the first of these quantities by the second.

3.3. Following a detailed and thorough analysis of similar concepts at present in use, the adoption of c.m.f. is definitely favoured by France (Doc. 207).

3.4. The United States of America (Doc. 9), while seeing no great harm in using the concept of cymomotive force, does not see the necessity for adopting this "specific terminology". Subject to subsequent study by the I.R.E. technical committee, the general applicability of the definition of c.m.f. is questioned, since it is based on the assumption that the inverse distance law has been proved correct.

This objection, founded on Norton's formulae (P.I.R.E., Vol. 25, 1937, pages 1203-1236), appears to disregard the fact that terms which do not obey the inverse distance law are of appreciable size only for distances shorter than a wave-length, while by definition, the c.m.f. must be assessed at a distance of ten wave-lengths.

3.5. Italy has submitted a short document (Doc. 222) in addition to its contribution in respect of Question No. 49 (Doc. 1). Reference is made in Doc. 222 to well-known works.

4. Study Programme No. 11 : *Effects of tropospheric refraction on frequencies below 10 Mc/s.*

4.1. Two contributions, one from the United Kingdom and one from the United States of America, both referring to measurements made before 1951, have been received. The measurements show that the effect of tropospheric refraction is not very marked for frequencies well below 10 Mc/s.

4.2. A conclusion is reached in the United Kingdom document (Doc. 97) that for frequencies in the region of 1.5-2 Mc/s there may sometimes be some refraction of the signal, but that in any case the value of $4/3$ times the true earth's radius for the effective radius is too high.

4.3. The United States report (Doc. 8) considers that the best general fit of the measured values is obtained by using as the effective radius of the earth, $4/3$ of its actual value.

Since the experiments were carried out in different areas and at different times, the only deduction possible is that the tropospheric effect varies with the area, while in all cases the effective radius of the earth differs very little from the true radius.

4.4. In future, tests should, as far as possible, be accompanied by meteorological observations designed to facilitate the calculation of the effective radius of the earth for the area under consideration, and the establishment of any correlation between the effective radius and the behaviour of the field measured.

5. Study Programme No. 12 : Temporal variation of ground-wave field strengths.

5.1. The United Kingdom contribution (Doc. 96) contains a fairly comprehensive description of the present state of knowledge of the problem. A graph shows the variation observed in 1950, 1951 and 1952 of a field received on 1,088 kc/s at a distance of 175 km from the transmitter at Droitwich. An annual fluctuation reaching a maximum in winter and a minimum in summer is revealed, the amplitude ratio being approximately 2 : 1.

The report recalls that measurements made in Switzerland in 1945 showed that the absorption effect varied with the degree of foliage on trees. A second set of measurements described in the P.I.R.E. in 1949 established a close inverse correlation between the field received and variations in temperature.

5.2. Although at the present time no completely adequate explanation is forthcoming, the negative influence of temperature on the field of medium-wave broadcasting stations at normal listening distances may be regarded as valid.

To assess this influence, the Electrical Engineering Department of the University of Edinburgh has undertaken a series of noon readings of the field strength of the Norwegian transmitters of Stavanger (1313 kc/s) and Vigra (692 kc/s).

It is hoped to submit a report on the results of these tests to the VIIth Plenary Assembly in September 1953, with a view to determining whether the propagation of the waves received is due to a tropospheric or a ground conductivity effect.

6. Study Programme No. 13 : Ground-wave propagation over mixed paths.

6.1. The following contributions have been received :

- (a) From the F.P.R. of Yugoslavia : A report by Milenco ARGIROVIC "Propagation of electro-magnetic waves over inhomogeneous ground" published in "Elektrotechnicki Vesnik"—Vol. XIX—No. 8-9. August-September 1951, pages 225-231 (Doc. 246).
- (b) From the Japanese HOSO KYOKAI (Japanese broadcasting organization) : Report by Kiyohisa SUDA, Tokyo, 1953 (Doc. 140).
- (c) Report from the "Radio Regulatory Bureau" of the P.T.T. Ministry of Japan : Tokyo, 1953 (Doc. 141).

6.2. Memoranda (a) and (b) make use of van der Pol's approximative formula, which gives attenuation as a function of the Sommerfeld numerical distance

$$(1) \quad A = \frac{E}{E_0} = \frac{2 + 0.3 \rho}{2 + \rho + 0.6 \rho^2}$$

E is the field at the actual distance D, and E₀ the field for the same distance D in free space. (E₀ = F/D, where F is the c.m.f. in the direction of propagation).

Equation (1) was proposed by Prof. van der Pol in 1930 for ground with a dielectric constant :

$$(2) \quad \epsilon_r \ll \frac{\sigma}{\omega \epsilon_0} = 60 \lambda \sigma \text{ (M.K.S. units);}$$

consequently, (for vertical polarization), the actual numerical distance is

$$(3) \quad \rho = \frac{\pi D}{60 \sigma \lambda^2}$$

6.3. For mixed paths d₁, d₂, d₃ ... in length over ground of conductivity of σ₁, σ₂, σ₃ ..., the two authors obtain an overall or equivalent conductivity σ_e, deduced from the following equation

$$(4) \quad \frac{d_1 + d_2 + d_3 + \dots}{\sigma_e} = \sum \frac{d_s}{\sigma_s}, \text{ i.e. } \sigma_e = \frac{D}{\sum \frac{d_s}{\sigma_s}}$$

If the conductivity thus obtained is assumed to apply to the whole path D, the overall numerical distance can be deduced :

$$(5) \quad \rho_e = \frac{\pi D}{60 \sigma_e \lambda^2}$$

and by means of (1), the attenuation for the whole path D is calculated.

The results obtained by the two authors are in very close agreement with the experimental measurements for the shorter and for overland paths, while for distances of approximately 100 km or over, and particularly for paths partially over the sea, there is a marked disagreement. The reasons given by the two authors for the disagreement do not tally.

6.4. The second contribution suggests the use of equation (4) for deducing the equivalent σ_e . The attenuation is then calculated by means of (1) with ρ obtained through (5). Alternatively, the field may be obtained direct from the propagation curves for conductivity σ_e derived from (4). For paths of over approximately 100 km, and for paths partially over the sea, the author proposes that the σ_e of the overland portions be calculated by means of (4), and that for the portions over the sea the well-known conductivity of 5000×10^{-14} e.m.u. (5 siemens/m in Japan) be assumed. With these two conductivity values, Millington's graphic method is applied. The process is called "Millington's modified method". This method has been tested on 52 mixed paths—British, Danish, Japanese and United States of America—on frequencies between 537 and 1510 kc/s. The table and the numerous figures annexed show that the method is comparable to Millington's original method, and that the results obtained thereby are in close agreement with experimental findings.

6.5. In his article, Mr. Argirovic notes that in equation (1), for each value of A (ρ) there are two corresponding ρ values, one positive and one negative. The two absolute values are equivalent to 2.79 when :

$$A = 0.30^*$$

For $A > 0.30$, the values of ρ are comprised between 0 and $+ 2.79$, and between $- 1.17$ and $- 2.79$. If A is < 0.30 , the positive roots increase more rapidly than the negative roots.

The author recalls that tests have shown that the field undergoes a marked $+$ or $-$ variation in the neighbourhood of the boundary, and suggests that this is due to the appearance of a negative numerical distance ρ , which is added (with its $-$ sign) when the wave passes to a medium of higher conductivity, and subtracted (still with the $-$ sign) on transition to a medium of lower conductivity. This variation in ρ would seem to explain the variation in A .

By applying this method to various mixed paths in Denmark, the author obtained results in satisfactory agreement with the experimental values. He admits that his method fails to satisfy the principle of reciprocity and that it is, therefore, defective from the theoretical point of view.

6.6. The two authors, in adopting formula (4) as a basis, give no theoretical justification for its application in equation (1). An analysis of the question, which seems to be of some interest, is made in Annex I to this report.

6.7. The third contribution, by an unnamed author, received from the Radio Regulatory Bureau, Tokyo, is purely mathematical, and is based on an article by P.C. Clemmow, published in "Nature" (London), 21 January 1950, Vol. 165 (pp. 107-108).

6.8. In this article, Clemmow expands Sommerfeld's problem of a homogeneous flat earth by examining, at a given distance from the source, a terrain of perfect conductivity, e.g. an ideal sea surface.

r_0 and r are the distances from the boundary to the transmitter and the receiver, respectively; E_1 and E_2 the respective fields, for homogeneous terrain, for paths wholly overland or wholly over the sea. With $r > r_0$ the following expression is obtained for the field received over the mixed path :

$$(6) \quad E = \sqrt{\frac{2r}{\pi r_0}} \sqrt{E_1 E_2}$$

6.9. Using van der Pol's formula (Physica—August, 1935, pp. 843-853), and with the aid of studies carried out by Y. Nomura (Sci. Rep. RITU Electr. Comm. Vol. 3, No. 2—1952), the author obtains the following formula for the attenuation of the field E for the whole path, in relation to the field E_0 in free space :

$$(7) \quad \frac{E}{E_0} = 2 \left| A_1 A_2 \left[1 + \frac{2}{i} \left(\sqrt{\frac{r\rho}{\pi r_0}} + \sqrt{\frac{r_0\rho_0}{\pi r}} \right) \right] \right|$$

where A_1 and A_2 are the attenuations (complex) on a flat earth, as functions of the numerical distance ρ_0 and ρ , for a path wholly overland or wholly over the sea.

* The author finds $A = 0.305$, having used $0.65\rho^2$ instead of $0.60\rho^2$ in the denominator of (1).

This formula is valid for any two media with very different propagation constants. For media with similar constants, the final and less rigorous formula is :

$$(8) \quad \frac{E}{E_0} = \left| \frac{A_1 + A_2}{2} + \frac{1}{i} \sqrt{\frac{r}{r_0}} (\sqrt{\rho} A_1 - \sqrt{\rho_0} A_2) \right|$$

Two diagrams are given showing the behaviour of the field calculated by the above process, one for passing from a wet earth to the sea, and one from a dry earth to the sea. They are in satisfactory agreement with the results obtained by Millington's method.

6.10. The report submitted by the Netherlands (J. Houtsmuller, Doc. 243) describes a study of over 2000 field-strength measurements made in the flat part of the Netherlands, where the nature of the soil varies considerably. The document assesses the effect of sudden change from one type of ground to another on surface waves which are normally propagated at the boundary line. It is recalled that a surface wave reaching the boundary line at the Brewster angle of incidence with minimum reflection, undergoes a sudden change, attenuated by transient phenomena, until it adapts itself to the new conditions. By developing these considerations, a formula is obtained for the field strength at a certain distance from the boundary line. A propagation constant for the whole of the mixed path, even when several types of soil are involved, enters into this formula*.

The author, referring to Bremmer's formula (I-IV p. 62) shows that this equivalent constant may be introduced into the denominator of the formula, while the constants of each path are introduced into the exponents.

In conclusion, it is shown that the effect of a given path differs according to whether it encompasses the transmitter (or the receiver), or lies between the two. This holds good particularly for short (metric) waves.

6.11. It should be noted that although no final solution of the problem of mixed paths has as yet been found, considerable progress has been made in obtaining empirical solutions applicable to many practical cases. Some progress has also been made in obtaining mathematical solutions. Their use, however, would, as yet, appear to be very limited, particularly since they are inapplicable for regions in the neighbourhood of the boundary.

7. Study Programme No. 14 : *Effects of irregular terrain on ground-wave propagation.*

7.1. The United Kingdom contribution (Doc. 95) announces the publication in "Marconi Review", in 1953, of a paper by G. C. Rider on propagation across valleys (points 1 and 2 of Study Programme No. 14) on 160 Mc/s. An article by W. Gough on "Propagation of metric and decimetric waves within the line of sight" has appeared in the Italian periodical "Marconi". The purpose of these investigations is to determine the propagation characteristics of these waves over actual terrain, using centimetric waves for the tests. The equipment is easy to handle, and the consequent mobility of the antennae makes it possible to effect a great many measurements.

Full use is made of wave reflection for the best choice of sites for antennae and of the most suitable path, thus providing a satisfactory answer to point 1.4 of Study Programme No. 14.

7.2. A contribution for Study Programme No. 14 was submitted by the Japanese Delegation to the VIth Plenary Assembly (1951) in the form of 8 documents, partly experimental and partly theoretical. A number of specific cases are analysed with a view to obtaining formulae or rules to justify the effect of the various parameters (waves, distance, structure and nature of terrain) on the quality of propagation, expressed by the strength of the field received. Perusal of these documents, which are listed in Doc. 262 (Geneva, 1951), is recommended to all those interested in the utilization of metric and shorter waves.

7.3. The contribution from the Control Commission in Germany submitted to the VIth Plenary Assembly (1951), and published in F.T.Z. (October 1951), should also be considered. Because of the very interesting experimental observations and numerous theoretical considerations contained therein, much benefit can still be derived from its perusal.

* Omitting the constant ϵr (formula (2)) a new expression for an equivalent conductivity can be deduced.

7.4. The United States of America has submitted an interesting contribution (Doc. 11) by Kenneth A. Norton, on transmission loss of space-waves propagated over irregular terrain*.

The author asserts that whenever antennae are elevated by more than a wavelength above the ground, subject to the divergence coefficient, the ground-wave is predominantly a space-wave consisting of the direct and ground-reflected waves.

The following expression is used for the divergence coefficient :

$$(9) \quad D = \left[1 + \frac{2d_1 d_2}{k_t a \cdot D \sin \psi} \left(1 + \frac{k_t \sin^2 \psi}{k'_t} \right)^2 \right]^{\frac{1}{2}}$$

This expression contains a correction term for the radius of curvature of the reflecting ground in the direction of propagation ($k_t a$) or in the normal direction ($k'_t a$). To determine the radius of the actual ground in the direction of propagation—in practice, the only important radius—a second degree curve is substituted for the real profile of the terrain :

$$(10) \quad h = h_0 + by + cy^2$$

in which the coefficients h_0 , b and c are obtained by the method of least squares, h being the height above sea level of the various points of the terrain, and y their distance from the lowest antenna measured along the terrestrial great circle, with, at sea level, the vertical propagation plane as the line of demarcation. The curve of this parabola is shown to be practically equivalent to $2c$. The effective radius $k_t a$, which takes account of the true radius of the earth (a) and the tropospheric coefficient k , is calculated.

The effective curvature of the ideal terrain is then **

$$(11) \quad \frac{1}{k_t a} = \frac{1}{k a} - \frac{2c}{a}$$

For a concave terrain (valley), the coefficient c is positive and $k_t a$ may thus be negative ; in that case the divergence coefficient (9) is greater than one, and becomes a convergence coefficient.

The author proves that his formula for transmission loss is in good agreement with the results obtained experimentally, and attributes the slight disagreement to the fact that the terrain under consideration did not satisfy Rayleigh's criterion, i.e. that the obstacle exceeded the limit $\lambda/4\pi \sin \psi$ (where ψ is the angle of elevation of the reflected wave).

In conclusion, the author endeavours to prove that the transmission losses, represented by his formula, show "log normal" distribution, as is usually observed in practice.

The contribution is particularly interesting since the concepts introduced mark a step forward in the analysis, ever more rigorous, of phenomena governing wave propagation.

7.5. Two short contributions from Japan deal with Study Programmes Nos. 13 and 14.

The first (Doc. 139) gives the conclusions reached from Doc. 140.

The second, for Study Programme No. 14, recalls the documents submitted to the VIth Plenary Assembly, Geneva, 1951, listed in Doc. 262, and used in the preparation of Report No. 2. It adds that, because of the mountainous nature of the country, the investigations are a matter of great interest to the Japanese Administration. It has been found, for instance, that the field of metric waves propagated across valleys is higher than the values given by the diffraction theory.

The field of metric waves in the shadow of buildings is easily calculated by Fresnel's diffraction formula.

* N.B.S. Report 1737—June 16, 1952, and "Transactions of the I.R.E. Professional Group on Antennas and Propagation", P.G.A.P.—3 August, 1952, pp. 152-166.

** If the height is measured in feet and the distance in miles, the following result, which coincides with that obtained by the author, is arrived at :

$$\frac{1}{k_t} = \frac{1}{k} - 1.4995 c, \text{ since } a = 3958.74 \text{ miles} = \frac{3}{4} \cdot 5280 \text{ miles; and}$$

$$5280 \text{ feet} = 1 \text{ mile.}$$

7.6. The Netherlands contribution (Doc. 242) on propagation over irregular terrain examines the desirability of drawing the profile of the terrain, assuming the path to be a flat plane, and consequently of representing the course of the waves by a parabola, with its parameter $h = D^2/R$ varying with the effective radius R of the earth. By drawing the parabolas on translucent paper, it is possible to superimpose them on the profile of the terrain and to make the best choice of sites for the antennae. This method seems very convenient, particularly as it has already been applied successfully*. The author observes that the antennae should, for preference, be placed on a slope declining in the direction of the corresponding antenna. This improves the reflection coefficient and facilitates focusing of the reflected waves.

8. Study Programme No. 15 : *Phase variations in ground-wave propagation.*

8.1. The United Kingdom contribution (Doc. 94) gives a summary of measurements made on two paths, 177 km and 200 km long, respectively, between two sets of slave stations of the Decca Navigator system. The estimated ground conductivity varied from 1.10^{-14} to 5.10^{-13} e.m.u. (10^{-3} and 5.10^{-2} S/m).

CW transmissions on 127.5 kc/s were used with the aid of mobile phase-measuring equipment. The difference between the phase of the signals from the two transmitters was measured with an accuracy of 0.25° at numerous points along each path. From the curves obtained, it was possible to deduce the deviation of the measured phase from the calculated phase on the assumption of a uniform phase-velocity equal to the free space value. A value of 299.230 km/s was deduced for the mean velocity over the path. This result is in agreement with the measurements made in Sweden in 1950.

To explain the variations measured, an examination was made of the profile and geological structure of the terrain. The results so far obtained have shown a high velocity over ground of good conductivity, and a low velocity over ground of poor conductivity.

The theoretical phase change was determined by means of Norton's curves (P.I.R.E. Dec. 1941) and with the aid of data obtained by Bremmer (Terrestrial Radio Waves), and, for mixed paths, by Millington's method adapted to the experimental path.

As predicted by Millington, a phase disturbance in the neighbourhood of the boundary between sections of different conductivity was observed. This was apparently due to acceleration of the phase as the wave passed from ground of high conductivity to ground of low conductivity, and retardation as it passed in the opposite direction. Within half a wavelength or less from the boundary there was a marked disagreement between the theoretical curve and the measured values.

8.2. The conclusion derived from these investigations is that the theoretical method used for the determination of phase changes produces values which offer a very good approximation to the measured phase changes.

The discrepancies are as likely to be due to inaccuracies in the estimation of the ground conductivity as to the failure of the theoretical method.

The publication in the near future of a report on the subject in the Proc. I.E.E., part III, is announced.

8.3. A. B. Schneider's paper on the ground-wave phase variation in CW transmitters in the 70-130 kc/s band, published in the Journal of the British Institution of Radio Engineers, Vol. 12, No. 3, March 1952, p. 181, provides a very detailed contribution.

Space-wave phase variations, also for CW transmissions in the 70-130 kc/s band, are examined by W. T. Sanderson in the same journal (p. 195).

9. Study Programme No. 16 : *Revision of the 1937 C.C.I.R. propagation curves and their possible extension to higher frequencies.*

9.1. The United Kingdom contribution (Doc. 93) refers to the points raised in connection with Question No. 6 (Revision of the propagation curves). It is suggested that, to take account of atmospheric refraction, the coefficient of 1.33—a value supported by experimental evidence—be adopted for the effective radius of the earth.

9.2. A very interesting contribution by H. Bremmer (Doc. 162) offers two series for calculating the attenuation of the ratio $W(\rho, \delta)$ of the actual field to the field over an infinitely conducting flat earth, this field being twice the free-space field, with the two variables ρ = numerical distance

* L. Sacco — Sui ponti radio dissimetrici — Ricerca Scientifica e Ricostruzione — Dec. 1946 pag. 1816-18.

and δ = propagation index, dependent on all the quantities entering into the calculation, i.e. polarization, nature of terrain, distance, wavelength, atmospheric refraction. The first series includes as a first term, the complex attenuation over a flat earth, and provides a correction to take account of the curvature of the earth and of atmospheric refraction.

Using this method, the flat earth attenuation values (see, for example, Annexes 4 and 5 to Doc. 124 of the Plenary Assembly, 1951) may be adapted for shorter distances to which the residue series is not applicable in practice because of its slow convergence. These results were obtained by Bremmer with the aid of the operational calculus. The solution is given in the form of a formula which can be used for numerical calculations to cover higher frequencies and shorter distances so as to extend the propagation curves, at the same time taking account of atmospheric refraction.

9.3. Italy has submitted a report (Doc. 260) (see point 2.3.2) designed to facilitate the construction of the propagation curves by means of relevant figures very carefully calculated with the aid of formulae based on Bremmer's residue series.

This would merely entail the preparation of a few nomograms providing separately (a) the attenuation due to distance (modulus and phase) and (b) the height gain (modulus and phase) for the first three modes of propagation, $s = 0, 1, 2$.

The parameters considered are : a propagation index (K) identical with that (δ) used by Bremmer in his residue series ; a reference distance dependent on the wavelength and the effective radius of the earth ; a reference height dependent on the wavelength and the terrain constants.

The 12 nomograms have as abscissae the ratios of the actual height to the reference height, and of the actual distance to the reference distance, respectively. The propagation index (K) is shown as the curve parameter. The ordinates give the attenuation due to distance and the height gain.

Whether or not the values for the propagation modes $s = 1$ and $s = 2$ should be taken into account is determined by their magnitude.

The "Istituto Nazionale per le Applicazioni del Calcolo" of Rome has completed a series of calculations relative to height gain. Further calculations are being made to determine the attenuation with distance (formula I-IV, page 6 of Bremmer). It is hoped that the nomograms will provide an accurate and simple method both for direct application and for plotting the propagation curves.

9.4. As regards points 1 and 3 of Study Programme No. 16, attention is drawn to an interesting article by K. Bullington (P.I.R.E. January 1953, pp. 132-135) on "Radio transmission beyond the horizon in the 40-4000 Mc/s band".

The great disagreement between the experimental and the theoretical results obtained would suggest that other theoretical or empirical bases should be sought for the construction of the new propagation curves.

10. Report No. 2 : *Ground-wave propagation over irregular terrain.*

10.1. No comments have been received in respect of Report No. 2. The probable explanation is either that it still provides an adequate summary of our knowledge of propagation over irregular terrain, or that Study Programme No. 14 may be considered complementary to the Report.

It is desirable that as a result of discussions on contributions for Study Programme No. 14, Report No. 2 should be extended, and possibly made into a Recommendation.

11. Report No. 3 : *Review of publications on propagation (ground-wave).*

11.1. The United States of America contribution (Doc. 45) considers Report No. 3 still valid and adequate. No further additions are thought necessary.

11.2. The report from the Japanese Administration (Doc. 138) contains a list of Japanese publications on propagation.

12. Resolution No. 5 : Means of expression.

12.1. In accordance with Resolution No. 5 (point 1), each study group of the C.C.I.R. should establish a list of definitions of the principal terms and symbols used in the branch of radiocommunication with which it is concerned. To facilitate the task, a draft list (shown in Annex II, part 1, to this report) was prepared by the Chairman and circulated in November 1952.

12.2. The remarks concerning the draft list, submitted by Professor van der Pol in response to a request from the Chairman are given in Annex II (part 2).

Letters have also been received from the Chairman of Study Group No. I and from the Federal German Republic. They are shown in Annex No. II (parts 3 and 4).

12.3. All these documents have been forwarded to the Chairman of Study Group No. XIV, to whom the final list, approved by Study Group No. IV after discussion of the relevant documents, will also be sent.

Luigi SACCO
Chairman of Study Group No. IV.

ANNEX I

EQUIVALENT CONDUCTIVITY IN MIXED PATHS

1. The following well-known formula of van der Pol has been used as a basis in contributions for Study Programme No. 13 (Mixed Paths) :

$$(1) \quad A = \frac{2 + 0.3 \rho}{2 + \rho + 0.6 \rho^2}$$

for calculating attenuation as a function of Sommerfeld's numerical distance, computed by assuming for the whole of the path $\sum d_s = D$, an equivalent conductivity σ_e derived from the following formula :

$$(4) \quad \sigma_e = \frac{d_s}{\sum d_s / \sigma_s} \text{ which gives } \rho = \frac{\pi D}{60 \sigma_e \lambda^2}$$

2. The reliability of this method has, in most cases, been confirmed experimentally, particularly as regards the shorter paths (< 100 km), the results for which are always in agreement with those obtained by Millington's method.

That the agreement is not fortuitous may be proved by substituting the following formula *, similarly approximated (for $\rho < 5$), for equation (1) :

$$(8) \quad A = e^{-0.4 \rho} = e^{-21 D / \sigma \lambda^2} \text{ (M.K.S. units).}$$

Formula (8) is used for calculating the field according to Millington's method, which is equivalent to the following equation :

$$(9) \quad E_D^2 = E(\sigma_1, d_1 + d_2) \cdot E(\sigma_2 + d_1 + d_2) \frac{E(\sigma_1, d_1) E(\sigma_2, d_2)}{E(\sigma_1, d_2) E(\sigma_2, d_1)}$$

* In the Bollettino R.T. del R.E., January 1926, L. Sacco had proposed

$$A = e^{-4\rho/3\pi} = e^{-0.43\rho} \text{ for } \rho < 3.$$

Equation (8) may be verified by means of the attenuation curve given in Annex 5 to Doc. 124 of the VIth Plenary Assembly, 1951.

By substituting $a = 21/\lambda^2$, we have

$$E^2(\sigma_1, d_1 + d_2) = \frac{F}{d_1 + d_2} \cdot e^{-a(d_1 + d_2/\sigma_1)}; \dots; E(\sigma_2, d_1) = \frac{F}{d_1} e^{-a d_1/\sigma_2}; \dots$$

where F is the electromotive force. The following equations are obtained:

$$(10) \quad E_D^2 = \frac{F^2}{(d_1 + d_2)^2} e^{-2a(d_1/\sigma_1 + d_2/\sigma_2)} \quad \text{and} \quad E_D = \frac{F}{D} e^{-a D/\sigma_e}$$

where $\sigma_e = \frac{d_1 + d_2}{d_1/\sigma_1 + d_2/\sigma_2}$ exactly as in (4).

Thus, for short numerical distance ($\rho < \text{approximately } 5$), Millington's method coincides with those used by Agirovic and Suda.

3. For $\rho > \text{approximately } 15$, the attenuation is given by

$$A = \frac{1}{2\rho} = \frac{60\lambda^2}{2\pi} \cdot \frac{\sigma}{d} = b \frac{\sigma}{d} \quad \text{with } b = 95 \cdot 10^{-4} \lambda^2$$

Equation (9) gives $E_D^2 = \frac{F^2 b^2}{(d_1 + d_2)^2} \cdot \sigma_1 \cdot \sigma_2$ from which

$$(11) \quad E_D = \frac{Fb}{D^2} \sqrt{\sigma_1 \cdot \sigma_2} = \frac{F}{D} \cdot \frac{b}{D} \sigma_e \quad \text{with}$$

$$(12) \quad \sigma_e = \sqrt{\sigma_1 \sigma_2}$$

as derived. Therefore, for long numerical distances, Millington's method is as good as that of equivalent conductivity calculated from (12).

4. Equations (10) and (11) show—and this is borne out by experience—that the field increases as the wave passes to a medium of higher conductivity, and vice versa.

For distance $d_1 + d_2$, with conductivity still at σ_1 , according to (8) the field is:

$$E = \frac{F}{d_1 + d_2} \cdot e^{-a(d_1 + d_2)/\sigma_1}$$

With, on the other hand a conductivity of σ_1 for d_1 and σ_2 for d_2 , according to (10) the field is:

$$E' = \frac{F}{d_1 + d_2} e^{-a(d_1 + d_2)/\sigma_e} \quad \text{which gives}$$

$$\frac{E'}{E} = e^{a(d_1 + d_2)(1/\sigma_1 - 1/\sigma_e)}; \quad \text{but } \frac{d_1 + d_2}{\sigma_e} = \frac{d_1}{\sigma_1} + \frac{d_2}{\sigma_2}, \quad \text{and thus}$$

$$(13) \quad \frac{E'}{E} = e^{a d_2 (1/\sigma_1 - 1/\sigma_2)}$$

and E' is $>$ or $<$ E according to whether σ_2 is $>$ or $<$ 1.

5. Similar results are obtained for $\rho > 15$. For the two cases described above, we have:

$$E_1 = \frac{F b \sigma_1}{(d_1 + d_2)^2}; \quad E'_1 = \frac{F b \sqrt{\sigma_1 \sigma_2}}{(d_1 + d_2)^2}$$

and consequently:

$$\frac{E'_1}{E_1} = \sqrt{\frac{\sigma_2}{\sigma_1}}$$

Thus E'_1 is still $>$ or $<$ E_1 , according to whether σ_2 is $>$ or $<$ σ_1 .

ANNEX II

(Part I)

DRAFT DEFINITIONS CONCERNING GROUND-WAVE PROPAGATION

1. *Diffraction* : Phenomenon governing distribution of light, or of an electro-magnetic field, in a space where the light (or the field), from a given source, is intercepted by screens or similar obstacles (Ref. 1. — Introduction).

2. *Radiated field* : Part of a field produced by an antenna, which varies according to the inverse distance law, and which constitutes, at distances beyond a few wavelengths from the antenna, practically the entire electro-magnetic field produced.

3. *Electrostatically induced field and electromagnetically induced field* : Parts of the field of an antenna, varying with distance respectively according to the inverse cube law and the inverse square law ; they are negligible at distances beyond a few wavelengths from the antenna.

4. *Diffraction zone* : Zone situated beyond the optical horizon of the transmitting antenna, where diffraction occurs due to the curvature of the earth's surface, at a distance of approximately $d_{km} > 50 T^{2/3} \lambda_m^{1/3}$ (see note 1). For this area the attenuation is essentially exponential, with the exponent proportional to : $d / \lambda^{1/3} a^{2/3} T^{2/3}$, where d = distance, a = earth's radius (6375 km) and T = tropospheric coefficient.

5. *Sommerfeld zone* : Zone near enough to the transmitting antenna for Sommerfeld's theory of propagation over plane earth to be used. The field of the surface wave may be represented by $E = KF(\rho)/d$, ρ being Sommerfeld's numerical distance. The zone comprises all points situated within the distance for which $\rho \simeq 20$; beyond this zone the attenuation tends to have the form : $F(\rho) = 1/2 \rho$.

6. *Optical zone* : Whereas for the longer waves Sommerfeld's zone ($\rho \leq 20$) is in part superimposed on the diffraction zone ($d_{km} > 50 T^{2/3} \lambda^{1/3}$), for the shorter waves a third area exists between the two, which may be called the *optical zone*, as optical methods may be used to calculate the field, except for the points near the horizon.

7. *Intermediary zone* : Zone consisting of the reception points near the optical horizon of the transmitter, and for which neither the formulae of geometrical optics, nor the formulae of spherical diffraction can be used. In this zone the field may be obtained by joining the curves of the field calculated by the optical method for points close to the transmitter and those calculated by the theory of spherical diffraction for points further away.

8. *Height-gain* : Ratio between the field at a height h above the ground and the field at the surface of the ground.

9. *Divergency coefficient* : A purely geometric coefficient, which takes into account the fact that a beam of rays incident upon a spherical convex surface diverges after reflection, as a result of the surface curvature; this means an attenuation of the field, which becomes more marked for rays under more grazing incidence. This coefficient is measured by the ratio between the field after reflection on the spherical surface and the field which would be obtained after reflection on the plane tangent to the spherical surface at the reflection point. (Ref. 1, page 95.)

10. *Zenneck wave* * : Plane wave, with elliptical polarization in the vertical plane of incidence, having exponential attenuation and which approximately represents the surface wave at a great distance from the transmitting antenna, when the dielectric coefficient of the terrain need not be taken into account. It is used for very short transmission paths, the exponent being represented by : jhd , when h is determined by $1/h^2 = 1/K_1^2 + 1/K_2^2$, where $K_1, 2$ are the propagation constants of the atmosphere and of the terrain respectively (see Note 2).

11. *Fresnel diffraction zones* : To apply Huygens' principle to a plane wave front, propagated in a given direction, one considers the intersection of the perpendicular to the plane of the wave, drawn from the reception point. The circle which has this intersection as its centre, and which

* See attached note.

comprises the points of which the distance to the reception point differs by n half-waves from the distance of the reception point to the plane of the wave, defines the limit of the n th Fresnel zone. The radius of this circle is $\sqrt{n \lambda d}$ (Ref. 3, page 78). The first zone is, in general, the most important, as regards its contribution to the received field.

12. *Zones of diffused reflection* : The theoretical point O of the reflection of a ray reaching reception point A is taken as the centre of a reflecting surface. Points P surrounding this centre, and having a distance PA from the reception point, differing by n half-waves from the distance PO, are located on an ellipse which defines the limit of the n th reflection zone. The first zone is, in general, the most important insofar as reflection is concerned (Ref. 3, page 110; Ref. 7, page 417).

13. *Reflection ellipsoids* * : Ellipsoids of revolution, the plane sections of which passing through the major axis (axis of revolution) are ellipses, i.e. loci of the points the sum of whose distances to the two corresponding antennae within the line of sight is equal to the direct distance between the antennae increased by n half-waves.

The antennae occupy the foci of the ellipses and are situated at $n \lambda/4$ from the extremities of the major axis.

The peaks of the surface of the terrain, tangential to the same ellipsoid, are the points of reflection which produce paths of equal duration.

13(b). *Generalized Fresnel (diffraction) zones* : are plane sections of the reflection ellipsoid, perpendicular to the major axis.

The zone at a distance d from the extremities of the major axis (D) is a circle with radius

$$r = \sqrt{nd \lambda (1 - d/D)}.$$

With a very high value of D/d an ordinary Fresnel zone is obtained.

All the points of the first zone ($n = 1$), when affected by one of the antennae, radiate with identical phases on the other antenna.

14. *Rough surface (practically non-reflecting)* : Surface of which the unevenness in the direction of the perpendicular is larger than $\lambda/16 \sin \psi$, ψ being the angle of elevation of the incident waves (Rayleigh's criterium) (Ref. 3, page 80 and 466, and ref. 7, page 411).

15. *Knife-edge diffraction* : Schematisation of the wave diffraction over orographic obstacles, when the latter have a rather sharp profile, and are distant enough from the ends of the circuit and high enough above the surrounding terrain for the wave-path to be raised several wavelengths above the terrain on either side of the obstacles. In this case, the formulae of the knife-edge diffraction theory may be used (Fresnel).

16. *Spherical diffraction* : Schematisation of the diffraction on the ground (spherical), also on orographic obstacles, rounded in form, nearly cylindrical or nearly spherical. Diffraction theory formulae for a smooth and homogeneous sphere, or for a smooth and homogeneous cylinder may be used. (Watson, van der Pol, Bremmer, Eckersley, Millington, etc.)

17. *Shadow factor* : Factor applicable to plane earth propagation formulae (Sommerfeld, etc.), to take account of the attenuation caused by the curvature of the earth.

18. *Shadow zone* : Zone with lowest elevation in the direction of propagation, in which exploration by radar is difficult, due to the interference of the direct ray with that reflected by the ground, or by orographic obstacles.

19. *Critical height* : Height above the ground, beyond which propagation is less influenced by the nature of the soil. It can be approximately calculated by the formula : $h_0 = 54 \alpha_0 \lambda^{2/3} T^{1/3}$, where α_0 is the real part of the complex expression τ_0 (Ref. 1, page 44); λ and h_0 in metres; T = tropospheric coefficient.

20. *Wave number* : (Nombre d'ondes, Wellenzahle) : The relation $K = 2\pi/\lambda$, or the number of waves contained in 2π units of length. It coincides with the propagation constant in non-attenuating media ($\sigma \ll \omega \epsilon$).

* The designation "Fresnel ellipsoid", which might be suggested, is already used in cristallography to denote an entirely different concept.

21. *Ground wave* : Part of the transmitted wave which is predominant along the surface, as the reflection coefficients may be considered to have the value -1 and of which the attenuation is a function of the terrain constants.

22. *Sky wave* : That part of the wave which is predominant above ground, with a reflection coefficient which is considerably different from -1 , and of which the attenuation is the function of the characteristics of the troposphere and the ionosphere.

Note 1 :

The limit of the diffraction zone is indicated by different values, according to various authors. Millington gives $d_{km} > 20 \lambda_m^{1/3}$, whereas Bremmer (Ref. 1, page 62) indicates $36 \lambda^{1/3}$ and Beckmann gives $40 \lambda^{1/3}$. It is proposed that a value $d_{km} > 50 \lambda_m^{1/3} T^{2/3}$ be assumed which gives : $e^{-\text{Im}(\tau_1 - \tau_0)\chi} < e^{-3} = \frac{1}{20}$; T is the tropospheric coefficient.

Note 2 :

The propagation constant of the transmission medium $K = \sqrt{\omega \mu (\epsilon \omega + i\sigma)}$ is called the *Wave number* (Wellenzahl) by certain authors, eg. Beckmann (p. 27); Stratton (pp. 331-333), Bremmer (pp. 138-140-155). It would seem appropriate to conserve this word (Wave number) for the propagation constant in non-conducting media ($\sigma = 0$ and K real).

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|-----------------------------------|--|
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DRAFT LIST OF PRINCIPAL TERMS AND SYMBOLS USED
FOR THE STUDY OF PROPAGATION ON THE EARTH'S SURFACE

Symbols.

1. *Small letters.*

- a = earth's radius (6375 km).
 b = distance from centre of transmitting antenna to earth's centre.
 c = velocity of light in free space.
 d = distance between points on the surface of the earth, measured along the great circle.
 e = basis of natural logarithms = 2.718...
 f = frequency.
 g = antenna gain according to the Radio Regulations.
 g_T, g_R = gain of transmitting antenna, gain of receiving antenna.
 h = height of the centre of the antenna above the ground.
 h_T, h_R = height of transmitting antenna, height of receiving antenna.
 i = instantaneous intensity of electric current.
 j = $\sqrt{-1}$, imaginary unit.
 k = constant, in general.
 l = length (of the antenna).
 n = index of optical refraction.
 q = conductivity coefficient of the transmission medium, $q = \frac{\sigma}{\omega \epsilon_0} = 60\lambda \sigma$ (M.K.S. units).

- r = distance of the centre of the transmitting antenna from earth's centre.
 t = time.
 v = phase velocity ($= c/n$) of electromagnetic waves.
 x, y, z = rectangular cartesian coordinates.
 w = Sommerfeld's complex numerical distance.

2. Capital letters.

- A = gain or attenuation at a distance = ratio between the actual field and the field in free space, at the same distance d .
 D = direct distance between points in space.
 E = electric field (V/m).
 E_0 = electric field in free space (V/m).
 F = factor, in general.
 G = gain, expressed in db.
 G_T, G_R = gain expressed in db, at transmission, at reception.
 H = magnetic field (A/m).
 I = amplitude of electric current (R.M.S. value).
 J = symbol of Bessel functions.
 K = wave number, or propagation constant of the transmission medium.
 K_0 = wave number, in vacuo $= 2\pi/\lambda = \omega/c$.
 $K_{1,2}$ = propagation constant in the atmosphere and in the terrain;

$$K_{1,2}^2 = K_0^2 \left(\frac{\epsilon_{1,2}}{\epsilon_0} + j \frac{\sigma_{1,2}}{\omega \epsilon_0} \right)$$

- M = modified index of atmospheric refraction, $M = 10^6 \left((n - 1) + \frac{h}{a} \right)$
 P = input power.
 $P.H.$ = horizontal polarisation.
 $P.V.$ = vertical polarisation.
 R = reflection coefficient (Fresnel).
 R_V = reflection coefficient for vertical polarisation (in the plane of incidence).
 R_H = reflection coefficient for horizontal polarisation (perpendicular to the plane of incidence).
 S = surface, in general.
 T = tropospheric index = ratio between the virtual and the real radius of the earth.
 U, V = difference of electric potential (volt).
 W = total radiated power.
 X, Y, Z = functions of the cartesian coordinates (x, y, z).

3. Greek letters.

- α = real part of the propagation constant.
 β = imaginary part of the propagation constant.
 α_s, β_s = real and imaginary parts of the expression τ_s .
 δ = divergence coefficient.
 ϵ = permittivity or dielectric constant of transmission medium (farad/m).
 ϵ_0 = permittivity of free space ($= 8.854 \mu\mu F/m$).
 $\epsilon_{1,2}$ = permittivity of the atmosphere and of the terrain.
 θ = zenith angle.
 λ = wavelength.
 μ = permeability or magnetic constant (henry/m).
 μ_0 = $1.257 \cdot 10^{-6}$ henry/m, magnetic permeability of free space and, in general of non-magnetic media.
 ν = frequency $= v/\lambda$.
 π = 3.1415...
 ρ = modulus of Sommerfeld's numerical distance (w).
 σ = conductivity of the transmission medium.
 τ_s = complex expression of spherical diffraction.
 φ = azimuth angle.
 χ = geometric parameter of spherical diffraction $= 0.0537 \frac{d_{km}}{\lambda_m^{1/3} T^{2/3}}$
 ψ = angle of elevation.
 ω = pulsation $= 2\pi f$, or $2\pi\nu$ = angular velocity or angular frequency.

APPENDIX TO ANNEX II

(Part. 1)

ON THE USE OF THE ZENNECK WAVE

1. Let us put * :

$$(1) \quad E_z = E_{z_0} \cdot e^{-jt + jhx}$$

where E_{z_0} is the vertical component of the electric field at departure point O, taken as the origin of the coordinates; x is the distance PO to observation point P in the direction of propagation; and h is the propagation constant, defined by the relation : $1/h^2 = 1/K_1^2 + 1/K_2^2$, where :

$$(2) \quad K_1 = K_0 = \omega/c = 2\pi/\lambda \text{ and } K_2^2 = K_0^2 (\epsilon/\epsilon_0 + j\sigma/\omega \epsilon_0),$$

are, respectively, the propagation constants of the atmosphere (supposedly perfectly dielectric) and of the terrain. Using M.K.S. units, one writes : $K_2^2/K_0^2 = \epsilon_r + jq$; ϵ_r = specific dielectric coefficient; $q = 60 \lambda \sigma$, λ in metres; σ in siemens/m.

2. Now, if only the case where $K_2^2 \gg K_1^2 = K_0^2$ is considered, one obtains from (2) :

$$\begin{aligned} \frac{1}{h} &\simeq \frac{1}{K_0} \left(1 + \frac{1}{2} \cdot \frac{K_0^2}{K_2^2} \right) \text{ and } h \simeq K_0 \left(1 - \frac{1}{2} \cdot \frac{K_0^2}{K_2^2} \right) \\ &= K_0 \left[1 - 1/2 (\epsilon_r + jq) \right] = K_0 \left[1 - \frac{\epsilon_r - jq}{2(\epsilon_r^2 + q^2)} \right] \\ &= K_0 \left[1 - \frac{\epsilon_r}{2(\epsilon_r^2 + q^2)} \right] + \frac{K_0 \cdot jq}{2(\epsilon_r^2 + q^2)} \end{aligned}$$

$$\text{Thus } jhx = jK_0 x \left(1 - \frac{\epsilon_r}{2(\epsilon_r^2 + q^2)} \right) - \frac{K_0 \cdot qx}{2(\epsilon_r^2 + q^2)}$$

When one has $q^2 \gg \epsilon_r^2$, the dielectric coefficient need not be taken into account, and one gets :

$$(3) \quad jhx = jK_0 x - K_0 x/2q$$

The wave is propagated at the velocity of light with the attenuation given by $\exp(-K_0 x/2q)$.

3. Sommerfeld's numerical distance, for vertical polarisation is written as ** :

$$\begin{aligned} w &= j \frac{K_1^3}{2 K_2^2} \left(1 - \frac{K_1^2}{K_2^2} \right) x = j \frac{K_0}{2} \cdot \frac{x}{\epsilon_r + jq} \cdot \left(1 - \frac{1}{\epsilon_r + jq} \right) \\ &= j \frac{K_0 x}{2} \cdot \frac{\epsilon_r - 1 + jq}{(\epsilon_r + jq)^2} = j \frac{K_0 x (\epsilon_r - 1)}{2(\epsilon_r^2 + q^2)} - \frac{K_0 \cdot qx}{2(\epsilon_r^2 + q^2)}, \end{aligned}$$

and if ϵ_r^2 need not be taken into account with regard to q^2 , one gets :

$$(4) \quad w = - \frac{K_0 x}{2q} = - \rho$$

From (3) and (4) it may be deduced that the attenuation coefficient of the Zenneck wave, for $q^2 \ll \epsilon_r^2$, is equal to Sommerfeld's numerical distance.

4. At a great distance from the transmitter, Sommerfeld's theory shows that attenuation becomes $F(w) = 1/2 \rho$, whereas the plane of the wave becomes nearly flat, as in the case of the Zenneck wave. One is thus led to take the Zenneck wave as representing the field beyond a sufficiently great distance d , over a small path x , where the distance from the transmitter is $d + x$.

* BECKMANN — Die Ausbreitung der Elektromagnetischen Wellen — Leipzig, 1940, page 27.

** BREMMER — Terrestrial Radio Waves, page 82.

Now, according to Sommerfeld, the field E_{S_0} at distance d is :

$$E_{S_0} = \frac{E_0}{d} \cdot \frac{1}{2\rho} = \frac{E_0}{dK_0 d/q} = \frac{q E_0}{K_0 d^2}, \text{ and the field at the distance } d + x \text{ is :}$$

$$E_S = qE_0/K_0 (d + x)^2.$$

If, on the other hand, the Zenneck wave were used, the field would be :

$$E_Z = \frac{q E_0}{K_0 d^2} e^{-K_0 x/2q}, \text{ and the ratio between the two becomes :}$$

$$(5) \quad \frac{E_S}{E_Z} = \frac{e^{K_0 x/2q}}{\left(1 + \frac{x}{d}\right)^2}$$

5. The distance x may now be sought at which this ratio (equal to unity for $x = 0$) exceeds unity by the quantity p .

Let us therefore put :

$$\frac{e^{K_0 x/2q}}{(1 + x/d)^2} = 1 + p$$

and take the logarithms of the two members; the result is :

$$\frac{K_0 x}{2q} = \log(1 + p) + \log(1 + x/d)^2$$

But, as p and x/d are very small, one may write :

$$\frac{K_0 x}{2q} = p + 2 x/d, \text{ or else : } x \left(\frac{K_0}{2q} - \frac{2}{d} \right) = p,$$

and as $K_0 d/2q = \rho$, it may be deduced that :

$$(6) \quad x = \frac{p \cdot d}{\rho - 2}$$

6. From the foregoing it can be seen that the Zenneck wave may be used with (3), up to distances given by (6), and the value of the field will be less than that given by Sommerfeld's theory by less than 100p per cent.

Example : $\lambda = 250$ m; $d = 200$ km; $\sigma = 10^{-2}$ S/m; hence :

$$\rho = \frac{2 \cdot 10^5 \cdot \pi}{60 \cdot 10^{-2} (250)^2} = 16$$

$$\text{and : } x = \frac{200 \cdot p}{16 - 2} = 14.3 p \text{ km; if } p = 0.20, \text{ it follows that } x = 2.86 \text{ km.}$$

Rome, 20 October, 1952.

Chairman of Study Group No. IV :

Luigi SACCO

ANNEX II

(Part 2)

REMARKS CONCERNING THE DRAFT LIST OF DEFINITIONS AND SYMBOLS

FOR STUDY GROUP No. IV

(By the Director, C.C.I.R.)

1. Diffraction : 2nd line after "electromagnetic field" add "periodic in time" and delete "from a given source".
4. Diffraction zone : The notation T for the ratio of the apparent to the real radius of the earth might lead to confusion as in physics T is usually used for absolute temperature.
5. Sommerfeld zone : It is perhaps not necessary to define a "Sommerfeld zone" for distances up to $\rho \simeq 20$, since everything is quite smooth even for values of ρ considerably higher or considerably lower than 20.
6. Optical zone : 3rd line, it would perhaps be better to use "the methods of geometrical optics" instead of "optical methods".
8. Height gain : Add to the sentence "in the diffraction zone".
9. Divergency coefficient: 2nd line, substitute "shows a greater divergence" for "diverges after reflection".
10. Zenneck wave : 3rd and 4th lines, perhaps the words "when the dielectric coefficient of the terrain need not be taken into account" should be omitted.

ANNEX II

(Part 3)

SWISS P.T.T.

GENERAL ADMINISTRATION

Berne, 2 February 1953

Professor L. SACCO,
Chairman of C.C.I.R. Study Group No. IV,
Lungotevere Flaminio 22
ROME

Subject : *Draft Definitions and List of Symbols.*

Dear Sir,

With reference to Professor van der Pol's letter of 13 November 1952, enclosing your document "Draft definitions concerning ground-wave propagation and Draft list of the principal terms and symbols used in the study of ground wave propagation", dated 15 October 1952, we have the pleasure to submit our comments as requested.

We have no comments to offer as regards the definitions. Preliminary study has led us to believe that the list as it stands could be incorporated in the final document.

We should like, however, to offer some criticism of the list of symbols, which should, in our opinion, be based on the following principles :

1. For electrical quantities, the terms adopted by the International Electrotechnical Commission (I.E.C.) should be retained.
2. Factors, coefficients, ratios and other non-dimensional numbers should, as far as possible, be indicated by small letters.
3. Symbols of quantity should be given without indication of the units (e.g. E represents an electric field, irrespective of whether it is expressed in V/m or in $\mu\text{V/m}$, etc.).

Bearing these principles in mind, the document should be amended as follows :

- A = Gain or attenuation at a distance.
The symbol A is used by the I.E.C. to designate " surface ".
It is suggested that p (loss) be adopted.
- E, E₀, H = Delete the units in parentheses.
- M = Refraction modulus : term established by Geneva Recommendation No. 54.
- P = Delete " input ". P is used by the I.E.C. The type of power is indicated by indices.
- R = Reflection coefficient, R to be replaced by r. r is available since the distance from the transmitting antenna to the centre of the earth is designated by b.
- S = Surface, in general : to be replaced by A (I.E.C.).
- T = Tropospheric index : T is generally used for absolute temperature. To avoid confusion, τ or θ is proposed.
- U, V = Difference of potential. According to the I.E.C., U is the symbol for the difference of potential, and V the symbol for electric potential. It is proposed that V be deleted.
- W = Total radiated power. According to the I.E.C., W = energy. It is suggested that P_r be used for radiated power.

Hoping that these comments may be of use in the preparation of the final list, I remain, etc.

*Director of Radio
and Telecommunication Services :*

Dr. E. METZLER

ANNEX II

(Part 4)

FEDERAL GERMAN REPUBLIC

MINISTRY OF P.T.T.

Professor L. SACCO,

Chairman of C.C.I.R. Study Group No. IV,
Lungotevere Flaminio 22

ROME

Frankfurt, 19 February 1953

Subject : C.C.I.R. letter ref. G IV/87 dated 13 November 1952,
" Draft definitions concerning ground-wave propagation "
and " Draft list of symbols ".

Dear Sir,

I am in receipt of the C.C.I.R. letter, enclosing your " Draft definitions concerning ground-wave propagation ", and " Draft list of symbols ". My colleagues have examined the two drafts with great interest.

I have nothing to add to your Draft Definitions, which appear to be in line with the present state of scientific knowledge, and are both clear and comprehensive.

As regards the List of Symbols, a difficulty may arise since many of the letters suggested may have to be used in future to denote other concepts. Your list of symbols would provide a useful and valuable basis for discussion.

I should like to suggest that the letter " u " to designate group velocity, be added to the list.

I am, dear Sir, etc.,

p.p. the Minister :

KIRCHNER

ANNEX III

LIST OF DOCUMENTS RELATING TO THE WORK OF STUDY GROUP No. IV

London Document No.		
154	<i>United Kingdom</i> .	Question No. 6
10	<i>United States of America</i>	Question No. 6
1	<i>Italy</i>	Question No. 49
222	<i>Italy</i>	Question No. 49
207	<i>France</i>	Question No. 49
9	<i>United States of America</i>	Question No. 49
97	<i>United Kingdom</i> .	Study Programme No. 11 (part 1)
8	<i>United States of America</i>	Study Programme No. 11
96	<i>United Kingdom</i> .	Study Programme No. 12
246	<i>Yugoslavia</i>	Question No. 6
140	<i>Japan</i>	Study Programme No. 14
141	<i>Japan</i>	Study Programme No. 13
139	<i>Japan</i>	Study Programme Nos. 13, 14 and 15
11	<i>United States of America</i>	Study Programme No. 14
95	<i>United Kingdom</i> .	Study Programme No. 14
94	<i>United Kingdom</i> .	Study Programme No. 15 (part 1)
93	<i>United Kingdom</i> .	Study Programme No. 16
260	<i>Italy</i>	Study Programme No. 16
162	<i>Netherlands</i> . . .	Study Programme No. 16
45	<i>United States of America</i>	Report No. 3
138	<i>Japan</i>	Recommendation No. 14
Annex II to Doc. 104	<i>Chairman of Study Group No. IV</i>	
	<i>Director of the C.C.I.R.</i>	
	<i>Chairman of Study Group No. I</i>	
	<i>German Federal Republic, Ministry of P.T.T.</i>	
243	<i>Netherlands</i> . . .	Study Programme No. 13
242	<i>Netherlands</i> . . .	Study Programme No. 14
		Ground Wave Propagation.
		Ground Wave Propagation.
		Presentation of antenna radiation data.
		Presentation of antenna radiation data.
		Use of cymomotive force for the presentation of antenna radiation data.
		Presentation of antenna radiation data.
		Effects of tropospheric refraction on frequencies below 10 Mc/s.
		Effects of tropospheric refraction on frequencies below 10 Mc/s.
		Temporal variations of ground-wave field strengths.
		Report : Estimation of medium-wave field strength over mixed paths.
		Report : New method of calculating ground-wave field strengths over mixed paths.
		Report on ground-wave propagation research in Japan.
		Effects of irregular terrain on ground-wave propagation.
		Effects of irregular terrain on ground-wave propagation.
		Measurement of the phase changes along a ground-wave path at low frequencies.
		Revision of the 1937 C.C.I.R. propagation curves and their possible extension to higher frequencies.
		The evaluation of ground-wave fields for short distances.
		Review of publications on propagation.
		List of publications on radio propagation.
		Draft definitions concerning ground-wave propagation.
		Remarks on the draft list of definitions and symbols of Study Group No. IV.
		Comments as above.
		Comments as above.

ANNEX IV
SUPPLEMENT TO CHAIRMAN'S REPORT *

SUMMARY OF CONTRIBUTIONS AND PROPOSALS SUBMITTED TO STUDY GROUP No. IV
(Original language: French)

1. Question No. 6 : *Ground-wave propagation.*

1. Revision of 1937-1938 C.C.I.R. propagation curves and their possible extension to higher frequencies.

Study Programme No. 16 : same subject.

1.1. *Proposal submitted by the United Kingdom* (Docs. 93 and 154).

1.1.1. *Presentation of curves.*

111.1. Frequency range from 10 to 800 Mc/s to include broadcasting, television and aeronautical bands.

111.2. Calculations to be carried out on the basis of the theory of propagation over smooth, homogenous earth with an earth's radius of 8500 km for bands above 10 Mc/s.

111.3. Specification of the radiation source is subject to decisions reached on Question No. 49.

111.4. Stockholm 1952 curves to be adopted for the 40 to 216 Mc/s band.

111.5. Distance limit since the last maximum within optical range : up to 200 km for moderate antenna heights; up to 500 km or more for antennae placed at very high altitudes.

111.6. Linear scale of distances and linear scale of fields in decibels above a field of appropriate value.

111.7. The use of curves expressing gain as a function of height should be avoided, while combinations based on height at emission and reception for which field strength is given directly should be adopted. These heights may be found in table 1 (p. 8 of Doc. 154).

111.8. Plotting of curves. With a linear scale for distances on the x-axis, the field may be shown on the y-axis and the heights h_1 and h_2 as parameters, or the field as a parameter and the heights on the y-axis (fig. 1 and 2 of Doc. 154); the first method is preferable.

111.9. Frequencies : those shown in table II (p. 9 of Doc. 154).

111.10. Polarisation : vertical and horizontal.

111.11. Ground constants : the two principal ones only : $\epsilon = 80$; $\sigma = 4 \times 10^{-11}$ for sea; $\epsilon = 15$; $\sigma = 10^{-11}$ for earth.

111.12. Number of diagrams : probably more than 200.

1.1.2. *Method of calculation.* The document recalls the methods elaborated by Bremmer (1949), K. A. Norton (1941), Burrows and Gray (1941), K. Bullington (1947), Domb and Pryce (1947) and the Marconi Wireless Telegraph Co. (unpublished).

Calculations from formulae are preferable to nonograms. Graphic interpolation is recommended for fields close to the horizon.

1.1.3. *Plotting of new curves* : it is recommended that a team of specialists be formed within the Secretariat of the C.C.I.R.

1.2. *Proposal submitted by the Netherlands* (Doc. 162). Formulae by M. H. Bremmer for the calculation of attenuation $W(P, S)$ (formulae 4 and 5, p. 3 of Doc. 162) for certain distances this side of the horizon. Formula 4 gives correction terms as a function of the effective radius of the earth (by means of the coefficient δ).

1.3. *Proposal submitted by Italy* (Docs. 1, 222 and 260).

1.3.1. The propagation curves must be drawn without reference to the radiating source, but they must be representative of the attenuation resulting from the transmission medium and show the *virtual distance* which would give the same attenuation in free space (Doc. 1).

* Doc. No. 336, London.

1.3.2. Adoption of *cymomotive force* in the direction of propagation to represent the wave source. Field strength at reception is obtained by dividing the c.m.f. by the virtual distance (Doc. 1).

1.3.3. *Utilization of curves and tables* calculated by the Istituto Nazionale per le Applicazioni del Calcolo (I.N.A.C.) (Docs. 260 and 287) for revision of propagation curves and their extension to higher frequencies.

2. *The effect of hills and other obstacles on wave diffraction in either the horizontal or vertical plane.* Question 6, point 2 and Study Programme No. 14.

2.1. *Contribution by the United States of America* (Docs. 10 and 11).

2.1.1. *K. A. Norton's formula* for space-wave transmission losses over irregular terrain. Method of calculating the divergence coefficient and the effective radius of the terrain in the neighbourhood of the reflecting point (Doc. 11).

2.1.2. *Hufford's integral equation* for determining field attenuation over an irregular terrain the geometrical profile and electrical constants of which are known, as a function of the distance from the transmitter (Doc. 10).

2.2. *Contribution of the Netherlands* (Doc. 242). Suggestions made by Houtsmuller : that the course of the waves be shown by parabolas and the great circle below the profile of the terrain by a straight line. The receiving antennae should be placed on a slope declining in the direction of the transmitter.

2.3. *Contribution by Japan* (Doc. 139). Appreciation of Report No. 2 of the C.C.I.R. (1951) and experimental divergences noted.

2.4. *Contribution by the United Kingdom* (Doc. 95).

Conclusions reached by Rider on propagation across valleys, the transmitter being located on the far side of an adjoining hill :

- (a) variations in the observed field correspond to predictions made by assuming the field in the valley to be produced by an imaginary transmitter upon the top of the hill;
- (b) a passive repeater on the hill increases the diffraction field in the valley, particularly where the field is weaker;
- (c) for calculating the diffraction field beyond the summit of the hill, knife edge diffraction formulae are less reliable than the formulae for diffraction from a cylinder with a radius equal to that of the hill.

2.5. *Contribution by the Control Commission for Germany.*

Article by Grosskopf which appeared in the F.T.Z. (September and October 1951) and was also submitted to the VIth Plenary Assembly of the C.C.I.R. (1951). A detailed report of numerous experimental results and theoretical interpretation of cases of propagation over irregular terrain of frequencies between 30 and 100 Mc/s.

2. Question No. 49 : *Presentation of antenna radiation data.*

1. *Proposal submitted by Italy* (Docs. 1 and 222).

1.1. Antenna radiation should be expressed by the diagram of the specific cymomotive force produced by it in all directions.

1.2. When different modes of propagation (ionospheric or tropospheric for example) are found to be possible, each path and each mode of propagation should be distinguished by a set of virtual distance curves labelled according to frequency or absorption coefficient, or in any other way.

2. *Proposal submitted by France* (Doc. 207).

2.1. For a given transmission of total radiated power P , calculate the field at the coordinates (φ, ψ, D) , using a diagram showing the specific c.m.f. of the transmitting antenna and propagation curves showing the attenuation with distance A (D) along the selected course.

3. *Contribution by the United States of America* (Doc. 9).

3.1. Difficulty of using c.m.f. for the entire range of the frequency spectrum, since United States of America practice is to deal rather with power concepts at the higher frequencies.

3.2. In general there is no range of distances within which the field intensity varies inversely with the distance (see Doc. 222 submitted by Italy).

3. Study Programme No. 11 : *Effect of tropospheric refraction on frequencies below 10 Mc/s.*

1. *Contribution by the United States of America* (Doc. 8).

The adoption of an effective radius equal to $4/3$ of the real radius of the earth gives a more satisfactory account of experimental results (C. R. Burrows 1935; H. L. Kirke, 1949).

2. *Contribution by the United Kingdom* (Doc. 97).

For frequencies in the neighbourhood of 1.5 to 2 Mc/s, there may sometimes be some refraction, but in any case the value of $4/3$ times the true earth's radius would be too high for the conditions which prevailed in these experiments.

4. Study Programme No. 12. *Temporal variation of ground-wave field strengths.*

1. *Contribution by the United Kingdom* (Doc. 96).

The negative influence of temperature on the field of medium-wave broadcasting stations at normal listening distances may provisionally be considered as fairly probable. It must still be decided whether temperature variations affect ground conductivity or atmospheric refraction.

5. Study Programme No. 13. *Ground-wave propagation over mixed paths.*

1. *Contribution by Yugoslavia* (Doc. 246).

The possibility according to Argirović of calculating sharp field variations in the neighbourhood of the boundaries between the transmission media by the introduction into van der Pol's attenuation formula of a negative numerical distance. The method does not satisfy the principle of reciprocity, but can be used to calculate the conductivity of inhomogeneous ground.

2. *Contribution by Japan.*

2.1. The Millington method (Docs. 140 and 232) modified by K. Suda by the introduction of an equivalent conductivity for the application of the Millington graphic method, or for the calculation of numerical distance and attenuation by means of the van der Pol formula.

2.2. Formulae deduced by developing the Clemmow diffraction method for calculating the field at points slightly removed from the boundary (Doc. 141).

3. *Contribution by the United Kingdom* (Doc. 261).

(a) The Millington method provides good general agreement with measured values even when a relatively coarse division of the path is adopted.

(b) With a finer division of the path, some of the more detailed variations of field can be attributed to conductivity changes.

(c) Better agreement is obtained by attributing to the first section of the path a higher value of conductivity than the one obtained experimentally.

4. *Contribution by the Netherlands* (Doc. 243).

Formulae for the calculation of field strength at a certain distance from the boundary with overall propagation constants satisfying the principal of reciprocity reveal the effect produced by mixed paths and account for the unfavourable influence of successive regions of good and bad conductivity.

5. *Contribution by the Chairman* (Doc. 104, Annex 1, p. 17).

Comparison of the Millington method with the equivalent conductivity method.

6. Study Programme No. 14.

See I, Question No. 6.

7. Study Programme No. 15. *Phase variations in ground-wave propagation.*

1. *Contribution by the United Kingdom* (Doc. 94).

The method of calculating theoretical phase changes consists of a process of adding together portions of the basic curves appropriate to the ground constants of the various sections of the path, and of applying a method which is analogous to the Millington graphic method for calcula-

ting field amplitude. The process is repeated for transmission over the path in the reverse direction and the arithmetic mean of the two values so obtained is taken as the required phase change. The ground constants may be deduced by using the phase variations with distance.

8. **Study Programme No. 16.** *Revision of the 1937 C.C.I.R. propagation curves and their possible extension to higher frequencies.*

See I, Question No. 6.

9. **Report No. 2.** *Ground-wave propagation over irregular terrain.*

None.

10. **Report No. 3.** *Review of publications on propagation (ground-wave).*

1. *Contribution by the United States of America* (Doc. 45).

Report No. 3 is still valid; no addition to it is deemed necessary.

2. *Contribution by Japan* (Doc. 138).

List of Japanese publications on propagation in general and on Study Group No. IV in particular (p. 2).

11. **Resolution No. 5, point 1 :** *Means of expression.*

1. Proposals by Chairman. Doc. 104, p. 20.
2. Remarks by Prof. B. van der Pol. Doc. 104, p. 31.
3. Remarks by the Chairman of Study Group No. I. Doc. 104, pp. 32 and 33.
4. Remarks by the Federal German Republic. Doc. 104, p. 34.

REPORT BY THE CHAIRMAN OF STUDY GROUP No. V*

(Tropospheric propagation)

(Original language : English)

1. General.

About twenty national administrations and a number of operating agencies and other organizations 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. Since the last Plenary Assembly in Geneva in 1951 and up to the time of writing, contributions have been received from various countries and lists of these are given in Appendices I, II and III.

2. The Stockholm meeting in May 1952.

A meeting of Study Group No. V was held in Stockholm between 15th and 23rd May, 1952, with the particular object of reporting on Study Programme Nos. 17 and 18, ("Tropospheric propagation curves for distances well beyond the horizon", and "Tropospheric wave propagation" respectively) in order to assist the work of the European Broadcasting Conference which was held in Stockholm during May and June 1952. The full report of this meeting of the Study Group was issued as C.C.I.R. Doc. 33 (final), Stockholm 1952. It is referred to as Document S/33 (final) in Appendix I of this report. The main result of the meeting was to revise the tropospheric wave propagation curves attached to Recommendation No. 55 of the C.C.I.R. Plenary Assembly in Geneva 1951. The modified curves, which will be found in Doc. 33 (final), give the estimated field strength at a height of 10 m above ground level, exceeded for 1 % and 10 % of the time on frequencies between 40 and 200 Mc/s at distances from 100 to 700 km from a half-wavelength dipole radiating 1 kilowatt. With reservations made by France, Czechoslovakia, the U.S.S.R. and the Ukrainian S.S.R., the Study Group agreed to recommend these modified curves for adoption for provisional use under the limited conditions defined in Geneva Recommendation No. 55, and revised at Stockholm (see Doc. S/33 (final)).

It was concluded at Stockholm that, until a much greater quantity of radio measurements have been made in various parts of the world, it is not practicable to give more specific recommendations. The hope was expressed, however, that the modified Stockholm propagation curves would form a useful guide insofar as they represented the state of knowledge available in this field early in 1952.

One of the major tasks of the Study Group at the forthcoming meeting in London will be to consider the advance in our knowledge of this subject in the past year or two, and to revise, as may be necessary, the propagation curves for submission to the Plenary Assembly for formal adoption. A brief review of the contributions which have so far been received towards this objective is included in the following sections of this report **.

Documentary contributions to the general work of Study Group No. V have been received from the *Federal German Republic, France, Italy, Japan, Netherlands, Switzerland, United Kingdom, United States of America* and from the *Secretariat of the C.C.I.R.* (see Appendices 1 and II).

* Doc. No. 105, London.

** The writer has experienced some difficulty in separating reports dealing with Study Programmes Nos. 17 and 18. It should, however, be quite clear that the object of Study Programme No. 17 is to draw up curves of tropospheric wave propagation conditions by revising and extending those already presented at Geneva (1951) and Stockholm (1952). On the other hand Study Programme No. 18 is concerned with the general investigation of radio-wave propagation through the troposphere and its dependence upon meteorological or other conditions. The results of the work carried out under Study Programme No. 18 are applied to the production of curves under Study Programme No. 17.

3. Study Programme No. 17. “ *Tropospheric propagation curves for distances well beyond the horizon* ”.

Most of the results of investigations described in these documents confirm the general validity of the Stockholm propagation curves, but they suggest some alterations in detail or in the conditions applying to the curves. For example, observations made in the Federal German Republic (Doc. 20) over periods up to 14 months on frequencies in the region of 90 Mc/s confirm the appropriateness of the Stockholm curves for distances between 150 and 250 km. Two examples at distances of 96 and 365 km show serious discrepancies possibly due to the extremely mountainous nature of the terrain. Similar agreement of observations with the C.C.I.R. curves with some similar discrepancies for transmissions between mountain peaks, is shown in the results reported from Switzerland (Doc. 159).

The United States of America refer in Doc. 12, to the fact that an extensive study of both VHF and UHF propagation is in progress in various parts of the world, and the statistical analysis of the results obtained will materially assist in the revision of the C.C.I.R. curves. In the meantime, it is suggested in Doc. 201, that distinct advantages are to be obtained by presenting the curves in terms of “ radio transmission loss ”, defined as the ratio of the total radiated power to the resulting signal power available from a loss-free receiving antenna. It is pointed out that in this form of presentation, allowance can be made for such factors as variation in height of transmitting and receiving antennae, and the fact that the “ effective gains ” of these antennae depend upon their individual characteristics and the exact radio transmission path involved for different distances. It is to be noted that the preliminary results from U.S.A. presented in Figure 1 of Doc. 201, are in reasonable agreement with the Stockholm curves, which at distances between 200 and 700 km appear to be a few decibels too high for the conditions concerned.

The Administration of France draws attention in Doc. 209, to the desirability of extending the scope of Study Programme No. 17 to cover the whole range of frequencies from 30 to 4000 Mc/s, and of supplementing the existing curves showing the field exceeded for 1 and 10 % of the time by others showing the median values and those for 90 and 99 % of the time. The results of measurements carried out in France during several months in 1949 and in 1952 over distances of 200 to 285 km and on frequencies between about 40 and 100 Mc/s are given in Doc. 210.

4. Study Programme No. 18. “ *Tropospheric wave propagation* ”.

The Italian Administration, in Doc. 195, describes the results of some investigations on wave propagation in the Mediterranean area where, it is pointed out, the gradient of the refractive modulus varies over a wide range and is frequently negative near the ground, and particularly at night. Some examples of the influence of this in varying the effective radius of the earth are given in the Document in which the results are compared with those obtained from various theoretical formulae.

In Docs. 160, 161 and 202*, submitted by the Japanese Broadcasting Organization, the theory of the propagation of VHF and UHF waves over a smooth earth and over mountains is examined and some useful nomograms have been devised to facilitate the calculations of field strength at various distances up to 800 km (500 miles). The formula derived from this work is compared both with the results of experimental measurements in Japan at distances up to about 100 km and in U.S.A. and the United Kingdom at greater distances. Another Document (No. 142) from Japan describes the research on tropospheric wave propagation conducted since the previous Plenary Assembly of the C.C.I.R. Observations have been made over land and sea on various frequencies between 30 and 4000 Mc/s, and in many cases the relevant meteorological characteristics were recorded by radio sounding-balloon technique.

The Federal German Republic describes in Doc. 21 some results of a study of the correlation between field strength and meteorological conditions over several land paths of some 200 km in length. The vertical distribution of the modified refractive index of the air has been studied up to heights of 2000 metres with the aid of radio sounding-balloon ascents, and the results related to radio transmission conditions at metre wavelengths over both land and sea paths. In one case of transmission over a path of 225 km, the signals were received on both a dipole and a Yagi antenna array; and it is shown that the ratio of the signals received on the two antennae

* These documents would appear to be of interest also to Study Group No. IV.

increased with the strength of the signal towards the theoretical value of the effective gain of the Yagi antenna over the dipole. This is claimed to be consistent with the observations of other investigators on reception of signals well beyond the horizon by scattering from centres of turbulence in the atmosphere.

Although full reports are not yet available, other investigations of interest to the Study Group are in progress under the authority of the United Kingdom. Some of these are concerned with an exploration of the characteristics of radio waves of frequency about 600 Mc/s when transmitted over land to distances up to 100 km. Other work conducted under the auspices of the Marconi International Marine Co. Ltd., has involved observations over short periods of about one week of the transmission conditions experienced in the Mediterranean area on a frequency of about 170 Mc/s, with in some cases the use of 80 Mc/s in addition. It has been found that for overland paths, some 60 km in length super-refraction was experienced, attributed to the formation of surface ducts, and this resulted in diurnal variations of the order of 40 db. It appeared also that the range of fading observed was proportional to the total attenuation of the path over distances of 20 to over 300 km. For transmission over sea, the diurnal variation of signal strength was much less than for overland conditions, although the rate of increase of fading range with path attenuation was nearly 70 % greater than for overland paths. Intermittent tests made on frequencies of 77 and 174 Mc/s over a 320 km path between Cyprus and Israel have shown a good correlation between the simultaneous records on the two frequencies. A seasonal trend has been observed, indicating that the refraction effects decline from the summer to the winter months (northern hemisphere).

At the Stockholm (1952) meeting of the Study Group, the Secretariat of the C.C.I.R. presented in Doc. S/17 (see Appendix I), the results of some field measurements made in Geneva on a frequency of 92.5 Mc/s over a distance of 310 km, from the FM station at Hornsgrinde. The desirability of continuing these observations was expressed at Stockholm, and the Director of the C.C.I.R. informs me that the measurements have now been continuous for a period of one year. The reliable results so made available are now being treated statistically, and a report will be presented at the Plenary Assembly in London.

5. Study Programme No. 19. “Measurement of field strength of radio signals”.

The Administration of the United States of America has put forward, in Doc. 13, 14, 15 and 16, recommendations on this Programme in response to various sections of Question No. 8 of Stockholm 1948 on this subject. In view of the importance of the technique of field strength measurement in connection with the study and application of radio wave propagation through the troposphere, these recommendations, and any others related thereto, should be carefully considered with a view to their general adoption as may be desired.

In addition to the above, Doc. 18 (U.S.A.) comprises a report on the merits of a standard noise generator as the source of the locally-generated signal used for calibrating field strength measuring apparatus.

6. Report No. 3. “Review of publications on propagation (Tropospheric)”.

In Doc. 45, the United States Administration expresses the view that this report is still valid and needs no addition or modification. Doc. 208, lists the relevant publications in France since 1950; while Doc. 138 from Japan gives a list of publications on radio propagation relevant to the three Study Groups Nos. IV, V and VI.

7. Reports Nos. 4, 5 and 6.

These reports, drawn up at Geneva in 1951 deal with various aspects of field strength measurement, and they would appear now to be adequately covered by the pursuit of Study Programme No. 19. This view, insofar as Report No. 6 is concerned, is supported by Doc. No. 19 from the U.S.A.

8. Co-operation with U.R.S.I.

At the meeting of the International Scientific Radio Union held in Sydney in August 1952, matters relating to the propagation of radio waves through the troposphere were discussed by Commission II under the presidency of Dr. C. R. Burrows (U.S.A.). Among the resolutions

adopted by this Commission were recommendations that the scattering of radio waves by fluctuations in the lower atmosphere should be studied in different countries, with particular reference to the dependence of this scattering on latitude, climate and terrain. The statistical characteristics of fluctuations in atmospheric refractive index should also be explored, making use of recent developments in micro-meteorological measuring technique. In addition, it was recommended that at all frequencies above 30 Mc/s research should be directed towards establishing a better understanding of the correlation between readily available synoptic meteorological data and radio propagation characteristics.

It is hoped that national administrations will take note of these resolutions in conducting their work for Study Group No. V, since the successful and efficient use of waves of all frequencies above 30 Mc/s depends upon the acquisition of a satisfactory and detailed knowledge of the propagation characteristics of such waves under all the conditions likely to be met with in practice.

11th May 1953

Chairman of Study Group No. V:

R. L. SMITH-ROSE

APPENDIX I

LIST OF DOCUMENTS REFERRED TO IN THIS REPORT AND CIRCULATED BY THE C.C.I.R.

Origin	Reference : Geneva 1951 Study Programme	Title of Document	C.C.I.R. Document No.	
			Stockholm 1952	London 1953
United Kingdom . .	17	Tropospheric propagation curves for distances well beyond the horizon	1	S/1
United Kingdom . .	18	Tropospheric wave propagation	10	S/10
Netherlands	17 and 18	Propagation properties of metre waves	7	S/7
Netherlands	17	Field strength measurements of London and Birmingham at Nora	23	S/25
Secretariat of C.C.I.R.	17	Field strength measurements at Geneva in the V.H.F. Region	17	S/17
Study Group No. V, Stockholm	17 and 18	Final Report of Sub-Group V (a) of Study Group No. V	33 (Final)	S/33 (Final)

APPENDIX II

LIST OF DOCUMENTS REFERRED TO IN THIS REPORT AND CIRCULATED BY THE C.C.I.R.

Origin	Reference : Geneva 1951 Study Programme	Title of Document	C.C.I.R. Document No. London 1953
Federal German Republic	17	Tropospheric propagation curves for distances well beyond the horizon	20
Federal German Republic	18	Tropospheric wave propagation	21
U.S.A.	17	Tropospheric propagation curves	12
U.S.A.	17	Tropospheric propagation curves for distances well beyond the horizon	201
Japan	17 and 18	Propagation formulae and calculating nomo- grams for VHF and UHF over the smooth earth	161
Japan	17 and 18	Supplement to above	202
Japan	17 and 18	Propagation formulae and calculating nomo- grams for VHF and UHF over the mountains	160
France	17	Curves of tropospheric propagation for dis- tances well beyond the horizon	209
France	17	Curves of tropospheric propagation for dis- tances well beyond the horizon	210
Switzerland	17	Propagation of ultra-short waves over the Alps ($f = 88$ to 94 Mc/s)	159
Italy	17 and 18	Tropospheric propagation	195
Japan	17 and 18	Report on tropospheric propagation research in Japan	142

APPENDIX III

LIST OF DOCUMENTS REFERRED TO IN THIS REPORT AND CIRCULATED BY THE C.C.I.R.

Origin	C.C.I.R. Reference Geneva 1951		Title of Document	C.C.I.R. Reference Stockholm 1948	C.C.I.R. Document No. London 1953
	S.P.	Report			
U.S.A. . . .	19	—	Field-strength measurement	Q. No. 8 para. A.1(a)	14
U.S.A. . . .	19	—	Field-strength measurement	Q. No. 8 para. A.1(c)	15
U.S.A. . . .	19	—	Field-strength measurement	Q. No. 8 para. A.4	16
U.S.A. . . .	19	—	Field-strength measurement	Q. No. 8 para. A.5	13
U.S.A. . . .	19	—	Field-strength measurement	Q. No. 8 para. A.7	18
U.S.A. . . .	—	3	Review of publications on propaga- tion	Rec. No. 14	45
France . . .	—	3	Publications on propagation (tropo- spheric) since 1950	Rec. No. 14	208
U.S.A. . . .	—	6	Measurement of field strength	—	19
Japan . . .	—	3	List of publications on radio propa- gation	Rec. No. 14	138

REPORT BY THE CHAIRMAN OF STUDY GROUP No. VI*

(Ionospheric radio propagation)

(Original language : English)

General.

(a) *Technical progress.*

Progress has continued steadily in many countries both in research upon ionospheric propagation and application to practical needs. There has not been a great amount of basic progress on the specific topics assigned to this Study Group by the Geneva 1951 Plenary Assembly. Two years is too short an interval for the most effective work of this kind; the decision of the Buenos Aires Plenipotentiary Conference to make the interval three years was timely.

Contributions have been prepared on all topics of the Study Group by various participants; the contributions and proposals are mentioned below, for each topic, under "Material for VIIth Plenary Assembly". The items designated "U.R.S.I. Comment" are statements prepared by the 1952 General Assembly of U.R.S.I. at Sydney (Australia) in response to C.C.I.R. requests on various subjects.

(b) *Participation by members.*

A number of participants of the Study Group have been active, have responded to communications from the Chairman, and have submitted contributions on all topics. Some others have contributed to one or more topics. A number of others have been participants in name only and have contributed nothing.

(c) *Meetings held.*

A meeting of the Study Group was held in Stockholm, May 15 to 24, 1952. The Chairman was prevented by illness from attending, and takes this opportunity to express appreciation for the good work done at the meeting and in particular thanks Dr. R. L. Smith-Rose who served as Acting Chairman and Dr. G. Millington who served as Vice-Chairman. The meetings gave special emphasis to Questions Nos. 50 and 52 and Study Programme No. 24, because of a request from the Extraordinary Administrative Radio Conference of 1951 for interim responses on these topics; accordingly an interim report (Stockholm, Doc. 41 revised) was issued on Question No. 50 and an interim report (Stockholm, Doc. 40 revised) was issued on Question No. 52 and Study Programme No. 24. These were issued as Annexes of a brief general report (Stockholm, Doc. 54). The Stockholm documents which were not fully disposed of at the Stockholm meeting are included under the several topics listed later in this report among the material for the VIIth Plenary Assembly; they are Docs. 5, 19, 20, 21, 30, 36, 40 revised and 41 revised.

(d) *Proposals for improvement of working.*

It would greatly help the functioning of Study Groups if each paper submitted on any of the topics would be duplicated immediately and sent to all participants of the Study Group. Lacking this, it is extremely difficult to carry on the work of the Study Group by correspondence. The papers submitted by participants are the necessary tools for the work. If they are not available

* Doc. No. 106, London.

until shortly before the Plenary Assembly, the possibility of effective work by correspondence between the Plenary Assemblies is largely negated. Such immediate duplication seems necessary, and the only practical way appears to be duplication by the office of the Director. Additional assistance and support should be provided by the C.C.I.R. as necessary. Other expedients have been tried. I have requested the participants of Study Group No. VI to make copies of their contributions available in sufficient numbers to distribute to the other participants. This led to such action in the case of only one country (my own) and one paper from one other country. The participants feel that the preparation of copies is the proper function of the office of the Director.

As the Director has emphasized, and as I mentioned in my letter of August 6, 1952, to all participants, it is desirable that each document deal with only one topic (i.e., Question, Report, etc.). If one document deals with several topics of the agenda it is impossible to keep the documents assembled with like material on a particular topic. Also, it is of particular practical advantage in the work during a Plenary Assembly to have separate papers on the different topics since they may be dealt with in different sessions. The responsibility for this is essentially on the members (administrations and companies) and on the participants in submitting documents.

Since a Plenary Assembly often issues responses to a topic in several of the categories (e.g., Recommendation, Question, Report), it is important that each of these responses contain a cross reference to the other responses by the same Plenary Assembly on the same topic. This has not been done fully hitherto and has led to confusion. This should be done by the Study Groups or by the Drafting Committee at the end of a Plenary Assembly.

There has been no clear distinction between "Question" and "Study Programme", nor any difference in the manner of handling them. It is therefore suggested that the category of "Study Programme" be eliminated. This requires action by the Plenary Assembly.

There is an error in the definition of "Report" (in Document 272 of Geneva), viz. an implication that it is not possible to have a Report and at the same time a response of another category (e.g., Recommendation, Question). We do in fact have several such cases of Report and responses in other categories on the same topic. This is indeed desirable and inevitable. The error in the definition of "Report" can be corrected by replacing the words "when the Group is not ready to submit a draft recommendation or a draft study program" by the words "for information". The Study Groups are functioning properly in this matter, but it is confusing to have the recorded definition of Report not conform to actual practice. The matter can be very simply corrected by an action of the Plenary Assembly.

Material for VIIth Plenary Assembly.

The documents listed under each of the topics below are regarded as supplementary to this report and available for consideration by the VIIth Plenary Assembly. On page 236 of Geneva Documents, Volume I, are listed fourteen topics (Questions, Study Programmes, Reports) assigned to Study Group No. VI. A fifteenth must be considered as added to the agenda of the Study Group, viz., Recommendation No. 58, since it required action by this Study Group.

RECOMMENDATION No. 58

This recommended that a Working Group formed of some of the members of Study Group No. VI serve as an interim body to start the coordination of pulse transmission tests and to set up schedules for tests. The Chairman of Study Group No. VI accordingly appointed the following Working Group: Ir. A. H. de Voogt (Netherlands), (Chairman), A. El Bardai (Egypt), R. P. Lejay (France), Mag. S. Silleni (Italy), Dr. N. Smith (U.S.A.), and Dr. R. L. Smith-Rose (U.K.).

Tests were organized and extensive correspondence was carried on, to notify prospective observers and to report results of observations. The work done and results obtained up to January 31, 1953, are summarized in a brief report (Doc. 44) by Chairman de Voogt, "Report of Working Group No. 6-J, C.C.I.R. (February 4, 1953)". A report on subsequent work is expected

later. As the report points out, the London Plenary Assembly should decide how this work is to be continued. The work is difficult but the interim work has shown it to be well worth while.

A document (Doc. 7) submitted by the U.S.A. on Recommendations Nos. 58 and 46 and Question No. 48, entitled "Report. Directivity of antennae at long distances and pulse transmission at oblique incidence", makes a number of suggestions on modes of continuing transmission tests for research on pulse and related objectives. This Report was submitted by the U.S.A. also to Study Group No. III.

QUESTION No. 50

This Question sought to determine what practical uses are made of radio propagation information, how reliable the information is and what improvements are needed. The Question aims to carry forward the information summarized in Report No. 3. A wealth of response to the Question is given in the following contributions :

Stockholm 1952 meeting. — Interim report : Practical uses of radio propagation data (Stockholm 1952, Doc. 41 revised). This is the interim report on this topic requested by the Extraordinary Administrative Radio Conference, 1951.

Sweden. — Comparison of ionospheric transmission forecasts with practical results (Stockholm 1952, Doc. 21).

United Kingdom. — Practical uses of radio propagation data (Stockholm 1952, Doc. 20).

Japan. — A calculation method of field intensity for high frequencies above 2 Mc/s (Stockholm 1952, Doc. 5).

Japan. — Report on practical uses of radio propagation data (Doc. 144).

New Zealand. — Report for the information of Study Group No. VI (Doc. 25).

New Zealand. — Paper for the information of Study Group No. VI (Doc. 26).

Australia. — O.T.C. observations on the reception in Melbourne of the Anglo/Australian beam telegraph circuit (Doc. 257). (An appendix gives a particularly valuable discussion of the problem of comparison of predictions and circuit performance data.)

Switzerland. — Graphs comparing predicted and operating frequencies (New York-Bern) (Doc. 248).

U.S.A. — Report by the U.S.A. : Practical uses of radio propagation data (Doc. 224).

These documents in themselves constitute a good response to Question No. 50. Probably the chief future work to which they point is modes of improvement of predictions and their use in practical operation. The Plenary Assembly might well formulate a new question along such lines.

Information and ideas on the practical application of radio propagation information to frequency allocation are given in the book "Radio spectrum conservation", published in 1952 by the Joint Technical Advisory Committee, I.R.E.-R.T.M.A., U.S.A., and in the commentary upon the book published by the European Broadcasting Union on pages 1 to 15 of its Bulletin of January 15, 1953.

QUESTIONS NOS. 51 AND 52 AND STUDY PROGRAMME No. 24

These are so closely related that they may well be considered together. They call for a vast amount of study, only a small part of which has been already accomplished. Results and comments of value are given in the contributions to date.

Stockholm 1952 meeting. — Interim report, Study of fading (Stockholm 1952, Doc. 40 revised). This is the interim report on this topic requested by the Extraordinary Administrative Radio Conference, 1951.

Japan. — Study on fading of broadcasting waves (540 to 1600 kc/s) (Doc. 146).

Japan. — Report of studies on mechanism and distribution of short period fading reflected from turbulent ionosphere (Study Programme No. 24) (Doc. 145).

Federal German Republic. — Contribution, Question No. 51 (Doc. 23).

Federal German Republic. — Contribution, Question No. 52 (Doc. 24).

Federal German Republic. — Contribution, Study Programme No. 24 (Doc. 22).

United Kingdom. — Studies made in the U.K. of H.F. radio wave propagation across the North Atlantic (Study Programme No. 24) (Doc. 175).

New Zealand. — Report for the information of Study Group No. VI, Question No. 52 (Doc. 27)

U.S.A. — Draft recommendation : Allowances for fading (Question No. 52) (Doc. 34).

U.S.A. — Draft Study Programme : Study of fading (Study Programme No. 24) (Doc. 43).

These documents may lead to a Recommendation and a new Question. The new Question will doubtless continue a number of the points included in the old.

QUESTION No. 53

This Question seeks to determine a basic index for ionospheric propagation predictions, superior to the sunspot numbers. The following contributions have been made to this study :

Stockholm 1952 meeting. — Report. Choice of a basic index for ionospheric propagation (Stockholm 1952, Doc. 30, corrected according to Doc. 52).

International Scientific Radio Union. — Comments on C.C.I.R. Question No. 53 (see also U.R.S.I. comments on Recommendation No. 69) (Doc. 252).

France. — Choice of a basic index for ionospheric propagation. Solar radio index. Report and draft resolution (Docs. 213 and 214).

United Kingdom. — Choice of a basic index for ionospheric propagation (Doc. 92).

Spain. — Choice of a basic index for ionospheric propagation (Doc. 233).

U.S.A. — Report. Choice of a basic index for ionospheric propagation (Doc. 35).

The preponderance of view in these contributions is that the present sunspot numbers constitute a reasonably satisfactory index, that a better one is desirable, and that several alternatives are worth further study. The alternatives include : a sunspot index calculated in a more significant way than the present sunspot numbers, total area of hydrogen or calcium flocculi, hydrogen radiation flux, solar radio noise (in particular, provisionally, radiation intensity at 3000 Mc/s and radio noise storm intensity between 60 and 300 Mc/s), geomagnetic quantities, noon fF₂, other ionospheric parameters such as fF₁, fF_e, total ionization, virtual heights, and ionospheric absorption.

It is doubtful whether a Recommendation can be made this year, but a new and more useful Question can be formulated.

STUDY PROGRAMME No. 20

This is essentially an invitation to continue researches on non-linear effects, such as wave interaction. The following contributions are available.

Stockholm 1952 meeting. — Report. Non-linear effects in the ionosphere (Stockholm 1952, Doc. 36, corrected according to Doc. 52).

United Kingdom. — Two Reports. One is Stockholm 1952, Doc. 19, the other was submitted in January 1953 (Doc. 91).

U.S.A. — Draft recommendation (Doc. 36).

Study Programme No. 20 indicated to the U.R.S.I. and other scientific bodies the urgent need for further fundamental information in this field. At its 1952 General Assembly in Australia the U.R.S.I. endorsed the Study Programme. A number of the papers presented at the General Assembly, notably one by V. A. Bailey, and also the discussions, offered considerable light on the phenomena.

The material available should lead to a Report which will be a revision and extension of Stockholm Doc. 36 above mentioned.

STUDY PROGRAMME NO. 21

This cited valuable summaries of existing knowledge in certain documents of the Washington and Geneva meetings. It invited further research by administrations and laboratories at vertical and oblique incidence over great ranges of frequency and distance. From these and previous results the Study Group was to compile a coordinated report. This has been impossible as very little data were contributed to the Study Group. Only one contribution was received, a Report from the U.S.A. It describes work done at the C.R.P.L. and at two universities; references are given to numerous published papers giving some of the results.

The U.R.S.I. was invited to examine the problem, but its General Assembly, in Australia in 1952, merely endorsed the Study Programme.

It is doubtful whether the C.C.I.R. can do anything further to stimulate progress on this. On the other hand, the normal conduct and publication of research by various organizations will actually accomplish the objective.

STUDY PROGRAMME NO. 22

This urged the continuous and detailed study of V.H.F. propagation via the layers of the ionosphere, particularly during the coming years of low solar activity. A summary of existing knowledge was given in Report No. 7. Three contributions have been received :

U.S.A. — Report. A study of V.H.F. ionospheric propagation (Doc. 39).

U.S.A. — Draft Study Programme (Doc. 38).

Japan. — Report of study on long distance propagation of waves on V.H.F. by way of sporadic E ionization (Doc. 147).

The U.S.A. Report and draft study programme constitute drafts which may be taken as a basis of discussion for adoption, suitably modified to take account of the Japanese contribution and of the many articles published in technical periodicals.

STUDY PROGRAMME NO. 23

This is a collection of numerous questions on radio noise requiring study. They may be grouped as follows :

- (a) Improvement of measurement methods (Secs. 1-4);
- (b) Location and counting of lightning discharges (Secs. 5-8);
- (c) Effects at the receiver (Secs 9-11);
- (d) Radio noise charts (Sec. 12);
- (e) Miscellaneous (Secs. 13-15).

The following contributions have been received :

International Scientific Radio Union. — Comments on C.C.I.R. Study Programme No. 23 (Doc. 252).

Secretariat. — Report on World symposium on atmospheric (W.M.O.) (Doc. 253).

United Kingdom. — Report. Measurement of atmospheric radio noise (Doc. 155).

United Kingdom. — Measurements of atmospheric radio noise at high frequencies during the years 1945 to 1951 (Annex to Doc. 155).

Netherlands. — Proposal. (A. H. de Voogt proposes that all standard-frequency stations stop transmission for one minute every half hour, to permit noise level recording (Doc. 247).)

U.S.A. — Report. Measurement of atmospheric radio noise (Doc. 42).

U.S.A. — Draft Recommendation. Worldwide atmospheric radio noise measurement programme (Doc. 40).

U.S.A. — Draft Recommendation. Worldwide allocation of certain frequencies (to facilitate radio noise measurement) (Doc. 41).

Topic (a), "Improvement of measurement methods", is the subject of the U.S.A. contributions. A programme for a worldwide network of observing stations is outlined, using an objective method to replace the Thomas method. The U.S.A. and the Netherlands both propose the silencing of some frequencies in such a way as to facilitate radio noise measurements; the U.S.A. proposes assigning certain frequencies in such a way as to provide areas of silence, the Netherlands supports the plan of point 13 of Question No. 54.

Topic (d), "Radio noise charts", is given special attention in the U.K. proposals. The excellent suggestion is made that new charts be drawn up at the Plenary Assembly, based on the existing R.P.U. 5 report, on the five-year summary of results by the Thomas method, and on such other data as may be presented. This proposal is in line with Recommendation No. 67 and Report No. 8.

Topic (b), especially the recording of lightning discharges, has been the subject of special effort but it has not yet been possible to achieve the design and testing of a simple and universally usable lightning discharge recorder. This is particularly regrettable, as the W.M.O. has very cooperatively done its part in preparing machinery for a world programme of counting lightning discharges, as recommended in Study Programme No. 23, points 7 and 8. Information on this is given in the above-listed report by the Secretariat on the W.M.O. symposium.

Information on some work that had been done to design a suitable recorder was presented at the VIth Plenary Assembly, Geneva 1951, from the U.K., U.S.A., France and the Union of South Africa. None had been sufficiently tested to assure their reliability for worldwide use. At the W.M.O. symposium in March of this year, a Swiss design was presented and tests of a device at Cambridge University, England, were described. The whole project has encountered unexpected difficulties. Most of the attempts at design have been made in localities where lightning storms are relatively infrequent. Vagaries in wave form of the lightning flash, the extreme range of intensities encountered, differing characteristics of lightning in different parts of the globe, and the difficult choice of sensitivity of the apparatus, all require considerably more testing than has been done. The Plenary Assembly may well make an urgent recommendation that all concerned intensify effort on this.

REPORT No. 3

This was prepared in accordance with Recommendation No. 14. Its substance has been carried forward in Question No. 50. No contributions have been received regarding Report No. 3; it is believed that it requires no further C.C.I.R. action.

REPORT No. 7

This was a response to Question No. 7, point 3. The subject is dealt with further under Study Programme No. 22. No contributions have been received regarding Report No. 7; it is believed that it requires no further C.C.I.R. action.

REPORT No. 8

This was a response to Question No. 10. The subject was dealt with in Recommendation No. 67. It is dealt with also herein under Study Programme No. 23. No further C.C.I.R. action is required on Report No. 8.

REPORT No. 9

This was a response to Question No. 36. No contributions have been received regarding Report No. 9 and no further C.C.I.R. action is required.

REPORT No. 10

This is a list of official agencies in the several countries for the exchange of information on radio propagation. One addition has been requested, viz., add under "Great Britain", Telegraphic address: "Radsearch, Slough". Further, change the Netherlands address to: Ir. A. H. de Voogt, Chief of the Division "Ionosphere and Radio Astronomy" of the Netherlands P.T.T. Service, Scheveningscheweg 6, The Hague, Netherlands.

CERTAIN GENEVA RECOMMENDATIONS

While none of the Recommendations were specifically allocated for study, some material on some of them has been contributed for various reasons.

Recommendation No. 56 was adopted upon the request of research workers on extra-terrestrial radio noise. However, at the U.R.S.I. General Assembly in Australia, 1952, at which the workers in this field were well represented, a resolution was adopted declaring the Recommendation impracticable (see U.R.S.I. Comment on Recommendation No. 56). It is therefore recommended that Recommendation No. 56 be rescinded. The importance of this research is such that all aid should be given to protecting the specific frequencies found necessary for the observations. A Recommendation might be adopted, requesting administrations, in assigning transmitting frequencies near those found specifically necessary for extra-terrestrial radio noise research, such as 1420 ± 3 Mc/s, to specify locations, frequencies, directive antennae, times of operation, etc., in such manner as to minimize interference to the measurements.

Recommendation No. 57 referred the standardization of ionosphere symbols, conventions, etc., to the U.R.S.I. for exclusive handling in the future. In its comment on C.C.I.R. Recommendation No. 57, the U.R.S.I. agreed to accept this work and indicated methods for carrying it out.

Recommendation No. 58 can be considered one of the topics assigned to Study Group No. VI, even though not listed on page 236 of Geneva Documents, Volume I, because it required action by the Study Group. It is dealt with above.

Recommendation No. 59, in its points 9, 10 and elsewhere called for common action in connection with short-time forecasts and disturbance warnings. Much remains to be worked out. Contributions toward this end were received as follows:

International Scientific Radio Union. — Comments on C.C.I.R. Recommendation No. 59 (Doc. 252).

U.S.A. — Report. Exchange of Information for Forecasts and Warnings (Doc. 31).

France. — Report and Resolution (Doc. 212).

These contributions contain some excellent proposals. They may lead to a further Recommendation or, perhaps better, a new Question so that methods and procedures may be further worked out by the Study Group.

Recommendation No. 69 requested the U.R.S.I. and other organizations to comment on solar prediction methods. At its General Assembly in Australia 1952, the U.R.S.I. prepared its comments on C.C.I.R. Recommendation No. 69. The comments were, however, principally on the choice of a basic index for ionospheric propagation, the subject matter of Question No. 53, and may be considered under that Question. A report, "Prediction of Solar Index", by the U.S.A. (Doc. 33), responds to point 5 of Recommendation No. 69. Whatever use is made of these contributions by the Plenary Assembly can presumably be combined with what is done on Question No. 53.

The Recommendation of Study Group Nos. IV, V and VI at Geneva on ionospheric absorption (inserted as a green sheet in Geneva Documents, Volume I, and which may be informally called Recommendation No. 69 A) encouraged research and exchange of information among all participating organizations and the U.R.S.I. The U.R.S.I. comments on C.C.I.R. (green sheet) Recommendation on ionospheric absorption, prepared by the General Assembly in Australia, 1952, emphasized the desirability of including work utilizing extra-terrestrial radio noise. No further action on this topic by C.C.I.R. is deemed necessary.

Miscellaneous.

A number of contributions of a general nature, not responses to a particular topic on the agenda of the Study Group, were received from some participants. One was from China : a tabulation of critical frequency values and related numerical data as measured at Taipei, Formosa. Several such contributions were received from Japan; they include : List of publications on radio propagation, Report on ionospheric propagation research in Japan, Report on standard of electromagnetic field intensity of high frequency, Report on sweep frequency pulse tests at oblique incidence; these in most cases referred to pre-Geneva topics, no longer on the agenda of the Study Group.

Resolution No. 5 indicated that each Study Group should establish a list of definitions of the principal terms and symbols in its field, but that work on this should not duplicate that carried out by other organizations. It was concluded that the second objective cancels the first, as the terms with which ionospheric propagation is concerned are adequately covered in generally accepted standards issued by international organizations such as U.R.S.I., I.R.E., I.E.C., and various national organizations.

J. Howard DELLINGER
Chairman, Study Group No. VI

REPORT BY THE CHAIRMAN OF STUDY GROUP No. VII*

(Standard frequency and time signal transmissions)

(Original language : French)

1. Main points of the documents allocated to Study Group No. VII for study.

Although not listed for further study, Recommendation No. 70 contains provisions which the Study Group must bear in mind, since it defines desirable standards of accuracy for standard frequency and time signal transmissions, as well as steps to be taken to reduce interference; it also advocates publication of measured standard frequency and time signal deviations and adjustments and sets forth the characteristics of the existing transmissions.

Question No. 54 is a repetition of Stockholm Recommendation No. 18. Some of the points are incorporated in Study Programme No. 25 while others, e.g. the collaboration of the International Time Bureau and U.R.S.I. are still on the agenda.

The experiments formerly envisaged in Recommendation No. 18 are further defined and their scope extended in Study Programme No. 25. The chief aim in view is to determine the world distribution of satisfactory standard frequency service areas, to consider the effect of interference, and to make a comparative study of transmitter characteristics : i.e. schedules, modulation frequencies, composition of time signals, etc. Other questions, e.g. directional aeriels, identification of minutes and interruption for noise measurements, have been broached. The Study Programme provides for the publication of information on service and interference areas and on stations causing interference to standard frequency transmissions.

2. Membership of Study Group No. VII.

The following Administrations, Companies and Organisations are members of Study Group No. VII :

Australia
United States of America
France
Overseas Territories of
the French Republic
Italy
Japan
Pakistan
Netherlands
Federal German Republic
United Kingdom of Great
Britain and Northern Ireland
Sweden
Switzerland
Czechoslovakia
Yugoslavia

B.B.C.
International Radio
Maritime Committee
Compagnie Générale de T.S.F.
Marconi International Marine
Communication Co., Ltd.
R.C.A.

International Time Bureau (B.I.H.)
I.B.O.
South African Council of Scientific
and Industrial Research
E.B.U.
U.R.S.I.

The participants were kept informed of the various questions relating to the work of the Study Group. No meetings of the Group took place between the VIth and VIIth Plenary Assemblies of the C.C.I.R.

* Doc. No. 107, London.

3. Contributions received.

The present report is based on the following contributions :

(a) *Administrations.*

United States of America	Doc. 48
France	Doc. 198
Italy	{ Doc. 176
Japan	{ Doc. 177
	Doc. 151
Netherlands	{ Doc. 157
	Doc. 158
United Kingdom	Doc. 90
Overseas Territories of the French Republic	Doc. 181

(b) *International organisation.*

International Time Bureau (B.I.H.)	Doc. 182
International Radio Scientific Union (U.R.S.I.)	Doc. 183

4. Work done and proposals.

The main points studied were :

- (a) extension of experimental stations;
- (b) modification of WWV and WWVH announcements;
- (c) measured frequency and signal deviations and adjustments;
- (d) determination of the service areas of the stations as a whole;
- (e) interference;
- (f) phenomena resulting from the simultaneous reception of several transmissions;
- (g) choice of modulation frequencies;
- (h) identification and use of time signals;
- (i) schedules;
- (j) accuracy;
- (k) use of the transmissions for propagation studies.

a) *Experimental stations.*

Practically no changes have taken place in the experimental transmissions listed in the table annexed to Recommendation No. 70.

As shown in paragraph 19, Annex I to Recommendation No. 70, towards the end of 1951, TOKYO JJY began experimental transmissions on 2.5, 5 and 10 Mc/s. Since April 1952, it has been transmitting regularly three times a week, i.e.

on Mondays on 2.5 Mc/s;
on Wednesdays on 5 Mc/s
on Fridays on 10 Mc/s.

Each transmission lasts from 0000-2400 hrs U.T. A 1000 c/s modulation is transmitted three times an hour for nine minutes at a time. The continuous superimposed time signals are composed of 7 cycles of a 1400 c/s modulation. (Study Programme No. 25, para. 5). Paragraphs 1 to 12, Column 4, in Annex I to Recommendation No. 70, could therefore be amended to read as follows :

- | | | |
|------------------|---------------------|---------------------------|
| 1. Tokyo; | 5. Vertical Dipole; | 9. 24; |
| 2. JJY; | 6. 1; | 10. 2.5 (a) 5 (b) 10 (c); |
| 3. Experimental; | 7. 3; | 11. 1 ^d 1000; |
| 4. 1; | 8. 3; | 12. 9 out of 20. |
- (a) Mondays; (c) Fridays;
(b) Wednesdays; (d) pulses of 7 cycles of 1,400 c/s tone.

The United Kingdom Administration has reported the construction of new transmitters at Rugby. The first of these was expected to be brought into service in March 1953. Simultaneous transmissions on three frequencies 24 hours a day with a power of 500 W are expected to start early in the summer of 1953. Detailed schedules will be submitted in due course.

Study Programme No. 25 provides for the putting into service of experimental stations in the Southern Hemisphere. No information on any such station has been received.

(b) *Modification of WWV and WWVH announcements.*

Some of the announcements mentioned in Geneva Doc. 322 have been modified. A wider service of propagation announcements transmitted at 19m.30s. and 49m.30s. of each hour was introduced on 1 July 1952. In addition to one of the three letters showing the current propagation conditions a figure is now used to denote the forecast of propagation conditions for the 12 hours following. The code is as follows :

Forecast	Propagation condition	Current
1.	Impossible	W
2.	Very Poor	W
3.	Poor	W
4.	Fair to Poor	W
5. 440 c/s	Fair	U = 1200 c/s
6.	Fair to Good	N
7.	Good	N
8.	Very Good	N
9.	Excellent	N

The WWV and WWVH announcements made every five minutes have been separated into groups, WWVH now transmitting during the first half of each minute and WWV during the second half.

(c) *Measured deviations and adjustments.*

Quarterly reports on Form A as provided for in Recommendation No. 70 (paras. 4 and 5 and Annex II) showing the measured deviations of the WWV and WWVH frequencies and of the WWV time signals for each day, together with the dates and times of the adjustments, have been submitted regularly by the United States Administration and circulated by the Secretariat of the C.C.I.R.

The United Kingdom Administration has issued the report on MSF for 1951 on Form A as a single document.

The time lag between the publication and the submission and distribution of these documents (sometimes as much as three months) is somewhat excessive. The value of the documents is thereby greatly reduced. The results should preferably be published quarterly rather than annually.

It will be seen that, on the whole, the deviation and adjustment values for WWV, WWVH and MSF, shown in the tables issued, fall well within the accuracy limits specified in Recommendation No. 70.

(d) *Determination of service areas.*

Study Programme No. 25, para. 2, makes provision for the regular publication of information on satisfactory service areas. The method of presentation is given in Annex I, Form B.

The U.S.A. Administration has been issuing regularly quarterly reports on Form B for WWV and WWVH. The U.K. Administration has assembled the information on MSF for 1951 in a single document.

It is to be regretted that no other Administration has followed these examples. As in the case of Form A, there has been delay in the distribution of the U.S.A. and U.K. documents.

In addition to Form B other important information on service areas is given in reports recently received by the Chairman. They give an overall picture of reception conditions in various parts of the world, and particularly in Europe, Africa, East Asia, North America and the Antarctic.

Some Administrations have established a permanent field strength recording service (for propagation study). The results obtained provide comprehensive information on the course of standard frequency reception over a number of successive years. Similar steps are being taken by France (15 and 20 Mc/s), the Netherlands (10, 15, 20 Mc/s), Sweden (10 and 20 Mc/s), Puerto-Rico (10, 15, 20 and 25 Mc/s), Peru (10, 15 and 20 Mc/s) and New Zealand (15 Mc/s). Recordings were made in Adelie Land (Antarctic) in 1951.

In Europe and the Mediterranean basin, reception of MSF and TURIN is usually excellent. Night-time reception of WWV on 5 and 10 Mc/s is also very good. Reception of 15 Mc/s is usually good in the afternoon and evening (favourable conditions prevailing later in the day in summer). In summer 20 Mc/s is received only in the evening. Reception of this frequency was fair during the winter of 1951-1952, while during the winter of 1952-1953 no reception could be effected. In general, daytime reception has been deteriorating from year to year. It should be noted that WWV transmissions are practically unusable at any season between daybreak and 11 or 12 hours U.T. WWVH is weakly received between 6 and 8 hours in winter. JJY does not appear to have ever been satisfactorily received in Europe.

As regards Africa, it may be seen from the information assembled that in Morocco reception conditions are similar to those in Europe, while in Central Africa (French Equatorial Africa, Liberia, Togoland, French West Africa, Sudan) WWV is satisfactorily received at night on 5, 10, 15 and 20 Mc/s (in daytime, 10, 15 and 20 Mc/s are complementary, according to the season). In Southern Africa (Northern Rhodesia, Madagascar), overall reception of the different WWV and WWVH frequencies provides an almost continuous service, except for a few hours around 07 hours U.T.

Japan, satisfactorily covered by JJY transmissions, is the main source of information as regards Asia. In addition WWVH is received on 5 Mc/s at night and on 10 and 15 Mc/s in the afternoon and evening. WWV is received occasionally. MSF and TURIN are not received in Japan. WWVH and JJY time signals are regularly recorded in Shanghai at 8.30 hours U.T.

In Southern Asia (Andaman, Malaya and Borneo) the three WWVH frequencies are received at various times of the day. WWV is not received. No reception in Asia of MSF has been reported.

Daytime reception (local time) of WWV on 5 and 20 Mc/s and of WWVH on 10 and 15 Mc/s is reported in Australia and New Zealand. The Mount Strombo Observatory records the time signals transmitted by WWV at 23 hours U.T. and by WWVH at 10.30 hours. Reception of MSF is as good as, or a little weaker than that of WWV.

In the Antarctic, 20 Mc/s is practically unusable, while 5 Mc/s is usable only during certain months of the year. 10 and 15 Mc/s together ensure an average daily period of 10 to 12 hours of satisfactory reception, WWVH transmissions supplementing those of WWV.

WWV provides satisfactory coverage in the United States of America and parts of Canada. In Alaska, reception of WWVH is usually better than that of WWV. No reception of MSF or JJY is reported in North America.

In Brazil, night time reception of WWV on 5, 10 and 15 Mc/s is reported to be good. Reception of WWVH is weaker.

(e) *Interference.*

Several Administrations complain of serious interference from stations outside the standard frequency service. The D Forms received give the following particulars :

permanent interference on 20 Mc/s from PUM, operating on 19,996.2 kc/s, was reported in 1951 and 1952 in Puerto Rico and Sweden.

permanent interference on 15 Mc/s from YSL working on 14,996 kc/s, was reported in 1951 in Texas and in 1952 by Puerto Rico, and

interference on 15 Mc/s by an unidentified transmitter was reported in 1951 in Guam.

The Japanese Administration urgently requests the clearance of the standard frequency bands. It may be noted that the List of Frequencies, 30 June 1952, besides allocating frequencies to the standard-frequency and time-signal stations, provides for the following assignments :

4 stations on	2500 kc/s
56 stations on	5000 kc/s
10 stations on	10 Mc/s
9 stations on	15 Mc/s
2 stations on	20 Mc/s
2 stations on	25 Mc/s

(f) *Simultaneous reception.*

No reports on Form C have been published. Few contributions deal with the problem and the conclusions reached are somewhat divergent. Some report more or less serious drawbacks, especially with time signals (France, Italy, the Netherlands, B.I.H.). Others (the United States of America, Japan) consider that no inconvenience is caused by interference between standard frequency stations. The Netherlands suggest that interference between WWV and a European transmitter situated more centrally than MSF could be eliminated in Europe by means of directional aerials.

(g) *Modulation frequencies.*

Several administrations have expressed a wish to use 1000 c/s. The United States proposes that 440, 600 or 1000 c/s be used, the choice being left to the transmitting station. It should be noted that in the list of users of the WWV and WWVH transmissions annexed to the American report, the use of the standard frequencies for musical purposes amounts to 2.7 %.

(h) *Time signals.*

Increased use is being made of time signals superimposed on the standard frequencies not only for purposes of time determination, navigation and geodesy, but also for frequency calibration. A higher degree of accuracy is achieved through this method than through the use of standard frequencies which are conditioned by propagation phenomena. The quality and improved usage of these superimposed time signals is a problem of paramount importance. Various difficulties, together with suggestions for overcoming them, are mentioned in reports submitted to Study Group No. VII.

The first problem is to identify the time signals of each transmitter when several transmissions are being received at once. Five-ms time signals, composed of 4 cycles of 800 c/s tone, 5 cycles of 1000 c/s, six cycles of 1200 c/s or 7 cycles of 1400 c/s are recommended in Study Programme No. 25. This method has been tried out by JJY on 1400 c/s, the frequency required to distinguish the signals from the permanent modulation tone of 1000 c/s. Although a special filter is required, results appear to be satisfactory despite the distortion produced. (The B.I.H. also stresses that filters affect the accuracy of the signals.)

The Netherlands suggest an alternative method which consists in time-shifting the pulses of certain transmitters by say, fourths or fifths of a second. The wanted pulses could be isolated by means of gate circuits, provided that, at certain intervals during a time programme, it is possible to receive only one station at a time. This method, however, might give rise to difficulties in the case of ordinary receivers not equipped with gate circuits. Moreover, if reception conditions were favourable for one station only, mistakes of identification might arise in the case of users who do not themselves possess a fairly accurate time standard.

As regards the composition of the time signals, the Japanese Administration recalls that JJY has for many years been transmitting (on 4 and 8 Mc/s) time programmes consisting of short interruptions of the carrier wave (20 ms at each second and 200 ms at each minute). The main advantages of this method are higher reception sensitivity (A1 telegraphy), elimination of filters, minimum interference, absence of difficulty in the coexistence of time signals and modulation tones. Consequently, the Japanese Administration is in favour of this method, at least for 2.5 and 5 Mc/s.

The Netherlands renews its proposal (Geneva, Doc. 302), that negative indication of the minutes obtained by omitting the 59th pulse be replaced by positive indication consisting either of an extension of the minute pulse or its replacement by a group of closely spaced pulses. The French Administration likewise advocates the use of a minute signal of longer duration.

(i) *Schedule.*

Two types of schedule were set for study in Study Programme No. 25.

The first was a comparison between simultaneous, or consecutive transmission of time signals and an audio modulation. Several reports point out the advantages of long periods reserved exclusively for the transmission of time signals. Others emphasize the importance of uninterrupted time signals. A compromise might be reached by adopting continuous second pulse transmissions, with the audio modulations periodically interrupted for at least five minutes. This method is used in JJY experimental transmissions.

No further study appears to have been made of special types of modulation, provided for in para. 7, Study Programme No. 25.

The second problem of programming relates to the transmissions themselves. The question of simultaneous emissions by several transmitters has not yet been studied in sufficient detail. The U.S.A. Administration advocates simultaneous transmission by all stations. Other Administrations feel that this might give rise to serious difficulties under certain propagation conditions and propose the use of periodic interruptions.

Considerations other than that of mutual interference make short interruptions desirable. The Japanese Administration points out the desirability of making an accurate comparison of the various transmissions. All the transmissions, except one, would in this case have to be interrupted for short periods; the transmitters would be selected cyclically. The French Administration advocates similar short periodic interruptions for identification in the course of field measurements.

Finally, short simultaneous interruptions for noise measurement, mentioned in Question No. 54 and Study Programme No. 25, are again asked for by the Netherlands, France and U.R.S.I. The United States Administration believes that sufficient space could be found in the reserved bands and that interruptions are unnecessary.

(j) *Accuracy.*

The United States of America draft Recommendation, based on paras. 1, 2 and 3 of Recommendation No. 70, suggests the steps to be taken for checking and adjusting transmitter control oscillators.

The draft Recommendation also suggests that the time signals from each standard frequency station should start simultaneously. The International Time Bureau draws attention to the fact that the time signals should not be adjusted in relation to a single observatory and that the various transmission services should make use of their own time determinations to reduce the risk of systematic error.

(k) *Propagation studies.*

Because of their known and constant radiation characteristics, standard frequency transmissions are being used more and more widely for propagation studies. The numerous permanent field strength recording installations have already been mentioned in 4. (d) above. The use of standard frequency transmissions for the rapid selection of frequency bands favourable to traffic is likewise reported. The forecasts emitted by WWV (see 4. (b)) and JJY should also be noted.

The use of these methods is obviously an argument in favour of permanent transmissions by the various stations, provided that simultaneous reception has no adverse effect on the accuracy of recordings. Should there be such an adverse effect, the use of short cyclic interruptions (see 4. (i)) would provide a suitable remedy.

Standard frequency transmissions and time signals are also used for determining the propagation speed of time signals. The tests carried out in 1951 between Turin and Washington, and later between Turin and London, are described in the Italian reports to Study Group No. VI

and Study Group No. VII. At its General Assembly in Sydney, U.R.S.I. stressed the value of these tests and set up a special sub-committee to coordinate research. Besides helping to solve propagation problems, these studies will lead to far greater accuracy in the use of time signal transmissions.

5. Conclusions and proposals.

The results of tests, together with various proposals, are described in the documents mentioned in this report.

In brief, it may be said that since the Plenary Assembly was held in Geneva, some progress has been made in the study of the standard frequency transmission service areas. Nevertheless, the only new experimental transmissions are those broadcast by JJY three days a week. Continuous MSF transmissions are announced. There are still no transmitters in the Southern Hemisphere. It will be a long time, therefore, before the wish expressed at Atlantic City for satisfactory world-wide reception at all times of the day is realized. Moreover, it has been possible to make no more than a cursory study of simultaneous reception.

As regards schedules and the choice of tones and time signals, the opinions expressed are so divergent that no definite conclusion can be drawn.

It would appear, therefore, that at the present time neither a Recommendation, nor a Study Programme can be drafted. Nevertheless, S.G. No. VII could take the following items as a basis for discussion in London, without invalidating the considerations of Study Programme No. 25.

DRAFT AGENDA

1. The desirability of establishing experimental stations in the Southern Hemisphere.
2. The desirability of extending the existing experimental transmission programmes (MSF, TURIN, JJY).
3. Continued study of service and interference areas. Continuation, generalization and acceleration of the publication of reports on Forms B, C and D.
4. Speeding up the distribution of reports on Form A.
5. Methods of clearing the standard frequency reserved bands.
6. Detailed study of simultaneous reception phenomena (including extensive experimental transmissions) with a view to ascertaining whether time sharing among transmitters is necessary.
7. Means of improving standard frequency and time signal accuracy.
8. The desirability of leaving the choice of 440, 600 or 1000 c/s as modulation frequency to the transmitting stations.
9. The composition of time signals :
 - (a) modulation at various frequencies;
 - (b) shifted pulses;
 - (c) carrier wave interruption;Improved minute signals.
10. Continuous time signal transmissions. Longer emission periods without superimposed audio modulation.
11. Short periodic interruptions of all transmissions for the measurement of noise.
12. Short interruptions of all transmissions, except one, for accurate comparison and identification during field strength measurements, the transmissions to be selected cyclically.
13. Continued study of special modulation methods.

A draft recommendation together with a Study Programme arising out of the meetings to be held in London by S.G. No. VII could be submitted to the Plenary Assembly.

6. Definitions.

In accordance with Geneva Resolution No. 5, the Chairman has submitted to the members of S.G. No. VII the following draft definitions of various terms as used by the Study Group, for ultimate transmission to S.G. No. XIV.

DRAFT DEFINITIONS

Standard frequency.

A specified frequency, emitted with a known high degree of precision and intended for general reception.

Standard frequency service. (see Radio Regulations, 1947, No. 33).

Standard frequency station. (see Radio Regulations, 1947, No. 54).

Time signal.

A signal indicating at its start, with a known high degree of precision, a specified instant of Universal time.

Time signal transmission.

A combination of time signals identifiable by their duration and grouping, intended for general reception.

Universal time (U.T.).

Greenwich mean time.

Time interval (of time signals).

The interval from the start of one time signal to the start of the next time signal in the same transmission.

(Frequency) *Drift* (may be regarded as a general term).

A slow continuous variation of the transmitted frequency with time.

(Standard frequency) *Deviation.*

The divergence between the actual frequency of a standard frequency transmission and the specified frequency.

(Time signal) *Deviation.*

The divergence between the starting time of a time signal and the specified moment.

(Standard frequency or time signal) *Adjustment.*

Adjustment to a standard frequency or time signal to correct drift or any other cause of deviation.

The Administrations of Australia, France, Overseas Territories of the French Republic, Italy, the Federal German Republic, Sweden and Switzerland, as well as the Compagnie Générale de T.S.F. have stated that they have no comments to make on this draft. The Administration of the Federal German Republic has translated the definitions into German.

The B.I.H. proposes that the following term be added :

Rhythmic signals.

Time signals, the intervals of which differ slightly from the mean time second and which divide the minute into a known number of equal intervals.

A proposal has also been made by U.R.S.I. to replace the first definition in the draft (" standard frequency ") by the term " standard frequency transmission " (the definition remains unchanged) and to add a new term :

Standard frequency.

A specified frequency which is stable and known to a high degree of precision.

The draft and proposals will be examined by S.G. No. VII in London and forwarded to S.G. No. XIV.

B. DECAUX

Chairman, Study Group No. VII.

ADDITION

TO REPORT OF CHAIRMAN OF STUDY GROUP NO. VII * (Standard frequency transmissions and time signals)

(Original language : French)

Since the main Report (Doc. 107) was written at the beginning of 1953, a quantity of further information has reached the chairman. It is submitted here with the same paragraph numbering as in Doc. 107. The new facts and proposals concern the following points in Section 4 :

- (a) extension of experimental stations;
- (c) measured frequency and signal deviations and adjustments;
- (d) determination of the service areas of the stations as a whole;
- (e) interference;
- (f) phenomena resulting from the simultaneous reception of several transmissions;
- (h) identification and use of time signals;
- (i) schedules;
- (k) use of the transmissions for propagation studies.

(a) *Experimental stations.*

Since 26 May, Rugby MSF has been permanently transmitting on 2.5, 5 and 10 Mc/s with exactly the same schedule as previously used for its intermittent transmissions (Doc. 304). However, each hour there is a complete break from minute 15 to minute 20, to enable measurements to be made on another station received simultaneously. Similar transmissions are planned for 15 and 20 Mc/s. The power is 0.5 kW.

Since 12 May, Torino has been transmitting the call-sign IBF every ten minutes.

The present characteristics of the standard-frequency and time-signal stations are summed up in the Table in Annex I, replacing Annex I of Recommendation No. 70.

(c) *Deviations and adjustments.*

The Administration of the United States is continuing the quarterly publication of reports on Form A for WWV and WWVH.

The Administration of the United Kingdom has published reports on Form A concerning MSF for 1952 in six-months periods.

(d) *Service areas.*

The Administration of the United States is continuing the quarterly publication of reports on Form B for WWV and WWVH. The data confirm the information summarized in the Report. (Doc. 104.)

It is pointed out that in France reception of MSF is always excellent on 5 Mc/s, regular at night on 2.5 Mc/s, while on 10 Mc/s reception has been possible during the last few weeks in the afternoon and evening.

(e) *Interference.*

The Administrations of the United States and the Federal German Republic have issued reports on Form D. Here are the chief points :

- on 2,500 kc/s : ship or coast stations (indicated in various regions);
- on 5,000 kc/s : HAM 5000.5 kc/s; IKD 4998.17; ILT 5000.8; ISZ 52 4995.1; LBD 4998.5; PPJ 5005.25; RKR 4998.5; RMJ 4995, and ship stations (Germany, August 1952);
- on 10 Mc/s : FNO 97/98 10,005.5 kc/s; OMZ 10,004; REW4 9998.6; SDQ 9995.83 and various unidentified stations (Morse, telex, broadcasting) (Germany, August 1952);
- on 15 Mc/s : YSL 14997 kc/s (Germany, August 1952, already indicated as permanent in 1951 and 1952 in the United States and at Puerto Rico); FUE 15002.5 to 15007.5 kc/s and divers unidentified inference (telex, broadcasting) (Germany, August 1952);

* Doc. No. 343, London.

- on 20 Mc/s : PUM 19996.2 kc/s (Germany, August 1952, already indicated as permanent in 1951 and 1952 in Puerto Rico and Sweden), DZR 42 (Germany, August 1952);
- on 25 Mc/s : 2nd harmonic (24999.8 kc/s) of ICZ (Germany, August 1952).

The issue of the Supplementary Information to the Radio Frequency Record has brought the total numbers of frequency assignments for stations other than standard-frequency and time-signal stations (already mentioned in Doc. 107) to :

4 on 2500 kc/s	41 on 10 Mc/s	6 on 20 Mc/s
96 on 5000 kc/s	15 on 15 Mc/s	5 on 25 Mc/s

counting only assignments exactly on these frequencies.

(f) *Simultaneous reception.*

Since permanent transmissions began from MSF, very serious interference has been noticed in France on Tuesdays during the simultaneous emission of MSF and IBF on 5 Mc/s, both stations producing about the same field strength. No accurate frequency measurements are then possible and the use of the time signals is made very complicated during the periods (minute 20 to 25 and 50 to 55) when both transmitters are emitting signals together.

Similar phenomena are often observed in the evening during simultaneous reception of WWV and MSF on 10 Mc/s.

(h) *Time signals.*

The frequencies and time intervals transmitted by MSF are now being referred to a "uniform time scale" making allowance for the movements of the poles and irregularities in the rotation of the earth. Similarly, since 1 April, the time signals from WWV and WWVH have been corrected to take account of the movements of the poles.

The B.I.H. has made various observations (Doc. 342) on some of the proposals in the documents submitted to Study Group No. VII. In particular, it issues a warning against the drawbacks involved in the unification of the origin of time signals as proposed in the United States of America report (Doc. 48, paragraph 2) as regards accuracy in the use of time signals.

It also refers to the way time signals are disturbed by the superimposed musical tone and the advantages of staggered interruptions.

As regards the Netherlands proposal (Doc. 158) to displace the time signals for identification purposes, the B.I.H. fears that this method might lead to errors in the case of users not equipped with an accurate chronometer.

Lastly, it points out that, for very accurate time comparisons, operation should take place at definite times, which is obvious in the case of intermittent time transmissions of the old type but which may be overlooked in the use of continuous transmissions.

Finally, we would point out that the U.R.S.I. has been asked by the Special Committee of the International Geophysical Year to convey to the C.C.I.R. a resolution stressing the advantages of organizing a world-wide system of high accuracy continuous time signal transmissions (also covering the southern hemisphere) before the operations planned for 1957-1958.

(i) *Schedules.*

For ease of comparison between the various time schedules, the table given in Annex II combines the schedules of IBF, JJY, MSF, WWV, WWVH.

(k) *Propagation studies.*

The French Administration (Doc. 198) proposes a special modulation for standard-frequency transmissions with the object of facilitating their use for measuring the field strength of each transmitter, in spite of the simultaneous reception of several of them. The idea is to superimpose on the existing modulations a tone of sufficiently high frequency for the sideband to be easily separated at the receiving end, the tone to be applied for several minutes per hour or half-hour, by circular permutation among the transmitters.

31 August 1953.

B. DECAUX

Chairman, Study Group No. VII

ANNEX I

PRINCIPAL CHARACTERISTICS OF STANDARD-FREQUENCY AND TIME-SIGNAL STATIONS

1	Stations	Hawai	Rugby	Tokio	Torino	Washington
2	Call-sign	WWVH	MSF	JJY	IBF	WWV
3	Service	Experimental	Experimental	Experimental	Experimental	Regular
4	Carrier power (kW) ¹	0.4	0.5	1	0.3	10
5	Type of antenna	Vertical dipole	Vertical dipole	Vertical dipole	Horizontal dipole ¹¹	Vertical dipole
6	Number of simultaneous transmissions	3	3	1	1	6
7	Number of frequencies used	3	3	3	1	6
8	Emissions	Days per week	7	7	3 ^{7, 8, 9}	1 ¹²
9		Hours per day	22	24 ⁵	24	6 ¹³
10	Standard frequencies used	Carriers (Mc/s)	5; 10; 15	2.5; 5; 10	2.5 ⁷ ; 5 ⁸ ; 10 ⁹	5
11		Modulations (c/s)	1 ² ; 440; 600	1 ² ; 1000	1 ¹⁰ ; 1000	1 ² ; 440; 1000
12	Duration of modulation tone (minutes)	4 out of 5 ³	5 out of 15	9 out of 20	5 out of 10 ¹⁴	4 out of 5 ²
13	Accuracy of frequencies ($\times 10^{-8}$)	± 2	± 2	± 2	± 2	± 2
14	Monthly oscillator drift ($\times 10^{-8}$) (in 1950)	+ 2	+ 0.5	+ 3		+ 1
15	Limits for frequency correction (10^{-8})	≤ 1	≤ 2	≤ 2	≤ 2	≤ 1
16	Duration of time-signal transmission (minutes)	continuous	5 out of 15	continuous	5 out of 10	continuous
17	Accuracy of time intervals	$\pm 2 \times 10^{-8}$ ± 1 micro-second	$\pm 2 \times 10^{-8}$ ± 1 micro-second	$\pm 2 \times 10^{-8}$ ± 1 micro-second	$\pm 2 \times 10^{-8}$ ± 10 micro-second	$\pm 2 \times 10^{-8}$ ± 1 micro-second
18	System of correcting signals	by frequency ⁴	by skips of 50 ms ⁶	corrected from an average of time signals	corrected from an average of time signals	by frequency ³

¹ Maxima; reduced power is used on certain frequencies on certain days.

² 5 cycles of 1000 c/s modulation pulses.

³ 440 and 600 alternately.

⁴ No phase adjustment on the signals themselves.

⁵ Interruption of all signals from minute 15 to minute 20 of each hour.

⁶ The 1st of the month if necessary.

⁷ Mondays.

⁸ Wednesdays.

⁹ Fridays.

¹⁰ 7 cycles of 1400 c/s modulation pulses.

¹¹ Direction of maximum radiation: NW-SE.

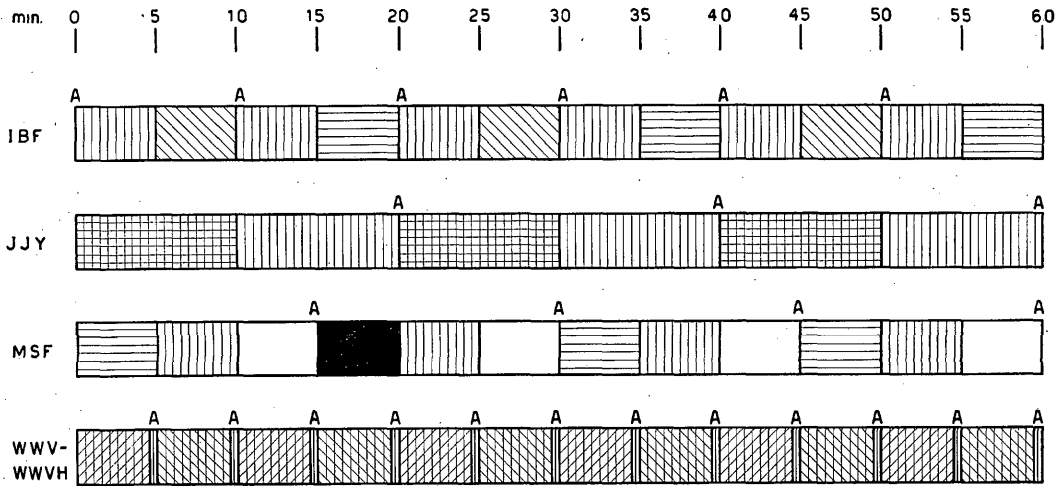
¹² Tuesdays.

¹³ From 0800 to 1100 h and from 1300 to 1600 h. U.T.

¹⁴ 440 and 1000 alternately.

ANNEX II

COMPARISON OF THE TIME TABLES OF STANDARD FREQUENCY TRANSMISSIONS AND TIME SIGNALS



 Silent period
 Unmodulated carrier
 One second pulses

 1.000 c/s modulation
 600 c/s modulation
 440 c/s modulation

A Announcements

REPORT BY THE CHAIRMAN OF STUDY GROUP No. VIII *

(International monitoring)

(Original language: English)

1. Study Group No. VIII of the C.C.I.R. was entrusted with Question No. 55 of the C.C.I.R., Geneva, 1951, i.e. a question relating to the accuracy of field-strength measurements at monitoring stations. In addition, the advisability of raising a new question dealing with automatic monitoring of channel usage was discussed by correspondence with members of the Study Group.

2. The following C.C.I.R. documents, Geneva, 1951, are relevant to the work of the Study Group dealing with Question No. 55 :

Recommendations Nos. 60, 61, 62, 63, 64, 65, 66 and 67;

Question No. 55;

Study Programme No. 19;

Reports Nos. 4, 5 and 6.

3. Members of the Study Group are :

Australia, Canada, United States of America, France, Hungary, Italy, Japan, Netherlands, Spain, Czechoslovakia, Yugoslavia, United Kingdom, Sweden, Switzerland, Morocco, B.B.C., Cable & Wireless Ltd., Compagnie Générale de T.S.F., Marconi International Communication Co. Ltd., R.C.A., R.A.I., I.B.O. and E.B.U.

The Chairmanship of this Study Group is held by Australia.

4. The work of the Study Group has been carried out by correspondence as the limited nature of the subject to be studied and the small number of contributions received has not warranted a meeting.

5. Contributions to the work of the Study Group have been received from the United States, the United Kingdom, Italy and Australia. A contribution relating to Question No. 16 of Stockholm (Bandwidth measurement by monitoring stations) was also received from Japan (Doc. 152). This subject, however, was referred to Study Group No. I by the VIth Plenary Assembly. The contributions relating to Question No. 55 are summarised below.

5.1. *United states (Doc. 49).*

Accuracies obtainable are ± 2 db from 15 kc/s to 30 Mc/s and ± 3 db from 30 Mc/s to 300 Mc/s when using a standard signal generator as voltage reference. The use of a bolometer secondary voltage standard for calibrating the standard signal generator does not improve this accuracy, i.e. the same accuracy is obtainable when using a signal generator calibrated yearly at a central laboratory. Provided adequate precautions are taken, the variation in field strength at various sites within a particular monitoring station are expected to be less than ± 2 db for frequencies up to 30 Mc/s and should not exceed 10 db for the frequency range 30 Mc/s to 300 Mc/s.

5.2. *United Kingdom (Doc. 170).*

Accuracies considered obtainable with commercial equipment are ± 2 db up to 30 Mc/s and ± 3 db to ± 4 db up to 300 Mc/s. The lowest field strength at which these accuracies are obtainable is controlled by receiver and atmospheric noise.

The improvement of precision possible, by the provision of improved means of calibration of standard signal generators, is discussed, and it is concluded that some improvement in overall measurement accuracy could be attained in this way.

* Doc. No. 108, London.

5.3. *Italy (Doc. 194).*

Estimated accuracies are ± 0.5 db for frequencies less than 3 Mc/s and ± 1 db for frequencies between 3 Mc/s and 100 Mc/s when measuring under optimum conditions. Under the less satisfactory measuring conditions accuracies will be lowered somewhat.

5.4. *Australia (Doc. 241).*

Accuracies estimated and corresponding measuring sensitivities are tabulated. The measuring accuracies estimated are :

Below 3 Mc/s	± 1.25 db
3 Mc/s — 10 Mc/s	± 1.5 db
10 Mc/s — 30 Mc/s	± 2.5 db
30 Mc/s — 300 Mc/s	± 3.0 db

Some improvement in both measuring accuracy and sensitivity is obtainable by the use of a voltage reference such as a "micropotentiometer" or device of similar accuracy.

6. *Conclusion.*

6.1. *Question No. 55.*

Before a recommendation is made, further contributions from other members of the Study Group would be desirable and in particular, from a survey of the contributions received so far, further study is required of :

- (a) The effect of equipment time constants on the accuracy of measurement of absolute field strength throughout the band 15 kc/s to 300 Mc/s at monitoring stations using measuring apparatus with or without automatic recorders, particularly when measuring emissions with interrupted or suppressed carriers.
- (b) The improvement in accuracy obtained by the use of devices such as noise generators, or the radio frequency "micropotentiometer", for voltage calibration.
- (c) Methods of measuring the field strength of multichannel suppressed-carrier emissions

6.2. *Proposed new Question (Doc. 89) dealing with the automatic monitoring of channel usage.*

A number of replies were received, all of which agreed that study of the problem of automatic monitoring of channel usage was warranted. It is intended to discuss this matter further at the London Assembly.

A. H. CANNON,
Chairman, Study Group No. VIII.

REPORT BY THE CHAIRMAN OF STUDY GROUP No. IX *

(General technical questions)

(Original language : English)

Captain C.F. Booth, who served as the Chairman of Study Group No. IX from 1948 onwards, was unfortunately unable to continue in this capacity after the autumn of 1952, and I was asked to take over his duties. I feel sure that it would be the wish of all members of the Study Group to express their appreciation of the very efficient way in which Captain Booth has discharged his responsibilities as Chairman of Study Group No. IX.

Since the VIth Plenary Assembly, Study Group No. IX has considered all the Questions and Study Programmes assigned to it, namely Questions Nos. 56 to 61 inclusive, and Study Programmes Nos. 26 to 29 inclusive. Of these tasks all except two are exclusively for the consideration of the C.C.I.R. The exceptions consist of Question No. 58 and Study Programme No. 28.

Question No. 58, "Standardisation of radiophoto and telephoto equipment", is for consideration by a mixed Commission of the C.C.I.T. and the C.C.I.R., which is to meet at Arnhem towards the end of May. Certain contributions have been made to this Question by members of C.C.I.R. Study Group No. IX, but it is proposed to defer making a report of progress on this particular Question until after the Arnhem meeting, which I propose to attend.

Study Programme No. 28 is divided into four sections :

1. For study by the C.C.I.F.
2. For study by the C.C.I.R.
3. For study by the C.C.I.F. with C.C.I.R. representation.
4. For study by the C.C.I.R. with C.C.I.F. representation.

Contributions have been received only in respect of paras. 2 and 4 and are surveyed in an annex to the present report. It is suggested that the material relating to para. 4 be discussed jointly with C.C.I.F. representatives at the forthcoming Plenary Assembly of the C.C.I.R.

Contributions have been received in respect of the other tasks assigned to Study Group No. IX. These contributions are listed in the table attached together with those relating to Question No. 58 and Study Programme No. 28 and are surveyed in annexes to this report.

I should like to take this opportunity of acknowledging my indebtedness to all those who have contributed so effectively to the work of the Study Group.

1st April, 1953.

H. STANESBY,
Chairman, Study Group No. IX.

* Doc. No. 109, London.

TABLE OF CONTRIBUTIONS

Question, Study Programme or Report	Subject	Country	Document Nos. VIIIth P.A., C.C.I.R.
Q. No. 56 S.P. No. 29	Watch on the distress frequency of 2182 kc/s	France U.K. U.S.A.	174 87 59
Q. No. 57	Watch on the R/T distress frequency of 2182 kc/s	France U.K. U.S.A.	180 77 51
Q. No. 58 R. No. 11	Standardisation of radiophoto and telephoto equipment	Japan U.K. U.S.A.	153 125 52
Q. No. 59	Power relationships for modulated emissions	U.K. U.S.A.	76 53
Q. No. 60	Preferred methods of specifying power supplied to an antenna by a radio transmitter	U.K. U.S.A.	75 54
Q. No. 61	Pulse transmission for radio direction finding	U.K. U.S.A.	74 55
S.P. No. 26 Q. No. 17	Identification of radio stations	U.K. U.S.A.	73 56
S.P. No. 27 Q. No. 19	5-unit radio teleprinter	U.K. U.S.A.	72 57, 190
S.P. No. 28	Wide band radio systems operating in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands	U.K. U.S.A.	88 58

ANNEX I

SURVEY OF CONTRIBUTIONS TO QUESTION NO. 56 AND STUDY PROGRAMME NO. 29

Alarm signal for use on the maritime radiotelephony distress frequency 2182 kc/s.

1. Contributions received.

Contributions have been received from the Administrations of France (Doc. No. 174), the United Kingdom (Doc. No. 87) and the United States of America (Doc. No. 59), and the views expressed are discussed below.

2. Summary of contributions.

The French contribution describes the results of tests undertaken jointly with the United Kingdom in response to the request in the Study Programme. The auto-alarm equipments used were essentially similar to those used for the previous series of tests in 1950-51, with the step-by-step selector used to register the signal sequences replaced by a chain of relays. The tests were carried out between Boulogne and Niton radio stations, under the severe conditions of noise and interference that exist in the Channel. The tests included a study of the effects of changing the response-times and the operating levels of the auto-alarm units. Laboratory tests were also made of the effects of variations in power supply voltage ($\pm 10\%$), ambient temperature (5° to 40° C) and in the selectivity of the auto-alarm. The tests showed that, in the opinion of the French Administration, the type of signal defined in Recommendation No. 71 is generally satisfactory and that it is now possible to recommend an alarm signal for final international adoption. The French recommendations are summarised, with those of the United Kingdom and the United States of America, in Table 1, Appendix 1.

The United Kingdom's contribution, also, describes the results of the joint tests made between Niton and Boulogne. The auto-alarm equipments used were generally similar to those used for the 1950-51 tests, with slight modifications described in the contribution. A circuit diagram of the modified equipment is attached to the contribution. The tests included an examination of the effects of changing the tune of the tone-selector circuits, the durations of the transmitted tones, the response time, and the signal-input level to the receiver. The United Kingdom Administration concludes that the type of signal specified in Recommendation No. 71 is suitable for an auto-alarm signal, and that it permits the design of auto-alarm equipment capable of receiving a large proportion of transmitted signals through very severe interference, whilst producing a very small number of false calls. The United Kingdom's recommendations are summarised in Table 1, Appendix 1.

The United States' contribution reports that the United States has, owing to more pressing commitments, not found it practicable to carry out more tests since the VIth C.C.I.R. Plenary Assembly. However, it considers that it is possible to apply the results of its previous tests during 1950-51 because the type of signal proposed in Recommendation No. 71 is fundamentally similar to that previously used. In consequence, the United States of America has reviewed the results of its earlier tests, and has considered related development work carried out by manufacturing and operating organisations in the United States of America on tone-signalling systems for use on radio circuits. As a result, it is concluded that the alarm-signal specified in Recommendation No. 71 is generally suitable, and that the tolerances specified in Point 1.2. of Recommendation No. 71 are acceptable for international recommendation. In Table 1, therefore, the characteristics proposed in Recommendation No. 71 are shown as recommended by the United States of America.

3. Discussion.

There is a considerable measure of agreement between the three contributions, as Table 1, Appendix 1, shows. There are, in fact, only two points of difference, namely, the duration of the tones and the response time of the receiver.

The French and United States' contributions support the tone-element durations of 250 $\pm$ 50 millisecon. specified in Recommendation No. 71, but the United Kingdom proposes the wider range 166 to 500 millisecon., plus a restriction on the relative durations of the two-tone elements. Adoption of the limits 200 to 300 millisecon. would not clash with the United Kingdom's proposals for duration, and would also meet its requirement that neither tone should exceed the other by 50 % in duration. It is, therefore, proposed that the recommended duration of each tone should be 250 millisecon. $\pm$ 50 millisecon.

The French contribution recommends that, in the absence of noise and interference, the automatic-receiving equipment should be capable of operating from the alarm signal in a period of from 3 to 6 seconds. The corresponding United Kingdom and United States' proposals are, respectively, nominally 6 seconds with a limit of 7 seconds; not more than 4 seconds. The French contribution suggests that increasing the response time above 4 seconds somewhat reduces the percentage of successful recognitions. On the other hand the United Kingdom contribution reports that increasing the response time from 4 to 8 seconds had no adverse effect on the successful recognition of alarm signals and comments that an improved protection against false calls results. It is proposed that the recommended response time should be 5 seconds $\pm$ 1 second.

It is considered that the contributions made to the Study Programme enable answers to be given to Points 1.1 and 1.2 which refer to the characteristics of the signal. Points 1.3 and 1.4 refer to the performance and design of the equipment itself, and on these points the French contribution recommends the performance standards shown in Table 1. The United Kingdom's contribution draws attention to the auto-alarm unit Type UK4, having the circuit attached to the contribution, as a satisfactory type of auto-alarm equipment. The United States' contribution proposes that the standard minimum performance requirements recommended should not exceed in scope those already established by international agreement* for auto-alarm devices for use on the radiotelegraph distress frequency, 500 kc/s. These recommendations are somewhat narrower in scope than those listed in Points 1.3 and 1.4 of the Study Programme. It is considered that this United States' proposal should be adopted in order to allow the greatest freedom of design and development compatible with reliable operation.

4. Proposed Recommendation.

The C.C.I.R.,

CONSIDERING :

- (a) That it is desirable and practicable to establish an internationally agreed alarm signal for use on the maritime radio-telephony distress frequency of 2182 kc/s;
- (b) That the alarm signal should meet the requirements contained in Recommendation No. 71, Points (b), (c), (d) and (e);
- (c) That the further examinations of this problem by the Administrations participating in Study Programme No. 29 are sufficient to determine the essential characteristics and tolerances of the signal that should be recommended for international adoption;
- (d) That it is possible to specify the minimum performance standards for automatic-alarm equipment, for both transmission and reception, to such an extent that future progress and development are not hampered;
- (e) That it is undesirable that the specification of performance standards for automatic-alarm equipment should exceed in scope the requirements already established by international agreement (Art. 37, paras. 31, 32, 33, International Radio Regulations, Atlantic City, 1947; and Chap. IV, Regn. 11, Convention for Safety of Life at Sea, London, 1948) for automatic alarm devices intended for the reception of the international alarm signal or the international distress signal in radio telegraphy, normally transmitted on the frequency 500 kc/s;

* Art. 37, para. 31, 32, 33 of the International Radio Regulations, Atlantic City, 1947; also Chap. IV, Regn. 11, of the Convention for Safety of Life at Sea, London, 1948.

RECOMMENDS :

1. That the alarm signal described below should be adopted internationally for use on the maritime radio-telephony distress frequency 2182 kc/s;
- 1.1. The alarm signal shall be composed of two sinusoidal audiofrequency tones, transmitted alternately. One tone shall have a frequency of 1300 c/s and the other tone shall have a frequency of 2200 c/s. The duration of each tone shall be 250 milliseconds;
- 1.2. The tolerance on the frequency of each tone shall be $\pm 1\%$; the tolerance on the duration of each tone shall be ± 50 milliseconds; the interval between successive tones shall not exceed 20 milliseconds; the ratio of the amplitude of the stronger tone to that of the weaker tone shall be within the range 1.0 to 1.2;
- 1.3. When generated by automatic means, the alarm signal shall be sent continuously for a period of 30 seconds; when generated by manual means, the signal shall be generated as continuously as practicable over a period of one minute;
2. That the automatic devices intended for the reception of the alarm signal shall fulfil the conditions listed below :
 - 2.1. The frequencies of maximum response of the tuned circuits, or other tone-selecting devices, shall be subject to a tolerance of $\pm 1\%$;
 - 2.2. In the absence of noise and interference, the automatic-receiving equipment shall be capable of operating from the alarm signal defined in 1, in a period of not less than four and not more than six seconds;
3. That automatic-alarm equipments, for both transmission and reception, shall fulfil the conditions listed below :
 - 3.1. They shall respond to the alarm signal, defined in 1, through intermittent interference caused by atmospherics and powerful signals other than the alarm signal; preferably without any manual adjustment being required during any period of watch maintained by the equipment;
 - 3.2. They shall not be actuated by atmospherics or by strong signals other than the alarm signal;
 - 3.3. They shall be effective beyond the range at which speech transmission is satisfactory;
 - 3.4. They shall give warning of faults that would prevent the apparatus from performing its normal functions during watch hours;
 - 3.5. They shall be capable of withstanding vibration, humidity, changes of temperature and changes in power-supply voltage equivalent to the severe conditions experienced on board ships at sea, and shall continue to operate under such conditions ;
4. That before a new type of automatic alarm equipment is approved for use on ships, the Administration concerned should be satisfied by practical tests, made under operating conditions equivalent to those obtaining in practice, that the equipment complies with the provisions of 1, 2 and 3 of this Recommendation ;
5. That Study Programme No. 29 be terminated.

APPENDIX I

Table 1

SUMMARY OF RECOMMENDATIONS

Characteristics	United States	France	United Kingdom
Tone frequencies	1300, 2200 c/s	1300, 2200 c/s	1300, 2200 c/s
Tone-frequency tolerances : (a) Transmitter (b) Receiver	$\pm 2\%$ Not specified	$\pm 1\%$ $\pm 1\%$	$\pm 1\%$ $\pm 1\%$
Tone duration	200 to 300 millisecc.	200 to 300 millisecc.	166 to 500 millisecc. Neither tone to exceed the other by 50 % in duration
Interval between tones	Not greater than 20 millisecc.	Not greater than 20 millisecc.	
Relative amplitude of tones		Ratio of the amplitude of the stronger to the weaker to lie in the range 1.0 to 1.2	
Response time in the absence of noise and interference	Not more than 4 sec.	3 to 6 sec.	Nominally 6 sec., not more than 7 sec.
Duration of the transmission (a) Automatic (b) Manual	30 sec. 1 minute	30 sec. 1 minute	
Transmitter operating conditions		Tone frequency tolerance to be met for $\pm 10\%$ change in supply voltage, and for temperatures in the range 5° to 40° C	
Tone-selector bandwidth		$\pm 4\%$ on each tone frequency for 6 db discrimination	
Tone selector stability		Tone frequency tolerance to be met over the temperature range 5° to 40° C	

ANNEX II

SURVEY OF REPLIES TO QUESTION NO. 57

(*Watch on the radio telephony distress frequency of 2182 kc/s*)

1. Contributions received.

Contributions have been received from the Administrations of France (Doc. No. 180), the United Kingdom (Doc. No. 77) and the United States of America (Doc. No. 51), and the views expressed are analysed in the table below.

ANALYSIS OF CONTRIBUTIONS

Aspect	Views Expressed		
	U.S.A.	U.K.	Franc
Restriction of use of 2182 kc/s to distress signals only		This is deprecated; it would made 2182 kc/s a "dead" frequency which would reduce the attention given to it by operators and lessen the chance that distress calls would be heard	This would not be permissible as the Atlantic City Radio Regulations, Art. 34 Sect. II, Nos. 813-827 allow other uses
Reduction of use of 2182 kc/s	The normal use of 2182 kc/s for calling and safety purposes should be reduced to a minimum and users should be educated in this direction	Administrations should enforce more strictly the prohibition of superfluous use	Administrations should make a realistic attempt to enforce respect for the Atlantic City Radio Regulations, especially Art. 34, Sect. II, No. 815, and to implement Rec. 6, point 1 of the E.A.R.C. Agreement
Calling on working frequency instead of 2182 kc/s	The maximum possible use should be made of working frequencies for calling	This is not opposed if it is essential for traffic requirements, but exclusive reservation of 2182 kc/s for distress would, it is felt, reduce the efficiency of the distress watch and could not be supported	Calling on 2182 kc/s should, if possible, be restricted to cases where contact cannot be established by other means
Loudspeaker distress-watch in ships not fitted with auto-alarm receivers	No system except standby loudspeaker monitoring should be used in ships not carrying auto-alarm receivers	A loudspeaker distress-watch in ships having no automatic alarm is favoured. The early adoption of an alarm signal with its distinctive characteristics would facilitate the recognition of a distress call whether or not an auto-alarm receiver were used.	The study should be undertaken of a receiver for small ships : (a) capable of working continuously on 2182 kc/s (b) discriminating at audio-frequency against frequencies other than the alarm signal to facilitate a loudspeaker distress-watch
Other views	All stations using 2182 kc/s should be provided with means for rapid wave-change to other frequencies for working		
	As far as possible only one channel should be designated internationally for calling safety and distress		
	The maximum use should be made of VHF for short distances		

2. Discussion of views.

There is no dissent from the view that 2182 kc/s may not, under existing regulations, or should not, be reserved exclusively for distress calls; indeed the United States' contribution proposes that no other frequency should, in fact, be designated on an international basis for calling and safety, as well as for distress, unless future experience clearly shows a need for a second frequency. On the other hand, there is general agreement that the unnecessary use of 2182 kc/s should be reduced to a minimum by education and by enforcing respect of regulations, and the United States of America makes certain other suggestions for reducing the use of 2182 kc/s.

There is some divergence of views as to the extent to which calling should take place on the working frequency; France and the United States of America favour the maximum possible use of working frequencies for calling, but the United Kingdom—while not opposing such a practice where traffic makes it desirable—fears that if widely adopted it would reduce the efficiency of the distress watch.

There is general support for the view that a loudspeaker distress watch is valuable in ships not fitted with auto-alarm receivers, and both France and the United Kingdom draw attention to the value of the alarm signal not only for auto-alarms but for aural watch.

3. Draft Recommendation.

The C.C.I.R.

CONSIDERING :

- (a) that while it is neither permissible under Atlantic City Regulations, Art. 34, Sect. II, Nos. 813-827, nor desirable to reserve the distress frequency of 2182 kc/s for distress calls alone, it is nevertheless desirable to reduce the unnecessary use of this frequency to a minimum;
- (b) that the use of an alarm signal with strongly distinctive characteristics would facilitate the reception of distress calls in ships carrying out aural watch as well as in those fitted with auto-alarms;
- (c) that a loudspeaker distress-watch in ships not fitted with auto-alarms would increase the efficiency of the distress-watch.

RECOMMENDS :

- 1. That the attention of Administrations be drawn to the need to take special steps to enforce respect of the Radio Regulations (especially No. 815 *) regarding the use of the distress frequency of 2182 kc/s.
- 2. That an alarm signal of a type such as that specified in C.C.I.R. Recommendation No. 71 be adopted internationally and brought into use at an early date.
- 3. That Administrations encourage those of their ships that are not fitted with auto-alarms for the distress frequency of 2182 kc/s to instal loudspeaker-watch receivers operating on that frequency.

* The English and French texts differ somewhat in the emphasis laid on the restriction of traffic on 2182 kc/s to urgency, safety and distress messages, the French text being the more restrictive.

ANNEX III

SURVEY OF REPLIES TO QUESTION NO. 59

(Power relationships for modulated emissions)

1. Contributions received.

Contributions have been received from the Administrations of the United Kingdom (Doc. No. 76) and the United States of America (Doc. No. 53), and the views expressed are summarized below.

2. Part 1 of the Question : The relation between VU readings and long-term power averages for speech and music.

Neither the United Kingdom's nor the United States' contribution considers that any relation between VU readings and the long-term-average power of speech or music is of much practical value for field-intensity studies. The United States' contribution points out that for a double-sideband amplitude-modulated signal the 6 db range in radiated power between zero modulation and the crests of 100 % modulation is substantially less than the variations in power of the audio input to the transmitter. The United Kingdom's contribution draws attention to the use of varying degrees of compression and limiting in many types of radio system.

The United States' contribution points out that with single-sideband, reduced-carrier operation the radio-frequency power output of the transmitter varies almost directly with the audio input power. Usually for speech and music the relation between VU readings and long-term-average power fluctuates too widely to be useful, but the relations listed below are quoted :

- (a) By the United Kingdom : For both high-quality and commercial speech the long-term-average power in db ref. 1 milliwatt is approximately equal to the VU reading minus 4.
- (b) By the United States of America : For smoothly-read speech the long-term-average power in db ref. 1 milliwatt is equal to the VU reading minus 2.

The discrepancy of 2 VU/db between the two conversion factors may well be due to the use of average, conversational speech in one case and " smoothly read " speech in the other; the conversion factor might be expected to be smaller in the latter case, as indeed it is.

3. Part 2 of the Question : Power relationships for various types of modulation.

The United States' contribution has nothing to add to the Annex to Recommendation No. 73.

The United Kingdom's contribution considers that it is undesirable to use the power relationships considered in studies of the attenuation of radio paths, and recommends that the transmitter output power be recorded in such studies.

4. Discussion.

The signals likely to be encountered can be divided into two classes :

Class 1. Where the radiated power is wholly or largely independent of the degree of modulation, or where there is no modulation.

Class 2. Where the radiated power is largely dependent on the degree of modulation.

It would appear that for Class 1 signals it should suffice for most field-intensity studies to specify the unmodulated-carrier power. In this connection it is worthy of note that for a double-sideband amplitude-modulated emission, 100 % modulated by a sine wave, the mean power radiated will be only 1.5 times (1.8 db higher than) that of the unmodulated carrier, while for

reasonably high percentages of modulation using smoothly-read text the mean power will be no more than 1.08 times * (0.3 db higher than) that of the unmodulated carrier.

When it is necessary to use Class 2 signals modulated by speech, music or conversation for field-intensity studies of great precision, it appears desirable to record the transmitter-output power with an instrument having similar characteristics to those of the field-intensity recorder in view of the uncertainty of the power relationships of the modulating signal.

5. Draft Recommendation.

The C.C.I.R.

CONSIDERING :

- (a) that the signals likely to be used for field-intensity studies can be divided into two classes :
 - Class 1 : where the radiated power is wholly or largely independent of the degree of modulation, or where there is no modulation;
 - Class 2 : where the radiated power is largely dependent on the degree of modulation.
- (b) that for modulation by speech, music or conversation, or indeed by certain other forms of intelligence, the power relationships of the modulating signal are variable.

RECOMMENDS :

- 1. that for signals of Class 1 it should suffice for most field-intensity studies to specify the unmodulated-carrier power;
- 2. that for all other cases, including signals of Class 2, it appears desirable when it is necessary to make field-intensity studies of high precision, to record the transmitter-output power with an instrument having similar characteristics to those of the field-intensity recorder.

ANNEX IV

SURVEY OF CONTRIBUTIONS TO QUESTION No. 60

*(Preferred methods of specifying power supplied to
an antenna by a radio transmitter)*

1. Contributions received.

Contributions have been received from the Administrations of the United Kingdom (Doc. No. 75) and the United States of America (Doc. No. 54).

2. Summary of views expressed.

The United Kingdom's contribution considers that there is no reason to distinguish between the purposes of monitoring and of frequency assignment for the specification of transmitter power.

The United States' contribution accepts that sometimes the specification of mean power is more useful for monitoring and that a statement of peak power may be better for frequency assignment. Both contributions draw attention to the relations between peak and mean power contained in Recommendation No. 73.

The United Kingdom's contribution is confined to frequencies below 30 Mc/s and recommends the specification of the mean power of the unmodulated-carrier wave for type A1 emissions and for all types of frequency and phase-modulated emissions. For type A2, A3 and A4 emissions it recommends specification in terms of the mean value of the unmodulated-carrier power together with a statement of the maximum modulation depth for a stated distortion. For type A3a and A3b emissions the specification of peak envelope power is recommended.

* Recommendation No. 73.

The United States' contribution, which is in the form a draft recommendation, generally favours the use of peak power for specification, as the engineering specification and adjustment of transmitters are commonly in terms of peak power. And, it comments that there is no great hardship in specifying the power of a radio transmitter in several different ways simultaneously.

3. Discussion.

Consideration (c) of Question No. 60 looks towards the use in some circumstances of alternatives to peak power and mean power for specifying the power of a radio transmitter, but the two contributions summarized above make no proposals for any alternative specification. Nor do they express any strong preference for the exclusive uses of peak or of mean power for particular purposes. In these circumstances, it is proposed that a recommendation on the lines of that contained in the United States' contribution should be adopted.

4. Draft Recommendation.

The C.C.I.R.

CONSIDERING :

- (a) That the Radio Regulations, Atlantic City, 1947, Article 1, Section IV, Nos. 60-64, call for the use of peak power in specifying the power of a radio transmitter, but permit the use of mean power in cases where the peak-power specification is not satisfactory or adequate;
- (b) That in some cases the mean power of the unmodulated carrier is a preferable method of rating the power of a transmitter with regard to monitoring and interference-producing capabilities;
- (c) That although the two alternatives provided in the Radio Regulations may not always be adequate for all the uses made of transmitter power ratings, there is no satisfactory alternative form of specification immediately available;
- (d) That there is little hardship in specifying the power of a radio transmitter in a number of ways simultaneously, as long as each way can be shown to be necessary;

RECOMMENDS :

1. That the Radio Regulations, Atlantic City, 1947, Article 1, Section IV, Nos. 60-64, should not be altered at present;
2. That additional methods of specifying and measuring the power of radio transmitters be added at such times as they may be properly justified.

ANNEX V

SURVEY OF REPLIES TO QUESTION No. 61

(Pulse transmission for radio direction-finding)

1. Contributions received.

Contributions have been received from the Administrations of the United Kingdom (Doc. No. 74) and the United States of America (Doc. No. 55), and the views expressed are summarized below.

2. Summary of contributions.

The United Kingdom's contribution considers in some detail the errors to be expected for continuous-wave and for pulse transmissions, on a frequency of about 8,000 kc/s, when a well-maintained U-type Adcock cathode-ray direction-finder, on a good site, is used by a first-class

operator. Attention is drawn to the facts that the estimates of errors are necessarily approximate, and that they refer to ionospheric reception at distances greater than 400 km under conditions commonly noted in the United Kingdom. Five sources of error are considered, namely : observational and instrumental errors, errors due to the surroundings of the direction-finder site, and errors caused by lateral deviation in the ionosphere and wave interference. The estimated total "standard errors **" are shown in Table 1.

TABLE 1

Condition	Standard Error ** (degrees)			
	Continuous Wave		Pulse	
	Single bearing	Mean *	Single bearing	Mean *
<i>Day-time</i>				
(a) When first order echoes via E or E _s layers are in use	3.1	2.1	1.9	1.7
(b) Otherwise			2.3	2.1
<i>Night-time</i>				
(a) When first order echoes via E or E _s layers are in use	3.4	2.5	1.9	1.7
(b) Otherwise			2.7	2.5
* Mean of 10 'snap' bearings in 5 minutes				

Table 1 shows that the estimated standard errors are somewhat lower for pulse than for continuous-wave transmissions, and that under the most favourable conditions the estimated standard errors for a single bearing for continuous-wave and pulse transmissions are in the approximate ratio of 1.8 : 1.

The contribution emphasizes that the estimated errors are tentative, and that any deterioration of observer, site or equipment will reduce any potential advantages of pulse operation. The maximum improvement from the use of pulse transmissions is expected to occur when direct first-order echoes from the E or E_s layer are receivable at adequate strength. In the United Kingdom this condition holds during day-time for ranges of about 400 to 2,000 km. and during night-time for ranges of about 700 to 2,000 km depending on the transmitter power available.

The United States' contribution notes that continuous-wave signals arriving by different paths combine at the receiving aerial and cause bearing errors that might be avoided by the use of pulses short enough for the various signal components to be separated. It considers that the night ranges of radio beacons could be considerably increased by conversion to pulse operation, although it is recognized that the accommodation of wideband pulse emissions, especially in the crowded medium-frequency beacon band, would be exceedingly difficult. It is proposed that preliminary tests of pulse transmissions for direction-finding should, and could conveniently, be made by using standard Loran stations before the work is extended to the international distress frequencies 500, 2182 and 8364 kc/s. The United States' contribution draws attention to advantages other than increased accuracy that may accrue from the use of pulse emissions for direction-finding; thus it considers that relatively simple equipment could be used, and comments that for a given range the power input of a pulse transmitter could be considerably less than that of a continuous-wave transmitter.

** The term "standard error" is used here in its statistical sense, and does not refer to the "standard-wave error" used to compare direction-finders in respect of polarization errors.

3. Discussion.

Both contributions agree that some reduction of errors is likely to result from the use of pulse emissions for direction-finding, but the United Kingdom's estimate of the reduction shows only a relatively small improvement, and it is for consideration whether the improvement offered is worth the cost in money and spectrum space. It seems desirable to carry out tests, and the United States' proposal to use standard Loran stations as the initial source of pulse emissions for this purpose is a valuable one.

The United States' contribution draws attention to advantages, other than increased accuracy, that may accrue from the use of pulse emissions for direction-finding. One of those quoted is the lower input for a given range required by a pulse transmitter compared with a continuous-wave transmitter, but it is not clear why this should be expected.

4. Draft Report.

The errors in high-frequency direction-finding can arise from a number of sources, thus :

1. Observational errors introduced by the operator.
2. Instrumental errors, including polarization errors and those due to deficiencies of the direction-finder site.
3. Errors due to radiation scattered from topographical features many wavelengths distant from the direction-finder.
4. Lateral deviation in the ionosphere.
5. Wave interference due to "coning" of each ray and between different modes of propagation.

The advantage of a pulse emission over a continuous-wave emission lies in its ability to allow signals arriving over different paths to be separated, and so to reduce errors arising from sources (4.) and (5.) above.

The degree of accuracy to be expected from the use of pulse emissions for radio direction-finding has been studied, and it is estimated that in the most favourable circumstances and for a frequency of about 8000 kc/s the standard errors of a single 'snap' bearing might be about 3 degrees for a continuous-wave emission and about 2 degrees for a pulse emission. The corresponding figures for the mean of ten such bearings taken in a period of five minutes are : continuous-wave 2.5 degrees, pulse 1.7 degrees.

It is proposed that initial tests of direction-finding on pulse emissions should be carried out by using standard Loran stations, which are described in a publication issued by the U.S. Navy Hydrographic Office entitled : "Catalog of Loran Charts and Service Areas" (price 30 cents). The United Kingdom's contribution to this question (Doc. No. 74) contains a useful list of references.

ANNEX VI

SURVEY OF CONTRIBUTIONS TO STUDY PROGRAMME No. 26 AND QUESTION No. 17

(Identification of radio stations)

1. Introduction.

At the VIth Plenary Assembly of the C.C.I.R. (Geneva 1951), certain material was presented in respect of Question No. 17 (Identification of radio stations) and Recommendation No. 79 was adopted. Study Programme No. 26, which was formulated at Geneva, covers those parts of Question No. 17 that were not disposed of in the Recommendation, but, in addition, it requests study of a matter arising out of the Recommendation itself, namely the signal that should be transmitted to indicate that a call-sign is about to follow which is superimposed on another transmission. In the circumstances, therefore, any contributions that have been received in respect of the remaining parts of Question No. 17 will be considered in relation to Study Programme No. 26 together with those explicitly referring to that programme.

2. Contributions received.

Contributions have been received from the Administrations of the United Kingdom (Doc. No. 73) and the United States of America (Doc. No. 56), and the information contained therein is discussed below :

3. Part 1 of the Study Programme : The problem of inserting call signs.

3.1. *United Kingdom's contribution.* The United Kingdom states that it has nothing to add beyond what is given in Recommendation No. 79 and recommends :

- (a) that the study should be continued;
- (b) that Administrations should be invited to specify the types of system regularly in service where the insertion of the call-sign is not at present practicable.

3.2. *United States' contribution.* The United States' contribution discusses identification techniques that have been employed on three types of transmission, namely, frequency-shift signals, multi-channel single-sideband suppressed-carrier signals and two multi-channel telegraph systems. It also makes some suggestions for future action.

Single-channel frequency-shift signals : A system is described in which, as proposed in Recommendation No. 79, a frequency-shift transmitter is amplitude-modulated by 1275 c/s tone which in turn is keyed on-off with the call-sign, the amplitude-modulation is carried out at high level which, it is recognized, is costly. No direct comment is made on the bandwidth occupied, but this is sensibly equal to the bandwidth occupied by the frequency-shift signals alone plus the spread due to the keyed amplitude-modulation, amounting to slightly more than 2550 c/s. Clearly the increase in bandwidth is considerable, but it could no doubt be reduced by using a lower frequency for amplitude-modulation. The contribution suggests that some other system of audio-frequency modulation less costly than that discussed should be considered.

Multi-channel single-sideband suppressed-carrier signals : Tests are described in which the suppressed carrier of a multi-channel single-sideband transmitter is keyed with the call-sign in Morse. During a mark the level of the normally-suppressed carrier is increased to approximately that of one sideband. It is not clear, however, whether two independent sidebands are radiated or whether two or more channels are accommodated in one sideband. It is stated that while the increased level of carrier is radiated there is some increase in crosstalk but not to a troublesome extent. This method of identification appears to meet all the requirements of Part 1 of the Study Programme, and, moreover, to be very economical.

Certain multi-channel telegraph systems : Methods are described for transmitting call signs in Morse on "twinplex" and "twinmode" systems normally transmitting Cable Code. Although

not explicitly described in the contribution, twinplex is understood to be a system in which at any moment any one of four different conditions can be indicated by transmitting one of four different radio frequencies spaced at 400 c/s intervals; in other words it amounts to a frequency-shift system capable of providing one channel using a four-condition code, or two channels using a two-condition code. The twinplex system tested was, however, used to provide one channel transmitting traffic in Cable Code, a code based on Morse in which three conditions, dot, space and dash are signalled with no time interval between successive elements of the same letter; hence only three of the four twinplex frequencies were needed. For identification, traffic slip was replaced by specially punched slip in which the identification signal was synthesized in straight-forward Morse Code from the appropriate sequence of dots and spaces in Cable Code. For example the letter A was made up from one dot, one space and three dots of Cable Code*; hence, during the identification period the transmission took the form of Morse transmitted by the normal frequency-shift means.

A development of the same method was used on a twinmode transmission, which is understood to be a twinplex signal, as described above, upon which a second twinplex transmission is superimposed by setting up the corresponding signals on an audio-frequency, frequency-shift, basis and using them to amplitude-modulate those of the first twinplex system. One of the twinplex systems was normally used for traffic in Cable Code, and identification was effected in the same way as before by replacing traffic slip by specially punched slip.

It seems, therefore, that these methods amount to substituting a two-condition code for a three-condition code for identification purposes using three-condition-code slip. It is stated in the contribution that monitoring stations using ordinary communication receivers were easily able to read the identification signals sent in this way.

This method of identification appears to satisfy one of the requirements of Part 1 of the Study Programme, namely, that the effective bandwidth of the emission shall not be increased, but the other condition is not satisfied, since traffic is interrupted on the twinplex system concerned, by the identification signal. Moreover, if the twinplex system had been used to provide two independent two-condition-code channels it seems that it would have been necessary to interrupt traffic on both channels during identification, which might be difficult operationally.

4. Part 2 of the Study Programme : The signal that should precede the call-sign.

The United Kingdom contribution implies that Part 2 of the Study Programme, as well as Part 1, should be given further study.

The United States contribution proposes that the signal that should be sent to indicate that the call-sign that follows is superimposed on another transmission, be sent in the same manner as the call-sign and be incorporated in the International Q-Code (Radio Regulations, Atlantic City, 1947, Appendix 9), the letters QRJ or QTT being adopted.

5. Discussion.

The method of identification for single-channel frequency-shift signals is expensive both in equipment and bandwidth and it appears that further study of these two aspects of the problem is needed. If a satisfactory solution is obtained, it should moreover be applicable to any multi-channel system operated solely on a frequency-shift basis.

The multi-channel single-sideband suppressed-carrier method appears from the trials to be quite satisfactory, bearing in mind that the increase in crosstalk is tolerable and occurs only during the identification signal.

The method of identification for twinplex and twinmode systems, although perfectly satisfactory in respect of equipment and bandwidth, appears to be applicable only to the particular systems described and when Cable code is used, moreover it involves interrupting the flow of traffic. It seems, therefore, that although the technique described is valuable, the question of identifying various multi-channel telegraph signals needs further study.

* Because three consecutive dot elements in Cable Code have no time intervals between them, they form a dash.

The proposal in respect of the signal preceding the call-sign appears to meet all requirements.

The diversity of the multi-channel telegraph systems in operation is so wide that it appears desirable for each administration to be invited to specify the systems that it employs, and to continue studying methods of identification that satisfy the requirements of the present Study Programme.

6. Proposed Recommendation.

The C.C.I.R.

CONSIDERING :

- (a) that a satisfactory method for identifying multi-channel single-sideband suppressed-carrier transmissions has been evolved;
- (b) that the nature of the signal referred to in Recommendation No. 79, para. 2.7, can now be specified;
- (c) that certain aspects of Question No. 17 and Study Programme No. 26 have been answered;
- (d) that many different types of multi-channel telegraph systems are in operation :

RECOMMENDS :

- 1. That the suppressed carrier of multi-channel single-sideband transmissions be keyed with the call-sign in Morse in such a way that during a mark the level of the carrier shall be increased substantially.
- 2. That the signal that should be sent to indicate that the call-sign that follows is superimposed on another transmission, be sent in the same manner as the call-sign and that the letters QRJ be incorporated in the International Q-Code (Radio Regulations, Atlantic City, 1947, Appendix 9) for this purpose.
- 3. That Question No. 17 and Study Programme No. 26 be deleted and replaced by Study Programme No. ...*
- 4. That Administrations be invited to specify the multi-channel telegraph systems that they employ, and to state in which of these systems identification constitutes a problem.

7. Proposed Study Programme.

The C.C.I.R.

CONSIDERING :

that Recommendations Nos. 79** and ...*** referring to the identification of radio stations do not cover all aspects of the problem,

DECIDES THAT :

the following studies should be carried out :

- 1. The problem of applying low-power amplitude modulation to frequency-shift signals for identification purposes be studied with the object of evolving a system that is economical both in equipment and bandwidth.
- 2. The problem of inserting call-signs in multiplex, synchronous and other special systems be studied by the Administrations operating those systems.

* Question No. 17 and Study Programme No. 26 have been replaced by Question No. 104 (XIII) and Study Programme No. 78 (XIII), respectively.

** Recommendation No. 79 is cancelled.

*** Now Recommendation No. 132.

ANNEX VII

SURVEY OF REPORTS ON STUDY PROGRAMME No. 27

(Five-unit radio teleprinter)

1. Contributions received.

Contributions have been received from the Administrations of the United Kingdom (Doc. No. 72) and the United States of America (Docs. Nos. 57 and 190), and the views expressed therein are summarised below.

2. Part 1 of the Study Programme : The effects of varying radio-path conditions on synchronous and start-stop systems.

2.1. U.K. Contribution.

The following general points are made :

(a) In comparison with start-stop systems, synchronous systems of equal traffic capacities have lower baud speeds in the ratio 5 : 7 (or 5 : $7\frac{1}{2}$ if, as in the U.K. a $1\frac{1}{2}$ -unit stop signal is used), hence a smaller bandwidth is required.

(b) When correctly adjusted, a synchronous system is inherently less susceptible to distortion than a start-stop system, and when the lower baud speed is taken into account a synchronous system will normally tolerate at least twice the amount of distortion that causes failure on a start-stop system, the distortion being measured in seconds in both cases, instead of in terms of the unit telegraph periods of the systems being compared.

Assuming that frequency-shift techniques are used, the adverse effects that radio circuits have on teleprinter operation can be divided into two classes :

(a) General fading, noise and interference, which give rise to distortion, and, in the limit, to complete failures; but in practice such failures are more often than not of short duration. These failures can give rise to character substitutions on synchronous and start-stop systems employing five-unit code, and on start-stop systems they can also give rise to false start signals or can inhibit a stop signal, either of which causes an average of about three character errors due to a temporary loss of synchronism. Such losses of synchronism can, however, be reduced considerably by providing special facilities in terminal equipment and regenerative repeaters, but the facilities in turn lead to certain difficulties in sending special signals that are required on some radio/land-line circuits.

(b) Selective fading, which can be regarded alternatively as the result of multipath propagation, can give rise to the effects discussed under (a) but is frequently characterised by a swinging bias to which synchronous systems are only half as sensitive as start-stop systems.

The U.K. contribution also briefly compares sampling and integrating methods of telegraph reception. For circuits capable of a speed of response greater than is necessary for the signals being received, integration methods are stated to be useful, but it is not established that integration is better than sampling on circuits in which the bandwidth is the minimum necessary. It is stated that integration methods are not well adapted to phasing and synchronising functions.

2.2. U.S.A. Contribution :

While not going into an analysis of the various factors involved, the U.S.A. contribution states that as a result of five years' experience of radio-teleprinter operation the answer to Part 1 of the Study Programme has been provided indirectly. During this time multiplex systems, mostly employing the equivalent of synchronous techniques, have been found capable of providing several channels aggregating a higher keying speed than single-channel, start-stop, five-unit,

teleprinter systems, and with fewer errors. This, it is stated, confirms the assumption that distortion of the start or stop pulse may create an error in the associated character and may cause lack of synchronism and errors extending over several further characters. It concludes that the need for an analysis of the problem no longer exists.

The U.S.A. contribution does not specifically refer either to sampling or integrating methods of reception.

3. Part 2 of the Study Programme : Special codes for radio circuits.

3.1. U.K. Contribution.

To assess the need for special protective codes associated with automatic error-detecting or correcting facilities, it is necessary to know, not only the grade of transmission afforded by the radio circuits concerned, but the accuracies required for various classes of traffic. It would, therefore, be helpful if international standards of accuracy were to be specified. Furthermore, the merits of various error-detecting and correcting systems could be more readily compared if some standard method of assessing their performance were to be adopted.

When radio transmission is poor and high accuracy is required, error correction as distinct from detection may be desirable, and automatic correction either by repetition of the character in error or by using a self-correcting code can be adopted. The only automatic error-correcting system in service at present is stated to be that of van Duuren, which uses a special seven-unit code, and involves more complex code-conversion processes than would be the case with a 5 + 2 code. Other systems are being developed in the United Kingdom. In the circumstances, it is regarded as unnecessary and undesirable to consider the standardization of error-detecting codes at present.

3.2. U.S.A. Contribution.

The comparison of special codes on radio circuits is a big undertaking and is not being undertaken as a specific project. However, as a result of other studies some information will be obtained that bears on the subject. Many multiplex systems use other than five-unit code, and a seven-unit protective code for radio circuits with auto-conversion for land lines is already proven and is used by a number of Administrations.

As a general matter, proposals are made for revising Question No. 19 and Study Programme No. 27 with the object of replacing them by another Study Programme, and certain other matters are mentioned connected with the standardization of printing devices and keyboards which appear to be proper to the C.C.I.T.

4. Conclusions.

There is virtually complete agreement that regardless of the relative error liabilities of synchronous and start-stop systems, there will continue to be a need for both. There is also agreement that synchronous systems generally give rise to fewer errors than do start-stop systems operating at the same or somewhat lower baud speeds, and that the poorer performance of the latter systems is partly due to the transient loss of synchronism that may follow the mutilation of a start or a stop signal.

It appears that another major factor handicapping the start-stop system is its inherently smaller tolerance to distortion which may, in part, be caused by fading, interference and noise on the radio circuit. The effects of mutilations of start or stop signals can be reduced by providing particular safeguards, but this may affect the sending of special signals needed on certain radio/land-line circuits. It is, therefore, desirable for the C.C.I.T. to consider as a matter of some urgency whether it is necessary to add any other signals to those currently specified for Telex circuits. In parallel with, or after, C.C.I.T. consideration of this matter, it appears desirable for the C.C.I.R. to study further how the effects of start and stop signal mutilations introduced by radio circuits can be reduced, as part of a more general study of interconnection devices for use between two radio systems, and between a radio system and a land-line. No great interest is displayed in integration methods of reception, and it would seem unprofitable to pursue the matter further at present.

Considerable work is in progress on the use of various codes over radio circuits and the conversion of these codes into five-unit code for land-lines. This work has not yet reached the stage at which it would be wise to consider standardization, and should be continued.

To facilitate these studies it appears desirable for the C.C.I.T. to specify the minimum standards of performance necessary for various classes of telegraphic traffic, and to consider the formulation of a standard method of assessing and comparing the traffic performance of various error-detecting and error-correcting systems. In this connection the interim proposal made in the U.K. contribution (Doc. No. 72) may be useful.

5. Draft Recommendations.

5.1. The C.C.I.R.

CONSIDERING :

- (a) that the C.C.I.T. has recommended the use on international telegraph circuits, subject to certain reservations, of five-unit apparatus employing the International Alphabet No. 2 (C.C.I.T. 6th Plenary Assembly, Doc. No. 145);
- (b) that considerable use is being made of synchronous and start-stop telegraph systems on international radio circuits;
- (c) that the use of the five-unit code is susceptible to errors which are not easily detectable;

RECOMMENDS :

that in considering whether or not to adopt synchronous or start-stop systems using five-unit code on radio circuits, Administrations recognize that :

- 1. Synchronous systems generally give rise to fewer errors than do start-stop systems operating at the same or somewhat lower baud speeds, and that the poorer performance of the latter is partly due to the transient loss of synchronism that may follow the mutilation of a start or a stop signal.
- 2. Another major factor handicapping the start-stop system is its inherently smaller tolerance to distortion.
- 3. Notwithstanding factors (1) and (2) above, the quality of the radio transmission, and certain operational factors including the minimum accuracy necessary for the type of traffic being handled and the volume of such traffic largely determine whether synchronous or start-stop systems are preferable in any particular case.

5.2. THE C.C.I.R.

CONSIDERING :

the problems raised in Question 19;

RECOMMENDS :

that the C.C.I.T. be invited to study, as a matter of some urgency :

- 1. whether it is necessary to add any other signals to those currently specified for use on Telex circuits;
- 2. the maximum error rates than can be tolerated for various classes of telegraph traffic;
- 3. the formulation of a standard method of assessing the traffic performance of various error-detecting and error-correcting systems. In this connection the C.C.I.T. may wish to take note of the interim proposal made by the United Kingdom in Doc No. 72 of the VIIth Plenary Assembly of the C.C.I.R.

6. Draft Study Programme.

As part of Study Programme No. 27 appears to have been completed, in view of the manifest lack of interest in integration methods of reception, and because it appears premature to consider the international adoption of special codes for radio circuits, it is proposed that Study Programme No. 27 be cancelled and its place taken by the following Study Programme :

The C.C.I.R.

CONSIDERING :

- (a) the problems raised in Question No. 19;
- (b) that refinements in the start-stop system are possible which can provide additional reliability when the system is used on a radio circuit;
- (c) that information is needed on the techniques that facilitate the interconnection of radio and land-line circuits;

DECIDES THAT THE FOLLOWING STUDIES SHALL BE CARRIED OUT :

1. Various protective codes and associated equipments should be compared in respect of their performance on radio circuits.
2. The desirable features of telegraph equipments for connection between radio circuits, and between radio and land-line circuits, should be investigated. In this connection the desirability of reducing the effects of start and stop signal mutilations should be considered.

ANNEX VIII

SURVEY OF CONTRIBUTIONS TO STUDY PROGRAMME No. 28

*Wide-band radio systems operating in the VHF (metric) UHF (decimetric)
and SHF (centimetric) bands*

1. Introduction.

Study Programme No. 28 is divided into :

1. Questions for study by the C.C.I.F.
2. Questions for study by the C.C.I.R.
3. Questions for study by the C.C.I.F. with C.C.I.R. representatives.
4. Questions for study by the C.C.I.R. with C.C.I.F. representatives.

Contributions have been received from the Administrations of the United Kingdom (Doc. No. 88) and the United States of America (Doc. No. 58). Both contributions deal only with questions in categories 2 and 4.

2. Discussion of reports received.

In the following discussion of the reports received the sub-paragraph title numbering used will correspond to that used in the formulation of the Study Programme in Volume I of the Geneva Documents of the VIth Plenary Assembly.

(2.1.) *Transmission characteristics.*

Both contributions reaffirm the general principle laid down in Recommendation No. 40, that for radio-telephone systems operating at frequencies above 30 Mc/s, the objective should be to attain the transmission performance recommended by the C.C.I.F. The U.K. contribution discusses the dependence of the transmission characteristics upon the type of radio system and draws attention to the fact that whilst the transmission characteristics of radio systems with frequency-division multiplexing may be readily related to the relevant C.C.I.F. standards, it is too early yet to consider the formulation of transmission characteristics for time-division multiplexing systems, and these, in any case, cannot be directly related in detail to existing C.C.I.F. standards.

(2.2.) *Propagation.*

Both contributions emphasize the large number of factors that have to be taken into account in any propagation study and refer to papers by Bullington in which simplified data in nomogram form is summarized. The need for different approaches to system surveys in the metric, decimetric and centimetric ranges is stressed in the U.K. study, as also is the advisability of the use of the highest suitable operating frequency.

The U.K. proposes the formulation of a specific question, since existing propagation questions have been framed to provide answers which were not directly usable by point-to-point system designers, and since the overall signal-to-noise ratio performance of radio systems is directly dependent upon propagation characteristics. This draft question is included in Paragraph 3 of this Report.

(2.3.) *Considerations involved in choice of sites for radio stations.*

Both contributions emphasize the large amount of preliminary work that is necessary before laying out a radio system, the need for accurate topographical maps (or, failing that, the need for aerial survey), and the need for test transmissions in order to confirm the proposed choice of station locations and antenna heights. Such test transmissions are regarded as essential at present, though it is suggested that it should be a longer-term aim of the radio engineer to determine the correlation between radio-propagation characteristics and geographical and climatic conditions in order that future planning may become less dependent on the results of local propagation tests. The contributions point out that it is particularly important to pay careful attention to length of link-section, antenna-height, etc., on any section of a decimetric or centimetric link that traverses terrain known to be subject to weather conditions of extreme stability, or where ground reflections are to be expected. Examples of such terrain quoted are over-water paths, extensive salt flats or other overland paths where the intervening ground is relatively flat and unbroken.

(2.4.) *Modulation processes and methods of multiplexing.*

Both U.K. and U.S.A. contributions indicate that any of the known methods of modulation may be used at frequencies above 30 Mc/s. Whilst the U.K. contribution considers that for long-distance broad-band systems there are operational and technical advantages in using frequency-division multiplex, in order that blocks of channels in such systems may be connected directly to similar blocks in line-transmission systems, and that advantage may be taken of the peak-load-sharing advantage inherent in such systems, it is considered undesirable to make specific recommendations at this stage for standards of modulation, multiplexing or inter-connection at radio frequencies.

(2.5.) *Radio equipment (Transmitters, receivers, relays, aeriels and transmission lines)*

The U.K. contribution states that a study of systems in current use has revealed a very great variety of types of equipment, considerable differences existing even between systems of similar performance operating at similar frequencies. The U.S.A. reply states that equipment will, in general, be engineered by the manufacturers and users to be suitable for each particular case, and the concern of the C.C.I.R. should be confined to the overall results obtained.

(2.6.) *Methods of measurement on the radio system.*

The U.K. contribution suggests that when a radio system is connected to landlines its overall performance can be measured between the landline-terminal points as though it were part of that system, but indicates that special consideration may have to be given to those parameters whose values are directly dependent upon variations in radio propagation conditions. The U.S.A. contribution indicates that the measurement methods to be used will generally be specified by the manufacturer or engineer designing the system.

(4.1.) *Supervisory and monitoring facilities on radio systems.*

The U.K. contribution indicates that it may be necessary to adopt different procedures on radio systems, the terminal stations of which contain channel-modulating and translating equipment, and on radio systems which are closely integrated with cable systems, e.g. radio systems in which the final audio or carrier line-terminal equipment is at a distant line-terminal station and well removed from the radio-terminal station. The U.K. reply also draws attention to the fact that in certain circumstances the performance of radio systems might be degraded by a

requirement for supervisory or pilot signals of an associated cable system being transmitted over the radio system and vice versa. Additional requirements may be imposed upon a cable system were it to be required to transmit, in addition, supervisory signals from the radio system. Thus there may be advantages in separating the two supervisory system in such cases. The U.S.A. contribution states that the supervisory and monitoring facilities on radio-relay systems will generally be specified by the manufacturer furnishing the system.

(4.2.) *The percentage of time during which the required transmission characteristics can be expected to be met for telephone, broadcast programme, telegraph and television signals.*

Both U.K. and U.S.A. contributions agree that this portion of the Study Programme is of the long-term type, and answers can be gained only with experience. The U.K. reply emphasizes the need for gathering as much information as possible on the end-to-end performance of multi-link broad-band radio-relay systems and suggests that it would be helpful for the C.C.I.F. to provide information to the C.C.I.R. on the percentage of time during which specified transmission characteristics, in particular noise-level or signal-to-noise ratios are achieved in practice on existing cable systems for various types of signal.

3. Draft Questions and Recommendations.

3.1. General.

It is evident from both the contributions submitted that the work of this Study Programme is of a very long-term nature. Indeed it is for consideration whether or not it is practicable at the present stage of development of the types of system being considered to be specific about many of the subjects mentioned in the Study Programme. The process of engineering evolution does not appear to have gone far enough for judgments to be arrived at which may not be shown to be wrong at a later stage of development. The U.K. document formulates a number of specific questions in an endeavour to make more definite the work of the C.C.I.R. in this matter. A number of those questions appear premature at this stage, but some of the subject matter has been incorporated in three draft questions below, together with a draft recommendation on supervisory and monitoring facilities.

3.2. Draft Questions.

QUESTION No. 1

The C.C.I.R.

CONSIDERING :

that the noise permissible in a radio system may be expected to depend in some measure on the length of the system, and that it may, therefore, be desirable for design purposes to specify a "circuit fictif de référence" for radio systems analogous to that specified by the C.C.I.F. for coaxial systems,

RECOMMENDS :

that study be given to the use of a "circuit fictif de référence" for the design and specification of radio systems, the elements appropriate to such a circuit, and the sub-division of the noise power appropriate to the complete circuit between the various elements.

QUESTION No. 2

The C.C.I.R.

CONSIDERING :

- (a) that the C.C.I.F. is interested in the definition of the overall system performance achieved for given percentages of time;
- (b) that designers of radio links in the VHF, UHF and SHF ranges require to know, from the point of view of sustained satisfactory operation, the tropospheric field strength that is exceeded for a high percentage of time over comparatively short distances approximating to optical path lengths;

- (c) that the planning of multi-repeated links requires the knowledge of the time-distribution curves of such propagation characteristics;
- (d) that from the point of view of overreach interference it is necessary to know the value of received field likely to be exceeded for a small percentage of time, at distances of approximately three times optical;

DECIDES THAT THE FOLLOWING QUESTIONS BE STUDIED :

1. What is the distribution with time of the values of path attenuation over approximately-optical paths in the UHF and SHF ranges, and particularly the values likely to be exceeded for 50 %, 1 % and 0.1 % of the time ?
2. What is the distribution with time of the values of path attenuation over optical and quasi-optical paths in the VHF range, and particularly the values likely to be exceeded for 50 %, 1 % and 0.1 % of the time ?
3. What is the value of path attenuation likely to be exceeded for 90 % and 99 % of the time at distances of approximately three or more times optical ?

Notes :

(a) The data accumulated in preparing Recommendation No. 55 C.C.I.R. (Geneva, 1951, Vol. I, p. 53) may provide some information on section 3 and possibly on sections 1 and 2 of this question. Since, however, the use of directional aerials and "staggered" paths can often avoid interference due to overreach, sections 1 and 2 are regarded as more urgent than section 3.

(b) It is recognized that it may be valuable to obtain data on the variation with time of the values of the earth's effective radius when providing answers to sections 1 and 2.

QUESTION NO. 3

The C.C.I.R.

CONSIDERING :

that it is the aim of the C.C.I.R. to make the operation of broad-band radio-relay systems similar to high-frequency cable systems,

DECIDES THAT THE FOLLOWING QUESTION SHALL BE STUDIED :

What are the quantities that it is essential to measure in order to maintain the overall performance of a radio link used in national or international networks, bearing in mind accepted line practice ?

3.3. *Draft Recommendation.*

RECOMMENDATION NO. 1

The C.C.I.R.

CONSIDERING :

- (a) That it is normal practice to divide high-frequency cable systems for maintenance, supervision and monitoring purposes into line-regulated sections;
- (b) That such sections are often about 100 miles long;
- (c) That at the end of such sections, in stations called subcontrol stations, supervisory, control and pilot signals are extracted and reinserted;

RECOMMENDS :

that the junctions between broad-band line and radio systems be made sub-control points (i.e., the junction of two regulated sections), except perhaps in those cases where the radio or line sections are extremely short.

4. Information required from C.C.I.F.

The further work of the C.C.I.R. on broad-band radio systems will be assisted if the following questions could be answered by the C.C.I.F.

I. CONSIDERING :

- (a) that in multi-channel systems for cable or radio transmission interference due to harmonics and intermodulation is an important limitation;
- (b) that mathematical studies of various aspects of this interference have been published;
- (c) that data on the distribution of signal amplitudes is an essential basis for such studies;
- (d) that studies of such data have been published in various countries;

THE FOLLOWING QUESTION SHOULD BE STUDIED :

Is it practicable to specify for design purposes a statistical distribution with time of the instantaneous signal amplitudes on individual channels, which can be regarded for practical purposes as representative of normal operating conditions at a point of zero relative level ?

II. CONSIDERING :

that it would be of long-term assistance to the C.C.I.R. for the C.C.I.F. to provide certain information on the performance of existing cable systems,

THE FOLLOWING QUESTIONS SHOULD BE STUDIED :

1. For what percentage of the time are the specified transmission characteristics achieved in existing cable systems ?
2. To what extent are these characteristics affected by the transmission of either multi-channel V.F.-telegraph traffic or V.F.-signalling tones over these cable systems ?

REPORT BY THE CHAIRMAN OF STUDY GROUP No. X*

(Broadcasting)

(Original language : English)

HISTORICAL BACKGROUND

As a result of the Vth Plenary Assembly of the C.C.I.R., (Stockholm, 1948), two questions were assigned to Study Group No. X; No. 23 relating to high-frequency broadcasting directive antenna systems; and No. 24 relating to single-sideband sound broadcasting in the LF, MF, and HF bands. During the Mexico City High Frequency Broadcasting Conference, the Technical Committee requested that Study Group No. X undertake the study of two additional questions; No. 37—High-frequency broadcasting; justification for use of more than one frequency per programme, and No. 39—High-frequency broadcasting : conditions for satisfactory reception. Also, during the Mexico City High Frequency Broadcasting Conference, the matter of establishing an exchange of recorded programmes on an international basis as a means of conserving spectrum space gained approval. Consequently, the C.C.I.R. Secretariat, acting in accordance with the Atlantic City Convention, circulated proposals. Following adoption by the stipulated number of administrations, Question No. 42 was assigned to Study Group No. X in the matter of standards for sound recording.

From March 13 to 24, 1950, Study Group No. X held a meeting in Washington. During this meeting, responses were prepared on all but Question No. 37, (see Vol. II, Documents of the VIth Plenary Assembly).

As a result of deliberations at the VIth Plenary Assembly, Study Group No. X responded to all five questions. The following table identifies these responses and lists their source (see Vol. I, Documents of the VIth Plenary Assembly) :

<i>Geneva 1951 Question</i>	<i>Previous Reference</i>	<i>Geneva 1951 Response</i>
Question No. 23	Stockholm Question No. 23	Recommendation No. 80
Question No. 37	Mexico City Document No. 635	Report No. 13 Study Programme No. 30
Question No. 39	Mexico City Document No. 635	Report No. 14
Question No. 62	Stockholm Question No. 24	Report No. 12
Question No. 63	Question No. 42 Chapter XVII, Art. 46, Para. 2, Radio Radio Regulations ITC	Recommendation No. 81 Study Programme No. 31 Resolution No. 4

From August 26 to September 4, 1952, Study Group No. X convened in Geneva. On September 17, 1952, the Director of the C.C.I.R. transmitted to all Study Group No. X participants the complete documentation of this meeting, by letter bearing the reference number M/18. All of the 27 documents are not appended to this report, but by virtue of the above mentioned distribution by the Director of the C.C.I.R. are considered a part of this report.

* Doc. No. 110, London.

STATUS OF THE WORK OF STUDY GROUP NO. X AS A RESULT OF
THE GENEVA 1952 MEETING

(Refer to Volume I, Documents of the VIth Plenary Assembly for complete
text of Questions, Study Programmes, etc.)

Question No. 23. — *High frequency broadcasting. Directive antenna systems.*

Recommendation No. 80 recommends that for the purposes of calculating interference, the field strength in directions other than the main lobe cannot be assumed to be less than 222 millivolts per meter/1 kW at one kilometer. It was the consensus of opinion of the Study Group that more practical experience and more theoretical information on the side lobe reduction is necessary, especially when consideration is given to a slew of the main beam. As a result, three suggestions for further study were made as listed in the attached copy of Doc. No. 20.

Question No. 37. — *High frequency broadcasting. Justification for use of more than one frequency per programme.*

Study Programme No. 30. — *The reception of high frequency broadcasting with synchronized transmitters.*

Report No. 13, entitled "The minimum number of frequencies necessary for the transmission of a high frequency broadcasting programme", stated the opinion that technical conditions do exist which would justify the use of more than one frequency to assure the continuous reception of one programme in the area to which the programme is directed, at certain times, and over certain paths. The report also stated that the use of directional antennae is essential in most cases to ensure a satisfactory signal-to-noise ratio, and further that this limits the geographical area covered by each transmitter. It also suggested that by synchronizing transmitters, the number of frequencies in the same band may be reduced to not more than two, and at the present time there is insufficient evidence to determine whether one frequency only would give satisfactory reception. As a direct result of this consideration, Study Programme No. 30 was proposed and adopted. In conclusion, the report states that the angle subtended by the reception area at the transmitter, its mean distance from the transmitter, and its depth differed for each case and thus limited the value of adopting defined geometric reception areas. Geneva 1952 Study Group No. X, Doc. No. 4, submitted a draft recommendation as to a means of ascertaining when more than one frequency might be required. The Study Group recommended that Doc. No. 4 be carefully studied by the administrations, so that definite conclusions may be reached at the VIIth Plenary Assembly. Report No. 13 appears in Volume I of the C.C.I.R. Documents of the VIth Plenary Assembly. Study Group No. X, Geneva 1952, Doc. Nos. 4 and 18 are attached herewith.

Question No. 39. — *High frequency broadcasting — Conditions for satisfactory reception.*

Report No. 14 (VIth Plenary Assembly) set forth, for purposes of information, a table showing the fading safety factors which are necessary to assure a specified signal-to-interference ratio for particular percentages of time, with reference to Washington (1950) Doc. Nos. 43 and 66, and VIth Plenary Assembly Doc. Nos. 160, 178 and 215. This table was derived from theoretical considerations and experience derived principally from medium wave broadcasting, upon which the committee cast some doubt as to the practicability of achieving in practice. In the course of the Geneva 1952 Study Group No. X meeting, Doc. No. 5 was submitted. This document aimed at encouraging investigation, by subjective methods, of the separate factors that go to make up a satisfactory standard of reception, and of the possibility of obtaining a statistical method of combining them into an overall index of "quality of reception". In view of the lack of sufficient time for study, the group recommended in Doc. No. 23 (attached)* that Doc. No. 5 be attached to this report and taken up again for consideration at the VIIth Plenary Assembly. Doc. No. 5 is therefore attached**.

Question No. 62. — *Single sideband sound broadcasting.*

The VIth Plenary Assembly, as a result of Stockholm Question No. 24, issued Report No. 12. This report in effect gave many answers to Stockholm Question No. 24, but did not conclude the work felt to be required in all respects. The Question was therefore continued in a modified form,

* See Annex I.

** See Appendix to Annex I.

bearing the number 62. No contributions were received at the Study Group No. X Geneva 1952 meeting, however the Study Group did approve the attached comments in Doc. No. 19.

Question No. 62, as set forth, contains two parts. Since Doc. No. 19 suggests a negative reply to part 1, and states concerning part 2 that the relative advantage of single sideband (SSB) and asymmetrical sideband (ASB) do not appear to be very great over a reduced spacing with double sideband (DSB), it is the chairman's opinion that consideration should be given to the acceptance of this report, unless the tests being carried out by the United Kingdom indicate otherwise, and that the Question be either terminated or revised.

Question No. 63. — *Standards of sound recording for the international exchange of programmes.*

Study Programme No. 31. — *Standards of sound recording for the international exchange of programmes.*

Resolution No. 4. — *Standards of sound recording for the international exchange of programmes.*

As a result of deliberations at the VIth Plenary Assembly, Recommendation No. 81, Study Programme No. 31, Resolution No. 4, and the continuance of a Question on standards for sound recording were approved. Question No. 42 was terminated after consideration at the Washington (1950) meeting of Study Group No. X and the Plenary Assembly.

Question No. 63 was not considered at the Geneva 1952 meeting of Study Group No. X. Study Programme No. 31 did not receive substantive attention at the Geneva 1952 meeting, but was amended (see Doc. No. 21 attached) to include additional subjects suggested by the United States of America in Doc. No. 9 and France in Doc. No. 1. Associated with Doc. No. 21 will be found Document No. 7 submitted by the German Federal Republic, Doc. No. 9 submitted by the United States of America and Doc. No. 1 submitted by France.

Resolution No. 4 (see Volume I, Documents of the VIth Plenary Assembly), which is associated directly with paragraph 4 of Recommendation No. 81 was adopted by the VIth Plenary Assembly with the hope that a postal exchange of comments would yield an agreement which would then later be submitted in writing to members for approval.

The postal exchange of comments from ten administrations relating to resolution No. 4 were first summarized in the chairman's memorandum of November 6, 1951 to members of Study Group No. X. These ten sets of comments were forwarded to members by the Vice-director of C.C.I.R. on October 26, 1951 by letter bearing file number G.10/68.

The Chairman had requested that comments and counter-comments be in his hands by December 31, 1951, but by memo dated December 18, 1951 suggested the date be extended to February 29, 1952.

In view of the fact that the postal exchange of comments did not yield as complete agreement as was felt to be desirable on Resolution No. 4, the chairman negotiated with the C.C.I.R. regarding a meeting of the Study Group for consideration of the Resolution as well as other questions assigned to Study Group No. X. Thus, the meeting was called for the period August 26 through September 5, 1952, and appropriate announcements were forwarded by the Director of C.C.I.R. to all participants in the work of C.C.I.R. Study Group No. X, on July 26, 1952.

As a result of the deliberations during this meeting, Doc. No. 24 attached, set forth a draft recommendation defining recording characteristics for both magnetic tape and discs, as well as a "Method of measuring the magnetization of a tape". This document was transmitted to all members of the C.C.I.R. on September 12, 1952, by the Director of C.C.I.R. (Reference M.15), with a request by the chairman that the vote be concluded if possible by January 1, 1953. As of January 16, 1953, responses had been received by the Director of C.C.I.R. from some 21 administrations, three of which requested further delay until March 1, 1953.

The standard proposed with respect to disc recording was specifically approved by 19 of the 21 administrations. Sixteen administrations approved the standard proposed for magnetic tape.

The chairman has advised the Director of C.C.I.R. that insofar as that part of Doc. No. 24 (paragraph (a) under "RECOMMENDS") relates to disc recording, it may be considered to be adopted in accordance with the original procedure outlined in Resolution No. 4 of the VIth Plenary Assembly. The 19 administrations indicating their approval were as follows :

Australia	France	Netherlands	Sweden
Belgium	Greece	New Zealand	Switzerland
Cambodia	India	Norway	Turkey
Ceylon	Luxembourg	South Africa	United States
Denmark	Monaco	Southern Rhodesia	of America

This agreement is issued as Recommendation No. 86.

The above comments relating to Doc. No. 24 must be qualified in the following respects. India, while accepting the disc recording standard, drew attention to certain points which may, in their opinion, give rise to doubts as to its exact interpretation. The United Kingdom and German Federal Republic did not specifically state approval of the disc standard in their comments on Doc. No. 24, and may wish to comment at a later date.

This, in effect, disposes of that portion of Resolution No. 4 relating to disc recording.

Concerning that portion of Resolution No. 4 relating to a magnetic tape standard, 16 administrations indicated full agreement of the proposal set forth in Doc. No. 24 of Geneva, 1952. These were :

Australia	Denmark	Netherlands	Southern Rhodesia
Belgium	Greece	New Zealand	Sweden
Cambodia	Luxembourg	Norway	Switzerland
Ceylon	Monaco	South Africa	Turkey

Three administrations, namely, those of the German Federal Republic, the United Kingdom and the United States of America, requested additional time in which to consider their positions. At the date of this writing, two of the above position papers have been received, the United States position has not yet been received.

The delays encountered in reporting on matters relating to magnetic tape have served, in the chairman's opinion, a very useful purpose in that a degree of understanding has been reached not only internationally, but domestically within some of the countries interested in the work, which might otherwise not have been reached. Since there appears to be some possibility of a relatively high order of agreement internationally, which will actually be applied and used domestically by many countries, the chairman feels there is justification in permitting one additional exchange of comments on the matter of frequency characteristics for magnetic tape. Since it is now (April, 1953) approximately five months before the VIIth Plenary Assembly, it seems inappropriate to suggest that the results of another exchange of comments yield the finalized work on this subject. The Chairman therefore has suggested that the work on this phase of Resolution No. 4 be finalized during the meetings of the VIIth Plenary Assembly.

Extraordinary Radio Administrative Conference (Study Programme No. 30 and Question No. 62)

Recommendation No. 14 of the E.A.R.C. invited the various administrations to give special priority to several of the C.C.I.R. questions and study programmes. Study Programme No. 30 and Question No. 62, assigned to Study Group No. X, were among those listed. As of April 1953, the United States of America and France had submitted responses on Study Programme No. 30 which were considered at the Geneva 1952 meeting of Study Group No. X, resulting in Doc. No. 22 which stated that it appeared likely that two or more synchronized transmitters, operating under the conditions of the examples cited, could be successfully synchronized on the same frequency for the transmission of the same programme. The Study Group, however, seeks additional experimental and operational data to confirm this theory, before making final conclusions.

The status of Question No. 62 is amply covered earlier in this report.

C.C.I.F. Questions Nos. 14 and 15.

The Director of the C.C.I.F. requested consideration of portions of C.C.I.F. Questions Nos. 14 and 15 by C.C.I.R. Study Group No. X. In response to an announcement forwarded on August 29, 1952, by the chairman, six administrations forwarded comments. They were :

Australia	Netherlands	South Africa
France	New Zealand	Switzerland.

In each instance, the chairman requested distribution of these comments to Study Group No. X.

These questions will be placed on the agenda of Study Group No. X for the VIIth Plenary Assembly for the compilation of a summarizing report to the C.C.I.F.

VIIth Plenary Assembly.

In view of the Geneva 1952 meeting of Study Group No. X, those documents approved and relating to the various questions and study programmes will be presented to the group for consideration. In addition, those documents received subsequent to the Geneva 1952 meeting, and prior to the VIIth Plenary Assembly, will also be considered. Following is a listing of documents and comments relating to each subject :

	Geneva 1952 documents	Others received subsequent To Geneva 1952 meeting
Question No. 23	No. 20	United Kingdom (Doc. 165) United States of America (Doc. 186)
Question No. 37	No. 4 No. 18	Canada France United Kingdom (Doc. 169) United States of America (Doc. 188)
Question No. 39	No. 5 No. 23	Canada New Zealand (Doc. 63) United States of America (Doc. 185)
Question No. 62	No. 19	None
Question No. 63	None	France New Zealand (Docs. 61, 62) United Kingdom (Doc. 192)
Study Programme No. 30	No. 4 No. 22	Canada United States of America (Doc. 184)
Study Programme No. 31	No. 1 No. 7 No. 9 No. 21	United States of America (Doc. 187)
Resolution No. 4	No. 2 No. 10 No. 11 No. 12 No. 13 No. 24	See previous comments in this report

Resolution No. 3. — *Publication of antenna charts.*

A review of the publication prepared and offered for distribution by the General Secretariat will be made at the VIIth Plenary Assembly.

Resolution No. 5. — *Means of expression.*

An attempt was made during the Geneva 1952 meeting to prepare an appropriate listing of those definitions and symbols useful to Study Group No. X* for Study Group No. XIV. Unfortunately, time did not permit the group to give this matter the required attention. However, the German Federal Republic and France have each contributed a list of technical terms, symbols and definitions relating to the field of work of Study Group No. X. This matter will be placed on the agenda of Study Group No. X for the VIIth Plenary Assembly.

April 7, 1953.

NEAL McNAUGHTEN,
Chairman Study Group No. X.

* List of Geneva 1952 Study Group No. X Documents to be associated with this Report : Nos. 4, 5, 18, 19, 20, 21, 23, 24.

ANNEX I TO THE REPORT BY THE CHAIRMAN OF STUDY GROUP No. X *

HIGH FREQUENCY BROADCASTING : CONDITIONS FOR SATISFACTORY RECEPTION

Only one document (No. 5) on this question was available for study in the meeting. Submitted by the United States of America, it aimed at encouraging the investigation, by subjective methods, of the separate factors that go to make up a satisfactory standard of reception, and of the possibility of obtaining a statistical method of combining them into an overall index of " quality of reception ".

The factors listed in the document include those usually taken into account by the normal signal-to-noise and signal-to-interference ratios and in addition those that relate to distortion produced by various propagation conditions.

The document suggests that much engineering effort, based solely on an improvement of signal-to-noise or signal-to-interference conditions, is wasted because insufficient account is taken of certain distortion factors which are usually met with in practice. The use of the proposed overall index of " quality of reception ", if it could be obtained, instead of the use of only signal-to-noise figures would give a better estimate of reception conditions.

The Study Group considered that the document needed much more careful and detailed study than could be given to it at the present meeting and therefore recommends that it be attached to the report and taken up again as one of the documents on this question, for consideration by the VIIIth Plenary Assembly of the C.C.I.R. in 1953.

APPENDIX ** TO ANNEX I UNITED STATES OF AMERICA (Original language : English)

PROPOSED STUDY PROGRAMME

High-frequency broadcasting : Conditions for satisfactory reception

Considerations related to this study programme are given in the annex.

The C.C.I.R.,

CONSIDERING :

- (a) That the reception of a high-frequency broadcast can be considered as being satisfactory if the transmission meets the following requirements :
 - A. The atmospheric noise as measured in the I.F. is (X1) db below the carrier.***
 - B. Interference (man-made noise) as measured in the I.F. is (X2) db below the carrier.
 - C. Interfering stations as measured in the I.F. are (X3) db below the carrier.

* Doc. No. 23, Meeting of C.C.I.R. Study Group No. X, Geneva, 1952.

** Doc. No. 5 (rev.), Meeting of C.C.I.R. Study Group No. X, Geneva, 1952, annexed to Doc. No. 23 of this meeting.

*** Receiver noise is assumed to be negligible.

- D. The relative attenuation over the necessary frequency band is within (X4) db. (This requirement will vary depending upon the shape of the attenuation-frequency curve, the percent modulation, and the proximity of any nulls to the carrier.)
- E. Rapid fades of more than (X5) db shall not occur at a rate in excess of (R) cycles per second.
- F. The relative envelope delay shall not exceed (T1) milliseconds for any component which is greater than (P1) percent of the total received field.
- (b) That some of the above factors have been obtained at various times with varying degrees of precision.
- (c) That it is desirable to establish an overall index of quality of the received signal.

DECIDES THAT THE FOLLOWING STUDIES SHOULD BE CARRIED OUT :

1. That the factors listed under (a) above, and their statistical distributions be determined subjectively.
2. That the values which are already available be reviewed to determine their applicability in the light of the practical standards of performance suggested in the annex.
3. That the effect of the percentage modulation on the quality of reception be determined by an appropriate experiment such as is outlined in the annex.
4. That a suitable statistical method of combining the factors, listed under (a) above, be developed in order to provide an overall index of quality of the received signal.

ANNEX *

The requirements which have to be met in order that a high-frequency broadcast can be considered satisfactory are given under (a) above. Each of these requirements can be determined subjectively, although a fairly wide range of values may result, depending upon the listener's interpretation of satisfactory reception. The just-noticeable level for the various types of distortion is much more readily obtained; however, since these values will result in unrealistic equipment requirements, one must use a level which is satisfactory to some arbitrary percentage such as 80 per cent of the listeners.

Values for (X1), (X2) and (X3) have been obtained at various times with varying degrees of precision. The values of (X1) and (X2) range from 30 to 50 db and a value of 28 db for (X3) has been suggested ¹.

Since the system and the receiving equipment are fixed, items D, E, and F are fixed for a given path at a given time. One possible exception to this is item D which can be varied somewhat by lowering the percentage of modulation. The second harmonic produced by a carrier fade will be approximately linear with relative carrier attenuation after the 100 per cent modulation point is reached; however, the effect of the distortion produced will be a function of the type of programme material being transmitted.

* Annex to Doc. No. 5 (rev.), Study Group No. X, Geneva, 1952.

The effect of carrier fading can be determined for various types of programme material with the aid of a sharp attenuation filter in the centre of a receiver I.F. Once this is obtained subjectively a very extensive statistical study will be required to find the likelihood of this selective fading. Potter² indicates that the worst selective fading occurs when the general signal level is fairly high. However, this might have been a peculiarity of the single circuit he studied. It seems evident that a reliable study on an overall statistical basis would be required for this analysis and that it will be a major undertaking.

Once the likely fading conditions are obtained, they could be used with the subjective results of harmonic distortion to find the improvement obtained with lowered modulation index. This improvement must now be balanced against the effect of increasing noise. Since the effects are not linear with original signal-to-noise ratio, individual cases would have to be worked out; however, it is possible that some rough figure such as 80 per cent maximum modulation could be reached.

A somewhat simpler solution might be obtained by considering the fixed parameters (D, E and F), each of which will have its own statistical limits of percentage of satisfactory reception. It is very probable that these fixed parameters will in themselves present a time limit of satisfactory service which is less than that which was being sought on a purely signal-to-noise or signal-to-interference basis. If this is true, it is very poor engineering to require the excess signal which will gain only a very small percentage increase in time of satisfactory service rather than the large percentage improvement anticipated on the simple assumption of noise only.

One way of considering the situation would be to start with the quality of reception which can be provided in a noise-free circuit for 90 per cent of the time and design the system for this lowered but practical standard of performance.

Operational transmission by means of existing high-powered stations over various transmission paths when noise is low may provide the simplest means of determining the first design point which would permit the signal-to-noise figures to be revised. The present allowances for fading might not need revision unless it can be definitely shown that the selective fading occurs during the null*, in which case the allowance could be reduced somewhat. Presently available data do not indicate this to be true, and it is expected that a lowering of standards to more nearly that which can be obtained due to multipath phenomena would be the most desirable approach.

If the cooperation of several transmitting stations could be obtained for these tests, it would be desirable to have the percentage of modulation varied, such as 70, 80 and 90 per cent maximum negative modulation, and obtain the statistical distribution of quality for each of these three conditions. Once these were obtained, using of course more than one geographic path, it would provide a basis for determining the probable gain in quality which might be expected by a lowered percentage of modulation. The anticipated overall effect of lowering the percentage of modulation is an improvement in quality in areas with good signal-to-noise ratio and a reduction in time of satisfactory service where the signal-to-noise ratio is poor. Apparently the desirability of reducing the percentage of modulation will depend upon available transmitter power and the signal-to-noise ratio existing in the most desired areas of reception.

Considerable care must be exercised in combining the statistical distributions for the various distorting factors. For several partial distributions of quality such as those for the case of the fixed distortions and the distortions due to noise, it is apparent that the combined distribution will be lower in quality than either of the individual distributions.

When the desired and interfering signals, each of which is fading, are considered, a different type of distributions combination is required. Considerable work has been done on combined distributions^{3, 4, 5, 6}.

References :

1. Report of Technical Committee, 30th Meeting, Document No. 475 E, International High Frequency Broadcasting Conference, Mexico City, 1948-49.
2. R.K. Potter, "Transmission characteristics of a short-wave telephone circuit", Proc. I.R.E. 1930, pp. 581-648.

* A null in this case means a general lowering of the amplitude of all the frequency components, not just that of the carrier.

3. K.A. Norton, M. Schulkin, R. Kirby, "Ground-wave propagation over irregular terrain at frequencies above 50 Mc", National Bureau of Standards, June 1949.
 4. K.A. Norton, H. Staras, M. Blum, "A statistical approach to the problem of multiple radio interference to F.M. and television service", Transactions of the I.R.E. Professional Group on antennae and propagation, Feb. 1952, pp. 43-49.
 5. Harry Fine, "Combination of several interfering signals in the VHF range". F.C.C. TID Report No. 4.2.3. August 1949.
 6. Harry Fine, "The normal distribution as applied to VHF broadcast service problems". F.C.C. TID Report No. 4.2.2. May 1949.
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REPORT BY THE CHAIRMAN OF STUDY GROUP No. XI*

(Television, including Questions relating to single sideband)

(Original language : English)

The VIth Plenary Assembly of the C.C.I.R. (Geneva 1951) referred to Study Group No. XI the following items :

- Question No. 64 Television standards (former Recommendation No. 29).
- Question No. 65 Assessment 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. 32 The requirements for the transmission over long distances.
- Study Programme No. 33 Television field frequency.
- Study Programme No. 34 Picture and sound modulation.
- Study Programme No. 35 Reduction of the 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.
- Report No. 15 Television systems.

Group meetings.

The Study Group met in Stockholm 20-27 May, 1952, for discussion of contributions sent in from different members.

The following contributions were sent in for this meeting :

	Country	Stockholm documents	1952
Question No. 65	United Kingdom	No. 37	May 21
Question No. 67	United Kingdom	No. 2 No. 29	April 28 May 17
Study Programme No. 32 . .	United Kingdom	No. 13 No. 39	May 9 May 21
Study Programme No. 35 . .	Netherlands United Kingdom	No. 4 No. 38	April 30 May 21
Report No. 15	United Kingdom	No. 42	May 23

* Doc. No. 111, London.

The Study Group had seven sessions. Whilst all the items referred to Study Group No. XI were considered at these sessions, special attention was given to Question No. 64 and Question No. 67, these items being of immediate concern for the European Broadcasting Conference held in Stockholm, May-June, 1952.

Concerning Question No. 64 the work was mainly confined to discussions about the ratio of vision to sound carrier powers. It was decided that statements concerning the power ratio were to be added as item (22) in the list of details of four television systems published in the Annex to Report No. 15. A working group under the chairmanship of Dr. Gerber (Switzerland) was set up to work out item No. 22.

Item No. 22 of the details of four television systems was then adapted to read :

Item	Description of item	Systems			
		405	525	625	819
22	Ratio of vision to sound effective radiated power	4 : 1	2 : 1 to 2 : 3	5 : 1	4 : 1

The greatest part of the time of the meeting was devoted to Question No. 67. A working group under the chairmanship of Mr. Hansen (Belgium) was set up to study this question. Its report is attached hereto as Annex, indicating desirable *protection ratios*—for vision and sound signals—of the 405, 625 and 819 line systems.

Contribution to the European Broadcasting Conference.

The chairman of Study Group No. XI submitted a report to the European Broadcasting Conference, summarizing the conclusions reached—with reservations made by the Bielorussian S.S.R., Czechoslovakia and the U.S.S.R.—by the participants in the work of the Study Group on Question No. 64 and Question No. 67.

Contributions submitted after the Stockholm meeting.

After the Stockholm meeting the following contributions were received *:

Question No. 65 :

Australia

Doc. No. 189 A recommended specification of the resolution of television picture signal generators.

Japan

Doc. No. 278 Report on assessment of the quality of television pictures.

United Kingdom

Doc. No. 171 Colour acuity

Doc. No. 172 Colour acuity : further work.

Doc. No. 173 A note on the definition of visual acuity.

(These contributions also refer to Question No. 68).

Question No. 67 :

United States of America

Doc. No. 64 Ratio of the wanted to the unwanted signal in television.

* The document numbers are those of the VIIth Plenary Assembly (London, 1953).

Question No. 68 :

Japan

Doc. No. 279 Report on resolving power and differential sensitivity of the human eye.

United Kingdom

Doc. No. 171 Colour acuity.

Doc. No. 172 Colour acuity : further work.

Doc. No. 173 A note on the definition of visual acuity.

(These contributions also refer to Question No. 65).

Study Programme No. 32 : *United States of America*

Doc. No. 163 Requirements for the transmission of television over long distances.

Study Programme No. 35 : *United States of America*

Doc. No. 66 Final report of ad hoc Committee of NTSC on dot-interlace or dot-arresting for black and white television.

Study Programme No. 37 : *United States of America*

Doc. No. 67 Revised specifications for field test of NTSC compatible color television.

Doc. No. 68 Narrow-band transmission of the NTSC color signal.

Doc. No. 69 Colorimetry in color television.

Doc. No. 70 Color-carrier reference phase synchronization accuracy in NTSC color television.

New Question :

United Kingdom

Doc. No. 86 Polarization advantage in the planning of television and VHF sound broadcasting services.

Recommendation No. 83 : *United States of America*

Doc. No. 65 Disturbances in television receivers resulting from harmonics and other non-essential radiations from radio transmitters.

(This contribution also refers to S.P. No. 2, relating to Question No. 1b—Study Group No. 1.)

Co-operation with C.C.I.F.

At the suggestion of the Director of the C.C.I.R., the Chairman attended the meeting of the 3rd Study Group of the C.C.I.F. at Florence, being held from the 8th to 13th October, 1951. At this meeting questions dealing with television were discussed.

At the invitation of the Institution of Electrical Engineers the Chairman attended the Convention on "The British contribution to television" from April 28th to May 3rd, 1952, held in London.

Conclusion.

During the last two years since the VIth C.C.I.R. Plenary Assembly in Geneva, many countries have earnestly started planning the introduction of television, which, especially in Europe, has caused a great demand for television channels. In order to make the planning of television stations easier, the work of Study Group No. XI has been concentrated to the study of Question No. 67, "Ratio of the wanted to the unwanted signal in television." The results received by the Study Group must be considered to be of great value, even if they can not be supposed to be definite. The contribution from Study Group No. XI to the European Broadcasting Conference in Stockholm 1952 proved to be very valuable and contributed to a great extent to the good results of the conference.

Stockholm, 28 June, 1953.

E. ESPING

Chairman, Study Group No. XI

ANNEX I

TO THE REPORT OF THE CHAIRMAN OF STUDY GROUP No. XI

REPORT OF SUB-GROUP XI-B *

The Sub-Group set up by Study Group No. XI consisted of :

Mr. G. HANSEN (Belgium), Chairman	
Mr. E. W. ALLEN (U.S.A.)	
Mr. F. DUCHATEAU (Belgium)	
Mr. A. B. HOWE (B.B.C.)	
Prof. F. KIRSCHSTEIN (German Federal Republic)	
Mr. C. W. SOWTON (United Kingdom)	
Dr. Ch. T. F. VAN DER WIJCK	} (Netherlands)
Mr. F. MAARLEVELD	
Mr. H. RINIA	

Terms of reference : QUESTION No. 67.

The Sub-Group has considered the case of 2nd grade service only. The field strengths to be protected for this service in bands 1 and 3 have not been precisely defined.

The protection ratios given in this report are considered acceptable for a short period of the time, which has not been precisely defined, but has been assumed to be between 1 % and 10 % of the time.

The protection ratios refer to a viewing distance of 4 times the picture height.

The protection ratios refer to just tolerable interference : protection ratios for just perceptible interference would be 6 to 10 db higher.

When utilizing the protection ratios, suitable allowance will have to be made for the fading by adding to these ratios the root-mean-square of the fading of the wanted and unwanted signal. This can be done by using the 1 % or 10 % curve, when the fading of the wanted signal is small compared to the fading of the unwanted.

No account has been taken of the possible effect of using directional receiving antennae or of the advantage which might be gained by using different polarizations for the transmission of the desired and undesired signals. The protection ratios quoted refer in all cases to the signals at the input of the receiver.

References :

- Documents 2 and 29 submitted by the United Kingdom;
- Proceedings of the J.T.A.C., Volume IV, 26 Sept. 1949;
- Tests made in Belgium;
- Tests made in the German Federal Republic;
- Tests made in the Netherlands.

* Doc. No. 48 of the meeting of C.C.I.R. Study Groups Nos. V, VI and XI, Stockholm, 1952.

1. *Co-channel interference—Protection ratio for the picture-signal when the desired and undesired signals have the same line frequency.*

- 1.a *Carriers separated less than 100 c/s but not synchronized.*

Just tolerable interference : 45 db.

Note : The difference between the above figure and the 35 db figure quoted in Doc. 2, page 2, 1a, is attributed to the fact that some of the receivers used for the experiment attenuate the DC component and the low frequencies, and therefore attenuate the beat note between the carriers.

- 1.b *Carriers separated by $2/3$ of the line frequency.*

Just tolerable interference : 30 db.

- 1.c *Carriers separated by $1/2$ of the line frequency.*

Just tolerable interference : 27 db.

2. *Co-channel interference—Protection ratio for the picture-signal when the desired and undesired signals have different line-frequencies.*

- 2.a *Carriers separated less than 100 c/s but not synchronized.*

Just tolerable interference : 45 db.

- 2.b and 2.c *Carriers separated by $1/2$ or $2/3$ of the line-frequency of the desired signal.*

As in case 1.b and 1.c., the offset brings an improvement in the protection of the picture-signal; this improvement is, however, reduced, due to the fact that the line-frequency of the undesired signal is different from the line-frequency of the desired signal; the amount of the reduction depends on the relation between the line-frequencies.

More tests are needed before figures can be given for the protection ratios in this case.

3. *Adjacent channel interference.*

The worst interference on the picture-signal results from the sound in the adjacent channel; the figures given below relate to the case when the separation between the video carrier and the adjacent-channel sound carrier is 1.5 Mc/s.

- 3.a *FM-modulated sound carrier.*

Just tolerable interference : -6 db.

- 3.b *AM-modulated sound carrier.*

Just tolerable interference : 0 db.

Fairly conservative values have been chosen, to take account of the divergence in performance between different types of television receivers. It is realized, however, that future developments in receiver design will probably enable somewhat higher interfering signals to be tolerated in all cases.

4. *Overlapping channel interference.*

In the attached drawing curves are given for the protection ratio required when a television signal, using 819 lines, 625 lines or 405 lines is interfered with by a vision signal of any of the systems or by a frequency-modulated sound signal. The curves cover the case when the carrier of the interfering signal lies within the vision channel of the wanted transmission. If the interfering signal is an AM sound signal, 5 db should be added to the protection ratios shown by the curves. These curves are tentative and may require modification in the light of further experience.

It is theoretically possible to gain a further advantage by the use of offset methods using a frequency separation between the carriers equal to an odd multiple of half the line frequency. More tests are needed before it could be said exactly what advantage could be derived.

The variation of line frequency would render difficult the use of offset at high odd multiples of half the line frequency.

In the particular case of overlapping sidebands, known as the "tête-bêche" arrangement, the protection ratio can be roughly estimated from the curves in the attached drawing and from the rejection afforded to the unwanted carrier. An example is given in Doc. 2, page 2, under 3a and b of table 1. More tests are needed before further guidance can be given for the protection ratios required for specific cases.

5. Protection ratio for the sound signal (for just tolerable interference).

5.a *Wanted and unwanted signals FM* : 20 db.

5.b *Wanted and unwanted signals AM* :

Frequency difference below the audio frequency range : 30 db.

Frequency difference within the audio frequency range : 40 db.

Frequency difference above the audio frequency range : 15 db.

5.c *Wanted signal AM, unwanted signal FM*.

No frequency difference : 40 db.

25 kc/s frequency difference : 30 db.

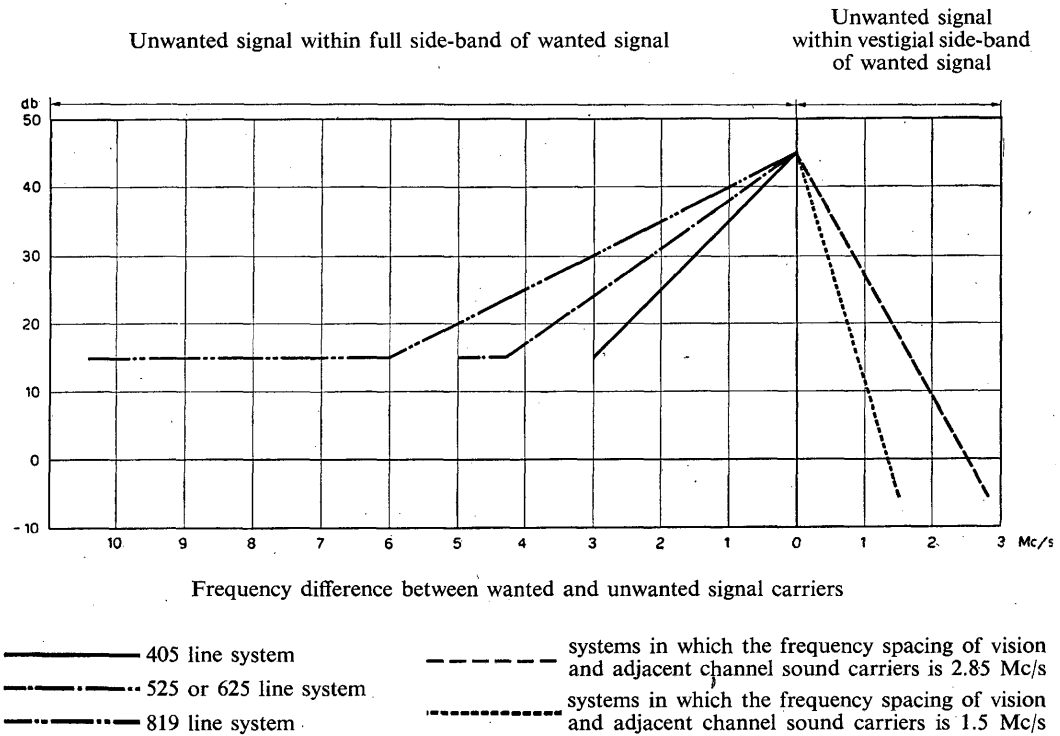
50 kc/s frequency difference : 40 db.

5.d *Wanted signal FM, unwanted signal AM* : 20 db.

The above quoted figures, while giving the protection ratios required, will in practice be used to determine the frequency separation which may be needed between the sound carriers.

APPENDIX I

PROTECTION RATIOS REQUIRED BY VISION SIGNAL AGAINST UNWANTED VISION OR FREQUENCY-MODULATED SOUND SIGNAL



Note. — For an amplitude modulated sound signal the protection ratios required are about 5 db higher

REPORT BY THE CHAIRMAN OF STUDY GROUP No. XII *

TROPICAL BROADCASTING

(Original language : English)

1. Programme.

1.1. The C.C.I.R. at its Sixth Plenary Assembly assigned the following Questions and Study Programme to Study Group No. XII :

- | | |
|--------------------------|--|
| Question No. 4 : | Interference in the bands shared by broadcasting; |
| Question No. 27 : | Maximum power for short-distance high-frequency broadcasting in the tropical zone; |
| Question No. 69 : | Best method for calculating the field strengths produced by a tropical broadcasting transmitter; |
| Question No. 70 : | Design of aerials for tropical broadcasting; |
| Question No. 71 : | Determination of noise-level for tropical broadcasting; |
| Study Programme No. 38 : | Short-distance high-frequency broadcasting in the tropical zone (tropical broadcasting). |

1.2. From amongst these Questions and Study Programme, the E.A.R.C., held in Geneva in November/December 1951, recommended that Study Programme No. 38 and Question No. 70 should be given special priority.

2. Composition.

2.1. The total number of participants in the work of the Study Group is 20, comprising 12 administrations, 6 private operating agencies, 1 international organization and 1 scientific organization.

2.2. Mr. S. S. Moorthy Rao was the Chairman of the Study Group till 1 October 1952, when he resigned his chairmanship on his appointment as Member of the I.F.R.B. Mr. B. V. Baliga was nominated by India as Chairman of the Study Group from 13 October 1952.

3. Meetings.

No meetings of the Study Group have been held; all the work between the participants has been done by correspondence.

4. Contributions.

4.1. Contributions have been received only from :

- (i) Overseas Territories of the French Republic and Territories administered as such—concerning Study Programme No. 38.2 (Doc. 164); and
- (ii) India—concerning Study Programme No. 38.2 (Doc. 262) and 38.4 (Doc. 263) and Question No. 69 (Doc. 264).

4.2. The contributions received from the two participants are summarized below :

4.3. *French Overseas Territories.*

The French Overseas Territories' document (No. 164) contains qualitative observations made over a period of one year on the reception obtained at distances ranging from 55 to 1575 kilometres from transmitters of 1 kW and lower powers operating on frequencies between 3 and 9 Mc/s. On

* Doc. No. 112, London.

the basis of these observations, French Overseas Territories have concluded that the provisional power limits given in Recommendation No. 84 are correct. They, however, recognize that these observations which were conducted during very short periods cannot be considered as sufficient to determine clearly the power needed for a continuous broadcasting service, and that a large number of measurements over a complete sunspot cycle will be needed before a definite reply can be given.

4.4. *India.*

4.4.1. India has submitted three reports on :

- (a) Study Programme No. 38, point 4, on the statistical analysis of field strengths produced by tropical broadcasting transmissions (Doc. 263);
- (b) Question No. 69 on the best method for calculating the field strengths produced by tropical broadcasting transmissions (Doc. 264);
- (c) Study Programme No. 38, point 2, on the practical examination of whether the provisions for power limits in Recommendation No. 84 are satisfactory (Doc. 262).

4.4.2. Doc. No. 263 has analysed the field strengths of three All India Radio 10 kW transmitters at Bombay, Madras and Calcutta, measured at Delhi over a period of 11 years from 1942 to 1952. The variation of the field strengths of these three stations with the months, seasons and epochs of the sunspot cycle for the post-meridian (1200 to 1400 hours—I.S.T.) and night time (2000 to 2200 hours—I.S.T.) periods and their correlation with the sunspot numbers have been brought out. The significant feature of this analysis is the close correlation of the sunspot numbers with the variation of field strengths during the *night time period*, which the existing theory of propagation does not take into account. It has been suggested that the low field strengths obtained during periods of high sunspot-activity are due to the presence of residual D and E layers at night time.

4.4.3. Doc. 264 from India deals with Question No. 69, namely, the best method for calculating the field strength produced by a tropical broadcasting transmission. In this report an attempt has been made to verify whether either of the two methods, namely the C.R.P.L. and S.P.I.M. (Service de Prévision Ionosphérique Militaire), could be utilised. It has been shown that :

- (a) whereas there is some correlation between the measured intensities and calculated values according to the C.R.P.L. method, neither of the methods is accurate enough for calculation of field strengths of tropical broadcasting transmissions;
- (b) the deviation between the values of field strengths measured and calculated even according to the C.R.P.L. is as much as 15 db during day time for frequencies between 6 and 9 Mc/s and 8 db during night time for frequencies in the 3 and 5 Mc/s bands; and
- (c) there is pronounced correlation between the sunspot number and the measured field strength even during the night period and that neither of the formulae takes this fact into account.

4.4.4. Doc. 262 from India deals with the practical examination of whether the provisional power limits in Recommendation No. 84 are satisfactory or whether they should be changed to give an acceptable tropical broadcasting service. The reception reports on tropical broadcasting transmissions on frequencies from 3 to 9 Mc/s at various times of the day, seasons and epochs of the sunspot cycle have been analysed; special listening tests have also been conducted during April 1951 and August/September 1952 to determine listener-satisfaction on the reception of transmitters of powers 5, 10, 20 and 100 kW. India's conclusions as a result of these observations are that :

- (a) even a power of 100 kW is only sufficient to produce a listener-satisfaction not exceeding 79 % around the noon period (up to 1500 hours local time) on 31 and 41 metres;
- (b) a 20 kW transmitter is only sufficient to produce not more than 72 % listener-satisfaction during evening hours on 60 metres; and
- (c) a 5 kW transmitter is only sufficient to give not more than 41 % listener-satisfaction during night time on 90 metres.

India, therefore, considers that it is neither appropriate nor justified to recommend, even tentatively, any power limits for tropical broadcasting stations.

5. Conclusions.

5.1. There is general agreement that no definite answer can be given to any of the questions without collection of considerably more experimental data over a number of years. However, the conclusions arrived at by French Overseas Territories and India on the practical examination of the need for imposing a power limit are completely different. French Overseas Territories hold the view that the provisional power limits given in Recommendation No. 84 can be considered as correct, whereas India maintains that their observations and experience prove that they are totally unsatisfactory. Further discussion on this problem at a meeting of the members of the Study Group is, therefore, necessary.

5.2. The response from the members of the Study Group has not been as good as last year. It would appear that the main causes for the lack of response are that :

- (a) no accepted methods of measurements of atmospheric noise-level and standards of signal-to-noise and signal-to-interference ratios are yet available for countries to proceed with the investigations; and
- (b) comprehensive technical data of field strength measurements and practical observations of reception conditions are not available for adequate statistical analysis.

6. Recommendations.

It is, therefore, recommended that :

- (a) a high priority be given to the standardization of the methods of measurement of atmospheric noise, and signal-to-noise and interference ratios; and
- (b) administrations be invited to :
 - collect extensive data by listening tests to enable a statistical analysis to be made; and
 - 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.

New Delhi, 13 June, 1953.

B. V. BALIGA

Chairman, Study Group No. XII.

REPORT BY THE CHAIRMAN OF STUDY GROUP No. XIII

(OPERATION QUESTIONS DEPENDING PRINCIPALLY
ON TECHNICAL CONSIDERATIONS)

Note by the Director of the C.C.I.R. :

As there are no subjects set for study by C.C.I.R. Study Group No. XIII, there is, in consequence, no Chairman's Report for this Study Group.

REPORT BY THE CHAIRMAN OF STUDY GROUP No. XIV

(Vocabulary)

(Original language : French)

1. Membership of the Study Group.

The following countries and organizations are members of Study Group No. XIV :

A. Administrations :

1. Federal German Republic
2. Commonwealth of Australia
3. Spain (Delegate : Mr. J. Garrido Moreno)
4. United States of America (Delegate : Mr. A. G. Jensen)
5. France (Delegate : Mr. Villeneuve)
6. Italy (Delegates : Mr. A. Ferrari-Toniolo; Mr. S. Silleni)
7. Japan
8. United Kingdom
9. Sweden
10. Swiss (Confederation) (Delegate : Mr. J. Dufour)
11. Federal People's Republic of Yugoslavia

B. Private operating agencies :

1. British Broadcasting Corporation (B.B.C.) (Delegate : Mr. W. J. Chalk)
2. Compagnie Générale de T.S.F. (Delegate : Mr. L. Bouthillon)
3. Companhia Portuguesa Radio Marconi
4. Marconi Int. Mar. Comm. Co. Ltd. (M.I.M.C.C.)
5. Radio Corporation of America (R.C.A.) (Delegates : Mr. H. H. Edwards;
Mr. P. F. Siling;
Mr. C. G. Mayer)
6. Kokusai Denshin Denwa Company Ltd.

C. International organisations :

1. European Broadcasting Union (E.B.U.)
2. International Scientific Radio Union (U.R.S.I.) (Delegate : Mr. E. Herbays)

D. Scientific and industrial organizations :

1. Telefonaktiebolaget L. M. Ericsson (Delegate : Mr. M. Vos)

2. The tasks of the Study Group.

The following questions and resolutions were referred by the VIth Plenary Assembly of the C.C.I.R. to Study Group No. XIV :

Question No. 72 : Decimal classification;

Question No. 73 : Classification of the frequency and wavelength bands used in radiocommunication;

Resolution No. 5 : Means of expression (definitions, vocabulary, graphical and letter symbols);

Resolution No. 6 : Unit systems.

3. Preliminary Reports by the Chairman.

The following preliminary reports, prepared by the chairman, were circulated to the members of the Group :

1. Report on Question No. 72 (Doc. 265).
2. Report on Question No. 73 (Doc. 266).
3. Report on Resolution No. 5 (Doc. 267).

I. — QUESTION No. 72

1.1. *Progress made.*

The proposal mentioned in paragraph 1.3 of preliminary report I gave rise to an exchange of correspondence between the C.C.I.s and the International Classification Commission for Electrical Engineering (C.I.C.E.) regarding the establishment, as an ancillary of the International Federation of Documentation, of which the C.I.C.E. itself is a branch, of a sub-commission for "the extension, standardization and revision of the universal decimal classification, as a system for the classification of documents of international application in the domain of telecommunications".

A circular was sent by the C.C.I.s on 8 July 1952 to the administrations of 20 countries which has previously shown an interest in the problems of vocabulary and classification, so that they might signify their intention of taking part in the work by nominating representatives for the sub-commission, the establishment of which had already been decided upon by the XIXth Congress of the F.I.D. held in Copenhagen, in September, 1952.

With the adhesion of Federal German Republic, France, Italy, the Netherlands, the United Kingdom and Switzerland, the sub-commission was set up in Copenhagen under the chairmanship of Mr. Ferrari-Toniolo (Italy), Member of the F.I.D., as well as of the C.C.I.R. and the C.C.I.F. The sub-commission began its work immediately by examining some of the proposals for classification contained in documents of the C.I.C.E.

The second meeting of the International Classification Sub-Commission for Telecommunications (I.C.S.C.T.) was held in Vienna in June.

The membership and the work of the sub-commission are described in Annex I.

1.2. *Contributions received.*

Contributions, approving the procedure adopted, have been received from the United States (Doc. No. 270), the Federal German Republic (Doc. No. 271), Italy (Doc. No. 272) and Australia (Doc. No. 268). It is generally agreed that no further action need be taken by the C.C.I.R. until the results of the work of the Sub-Commission become available.

1.3. *Draft Resolution :*

The C.C.I.R.

CONSIDERING :

that, as a result of the agreements reached between the C.C.I.s (C.C.I.T., C.C.I.F. and C.C.I.R.) and the International Federation of Documentation (F.I.D.), the revision of the decimal classification in the field of Telecommunications has been entrusted to the International Classification Sub-commission for Telecommunications set up by the F.I.D. as an ancillary of the International Classification commission for Electrical Engineering (C.I.C.E.),

CONSIDERING :

that the membership of the I.S.C.T.C. is confined to a few engineers, experts in telecommunications, appointed by Administrations, members of the C.C.I.s, and librarians, experts in decimal classification,

HAVING NOTED WITH SATISFACTION :

that the Sub-commission has begun its work in a spirit of co-operation with the C.C.I.s,

RESOLVES :

that the I.S.C.T.C. will pursue, in the same spirit of collaboration, the task of standardizing the classification, acting conjointly with the C.C.I.s as far as possible on a general plane common to all branches of telecommunication.

II. QUESTION NO. 73

2.1. *Contributions received.*

Contributions have been received from the United States of America (Doc. No. 60), the United Kingdom (Doc. No. 85), the Federal German Republic (Doc. No. 271), Australia (Doc. No. 268) and Italy (Doc. No. 272).

It is unanimously agreed that

- classification should be by frequencies and not by wavelengths,
- the frequencies should be divided into decade bands, designated in terms of the common logarithm.

As regards the designation of the bands, all the above administrations, with the exception of that of Federal German Republic, are in favour of using progressive whole numbers, the exponents of 10 in the formula $F = K 10^N$, F being expressed in c/s.

Federal German Republic would prefer band divisions of tens and hundreds of kc/s, units, tens and hundreds of Mc/s and gigacycles, and units of teracycles.

As regards the limit frequencies ($F_1 = K_1 10^N$ and $F_2 = K_2 10^N$), two divergent proposals are offered :

A. The United States of America proposes $K_1 = 1$, $K_2 = 10$, while.

B. The United Kingdom suggests $K_1 = 0.3$, $K_2 = 3$.

The United States' proposal is supported by Federal German Republic and that of the United Kingdom by Australia and Italy.

The arguments put forward by the two countries in support of their respective systems are :

For System A

(limits : integral powers of 10)

1. All $F = K 10^N$ c/s frequencies, for K comprised between 1 and 10, fall within band N . The system is easy to use and to remember (U.S.A.).
2. System A can be used for all parts of the spectrum, not only in the general field of communications, but also in associated fields (U.S.A.).
3. The band numbers agree with the principal points on logarithmic paper (U.S.A.).
4. The change from a wavelength designation to a frequency designation in the past has shown that the change from the present band limits will not give rise to great difficulty. System A is simpler and more attractive (U.S.A.).
5. Since system B does not provide a convenient classification in line with propagation and physical characteristics, there is no reason why the existing arrangement should not be altered (Federal German Republic).

For System B

(retention of the existing limits, 3 times the powers of 10)

1. All $F = K 10^N$ c/s frequencies, for K comprised between 0.3 and 3 fall within band N . This rule is easy to apply (U.K.).
2. System B can be extended indefinitely (U.K.). Moreover, the C.C.I.R. is concerned only with the classification of frequencies used in radiocommunications (Italy).
3. In each band there is one frequency expressed in c/s per each integral power of 10 : its exponent determines the band number (U.K.).
4. The present system is firmly established and universally used. The introduction of numbers to designate the bands would cause very little trouble to users (U.K.).
5. Classification B is in at least as satisfactory agreement as any other system with the limits of the physical characteristics (particularly those of propagation) of electro-magnetic waves (Italy, U.K., Aust.).

6. No wavelengths are given with the frequencies in the R.R. Frequency Allocation Table; there is no need whatsoever to retain any range classification based on metric subdivision (Federal German Republic).

7. Any system, such as system B, connected directly or indirectly with wavelengths, is defective in that, with a given frequency, the wavelength may vary within the system with the type of transmission, medium, etc. (U.S.A.).

6. System B, likewise founded on frequency allocation, can be used without reference to wavelengths (note by the Chairman).

7. Classification B is in fair, and certainly better, agreement than classification A, with the technical characteristics of the various frequency bands (Australia).

2.2. Proposals for submission to the VIIIth Plenary Assembly.

The United States of America has submitted its proposal in the form of the following draft recommendation :

The C.C.I.R.

CONSIDERING :

- (a) That it is desirable and important that any new system of frequency band allocation be capable of designating frequency bands of all frequencies without regard to the part of the spectrum occupied;
- (b) That consideration should be given to the use of any system for designating frequency bands not only by persons within the general field of communications, but also those in associated fields, such as servo-mechanisms and control, industrial electronics, etc.;
- (c) That industrial electronic applications far outweigh communication applications;
- (d) That frequency bands limited by frequencies equal to integral powers of 10 c/s are easier to remember and use than frequency bands limited by frequencies equal to 3 times integral powers of 10 c/s;
- (e) That a system of designating frequency bands limited by frequencies equal to integral powers of 10 c/s has the substantial advantage that the band numbers agree with the principal points on logarithmic paper which is used more than any other for the plotting of variations of quantities with frequency;
- (f) That any system associated with wavelengths either directly or indirectly has the considerable disadvantage that frequencies are usually specified, but wavelengths are dependent on the medium and in a given system may vary radically from point to point in the system depending on the type of transmission system or medium, etc.;
- (g) That experience in changing a widely used wavelength designation to frequency designations some years ago shows that the change from present band limits to those recommended herein is not of insurmountable difficulty and probably not of very great difficulty;
- (h) That this experience indicates that an apparent advantage because of continuity should not be permitted to cause the adoption of a less attractive system on a permanent basis, when the opportunity for making a basic change is at hand;
- (i) That the present letter system of designation finds limited use, but the opportunities for using a band designation system are great, thus indicating the desirability of adopting the simplest system;

RECOMMENDS :

That the system of frequency band designation, shown in the attached table, be adopted (for Table, see Doc. No. 60).

Study Group No. XIV must decide whether the classification of frequencies by band numbers (possibly using the alternative designations proposed by the Federal German Republic should be adopted, and if so, to weigh carefully the pros and cons of the two systems proposed and to decide which of the two should be submitted to the Plenary Assembly.

III. RESOLUTION No. 5

3.1. *The present state of the work.*

In accordance with the recommendations contained in point 2 of the Resolution, the C.C.I.R. Secretariat, in co-operation with the study groups (point 1) and administrations (point 3), has collected a number of documents which could be used as a basis for a preliminary draft list of definitions.

The Director of the C.C.I.R., realizing the impracticability, because of lack of personnel and time, of drafting a preliminary list of the 1500 terms and numerous definitions contained in the great volume of documents involved, agreed with the chairman of Study Group No. XIV (point 4) that, in the first instance, the terms and definitions appearing in I.T.U. documents, together with those suggested by the C.C.I.R. study groups, should be assembled as proposed in Preliminary report No. III.

The resulting "working document for the preparation of a preliminary draft list of definitions of essential terms used in radiocommunication" will facilitate the work of the Group, since it condenses into a "single list" the terms and definitions contained in a great many documents, viz. :

- The International Telecommunication Convention;
- The Atlantic City Radio Regulations;
- Documents of the Vth Plenary Assembly, Stockholm, Vol. 1;
- Documents of the VIth Plenary Assembly, Geneva, Vol. I;
- Definitions and terms used by the study groups, submitted by the chairman or members of the study groups.

3.2. *Contributions received.*

In response to a request from the Secretariat to Administrations for contributions of terms and symbols used in radiocommunications, the C.C.I.R. has received a number of national publications, a preliminary list of which is given in Annex II. The Department of State, Washington, has also authorised the C.C.I.R. to reproduce documents emanating from the I.R.E. and the A.S.A.

A new Question on the standardization of electronic circuits has been proposed by the Australian Administration (Doc. 269 and "The utility factor in circuit diagrams" by C. E. Williams, published in the P.I.R.E., September 1952).

3.3. *Work envisaged for the London Conference.*

The vocabulary Study Group will be called upon to deal with problems of procedure and organization as well as those of principle.

3.3.1. *Vocabulary and lists of graphical and letter symbols.*

A number of people will have to take part in drafting the vocabulary and lists of symbols.

The final documents must, in fact, be the result of co-operation on the part of experts in the various branches of technical science, of many lands and many languages, helped by a number of assistants, typists, etc.

To obtain the greatest uniformity possible, thus obviating unnecessary collation, the lists to be prepared by the various working groups should, from the very outset, satisfy certain well-defined criteria which it will be the task of Study Group No. XIV to establish.

Moreover, the Study Group must endeavour to work out a method which would simplify the work to the utmost and permit it to be carried out in an orderly fashion, without duplication and in the shortest time possible; in short, with maximum efficiency and minimum expense.

As regards the agenda, various points which might be usefully examined are given below.

3.3.1.1. *Vocabulary and definitions.*

To promote better understanding among technicians in specialized fields, it would suffice to include in the vocabulary only the definitions of those terms which lack clarity, are ambiguous or are used to denote more than one concept.

The establishment of terms in various languages expressing, accurately and rigorously, the same concept, might also be considered. Moreover, it might be desirable to define the shades of meaning by which the terms, equivalent from the linguistic and etymological point of view, differ according to usage in the various countries.

If, on the other hand, the vocabulary is intended for a wider and less- or unspecialized public, a great number of general terms must be included (which in the former case need not be mentioned or at least defined). Moreover, much more detailed definitions would have to be provided.

Since the radiocommunication vocabulary is to become an integral part of the international telecommunications vocabulary, care must be taken to avoid duplication of the terms used in the preliminary drafts prepared by the C.C.I.F. and the C.C.I.T. This does not apply to certain definitions requiring revision in the light of radio technology.

The interdependence of the work on terminology carried out by the three C.C.I.s makes it necessary for the C.C.I.R. to take into consideration and to express its opinion on the desirability of extending to the radiocommunication vocabulary, the criteria used by the C.C.I.F. when preparing the "First draft list of essential terms used in telephony". These criteria, recalled in Preliminary report No. III (para. 2.2.1.1), are :

- standardization and co-ordination of technical terms;
- acceptance, in general, of existing practice;
- establishment of directives regarding terms about to come into use;
- division of synonymous terms into "recommended" terms or their equivalents, terms "not recommended" and terms "deprecated";
- provision of explanations and comments (possibly illustrated by formulae and diagrams), particularly of practical interest, while leaving to the International Electrotechnical Commission (C.E.I.) the task of establishing universally acceptable definitions;
- classification of terms by chapters in an organic or functional order with a view to grouping special terms bearing on any given aspect of telecommunications;
- grouping together of inter-dependent definitions in the same chapter.

3.3.1.2. *Problems of organization.*

The organization of future work will to a certain extent be affected by any decisions adopted on matters of principle.

Nevertheless, arrangements must be made in advance for the appointment of persons to select from the material available the terms to be inserted in the vocabulary (the means of expression to be included in the list), to compare the various definitions (and symbols) contained in the documentation, and if necessary to draft a new formula in conformity with C.C.I.R. directives.

Secondly, since the reproduction and distribution of the whole set of documents in the hands of the Secretariat would no doubt be a formidable task, a means of supplying suitably arranged material to the persons thus engaged must be worked out. Moreover, the final task would be facilitated if each participant could have at his disposal only that portion of the documentation which concerned him.

The Director of the C.C.I.R. can best judge the extent to which the specialized secretariat can help in the work of the vocabulary Study Group. It is hoped that he will inform the Study Group of any additional facilities which would be required to enable the Secretariat to carry out its task as expeditiously as possible.

3.3.2. *Standardization of electronic circuits.*

The Australian proposal is based on arguments advanced by C. E. Williams for a more expressive and functional graphic representation of electronic circuits. A suitable layout of the circuit components is advocated for this purpose.

The Study Group may think it advisable to submit the Australian proposal as a Study Programme to the VIIIth Plenary Assembly.

IV. — RESOLUTION No. 6

Contributions have been received from the United States of America (Doc. 270), the Administrations of the Federal German Republic (Doc. 271) and Italy (Doc. 272). An article on the subject has been published in the Telecommunication Journal (Jan. 1953), under the signature of Mr. J. Lalou.

It is unanimously agreed that the adoption or rejection "by official channels" of the Giorgi MKS system of measurement units depends on the results of the investigations now in progress.

On the other hand, the Resolution was merely intended to draw the Administrations' attention to the system, without placing them under any obligation to use it.

Since this aim may be regarded as having been achieved, the Study Group must decide whether the matter may now be considered closed.

Rome, 19 May, 1953.

T. GORIO

Chairman, Study Group No. XIV.

ANNEX I

INTERNATIONAL CLASSIFICATION SUB-COMMISSION FOR TELECOMMUNICATIONS

A. Membership

Chairman : Prof. A. Ferrari-Toniolo (Istituto Superiore delle Poste e delle Telecomunicazioni, Rome, Italy).

Secretary : D. C. Griffith *, Librarian and Information Officer, Post Office Engineering Dept., Research Branch, Dollis Hill, London.

Assistant secretary : W. E. Clason (Philip's Gloeilampenfabrieken N.V., Eindhoven).

French language adviser : S. Noguès *, in charge of the Central Library at the P.T.T. Ministry, Paris.

P.T.T. Engineers (maximum 6)	P.T.T. Document Experts (maximum 6)	Industrial engineers or Document experts (maximum 4)	Engineers or Document experts of organizations using U.D.C. (maximum 4)
J. Dufour (Switzerland)	C. Frachebourg (Switzerland)	W. E. Clason (Netherlands)	Bulden (Netherlands)
A. Ferrari-Toniolo (Italy)	D. C. Griffith (United Kingdom)	V. L. Rastorgonoff (United Kingdom)	G. N. J. Beck (United Kingdom)
F. Moench (Federal German Republic)	E. Moulijn (Netherlands)	(2 vacancies)	(2 vacancies)
D. van der Berg (Netherlands)	S. Noguès (France)		
(2 vacancies)	V. Quintas (Spain)		
	(1 vacancy)		

* If they agree.

B. The work of the I.C.S.C.T.

1st MEETING HELD IN COPENHAGEN, SEPTEMBER, 1952

1. Appointment of the reporters :

D. C. Griffith,	for telephony	621.395
G. N. J. Beck,	for television	621.397
E. Moulijn,	for quality of reception	621.38
	for signal strength	621.381
	for interference	621.382
2. Classification of calculating machines
referred to the C.I.C.E. 681.15
3. Draft proposal for the extension of wave and pulse classification 621.37
(publication postponed for 4 months)
4. Draft proposals for
radio antennae 621.396.67
radar 621.396.96
(approved)
5. Proposal for the establishment of a co-ordinating agency for terminology between the F.I.D., the I.T.U. and the I.S.O.

2nd MEETING HELD IN VIENNA, JUNE, 1953

An important item on the agenda was the establishment of "a list of terms not easily classifiable", a task to be accomplished after a comparative study of the methods employed by the principal users of the U.D.C. System (Science Abstracts, Wireless Engineer, F.T.Z.), account being taken of C.C.I.T., C.C.I.F. and C.C.I.R. requirements.

ANNEX II

FIRST LIST OF DOCUMENTS RELATING TO RESOLUTION No. 5

A. — Vocabulary

1. C.C.I.R. A single list of terms extracted from I.T.U. documents.
2. France French electrotechnical vocabulary (Group 60 : Radiocommunications), 20 January 1948 Edition.
3. United States of America American Standards Association (A.S.A.), C 42. Definitions of electrical terms (Group 65 : communications). 1 December 1949.
Institute of Radio Engineers, I.R.E. Standard definitions of terms on : Facsimile (1942), Piezo-electric crystals (1945), Television (1948), Antenna modulation systems, Transmitters (1948), Radio aids to navigation (1949), Radio propagation (1950), Electronic computers (1950), Electron tubes (1950), Network topology (1950), Transducers (1951), Pulses P. I (1951), Electro-acoustics (1951), Pulses P. II (1952), Magnetrons (1952).
4. United Kingdom British Standards Institution B.S. 204 : 1943, Glossary of terms used in telecommunication with 5 supplements : No. 1 (1948) on waveguide technique, No. 2 (1949) on radio propagation, No. 3 (1949) Fundamental radio terms, No. 4 (1950) on radar, No. 5 (1951) Piezo-electric terms.

B. — List of graphical and letter symbols

1. Federal German Republic German industrial standards :
DIN 40710 Spannung-Strom, Schaltarten, Wechselspannungssysteme.
DIN 40711 Leitungen und Leitungsverbindungen.
DIN 40712 Allgemeineschaltungsglieder.
2. United States of America Institute of Radio Engineers (I.R.E.) :
I.R.E. Standards on abbreviations, graphical symbols, letter symbols and mathematical signs (1948).
I.R.E. Standards on piezo-electric crystals (1949);
I.R.E. Standards on designations for electrical, electronic and mechanical parts and their symbols (1949);
I.R.E. Standards on abbreviation of radio electronic terms (1951).
3. United Kingdom (Doc. No. 156) British Standards Institution :
B.S. 530, 1948, Graphical symbols for telecommunications with 4 supplements : No. 1 (1950) Component references, No. 2 (1951) Graphical symbols used in waveguide technique, No. 3 (draft awaiting approval) Additional symbols for electronic tubes, No. 4 (in preparation) Miscellaneous additional symbols.

Note : The documents mentioned in paragraphs 2, 3 and 4 of preliminary report III (Doc. No. 267) should be added to the above list.

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

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

COVERING THE PERIOD BETWEEN
THE VITH PLENARY ASSEMBLY (JUNE-JULY 1951) AND THE
VIITH PLENARY ASSEMBLY (SEPTEMBER-OCTOBER 1953)

(Original language : English)

General.

The present report records some of the more important activities of the C.C.I.R. Specialized Secretariat since the last Plenary Assembly of the C.C.I.R. (July 1951) and draws the attention of the forthcoming Plenary Assembly of the C.C.I.R. to some points of importance for the future.

It is divided into three main parts :

1. The work of the Specialized Secretariat.
2. The organization of the Specialized Secretariat—past, present and future—including estimates of expenditure.
3. The provisions of the Atlantic City and Buenos Aires Conventions concerning the C.C.I.s.

1. Work of the Specialized Secretariat.

1.1. *Work given to the Specialized Secretariat by the VIth Plenary Assembly.*

Apart from the day to day work of the Specialized Secretariat, about which some remarks are made below, the Plenary Assembly gave this Secretariat five specific tasks which have been accomplished as follows :

1.1.1. Under Resolution No. 3, the Secretariat was required to arrange for the publication of antenna charts, which are intended to facilitate the proper choice of transmitting antennae. A lot of detailed numerical work has been done in preparing these diagrams, and the book of charts is now about to be published. Some 700 copies have already been ordered. The small amount of explanatory text will be available in English, French or Spanish.

1.1.2. Under Study Programme No. 10, the Secretariat was requested to prepare an indexed bibliography on publications regarding the theory and general practice of communications. It is to include the title, with a summary, of articles published on this subject. This bibliography contains some 350 entries and some 125 pages of stencilled text. It will be available in the early summer of this year.

1.1.3. Under Recommendation No. 69 the Director of the C.C.I.R. was required to prepare, six months in advance, predictions of the smoothed relative sunspot number utilizing auto-correlation techniques.

As a thorough investigation showed, no method based on the auto-correlation function and which could be applied to sunspot prediction was available in the scientific literature. Thus the work had to be started ab initio, and even the whole mathematical basis of the problem had to be worked out. The research has now reached a stage which shows that a promising approach, now developed, may well prove to be successful. An extensive report on this difficult subject has been prepared for the Plenary Assembly (see Doc. No. 258).

1.1.4. Under Recommendation No. 70 and Study Programme No. 25 the Secretariat was asked to distribute information regarding measured and corrected values of standard frequency transmissions and time signals and information on reception conditions of such signals. At present this information is distributed by the Specialized Secretariat to some 50 services in various parts of the world.

* Doc. No. 115, London.

1.1.5. Under C.C.I.R. Resolution No. 5, the Director, as far as his other duties permitted, collected information concerning vocabulary and means of expression. Agreement with the chairman of Study Group No. XIV (Vocabulary) has been reached, so that the latter has been enabled to make suitable proposals for discussion by the VIIth Plenary Assembly.

1.2. Thanks to a small amount of technical apparatus available in the C.C.I.R. Specialized Secretariat, and to the low electrical noise level of the present site of the C.C.I.R. offices, it has been possible to make a continuing series of measurements of radio signal strength in Geneva in connection with Study Programmes Nos. 17 and 18 of Study Group No. V (Tropospheric propagation) and to take part in a series of measurements organised as a result of C.C.I.R. Recommendation No. 46. The first series of these recordings was presented to the Stockholm meeting of Study Group No. V. The group used them along with others, in the preparation of its report for the European Regional VHF Broadcasting Conference and recommended that this work of the C.C.I.R. Secretariat be continued and extended, a course which is being followed. Recordings of the field of a VHF broadcasting station some 350 km distant from Geneva over a whole year are now available and have been analysed statistically. A report (Doc. No. 282) is being submitted to Study Group No. V for consideration in London.

1.3. *Day to day work of the Specialized Secretariat.*

As to the day to day work of the Secretariat, apart from the above specific tasks, the Director has to report that the work has gone on normally. Later, in Section 2 of this report, he makes some suggestions for relatively minor changes in the organization of the Secretariat, to take account of the experience gained, and with a view to an increase in efficiency at no increase in cost.

As part of its normal administrative tasks, the Specialized Secretariat of the C.C.I.R. organized and furnished, at least in part, the staff for the following study group meetings :

- (a) Meetings of Study Groups Nos. I and III (The Hague, April 1952);
- (b) Meetings of Study Groups Nos. V, VI and XI (Stockholm, May 1952);
- (c) Meeting of Study Group No. X (Geneva, August/September 1952);

One or more representatives of the C.C.I.R. Specialized Secretariat attended the following meetings of the I.T.U. :

- (a) XVIth Plenary Assembly of the C.C.I.F. (Florence, October 1951);
- (b) Extraordinary Administrative Radio Conference (Geneva, August/December 1951);
- (c) 7th Meeting of the Administrative Council (Geneva, April 1952);
- (d) European Broadcasting Conference (Stockholm, June 1952);
- (e) Meetings of C.C.I.T. Study Groups Nos. I and VI (Geneva, November 1952);
- (f) Plenipotentiary Conference (Buenos Aires, September/December 1952);
- (g) 8th Meeting of the Administrative Council (Geneva, May 1953);
- (h) VIIth Plenary Assembly of the C.C.I.T. (Arnhem, May/June 1953).

The Specialized Secretariat of the C.C.I.R. edited and supervised the publication of the final documentation of the VIth Plenary Assembly, which appeared in three volumes, viz. :

Volume I : Recommendations, Questions, Study Programmes, Reports and Resolutions, List of Study Groups (number of copies sold : 1292);

Volume II : List of participants, Reports of study group chairmen, Report of the Director, C.C.I.R., Report of Drafting Committee, Report on technical assistance, Index to documents (number of copies sold : 872);

Volume III : Minutes of the Plenary Meetings (number of copies sold : 567).

Throughout the period under review one or more members of the Specialized Secretariat served on a number of internal I.T.U. committees, e.g.

- the Co-ordination Committee (including work on technical assistance);
- the Editorial Committee of the I.T.U. Journal;
- Staff committees, etc.

1.4. Translation and reproduction of documents for distribution within a study group.

Different procedures have been adopted by the study group chairmen with respect to translation and reproduction of study group documents. The Director would therefore welcome a clear directive from the VIIth Plenary Assembly as to future action.

The problem is to decide who should translate and reproduce study group working documents in the future—the authors, the study group chairmen or the Specialized Secretariat. If it is the wish of the Plenary Assembly, the Director is prepared to do it all in future provided the necessary credits are allowed. Rather than increase the number of personnel in the Specialized Secretariat, he would propose to engage supernumerary personnel when necessary and to charge the cost to the extraordinary budget. The estimated extra expenditure—based on past experience and on the assumption that all study group chairmen wished the Specialized Secretariat to do this work—would be of the order of 9,000. Swiss francs per year. There would inevitably be some increased delay.

1.5. Organization of study group meetings.

Six C.C.I.R. study groups met during 1952, as their chairmen judged that their work was not proceeding satisfactorily by correspondence alone. With a view to economy both in time and money, the Director of the C.C.I.R. was able to arrange for some of the meetings to be grouped, thus complying with Chapter 13, para. 2 of the General Regulations.

Study Group No.	General work	Chairman and country	Meeting place and date
I	Radio transmitters	Dr. Ing. E. Metzler (Switzerland)	The Hague
III	Complete radio systems employed by the different services	Dr. H. C. A. van Duuren (Netherlands)	The Hague
V	Tropospheric propagation	Dr. R. L. Smith-Rose (United Kingdom)	Stockholm
VI	Ionospheric propagation	Dr. R. L. Smith-Rose acting for : Dr. J. H. Dellinger (United States of America)	Stockholm
XI	Television	Mr. E. Esping (Sweden)	Stockholm
X	Broadcasting	Mr. N. McNaughten (United States of America)	Geneva

For Study Groups Nos. I, III and VI, the primary object was to give interim reports on C.C.I.R. questions considered urgent by the Extraordinary Administrative Radio Conference, held in Geneva during the autumn of 1951 (E.A.R.C. Recommendation No. 14). These study groups placed special emphasis on the possibilities of reducing the bandwidth occupied by, and interference caused to radiotelegraph and radiotelephone services by the use of suitable coding, specialized equipment and the proper utilization of operating channels.

Study Groups Nos. V and XI met in Stockholm immediately before the C.E.R. met there to examine the use of the frequency bands between 41 and 216 Mc/s allotted to television and sound

broadcasting. One object was to consider and make available to this conference the latest technical data on propagation of electromagnetic waves in the troposphere and on the ratio of wanted to unwanted signals in television and VHF sound broadcasting. The curves in C.C.I.R. Recommendation No. 55 were amended in the light of the latest information and were used as basic technical data by the C.E.R. In addition to these more urgent questions, other items on the agenda of the five study groups were also considered.

It was arranged to hold the meetings of Study Groups Nos. I and III, as well as those of Study Groups Nos. V and VI together, as this enabled the same delegates to attend two study groups discussing related subjects. Similarly, the meeting of Study Group No. XI was arranged at the same time as the meetings of Study Groups Nos. V and VI, immediately to precede the meeting of the C.E.R. as many of the delegates to the latter wished also to take part in the meetings of the former.

Study Group No. X met in Geneva in August to prepare an interim report on a question considered urgent by the E.A.R.C., concerning the use of more than one frequency for one broadcast programme to one reception area; and also to endeavour to reach agreement on an international standardization of characteristics of recording systems, for both disc and magnetic tape, used in the international exchange of broadcasting programmes. Agreement was reached for disc recording and near agreement for magnetic tape, although further work was considered necessary on the latter subject.

The extraordinary expenses occasioned by these Study Group meetings are dealt with further on in this report.

1.6. Nomination of new study group chairmen.

During the latter part of 1952, the Director was advised by their respective Administrations that Captain C. F. Booth (United Kingdom) and Mr. Moorthy S. S. Rao (India) could no longer continue as Chairmen of C.C.I.R. Study Group No. IX (General technical questions) and Study Group No. XII (Tropical broadcasting), respectively, due to their appointment to new functions. It is believed that the Plenary Assembly will wish to express its thanks to Captain Booth and Mr. Rao for all their services rendered to the C.C.I.R. and to welcome and to approve their successors, Mr. H. Stanesby and Mr. B. V. Baliga, nominated by the Administrations of the United Kingdom and India, respectively.

1.7. Preparatory work for the VIIth Plenary Assembly.

1.7.1. It is estimated that the preparatory documentation will contain approximately 1,400 pages of text, in each of the languages, English, French and Spanish, and 450 pages of diagrams, and the work of translation into the three working languages of the Union, English, French and Spanish, and reproduction is already well in hand. It is obviously uneconomical to inflate the permanent staff of the C.C.I.R. Secretariat sufficiently to cope with this high peak load preparatory to a plenary session, and, with the assistance of the General Secretariat, 20 extra staff have been engaged temporarily. The cost is being charged to the extraordinary budget of the C.C.I.R.

In total some 350 copies in English, 150 in French and 50 in Spanish of each document are required, making a total of over 1,000,000 sheets of paper, or approximately 5 tons.

As far as can be estimated now, it would appear that the provision of 500,000 Swiss francs made in the 1953 extraordinary budget and approved by the Administrative Council during its VIIth session (Resolution No. 238) will prove sufficient to cover both this preparatory work and the costs of the Plenary Assembly itself.

1.7.2. Agreement with United Kingdom Administration for the organization of the VIIth Plenary Assembly in London in September and October 1953.

Agreement was drawn up and signed between the United Kingdom Administration and the C.C.I.R. concerning the organization of the VIIth Plenary Assembly, as suggested in Administrative Council Resolution No. 83. This agreement was submitted by the Director to the 8th meeting of the Administrative Council and the document was approved by it.

1.7.3. Late submission of documents of study groups and study group chairmen's reports.

Note : The Director would again like to draw the attention of all concerned to Recommendation No. 33 of Stockholm, which in part states :

1. "that the reporters of each study group shall send their contribution to the group chairmen at least six months before the date of opening of the C.C.I.R. Plenary Assembly; "
2. "that the group chairmen shall send their reports to the Director of the C.C.I.R. so that he receives them at least four months before the date of opening of the C.C.I.R. Plenary Assembly."

In fact, experience has shown that the periods mentioned are minimum ones due to the great volume of preparatory work for the Plenary Assembly on the one hand, and the destinations, distant from Geneva, to which part of these documents must be despatched on the other. Documents were still being received at the date of this report, i.e. 1st July, 1953, only nine weeks before the scheduled opening of the Plenary Assembly, and the Director feels that it is his duty to the members to emphasise the fact that, in such circumstances, it is physically impossible to ensure reception of all preparatory documents one month prior to the opening of the Plenary Assembly, as described in Stockholm Recommendation No. 33.

1.8. *Relations with other international organizations.*

The Director has always been of the opinion that it is essential for the senior technical staff of the C.C.I.R. Secretariat to keep closely in touch with radio developments, not only through the perusal of reviews and technical books, but also by studies at first hand and visits to different technical bodies with a view to direct discussion of technical problems and the exchange of technical information.

Thus, during the period between the VIth and the VIIth Plenary Assemblies of the C.C.I.R., the Director, the Vice-Director or one of the C.C.I.R. engineers attended several meetings of other international bodies with whom the C.C.I.R. had relations, either as a result of decisions of the VIth Plenary Assembly, or because of study by these organizations of problems related to C.C.I.R. activities. Details are as follows :

- International meeting on automatic control, Cranfield (England), July, 1951 : Problems discussed concerned theory and practice of servo mechanisms which obey the same laws as the usual radio oscillators.
- International symposium on non-linear vibrations, Ile de Porquerolles (France), September, 1951 : The theory of non-linear vibrations governs the properties of circuits utilizing radio tubes.
- Meeting of the Technical Committee of the U.E.R., Brussels, September, 1951 : A number of questions of interest to the C.C.I.R. were discussed, in particular sky-wave field measurements.
- UNESCO Conference on the foundation of an International Mathematical Centre, Paris, November, 1951.
- Annual meeting of the Swiss National U.R.S.I. Committee, Zurich, December, 1951 : A yearly review of the most important work done in Switzerland on radio subjects.
- Lecture on Theory of Communications, (under the auspices of the I.E.E.), London, January, 1952 : On the practical benefits communication engineers can expect from modern communication theory. (C.C.I.R. Question No. 44 and Study Programme No. 10.)
- Meeting of the B.B.C. and the Staatsradiofonien (Denmark) on recording, London, February, 1952 : It was possible to secure agreement on some controversial aspects of magnetic tape recording which appeared to be likely to delay work in progress under C.C.I.R. Resolution No. 4.
- British contribution to television, I.E.E. Convention, London, May, 1952 : Many questions of interest to the work of C.C.I.R. Study Group No. XI were dealt with in some 70 papers presented at the Convention.
- Xth General Assembly of the U.R.S.I., Sydney (Australia), August, 1952 : Official collaboration between U.R.S.I. and C.C.I.R. on the scientific aspect of some ten important C.C.I.R. questions. Opportunity was taken on the return journey to discuss recent developments at various radio research laboratories in the United States of America.

- Symposium on Theory of Communications, (under the auspices of the I.E.E.), London, September, 1952 : Questions regarding different sides of theory and its practical application were treated. (C.C.I.R. Question No. 44 and Study Programme No. 10.)
- Annual meeting of the Swiss National U.R.S.I. Committee, Zurich, December, 1952 : A yearly review of the most important work done in Switzerland on radio subjects.
- World Symposium on Atmospherics, W.M.O., Zurich, 1953 : A number of questions were treated on which direct collaboration exists between W.M.O. and C.C.I.R. (in general concerning the influence of atmospherics on radio communication reception).
- Meeting of the U.E.R. working group to consider the sky-wave propagation measurement campaign, Milan, May, 1953 : The results of sky-wave measurements of interest to the work of C.C.I.R. Study Group No. VI were discussed and will be presented by the U.E.R. to the Study Group in London.

1.9. *Urgent subjects.*

Certain of the Questions and Study Programmes of the C.C.I.R. were judged to be urgent by the E.A.R.C. The chairmen of most of the study groups dealing with these urgent problems felt it necessary to hold meetings so as to speed up the work of their groups on these questions.

The Director would welcome the guidance of the Plenary Assembly as to how urgent questions should be dealt with in the future. He would draw the attention of members to the long delays which frequently occur in practice when questions are dealt with by correspondence alone. Consideration of this problem is rendered even more timely by the decision of the Buenos Aires Plenipotentiary Conference to hold plenary assemblies of the C.C.I.R. in future normally only every three years. The Plenary Assembly might wish to provide for some form of "interim" recommendations to be issued in certain conditions which it would lay down.

1.10. *New subjects for study.*

1.10.1. The attention of members is drawn to Buenos Aires Resolution No. 5, as follows :

New questions for study by the International Radio Consultative Committee

The Plenipotentiary Conference of the International Telecommunication Union, Buenos Aires,

INSTRUCTS

The International Radio Consultative Committee :

1. to study, on as broad technical bases as possible, the influence of intentional or parasitic oscillations on radio services, especially broadcast and mobile services;
2. to issue recommendations for the eventual establishment of standards permitting a harmonious co-existence of radio services with industrial installations producing radio oscillations."

This subject has become C.C.I.R. Question No. 74 and it has been submitted to Study Group No. IX. Collaboration with the C.I.S.P.R. is envisaged.

1.10.2. Resolution No. 32 of the Buenos Aires Convention reads as follows :

" Linking of certain regions to the world telephone network

The Plenipotentiary Conference of the International Telecommunication Union, Buenos Aires,

CONSIDERING

1. that many inhabited regions of the world, and even regions of some importance, do not yet enjoy the advantages of telephony;
2. that the social, economic and cultural interests of such regions require that they be linked to the general international network;

3. that the realization of this objective poses technical and economic problems;
4. that the studies and trials involved might result in a considerable financial outlay for individual administrations;
5. that the C.C.I.F. and the C.C.I.R. have been entrusted under Administrative Council Resolution No. 247/CA7 *, with studies relating to the linking of the Middle East and Southern Asia to the European network;

INSTRUCTS

the C.C.I.F. and the C.C.I.R. to undertake joint studies with a view to recommending suitable means, having regard to technical and economic considerations, for linking to the world telephone network regions not yet connected thereto."

While this is a C.C.I.F. question, the collaboration of the C.C.I.R. is required and the Director would accordingly ask the Plenary Assembly to lay down the lines along which this should be given. In particular, C.C.I.R. representation at a preliminary conference to be held in Karachi in December 1953 is thought to be necessary and financial provision has already been made in the 1953 extraordinary budget. The detailed questions, or study programmes, which may result from discussion in the Plenary Assembly should, in the view of the Director, be given to Study Group No. IX.

2. The organization of the Specialized Secretariat

2.1.1. *Personnel—General.*

The Director has continued to build up progressively the staff of the Specialized Secretariat so that it should always be efficient and fully occupied. As recommended by the VIth Plenary Assembly in Resolution No. 9 a technical editor (for the French language) and a technical operator have been engaged permanently. On the other hand the post of office technical assistant, class 4, has remained vacant and it is now the Director's considered opinion that this post should not be filled, but that a technical editor for the English language should be engaged permanently. It will be necessary to approve a class 2 post in replacement for the class 4 post for this purpose, but the overall personnel costs will not be increased since the Director finds it possible to reduce the staff of the Secretariat by one, and indeed to effect a saving of approximately 5,000 Swiss francs in the 1954 budget due to this change. In proposing this reduction in staff numbers the Director has assumed that no extra work will be given to the specialized Secretariat by the VIIth Plenary Assembly. The staff now proposed from 1 January 1954 which includes certain reclassifications—in accordance with the decisions of the Buenos Aires Conference—and which has been approved at the 8th Session of the Administrative Council is given in Annex I.

As a result of Buenos Aires Resolution No. 22 some reclassification of staff throughout the Union has just been approved by the Administrative Council and this accounts for the differences in the classes shown in this table for the present establishment in the C.C.I.R. Specialized Secretariat and the classes shown in C.C.I.R. Resolution No. 9.

* Administrative Council Resolution No. 247/CA7 reads as follows :—

"New question for study by the three C.C.I.s on Telecommunication network switching
The Administrative Council,

BEARING IN MIND

the provisions of Article 8, paragraph 2, of the Atlantic City Convention,

CONSIDERING

the advantages that the countries of the Middle East and Southern Asia would derive from the establishment of a switching programme for their telecommunication networks and from the study of how to connect those networks with the major international lines in Europe and the Mediterranean Basin,

RESOLVES

that the following question be studied by the three C.C.I.s :

'To study the best way of connecting countries in the Middle East and Southern Asia with the network of major international telecommunication lines in Europe and the Mediterranean Basin, by metallic lines or by radio relay links.'

Note : This question will be studied by the "Joint Committee for the General Switching Programme" of the C.C.I.F., with representatives of the C.C.I.T., the C.C.I.R., I.C.A.O., W.M.O., E.B.U. and I.B.O.; its aim is to meet the telecommunication requirements of the public telegraph and telephone services simultaneously with those of civil aviation, meteorology and broadcast programme relays."

2.1.2. *Director.*

The Director advises members that he will attain the age of 65 in January 1954 and that under the I.T.U. Staff Regulations (Article 57) retirement normally takes place at the end of the year in which a male staff member completes his 65th year, but that a possibility is provided for an extension not exceeding two years. Under para. 1 of chapter 13 of the General Regulations annexed to the Buenos Aires Convention, Plenary Assemblies of the C.C.I.s will in future normally meet every three years, so that the VIIIth Plenary Assembly of the C.C.I.R. would not meet until the autumn of 1956.

It will, therefore, be necessary for the VIIth Plenary Assembly, by virtue of Article 8, para. 4 c) of the Atlantic City Convention, to consider the question of an extension of two years of the term of office of the present Director, or the election of a successor. This question will therefore be put on the agenda among the administrative questions.

2.2. *Ordinary budget of the Specialized Secretariat.*

Annex II-A gives the estimate of expenses approved by the VIth Plenary Assembly for the years 1951, 1952 and 1953, together with the budgets approved by the Administrative Council for these years and the actual expenditure for 1951 and 1952. The details of the 1953 and 1954 budgets approved by the Administrative Council as well as estimates of expenditure for 1955 and 1956 are given in Annex II-B.

2.3. *Offices of the Specialized Secretariat.*

In his report to the VIth Plenary Assembly, the Director drew the attention of C.C.I.R. members to the suitability and adequacy of the present premises for the work of the Secretariat. In particular, noise measurements made at the Villa Bartholoni, the offices of the C.C.I.R., and at the Palais Wilson, the offices of the rest of the I.T.U., on low, medium and very high frequencies, show that the energy level of radio noise is from 10 to 200 times lower at the Villa Bartholoni than at the Palais Wilson. It is important that the C.C.I.R. should continue to occupy this, or an equally low noise level site, in view of the measurements mentioned in para. 1.2. of this report.

3. **The relative provisions for the C.C.I.s in the Atlantic City and Buenos Aires Conventions.**

The general organization set out in the Atlantic City Convention was left virtually unchanged although some changes in detail were made. Some of the main provisions of the Atlantic City and Buenos Aires Conventions and General Regulations concerning the organization and the work of the C.C.I.s are set out in Doc. No. 283 for the convenience of members.

ANNEX I

PROPOSED STAFF OF THE C.C.I.R. SPECIALIZED SECRETARIAT (as of 1 January 1954)

No.	Classification	Function	Class
1	Director	—	A
2	Vice-Director	—	B
3	Counsellor	Engineer I	D
4	Secretary, 1st Class	Engineer II	1
5	Secretary, 1st Class	Admin. secretary	1
6	Secretary, 2nd Class	Techn. editor (Fr.)	2
7	Secretary, 2nd Class	Techn. editor (Eng.)	2 *
8	Technical Assistant	Techn. operator I	3
9	Asst. admin. officer	Secr. Director	4
10	Asst. admin. officer	Secr. Vice-Director	4
11	Office assistant I	Admin. assistant	5
12	Office assistant I	Admin. assistant	5
13	Office assistant I	Techn. operator II	5 *
14	Secretary-stenographer	Secretary-stenographer	5
15	Machine operator	Mimeograph operator	7 **
16	Office clerk	Caretaker	7

* Not yet filled as of 1 July 1953.

** To be filled intermittently, as the need arises.

ANNEX II-A

ORDINARY C.C.I.R. BUDGETS 1951-1953

	1951	1952	1953
Approved C.C.I.R. Resolution No. 7 . .	472,500.—	450,970.—	512,955.—
Approved Administrative council I.T.U. .	472,500.—	462,400.—	494,300.—
Actual expenditure	430,269.70	383,816.79	—
Credit balance	42,230.30	78,583.21	—

ANNEX II-B*

C.C.I.R. ORDINARY BUDGETS FOR 1953 AND 1954, AS APPROVED BY THE 8TH SESSION OF THE ADMINISTRATIVE COUNCIL

Section 6. C.C.I.R.

Estimates of C.C.I.R. ordinary expenditure for 1955 and 1956

Subheads	1953	1954	1955	1956
1. Staff				
.10 (a) Salaries	287.030	305.000	333.410	340.320
.10 (b) Cost-of-living allowance	4.600	4.600	4.800	4.950
.11 Superannuation and benevolent funds	47.380	49.900	55.790	56.790
.12 Expatriation allowances	15.800	7.610	2.500	2.000
.13 (a) Family allowances	5.600	6.400	6.400	7.200
.13 (b) Children's education allowance	1.500	1.500	1.500	1.500
.14 Removal expenses	3.000	3.000	2.500	2.000
.15 Overtime	500	500	500	500
.16 Gratuities for long service	—	—	—	—
.17 Home leave	25.000	3.000	30.000	4.000
.18 Temporary staff	6.300	6.600	6.900	7.200
.19 Other staff expenses	—	—	—	—
.191 Other Union contributions to the pension scheme	23.500	4.100	7.500	7.500
.193 Management expenses of the staff pension scheme	2.500	2.500	2.500	2.500
— Reclassification of certain posts	4.180	3.275	3.300	3.300
	426.890	397.985	457.600	439.760
2. Travel and representation expenses				
.20 Travel expenses in Switzerland	500	500	500	500
.21 Travel expenses outside Switzerland	12.500	15.500	15.500	15.500
.22 Representation of the Union at meetings of other organizations	—	16.000	—	16.000
	13.000	16.000	16.000	16.000
3. Offices				
.30 Rent				
.301 Rent of Palais Wilson	—	—	—	—
.302 Rent of Maison des Congrès	—	—	—	—
.303 Rent of Villa Bartholoni	15.000	18.000	18.000	18.000
	15.000	18.000	18.000	18.000
.31 Office equipment				
.310 Books, maps, papers	5.000	5.000	5.000	5.000
.311 Furniture and machines	2.000	2.000	2.000	2.000
	7.000	7.000	7.000	7.000
.32 Office overheads				
.320 Office supplies	5.000	6.000	6.000	6.000
.321 Lighting, heating	5.000	5.000	5.000	5.000
.322 Postage	2.500	2.500	2.500	2.500
.3221 Telephone service	4.500	4.500	4.500	4.500
.323 Service (cleaning, upkeep, concierge)	500	500	500	500
	17.500	18.500	18.500	18.500
.33 Installations, transfer and repairs to premises				
.331 Installation of the office and repairs to premises	500	500	500	500
.332 Technical apparatus	10.000	10.000	9.000	8.000
	10.500	10.500	9.500	8.500
.34 Central library (contribution)	2.500	3.000	3.000	3.000
.35 Darkroom (contribution)	500	500	500	500
5. Miscellaneous and unforeseen				
.51 Miscellaneous	1.000	1.500	1.000	1.000
.52 Unforeseen	410	615	900	740
	1.410	2.115	1.900	1.740
TOTAL	494.300	473.600	530.000 **	513.000 **

* Note by the Director. The VIIth Plenary Assembly of the C.C.I.R. at its eight session (see London Doc. 834, p. 30) took note of the C.C.I.R. ordinary budgets for 1953 and 1954, as already approved by the Administrative Council, and accepted the estimates of C.C.I.R. ordinary expenditure for the years 1955 and 1956 as given in this Annex II-B.

** The figures approved by the Plenipotentiary Conference in Buenos Aires for 1955 and 1956 are Sw. frs. 535.800 and 513.000 respectively.

EXTENSION OF THE MANDATE OF THE DIRECTOR, C.C.I.R.

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EXTENSION OF THE MANDATE OF THE DIRECTOR, C.C.I.R.

On a proposal by the Swedish Administration, and in accordance with Art. 57 of the I.T.U. Staff Regulations, an extension of the mandate of Prof. Dr. Balth. van der Pol. as Director of the C.C.I.R. until 31st December 1956, was accepted by acclamation at the VIIth Plenary Assembly.*

* See Doc. No. 436, London.

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LIST OF DOCUMENTS OF THE VIIth PLENARY ASSEMBLY

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LIST OF DOCUMENTS OF THE VIIth 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 one addendum.

⁴ documents having three addenda.

⁵ documents which have been revised.

⁶ documents having an amendment.

A. — In numerical order

No.	Submitted by	Title	Subject	Study Group
1 ¹	Italy	Presentation of antenna radiation data	Question 49	IV
2	United States of America	Bandwidth and signal-to-noise ratios in complete systems	Question 3 Study Progr. 8	III
3	United States of America	Presentation of the results of atmospheric radio noise measurements for the requirements of operational services	Question 11	III
4	United States of America	Application of atmospheric radio noise measurements to the requirements of operational services	Question 11	III
5 *	United States of America	Voice-frequency telegraphy on radio circuits	Question 43 Study Progr. 9	III
6	United States of America	Theory of communication and its practical applications	Question 44 Study Progr. 10	III
7	United States of America	Directivity of antennas at long distances and pulse transmission at oblique incidence	Recommend. 46 and 58 Question 48	III
8	United States of America	Effect of tropospheric refraction on frequencies below 10 Mc/s	Study Progr. 11	IV
9	United States of America	Presentation of antenna radiation data	Question 49	IV
10 *	United States of America	Ground-wave propagation	Question 6 para. 2	IV

No.	Submitted by	Title	Subject	Study Group
11 *	United States of America	Effects of irregular terrain on ground-wave propagation	Study Progr. 14	IV
12	United States of America	Tropospheric propagation curves	Study Progr. 17	V
13	United States of America	Field-strength measurement—Influence of local conditions on interpretation and accuracy of measurements of field strength	Study Progr. 19 Question 8, para. A.5	V
14	United States of America	Field-strength measurement—Best methods for expressing the field strength of unmodulated continuous-wave transmissions	Study Progr. 19	V
15	United States of America	Field-strength measurement—Best methods for expressing field strength for pulse transmissions	Study Progr. 19 Question 8, para. A.1c	V
16	United States of America	Field-strength measurement—Desirable and attainable accuracy of field-strength measurement for each frequency band	Study Progr. 19 Question 8, para. A.4	V
17	Belgium	A note on the theory of repeated automatic-sweep radio-spectrum analysers	Question 1a	I
18	United States of America	Field-strength measurement—Merits of a standard noise generator as the source of the locally-generated signal	Study Progr. 19 Question 8, para. A.7	V
19	United States of America	Measurement of field strength. Merits of a standard noise generator as the source of the locally-generated signal	Report 6	V
20	Federal German Republic	Tropospheric propagation curves for distances well beyond the horizon	Study Progr. 17	V
21 ¹	Federal German Republic	Tropospheric wave propagation	Study Progr. 18	V
22 *	Federal German Republic	Study of fading	Study Progr. 24	VI
23 *	Federal German Republic	Severity of fluctuation in field at reception	Question 51	VI
24 *	Federal German Republic	Allowances for fading	Question 52	VI
25 *	New Zealand	Practical uses of radio propagation data	Question 50	VI
26 *	New Zealand	The application of high-frequency predictions to the Tasman region	Question 50, para. 3	VI

No.	Submitted by	Title	Subject	Study Group
27 *	New Zealand	Allowances for fading	Question 52	VI
28	New Zealand	Choice of a basic index for ionospheric propagation—Report	Question 53	VI
29	New Zealand	Measurement of atmospheric radio noise—Report	Study Progr. 23, paras. 7 & 8	VI
30	New Zealand	Study of fading—Report	Study Progr. 24, paras. 3 & 4	VI
31	United States of America	Exchange of information for forecasts and warnings	Recomm. 59	VI
32	United States of America	Atmospheric noise data	Recomm. 67	VI
33	United States of America	Prediction of solar index	Recomm. 69	VI
34	United States of America	Allowances for fading	Question 52	VI
35	United States of America	Choice of a basic index for ionospheric propagation	Question 53	VI
36	United States of America	Non-linear effects in the ionosphere	Study Progr. 20	VI
37 * 3	United States of America	Radio propagation at frequencies below 1500 kc/s	Study Progr. 21	VI
38	United States of America	Ionospheric propagation of waves in the range of 30 to 300 Mc/s	Study Progr. 22	VI
39 *	United States of America	A review of VHF ionospheric propagation	Study Progr. 22	VI
40	United States of America	World-wide atmospheric radio noise measurement programme	Study Progr. 23	VI
41	United States of America	World-wide allocation of certain frequencies	Study Progr 23	VI
42	United States of America	Measurement of atmospheric radio noise	Study Progr. 23	VI
43	United States of America	Study of fading	Study Progr. 24	VI
44	Netherlands	Pulse transmission at oblique incidence—Report Working Group VI-J	Recomm. 58	VI
45	United States of America	Review of publications on propagation	Report 3	IV, V, VI
46	United States of America	Long-distance propagation of waves of 30 to 300 Mc/s by way of ionization in the E and F regions of the ionosphere	Report 7	VI

No.	Submitted by	Title	Subject	Study Group
47	United States of America	Rapid exchange of information on propagation	Report 10	VI
48	United States of America	Standard frequency transmissions and time signals	Question 54 Study Progr. 25	VII
49	United States of America	Accuracy of field-strength measurements by monitoring stations	Question 55 Recomm. 21	VIII
50 ¹	Secretariat of C.C.I.R.	List of documents (Nos. 1 to 50)		
51	United States of America	Watch on the radio telephone distress frequency of 2182 kc/s	Question 57	IX
52	United States of America	Proposal relating to the standardization of radiophoto and telephoto equipment	Question 58	IX
53	United States of America	Power relationships for modulated emissions	Question 59	IX
54	United States of America	Preferred methods of specifying power supplied to an antenna by a radio transmitter	Question 60	IX
55	United States of America	Relating to pulse transmission for radio direction-finding	Question 61	IX
56 *	United States of America	Identification of radio stations	Question 17 Study Progr. 26	IX
57	United States of America	5-unit radio teleprinter—Report	Question 19 Study Progr. 27	IX
58	United States of America	Wide-band radio systems operating in the VHF (metric), UHF (decimetric) & SHF (centimetric) bands	Study Progr. 28	IX
59	United States of America	Alarm signal for use on the maritime radio telephone distress frequency 2182 kc/s	Recomm. 71 Study Progr. 29	IX
60	United States of America	Classification of the frequency and wavelength bands used in radio communication	Question 73	XIV
61	New Zealand	Standards for sound recording for the international exchange of programmes	Question 63	X
62	New Zealand	Standards for sound recording for the international exchange of programmes	Question 63	X
63	New Zealand	High-frequency broadcasting. Conditions for satisfactory reception	Question 39	X
64	United States of America	Ratio of the wanted to the unwanted signal in television	Question 67	XI
65 *	United States of America	Disturbances in television receivers resulting from harmonics and other non-essential radiations from radio transmitters	Recomm. 83	XI

No.	Submitted by	Title	Subject	Study Group
66	United States of America	Final report of "ad hoc" Committee of N.T.S.C. on dot-interlace or dot-arresting for black-and-white television	Study Progr. 37	XI
67	United States of America	Revised specifications for field-test of N.T.S.C. compatible color television	Study Progr. 37	XI
68	United States of America	Narrow-band transmission of the N.T.S.C. color signal	Study Progr. 37	XI
69	United States of America	Colorimetry in color television	Study Progr. 37	XI
70	United States of America	Color-carrier reference phase synchronization accuracy in N.T.S.C. color television	Study Progr. 37	XI
71	Belgium	5-unit code for radio teleprinter	Question 19	IX
72	United Kingdom	5-unit radio teleprinter	Study Progr. 27 Question 19	IX
73	United Kingdom	Identification of radio stations	Study Progr. 26	IX
74	United Kingdom	Pulse transmission for radio direction-finding	Question 61	IX
75	United Kingdom	Preferred methods of specifying power supplied to an antenna by radio transmitters	Question 60	IX
76	United Kingdom	Power relationships for modulated emissions	Question 59	IX
77	United Kingdom	Watch on the radio telephony distress frequency of 2182 kc/s	Question 57	IX
78	United States of America	Bandwidths of emissions	Study Progr. 1 Question 1a	I
79 *	United States of America	Measurement of bandwidth of emissions	Question 1a	I
80 *	United States of America	Harmonic and parasitic emissions	Question 1b Study Progr. 2	I
81 *	United States of America	Frequency stabilization of transmitters	Question 1c Study Progr. 3	I
82	United States of America	Telegraphic distortion	Question 18 Report 1	I
83	United States of America	Frequency-shift keying	Question 20 Study Progr. 4	I
84	United States of America	Arrangement of channels in multi-channel transmitting for long-range circuits	Question 46	I
85	United Kingdom	Nomenclature of frequency bands	Question 73	XIV

No.	Submitted by	Title	Subject	Study Group
86	United Kingdom	Polarization advantage in the planning of television and VHF sound broadcasting services	New question	XI
87 ^a	United Kingdom	Alarm signal for use on the maritime radio telephony distress frequency 2182 kc/s	Study Progr. 29	IX
88	United Kingdom	Wide-band radio systems operating in the VHF (metric), UHF (decimetric and SHF (centimetric) bands	Study Progr. 28	IX
89	United Kingdom	Automatic monitoring of channel usage	Proposed new question	VIII
90	United Kingdom	Standard frequency transmissions and time signals	Study Progr. 25	VII
91	United Kingdom	Non-linear effects in the ionosphere	Study Progr. 20	VI
92	United Kingdom	Choice of a basic index for ionospheric propagation	Question 53	VI
93	United Kingdom	Revision of the 1937 C.C.I.R. propagation curves and their possible extension to higher frequencies	Study Progr. 16	VI
94	United Kingdom	Measurement of the phase changes along a ground-wave path at low frequencies	Study Progr. 15	VI
95 [*]	United Kingdom	Effects of irregular terrain on ground-wave propagation	Study Progr. 14	VI
96 ^{*3}	United Kingdom	Temporal variations of ground-wave field strengths	Study Progr. 12	IV
97	United Kingdom	Effects of tropospheric refractions on frequencies below 10 Mc/s	Study Progr. 11 para. 1.	IV
98 ^{*3}	United Kingdom	Selectivity of receivers (excluding television receivers)	Study Progr. 6	II
99 [*]	United Kingdom	Selectivity of receivers (television receivers)	Study Progr. 6	II
100 ¹	Secretariat of C.C.I.R.	List of documents issued (51 to 100)	—	—
101 ^{*3}	Chairman, Study Gr. I	Report of Chairman of Study Group I	—	I

No.	Submitted by	Title	Subject	Study Group
102* ¹	Chairman, Study Gr. II	Report of Chairman of Study Group II	—	II
103	Chairman, Study Gr. III	Report of Chairman of Study Group III	—	III
104* ²	Chairman, Study Gr. IV	Report of Chairman of Study Group IV	—	IV
105	Chairman, Study Gr. V	Report of Chairman of Study Group V	—	V
106	Chairman, Study Gr. VI	Report of Chairman of Study Group VI	—	VI
107	Chairman, Study Gr. VII	Report of Chairman of Study Group VII	—	VII
108	Chairman, Study Gr. VIII	Report of Chairman of Study Group VIII	—	VIII
109	Chairman, Study Gr. IX	Report of Chairman of Study Group IX	—	IX
110	Chairman, Study Gr. X	Report of Chairman of Study Group X	—	X
111	Chairman, Study Gr. XI	Report of Chairman of Study Group XI	—	XI
112 ¹	Chairman, Study Gr. XII	Report of Chairman of Study Group XII	—	XII
113	Chairman, Study Gr. XIII	Report of Chairman of Study Group XIII	—	XIII
114	Chairman, Study Gr. XIV	Report of Chairman of Study Group XIV	—	XIV
115	Director, C.C.I.R.	Report of Director, C.C.I.R.	—	—
116* ³	United Kingdom	Sensitivity and noise-figure of receivers. The measurement of sensitivity and noise- figure of television receivers.	Question 47	II

No.	Submitted by	Title	Subject	Study Group
117 *	United Kingdom	Sensitivity and noise-figure of receivers. Measurement of noise-figure of receivers above 30 Mc/s.	Question 47	II
118 * ³	United Kingdom	Sensitivity and noise-figure of receivers	Question 47	II
119 *	United Kingdom	Sensitivity and noise-figure of receivers. Measurement of sensitivity of frequency-shift telegraphy receivers.	Question 47	II
120	United Kingdom	Arrangement of channels in multi-channel transmitters for long-range circuits. Arrangement and designation of channels on multi-channel radiotelephone systems.	Question 46	I
121 *	United States of America	Noise and sensitivity of receivers	Question 47	II
122 *	United States of America	Stability of receivers	Study Progr. 5	II
123 *	United States of America	Selectivity of receivers	Study Progr. 6	II
124 *	Belgium	Reduction of harmonics and combined waves from high-power broadcasting transmitters	Question 1b Study Progr. 2	I
125	United Kingdom	Standardisation of radiophoto and telephoto equipment	Question 58 Report 11	IX
126	Japan	Proposal on arrangement of channels in multi-channel SSB transmitters	Question 46	I
127 *	Japan	Report on bandwidth of emissions	Study Progr. 1	I
128	Japan	Report on measurement of bandwidth of emissions	Study Progr. 1	I
129	Japan	Report on bandwidth of class A2 emissions	Study Progr. 1	I
130 *	Japan	Power measurement of the higher harmonics of transmitters	Study Progr. 2	I
131 *	Japan	Frequency stabilization of transmitters proposal	Study Progr. 3	I
132 *	Japan	Proposal on stability of receivers	Study Progr. 5	II

No.	Submitted by	Title	Subject	Study Group
133*	Japan	Noise figure and sensitivity. Present position in Japan	Question 47	II
134	Japan	Report on communication theory and its practical applications	Study Progr. 10 Question 44	III
135	Denmark	Standards for sound recording for the international exchange of programmes	Question 63	X
136*	Netherlands	Spectrum analyzer	Question 1 (§b)	I
137	Japan	References of communication theory in Japan	Study Progr. 10	III
138	Japan	List of publications on radio propagation	Recomm. 14	IV, V & VI
139*	Japan	Report on ground-wave propagation research in Japan	Study Progr. 13, 14 & 15	IV
140*	Japan	Estimation of medium-wave field strength over mixed paths—Report	Study Progr. 13, 14 & 15	IV
141	Japan	New method of calculating ground-wave field strengths over mixed paths—Report	Study Progr. 13, para. 3	IV
142	Japan	Report on tropospheric propagation research in Japan	Study Progr. 17 & 18	V
143	Japan	Report on ionospheric propagation research in Japan	Recomm. 14	VI
144*	Japan	Report on practical uses of radio propagation data	Question 50	VI
145*	Japan	The mechanism and distribution of short-period fading under conditions of ionospheric turbulence	Study Progr. 24, paras. 1 & 3	VI
146*	Japan	Report on study of fading of broadcasting waves (540-1600 kc/s)	Study Progr. 24, para. 1	VI
147	Japan	Study of long-distance propagation of VHF waves by sporadic E ionization—Report	Study Progr. 22	VI
148	Japan	Report on sweep-frequency pulse tests at oblique incidence	Recomm. 9	VI
149	Japan	Electromagnetic field standards at high frequencies—Report	Question 8, para. A 4	VI
150	Secretariat of C.C.I.R.	List of documents issued (101 to 150)	—	—
151	Japan	Standard-frequency transmissions and time signals	Study Progr. 25	VII
152 ¹	Japan	Bandwidth measurement by monitoring stations—Report	Question 16	VIII

No.	Submitted by	Title	Subject	Study Group
153	Japan	Standardisation of radiophoto and telephoto equipment	Question 58	IX
154*	United Kingdom	Ground-wave propagation	Question 6	IV
155	United Kingdom	Measurement of atmospheric noise—Report	Study Progr. 23	VI
156	United Kingdom	Means of expression	Resolution 5	XIV
157 ³	Netherlands	Reception of standard time signal transmissions from WWV in the Netherlands	Question 54 Study Progr. 25	VII
158	Netherlands	Reception of standard frequency and time signal transmissions from WWV in the Netherlands—Report	Question 54 Study Progr. 25	VII
159	Switzerland	Propagation of ultra-short waves beyond the Alps	Study Progr. 17	V
160*	Japan	Propagation formulae and calculating nomograms for VHF and UHF over mountains	Study Progr. 17 & 18	V
161	Japan	Propagation formulae and calculating nomograms for VHF and UHF over the smooth earth	Study Progr. 17 & 18	V
162	Netherlands	The evaluation of ground-wave fields for short distances	Study Progr. 16	IV
163	United States of America	Requirements for the transmission of television over long distances—Report	Study Progr. 32	XI
164	Overseas Territories of the French Republic	Report	Study Progr. 38 Questions 4 & 27	XII
165	United Kingdom	High-frequency broadcasting. Directive aerial systems	Question 23	X
166*	United Kingdom	Selectivity of receivers : the measurement of selectivity of television receivers	Study Progr. 6	II
167*	United Kingdom	Stability of receivers	Study Progr. 5	II

No.	Submitted by	Title	Subject	Study Group
168*	United Kingdom	A radio frequency spectrum analyser for the HF band	Study Progr. 1	I
169	United Kingdom	High-frequency broadcasting. Common frequency operation	Question 37 Study Progr. 30	X
170	United Kingdom	Accuracy of field-strength measurement by monitoring stations	Question 55	VIII
171	United Kingdom	Colour acuity	Questions 65 & 68	XI
172	United Kingdom	Colour acuity : further work	Questions 65 & 68	XI
173	United Kingdom	A note on the definition of visual acuity	Questions 65 & 68	XI
174	France	Alarm signal for use on the maritime radio telephony distress frequency, 2182 kc/s	Study Progr. 29	IX
175	United Kingdom	Studies made in the United Kingdom of HF radio-wave propagation across the North Atlantic	Study Progr. 24	VI
176	Italy	Measurements of the propagation time of time signals in May, 1951	Recomm. 70 Question 54 Study Progr. 25	VI, VII
177	Italy	Standard-frequency transmissions and time signals	Question 54 Study Progr. 25	VII
178*	Italy	Broadcasting and television receivers	Question 47 Rec. 41 & 42 Study Progr. 5 & 6	II XI
179	United Kingdom	Presentation of the results of atmospheric radio noise measurements for the requirements of operational services	Question 11	III
180	France	Watch on the radio telephony distress frequency of 2182 kc/s	Question 57	IX
181	Overseas Territories of the French Republic	Standard-frequency transmissions and time signals	Study Progr. 25	VII
182	International Time Bureau (B.I.H.)	Standard-frequency and time signal transmissions	Recomm. 70 Study Progr. 25	VII
183	International Scientific Radio Union	Standard-frequency transmissions and time signals	Recomm. 70 Question 54 Study Progr. 25	VII
184	United States of America	The reception of high-frequency broadcasting with synchronized transmitters—Report	Study Progr. 30	X

No.	Submitted by	Title	Subject	Study Group
185*	United States of America	High-frequency broadcasting. Conditions for satisfactory reception	Question 39	X
186	United States of America	High-frequency broadcasting. Directive antenna systems—Proposed Report	Question 23	X
187	United States of America	Standards of sound recording for the international exchange of programmes	Study Progr. 31	X
188*	United States of America	High-frequency broadcasting. Justification for use of more than one frequency per programme	Question 37	X
189	Australia	A recommended specification of the resolution of television picture signal generators	Question 65	XI
190	United States of America	5-unit radio teleprinter	Question 19 Study Progr. 27	IX
191*	Switzerland	Measurement of bandwidth of emissions. Description of a frequency analyser	Recomm. 37	I
192	United Kingdom	Standards of sound recording for the international exchange of programmes	Question 63 Study Progr. 31	X
193*	Netherlands	Frequency stabilization of transmitters	Study Progr. 3	I
194	Italy	Accuracy of field-strength measurement by monitoring stations	Recomm. 21 Question 55	VIII
195	Italy	Tropospheric propagation—Reports	Study Progr. 17 & 18	V
196 ¹	Italy	Radio noise measurement	Study Progr. 23	VI
197*	France	Sensitivity and noise figure of receivers	Question 47	II
198	France	Standard-frequency transmissions and time signals	Recomm. 70 Question 54 Study Progr. 25	VII
199*	Italcable	Measurement of the spectra of A1 telegraphy emissions	Recomm. 36 Study Progr. 1	I
200 ¹	Secretariat of C.C.I.R.	List of documents issued (151 to 200)	—	—
201	United States of America	Tropospheric propagation curves for distances well beyond the horizon—Report	Study Progr. 17	V
202	Japan	Propagation formulae and calculating nomograms for VHF and UHF over the smooth earth. Supplement to Doc. 161-E	Study Progr. 17 & 18	V
203	Director, C.C.I.R.	Report by Director, C.C.I.R.	Draft new question	Plenary

No.	Submitted by	Title	Subject	Study Group
204	France	Bandwidth and signal-to-noise ratios in complete systems	Question 3 Study Progr. 8	III
205*	France	Voice-frequency telegraphy on radio circuits	Question 43 Study Progr. 9	III
206*	France	Directivity of antennae at great distances	Question 48	III
207	France	Use of cymomotive force for the presentation of antenna radiation data	Question 49	IV
208	France	Publications on (tropospheric) propagation issued in France since 1950	Report 3	V
209	France	Tropospheric propagation curves for distances well beyond the horizon	Study Progr. 17	V
210	France	Tropospheric propagation curves for distances well beyond the horizon	Study Progr. 17	V
211	France	Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings	Recomm. 5	VI
212	France	Draft resolution on the preparation of short-term forecasts of ionospheric disturbances	—	VI
213 ¹	France	Choice of a basic index for ionospheric propagation—a solar radio index—Report	Question 53	VI
214 ¹	France	Draft Resolution	Question 53	VI
215	France	High-frequency broadcasting. Justification for use of more than one frequency per programme	Question 37	X
216	France	Weighting curves of psophometers	Question 15 of C.C.I.F.	X
217	France	Reply by the Radiodiffusion Francaise to C.C.I.F. Question 14	Question 14 of C.C.I.F.	X
218	France	Recording : draft technical vocabulary	Resolutions 4 & 5	X, XIV
219	France	Standards of sound recording	Question 63	X
220 ¹	Netherlands	Presentation of the lower limiting frequency of a radio circuit and of the predicted signal-to-noise ratio	Question 50	VI
221 ¹	Netherlands	Production and reduction of ionospheric data standards, symbols and conventions	Recomm. 57	VI
222	Italy	Presentation of antenna radiation data	Question 49	IV

No.	Submitted by	Title	Subject	Study Group
223	Federal German Republic	Classification of the frequency and wave-length bands used in radio-communication	Question 73	XIV
224*	United States of America	Practical uses of radio propagation data	Question 50	VI
225	United Kingdom	Proposed changes to Doc 24 of the meeting of Study Group X, Geneva, 1952	Recomm. 86	X
226	United Kingdom	Standards of sound recording for the international exchange of programmes	Question 63	X
227	United Kingdom	Frequency characteristic in magnetic recording	Question 63	X
228	Federal German Republic	What is the best way of arranging and designating the channels in multi-channel transmitters for long-range circuits ?	Question 46	I
229	Sweden	Investigation of transmission conditions on metric waves (1.6 m) in the relations Stockholm-Mariehamn	Study Progr. 18	V
230	Sweden	Preliminary results obtained by two different methods for measuring atmospheric radio noise	Study Progr. 23	VI
231*	Japan	Report on reliability of MUF prediction. (Continuation of Doc. 144)	Question 50	VI
232	Japan	Report of studies on estimation of medium-wave field strength over mixed paths	Study Progr. 13	VI
233*	Spain	Choice of a basic index for ionospheric propagation (information additional to the report on Question 53, Doc. 30, Stockholm, 1952)	Question 53	VI
234	Netherlands	Identification of radio stations	Question 17 Study Progr. 26	IX
235*	Netherlands	Noise figure of an F.M. receiver	Question 47	II
236*	Netherlands	Two-signal selectivity measurements	Study Progs. 6 & 7	II
237*	Netherlands	Stability of receivers	Study Progr. 5	II
238*	Federal German Republic	Sensitivity and noise figure	Question 47	II
239*	Federal German Republic	Selectivity of receivers	Study Progr. 6	II
240*	Federal German Republic	Stability of receivers	Study Progr. 5	II

No.	Submitted by	Title	Subject	Study Group
241	Australia	Accuracy of field-strength measurement by monitoring stations	Question 55	VIII
242*	Netherlands	Effects of irregular terrain on ground-wave propagation	Study Progr. 14 Question 6, para. 2.3.4 Question 7, para. 1	IV
243* ¹	Netherlands	Ground-wave propagation over mixed paths	Question 6, para. 1 Study Progr. 13	IV
244*	United of America	Relating to pulse transmission for radio direction-finding	Question 61	IX
245	United States of America	Relating to identification of radio stations	Question 17 Study Progr. 26	IX
246*	Yugoslavia (F. P. R. of)	Ground-wave propagation : methods of calculating the conductivity of inhomogeneous ground	Question 6	IV
247	Netherlands	Measurement of atmospheric radio noise—Proposal	Study Progr. 23	VI
248*	Switzerland	Comparative study of frequencies actually used and those predicted by the C.R.P.L.	Question 50, para. 3	VI
249	U.R.S.I.	Theory of communications and its practical applications	Study Progr. 10	III
250	Secretariat of C. C. I. R.	List of documents issued (201 to 250)		
251	International Scientific Radio Union (U.R.S.I.)	Xth General Assembly, Sydney, 1952	Study Progrs. 18 & 19 Report 4	V
252	International Scientific Radio Union (U.R.S.I.)	Xth General Assembly, Sydney, 1952	Question 53 Study Progr. 20, 21 & 23 Recomm. 56, 57, 59 & 69 Draft Recomm., (Green Sheet), Vol. I, C.C.I.R. VIth P.A.	VI
253	Secretariat of C.C.I.R.	Report on World symposium on atmospheric (W.M.O.)	Study Progr. 23	VI
254	Federal German Republic	List of technical terms used in the work of Study Group I	Resolution 5	I, XIV
255	Federal German Republic	Means of expression used in questions, study programmes, recommendations and documents with which Study Group III is concerned	Resolution 5	III, XIV

No.	Submitted by	Title	Subject	Study Group
256	Denmark and report by Director, C.C.I.R.	Transmission from coast stations of the alarm signal for the purpose of testing the automatic alarm apparatus installed on board ships	Proposed new question	Plenary Assembly
257*	Australia	Observations on the reception in Melbourne of the Anglo-Australian beam telegraph circuit	Question 50	VI
258	Secretariat of C.C.I.R.	Preliminary report on Recommendation 69—Prediction of solar index	Recomm. 69	Plenary Assembly
259	Denmark	Microwave propagation studies for over-seas paths in Denmark	Study Progr. 17 & 18	V
260*	Italy	Revision of the 1937 propagation curves and their possible extension to higher frequencies	Study Progr. 16	IV
261	United Kingdom	Ground-wave propagation over mixed paths	Study Progr. 13, paras. 1 & 2	IV
262 ¹	India	A practical examination of the provisional power limits recommended in C.C.I.R. Recommendation 84	Study Progr. 38, para. 2	XII
263	India	Statistical analysis of field strength of All India Radio regional transmitters	Study Progr. 38, para. 4	XII
264 ¹	India	Best method of calculating sky-wave field intensity produced by a transmitter working in the tropical zone	Question 69	XII
265	Chairman of Study Gr. XIV	First preliminary report by the Chairman of Study Group XIV	Question 72	XIV
266	Chairman of Study Gr. XIV	Second preliminary report by the Chairman of Study Group XIV	Question 73	XIV
267	Chairman of Study Gr. XIV	Third preliminary report by the Chairman of Study Group XIV	Resolution 5	XIV
268	Australia	Classification of the frequency and wave-length bands used in radiocommunication	Questions 72 & 73	XIV
269*	Australia	Means of expression	Resolution 5	XIV
270	United States of America	Decimal classification—Systems of units	Question 72 Resolution 6	XIV
271	Federal German Republic	Contribution of the P.T.T. administration of the Federal German Republic to the work of Study Group XIV	Questions 72 & 73 Resolutions 5 & 6	XIV
272	Italy	Contribution to the work of Study Gr. XIV	Questions 72 & 73 Resolutions 5 & 6	XIV

No.	Submitted by	Title	Subject	Study Group
273*	United Kingdom	Voice-frequency telegraphy on radio circuits	Study Progr. 9	III
274*	Austria	Measurement of bandwidth of emissions	Recomm. 37	I, IV, VI
275	United States of America	Proposed amendments to Recommendation 81—Standards of sound recording for the international exchange of programmes	Question 63	X
276	United States of America	Proposed changes to Study Group X, Doc. 24 resulting from the Geneva 1952 meeting relating in particular to magnetic tape recording	Doc. 24 (Geneva 1952) Question 63 Resolution 4 Recomm. 86	X
277	United States of America	Reading of volume or peaks of broadcast transmission—Psophometer for broadcast transmission	C.C.I.F. Questions 14 & 15	X
278	Japan	Report on assessment of the quality of television pictures	Question 65	XI
279	Japan	Report on resolving power and differential sensitivity of the human eye	Question 68	XI
280*	Spain	Choice of a basic index for ionospheric propagation	Question 53	VI
281*	Spain	F.O.T. prediction at any distance according to the Spanish method	Question 53	VI
282	Secretariat of C.C.I.R.	Field-strength measurements at the headquarters of the C.C.I.R.	Study Progr. 17	V
283	Director, C.C.I.R.	The International telecommunications conventions : Atlantic City 1947 and Buenos Aires 1952	Comparison of texts of Atlantic City and Buenos Aires conventions	Plenary Assembly
284	Federal German Republic	Identification of radio stations	Question 17	IX
285	Federal German Republic	5-unit radio teleprinter	Question 19	IX
286*	Secretariat of C.C.I.R.	Note on " Diversity reception "	Study Progs. 8, 18 & 24	III, V & VI
287*	Italy	Revision of propagation curves, and their possible extension to higher frequencies (supplement to Doc. 260)	Study Progr. 16	IV
288*	Japan	Report on the application of statistical analysis to measurements of the frequency stability of radio transmitters and of the accuracy of frequency measuring equipment	Study Progr. 3	I
289 ¹	Japan	Report on F.M. distortion of radio repeater	Study Progr. 28	IX
290*	Japan	Report on selectivity of receivers	Study Progr. 6	II

No.	Submitted by	Title	Subject	Study Group
291	Japan	Report on general characteristics of micro-wave signal variations caused by formation of radio ducts	Study Progr. 18	V
292	Japan	Report on method of measuring k_e and p_e by means of continuous recording of field intensity	Study Progr. 18	V
293	Japan	Report on formation of radio ducts in Japan	Study Progr. 18	V
294	Japan	Report on general aspects of k-type fading	Study Progr. 18	V
295	Japan	Report on distribution function of micro-wave field intensity	Study Progr. 18	V
296 ¹	Japan	Report on the effect of antenna aperture on the reflection coefficient of the earth	Study Progr. 28	IX
297	Japan	Report on problems concerning the reliability of microwave relay links	Study Progr. 28	IX
298	Secretariat of C.C.I.R.	Note by the Director of the C.C.I.R.	Questions 14 & 15 of C.C.I.F.	X
299	Secretariat of C.C.I.R.	Note by the Director of the C.C.I.R. and brief comments by Canada	Questions 37 & 39 Study Progr. 30	X
300 ⁵	Secretariat of C.C.I.R.	List of documents (251 to 300)	—	—
301	Netherlands	International television : the Coronation transmissions	Study Progr. 36	XI
302	Netherlands	A line converter using the image iconoscope	Study Progr. 36	XI
303*	Switzerland	Practical uses of radio propagation data	Question 50	VI
304	United Kingdom	Standard-frequency transmissions from the United Kingdom	Question 54 Study Progr. 25	VII
305*	United Kingdom	Single-sideband broadcasting	Question 62	X
306*	France	Allowances for fading	Question 52	VI
307	Secretariat of C.C.I.R.	Extension of the Director's mandate (letter from the Swedish Administration)	—	Plenary Assembly
308	France	Draft recommendation concerning Question 50	Question 50	VI
309*	France	Comparison of ionospheric predictions with actual propagation conditions	Question 50	VI
310	Switzerland	Standards of sound recording for the international exchange of programmes	Question 63	X
311	Switzerland	Measurement of speed variations and flutter	Study Progr. 31	X

No.	Submitted by	Title	Subject	Study Group
312	Secretariat of C.C.I.R.	Report by the Director—Joint Study Group C.C.I.T.-C.C.I.R.	Question 58 C.C.I.T. Questions V-8a & V-8c	IX
313	Secretariat of C.C.I.R.	Technical assistance to under-developed countries	Technical assistance	Plenary Assembly
314	Secretariat of C.C.I.R.	Telegraphic distortion	Plenary Assembly of C.C.I.T.	I
315	Secretariat of C.C.I.R.	Definitions, symbols, vocabulary	Plenary Assembly of C.C.I.T.	XIV
316	Secretariat of C.C.I.R.	Publication of codes in use in international telegraph services	Findings of C.C.I.T. Plenary Assembly	XIII
317	Secretariat of C.C.I.R.	5-unit radio teleprinter and co-operation between synchronous and start-stop systems	Findings of C.C.I.T. Plenary Assembly	IX
318	Secretariat of C.C.I.R.	Voice-frequency telegraphy on radio circuits	Findings of C.C.I.T. Plenary Assembly	III
319	Secretariat of C.C.I.R.	Status of C.C.I.R. Recommendations	—	Plenary Assembly
320	Federal German Republic	The merits of the several possible systems of modulation and multiplexing in respect of the effective integration of line and radio systems	Study Progr. 28 para. 3.2	IX
321 ¹	Federal German Republic	The addition to and withdrawal of channels from a relay system at intermediate stations	Study Progr. 28 para. 3.3.	IX
322 ¹	Federal German Republic	Monitoring and basic principles of maintenance and reliability of radio relay links integrated into the general network	Study Progr. 28 para. 3.6	IX
323*	European Broadcasting Union (Technical centre)	On the choice of intermediate frequency for domestic supersonic-heterodyne broadcast receivers	—	II
324*	European Broadcasting Union (Technical centre)	On the choice of intermediate frequencies for television receivers and associated questions	Question 47 Study Progr. 5 & 6	II & XI

No.	Submitted by	Title	Subject	Study Group
325	European Broadcasting Union (Technical centre)	The Hamburg recording convention	Question 63 Resolution 4 Study Progr. 31	X
326	European Broadcasting Union (Technical centre)	Technical terminology	Resolution 5	X, XI & XIV
327 ¹	European Broadcasting Union (Technical centre)	First results of a campaign of field-strength observations	Study Progr. 21	VI
328 ⁵	Belgium	Use of A.C.E.C. teleprinters (Coquelet system). Summary of present position (Annex to Doc. 71)	Question 19	IX
329	Austria	Report on ground-wave propagation	Question 6	IV
330 ³	United Kingdom (B.B.C.)	Programme meters	Question 14 of C.C.I.F.	X
331*	Federal German Republic	Frequency stabilisation of transmitters	Study Progr. 3	I
332*	Federal German Republic	Radio propagation at frequencies below 1,500 kc/s	Question 5 Study Progr. 21	VI
333	Federal German Republic	Study of fading	Study Progr. 24 Question 14.c	VI
334*	Federal German Republic	Requirements for the transmission of television over long distances	Study Progr. 32	XI
335*	Switzerland	Temporal variation of ground-wave field strengths	Study Progr. 12	IV
336 ¹	Chairman of Study Group IV	Summary of contributions and proposals submitted to Study Group IV—Supplement to Chairman's report	—	IV
337	United Kingdom	Conversion of a television signal from one standard to another	Study Progr. 36	XI
338	Sweden	Study of the assigning of the separate calling frequency and the especially reserved distress frequency for radio telephone in the band 2000-2850 kc/s	Study Progr. 29 Questions 56 & 57	IX
339	Belgium	5-unit code for teleprinters	Study Progr. 27 Question 19	IX

No.	Submitted by	Title	Subject	Study Group
340*	U.S.S.R.	Filtering of short-wave transmitter harmonics	Study Progr. 2	I
341	U.S.S.R.	Picture sharpness and degree of contrast required in television	Study Progr. 37	XI
342	International Time Bureau	Supplementary note on time signals	Study Progr. 25	VII
343	Chairman of Study Group VII	Standard-frequency transmissions and time signals—Addition to Chairman's report	—	VII
344	Italy	Classification of the frequency and wavelength band used in radiocommunication	Question 73	XIV
345*	Italy	Nomogram and chart for reliability computations of radio circuits, via the ionosphere	Doc. 86, meeting Study Group X Washington, 1950	VI
346*	Director of C.C.I.R.	New questions submitted by the I.F.R.B.	—	Plenary Assembly
347	Report by Director of C.C.I.R.	Letter from the I.F.R.B.	—	Plenary Assembly
348*	Netherlands	Ground-wave propagation over mixed paths (supplement to Doc. 243)	Question 6 para. 1 Study Progr. 13	IV
349*	France	Description of a spectroscope	Question 1 Study Progr. 1 Recomm. 37	I
350	Secretariat of C.C.I.R.	List of documents issued (300 to 350)	—	—
351	Netherlands	Report	Study Progs. 1 & 3	I
352	Netherlands	Proposal concerning Sinpo signal reporting code	Recomm. 85	XIII
353	France	Measurement of atmospheric radio noise—Report	Study Progr. 23 paras. 3, 4, 5 & 6	VI
354*	France	Suggestions and comments by the French administration on the programme of work of Study Group XIV	Questions 72 & 73 Resolutions 5 & 6	XIV
355	Australia	The prediction of sunspot numbers	Recomm. 69	VI
356	Australia	Short critique of solar index prediction methods	Recomm. 69	VI
357	Australia	Some experiments on the prediction of sunspot numbers	Recomm. 69	VI

No.	Submitted by	Title	Subject	Study Group
358	Study Group IX	Summary record of the 1st meeting (4 September, 1953)	—	IX
359	Study Group X	Summary record of the 1st Meeting (4 September, 1953)	—	X
360	United States of America	Proposed new recommendation : " Co-ordination of international tests "	Recomm. 58	VI
361	United States of America	Directivity of antennae at great distances—Report	Question 48	III
362	United States of America	Lightning-stroke counters—Report	Study Progr. 23 para. 6	VI
363 ¹	United Kingdom	Tropical broadcasting	Question 70 Study Progr. 38	XII
364	Austria	Bandwidths of emissions—Draft Recommendation	Recomm. 36	I
365	Study Group IV	Summary record of the 1st meeting (4 September, 1953)	—	IV
366	Secretariat of C.C.I.R.	E.A.R.C. Recommendation 14	—	Plenary Assembly
367*	Netherlands	Proposal	Study Progr. 3	I
368	Sub-group IX A	Draft recommendation proposed by Sub-group IX-A in answer to Question 57	Question 57	IX
369	Sub-Group IX B	Summary record of the 1st meeting (7 September, 1953)	—	IX
370	Federal German Republic	Multifrequency ionospheric sounding equipment for oblique incidence	Study Progr. 29 Question 56	VI
371	Sub-group IX A	Draft recommendation from Sub-group IX A concerning Question 56 and Study Programme 29	Study Progr. 29 Question 56	IX
372*	Union of South Africa	Frequency stabilisation of transmitters—stability of receivers	Question 1c. Study Progr. 5	I & II
373	France	Standards of sound recording for the international exchange of programmes	Draft Recomm. 86	X
374	Sub-group XI B	Report of Sub-group XI B	—	XI
375	Study Group III	Summary record of the 1st meeting (7 September, 1953)	—	III
376	Study Group IX	Summary record of the 2nd meeting (7 September, 1953)	—	IX
377	India	A practical examination of the provisional power limits recommended in C.C.I.R. Recommendation 84	Study Progr. 38 para. 2	XII

No.	Submitted by	Title	Subject	Study Group
378	France	Synopsis of results of measurements of sensitivity of human eye using different variables	Questions 65 & 68	XI
379*	France	Conversion of television standards. Arrangements for relaying the Coronation	Study Progr. 36	XI
380	France	Experimental determination of the ratio of the wanted to the unwanted signal for the protection of an 819-line television picture against a pure carrier or a carrier modulated by a square signal	Question 67	XI
381	Sub-Gr. IX C	Summary record of the 1st meeting (7 September, 1953)	—	IX
382	Secretariat of C.C.I.R.	List of Stockholm recommendations	—	Plenary Assembly
383	Study Gr. V	Summary record of 1st meeting (8 September, 1953)	—	V
384 ⁸⁵	Sub-Gr. IX C	Wide-band radio systems operating in the VHF (metric) UHF (decimetric) and SHF (centimetric) bands	Study Progr. 28	IX
385	United States of America	Measurement of field strength of radio signals—Report	Study Progr. 19 Question 8	V
386	United States of America	Presentation of antenna radiation data—Report	Question 49	IV
387	Study Gr. XIV	Summary record of the 1st meeting (4 September, 1953)	—	XIV
388	Study Gr. I	Summary record of the 1st meeting (8 September, 1953)	—	I
389	Sub Gr. III A	Summary record of the 1st meeting (9 September, 1953)	—	III
390	Sub-Gr. II A	Summary record of the 1st meeting (7 September, 1953)	—	II
391	Sub-Gr. IX D	Draft recommendation proposed by Sub-Group IX D in answer to Question 59	Question 59	IX
392	Sub-Gr. IX D	Draft recommendation proposed by Sub-Group IX D in answer to Question 60	Question 60	IX
393	Study Gr. VI	Summary record of the 1st meeting (4 September, 1953)	—	VI
394	Study Gr. XII	Summary record of the 1st meeting (8 September, 1953)	—	XII
395	Secretariat of C.C.I.R.	Minutes of the inaugural ceremony of the VIIth Plenary Assembly of the C.C.I.R. (3 September, 1953)	—	Plenary Assembly

No.	Submitted by	Title	Subject	Study Group
396	Sub-Gr. XI A	Ratio of the wanted to the unwanted signal in television—Draft Report	Question 67	XI
397	Sub-Gr. VIII A	Summary record of the 1st meeting (8 September, 1953)	—	VIII
398	Sub-Gr. VIII A	Automatic monitoring of channel occupancy—Draft new question	—	VIII
399	Study Gr. III	Summary record of the 2nd meeting (9 September, 1953)	—	III
400	Secretariat of C.C.I.R.	List of documents issued (351 to 400)	—	—
401	Study Gr. VII	Summary record of the 1st meeting (8 September, 1953)	—	VII
402	Study Gr. V	New question proposed by Study Group V (submitted by Sub-Group V C). Field measurement in the neighbourhood of obstacles	Recomm. 66	V
403	Sub-Gr. II B	Summary record of the 1st meeting (7 September, 1953)	—	II
404	Study Gr. XI	Summary record of the 1st meeting (7 September, 1953)	—	XI
405 ¹	Study Gr. IV	Summary record of the 2nd meeting (8 September, 1953)	—	IV
406*	C.C.I.T.	Communication by the Director of the C.C.I.T. to the VIIth Plenary Assembly of the C.C.I.R. on Universal decimal classification	Recomm. 1-5 of C.C.I.T.	XIV
407	Study Gr. II	Summary record of the 1st meeting (4 September, 1953)	—	II
408	Sub-Gr. IX C	Summary record of the 2nd meeting (10 September, 1953)	—	IX
409	Sub-Gr. IX C	Summary of Information on C.C.I.F. "Circuit fictif de référence"	—	IX
410	Sub-Gr. II B	Summary record of the 2nd meeting (9 September, 1953)	—	II
411	Sub-Gr. III A	Summary record of the 2nd meeting (11 September, 1953)	—	III
412	Secretariat of C.C.I.R.	List of Sub-Groups	—	Plenary Assembly
413	Study Gr. VII	Corrigendum to documents concerning Study Group VII	—	VII
414	Study Gr. IX	Summary record of the 3rd meeting (10 September, 1953)	—	IX

No.	Submitted by	Title	Subject	Study Group
415	Sub-Gr. VI A	Summary record of the 1st meeting (9 September, 1953)	—	VI
416	C.I.R.M.	Use of the 152-162 Mc/s band	—	III
417	Study Gr. VIII	Summary record of the 1st meeting (7 September, 1953)	—	VIII
418	Sub-Gr. III A	Proposal submitted by Sub-Group III A for the consideration of Study Group III to replace Recommendations 1 & 43	Recomm. 1 & 43	III
419	Study Gr. XIV	Summary record of the 2nd meeting (8 September, 1953)	—	XIV
420	Sub-Gr. VIII A	Draft Study Programme—Frequency mea- surements above 50 Mc/s by monitoring stations	—	VIII
421	Sub-Gr. VIII A	(Summary record of the 2nd meeting 11 September, 1953)	—	VIII
422	Study Gr. V	Draft revision of Recommendation 55— Tropospheric wave propagation curves	Recomm. 55	V
423	Study Gr. VI	Summary record of the 2nd meeting (7 September, 1953)	—	VI
424	Study Gr. VI	Summary record of the 3rd meeting (9 September, 1953)	—	VI
425	Sub-Gr. XIV A	Summary record of the 1st meeting (11 September, 1953)	—	XIV
426	Federal German Republic	Modifications proposed to Doc. 24 of the Study Group X meeting in Geneva (1952)	Question 63 Recomm. 86	X
427	Study Gr. V	Summary record of the 2nd meeting (10 September, 1953)	—	V
428	Sub-Gr. II C	Summary record of the 1st meeting (8 September, 1953)	—	II
429	Sub-Gr. II C	Summary record of the 2nd meeting (10 September, 1953)	—	II
430	Sub-Gr. II C	Summary record of the 3rd meeting (11 September, 1953)	—	II
431	Federal German Republic	Minimum requirements for satisfactory service	Study Progr. 8	III
432	Federal German Republic	Results of measurements of directivity of antennae at great distances	Question 48	IX
433	Sweden	Ionospheric propagation of waves in the range 30-300 Mc/s	Study Progr. 22	VI

No.	Submitted by	Title	Subject	Study Group
434	Sub-Gr. II B	Summary record of the 3rd meeting (11 September, 1953)	—	II
435*	France	Circuit characteristics for the transmission of television signals over long distances	Study Progr. 32	XI
436	Secretariat of C.C.I.R.	Minutes of the first Plenary session (3 September, 1953)	—	Plenary Assembly
437	Netherlands	Proposal concerning the terms of reference of Study Group X	—	X
438 ¹	Study Gr. XI	Summary record of the 2nd meeting (9 September, 1953)	—	XI
439 ³	Netherlands	Remarks and supplementary proposals in connection with the Chairman's report	Question 54 Study Progr. 25	VII
440	Sub-Group IX C	Summary record of the 3rd meeting (14 September 1953)	—	IX
441	Sub-Group IX B	Report of Sub-Group IX B regarding C.C.I.R. Question 58, Recommendation 25 and Report 11	Question 58 Recomm. 25 Report 11	IX
442	Sub-Gr. IX B	Report of Sub-Group IX B	Question 19 Study Progr. 27	IX
443*	United States of America	Allowances for fading (replaces Doc. 34)	Study Progr. 24 Question 52	III & VI
444	Sub-Gr. III B	Draft study programme	Question 44	III
445	Sub-Gr. III B	Draft recommendation	Question 44	III
446	Study Gr. IV	Summary record of the 3rd meeting (14 September 1953)	—	IV
447	Study Gr. II	Summary record of the 2nd meeting (14 September 1953)	—	II
448	Denmark	Long distance wide-band radio relay systems	Study Progr. 28	Plenary Assembly
449	Sub-Gr. XIV A	Draft report—Decimal classification	Question 72	XIV
450	Secretariat of C.C.I.R.	List of documents issued (400 to 450)	—	—
451	Sub-Gr. II B	Revision of text for Study Programme 6— Selectivity of receivers	Study Progr. 6	II
452	Sub-Gr. XI C	Report	Questions 65 & 68	XI
453	Study-Gr. IX	Summary record of the 4th meeting (14 September, 1953)	—	IX

No.	Submitted by	Title	Subject	Study Group
454	Sub-Gr. X A	Standards of sound recording for the international exchange of programmes—Draft Recommendation	Question 42	X
455 ¹	Sub-Gr. X A	Standards of sound recording for the international exchange of programmes—Lateral-cut recording on disc—Draft Recommendation	Question 42	X
456	Sub-Gr. XIV A	Summary record of the 2nd meeting (15 September, 1953)	—	XIV
457	Austria	Comparison between predicted cut-off frequency values and actual ionospheric conditions	Question 50	VI
458 ⁵	Sub-Gr. VI C	Sub-Group VI-C	Study Progr. 20	VI
459	Sub-Gr. VI A	Summary record of the 2nd meeting (15 September, 1953)	—	VI
460	Sub-Gr. VI F	Summary record of the 1st meeting (14 September, 1953)	—	VI
461	Sub-Gr. II C	Summary record of the 4th meeting (15 September, 1953)	—	II
462	United States of America	Bearing and position classification for HF and VHF direction-finding. Proposed new question	—	Plenary Assembly
463	United States of America	Development of a marine identification system to facilitate safe movement of vessels in congested and restricted areas—Proposed new question	—	Plenary Assembly
464	Sub-Gr. VI A	Pulse transmission tests at oblique incidence—Draft recommendation	Recomm. 58	VI
465	Sub-Gr. IX D	Draft recommendation prepared by Sub-Group IX D on Question 61	Question 61	IX
466	Sub-Gr. V A	Revised draft of Study Programme 17—Tropospheric propagation curves for distances well beyond the horizon	Study Progr. 17	V
467	Study Gr. III	Summary record of the 3rd meeting (16 september, 1953)	—	III
468 ⁴	Study Gr. II	New text for Recommendation 42—Selectivity of receivers (first part only)	Recomm. 42	II
469	Study Gr. V	Summary record of the 3rd meeting (15 September, 1953)	—	V
470	Sub-Gr. VII A	Standard-frequency transmissions and time signals—Draft recommendation	—	VII
471	Sub-Gr. III A	Bandwidth required at the receiver output—Draft recommendation	—	III

No.	Submitted by	Title	Subject	Study Group
472	Study Gr. I	Summary record of the 2nd meeting (16 September, 1953)	—	I
473	Sub-Gr. VI F	Identification of precursors indicative of short-term variations of ionospheric pro- pagation conditions—Draft study pro- gramme	Question 53	VI
474	Sub-Gr. VI F	Prediction of solar index—Draft recom- mendation	Recomm. 69	VI
475	Sub-Gr. VI F	Choice of a basic solar index for iono- spheric propagation—Draft study pro- gramme.	Question 53	VI
476	Sub-Gr. II B	Summary record of the 4th meeting (15 September, 1953)	—	II
477	Czechoslova- kia	Letter	—	Plenary Assembly
478 ¹³	Sub-Gr. II C	Text for new recommendation on stability of receivers	Study Progr. 5, part. I	II
479	Study Gr. VIII	Summary record of the 2nd meeting (16 September, 1953)	—	VIII
480	Study Gr. IX	Summary record of the 5th meeting (17 September, 1953)	—	IX
481	Study Gr. II	Summary record of the 2nd meeting (16 September, 1953)	—	II
482	Study Gr. VIII	Letter from the Chairman of Study Group VIII to the Chairman of Study Group IX	—	VIII & IX
483	Sub-Gr. VIII A	Bandwidth measurement by monitoring stations—Draft study programme	—	VIII
484	Sub-Gr. I B	Frequency-shift keying (draft recommenda- tion)	Recomm. 39 Question 20	I
485	Sub-Gr. IX D	Report of Sub-Group IX D	Recomm. 72, 73, 74, 75, 76, 77, 78	IX
486	Sub-Gr. V B	Investigation of multipath transmission through the troposphere—Draft study programme	—	V
487 ⁵	Sub-Gr. V B	Presentation of data in studies of tropo- spheric wave propagation (Study Pro- grammes 17 & 18)—Draft recommendation	Study Progrs. 17 & 18	V
488	Sub-Gr. VI D	Report and recommendations regarding the design of local lightning flash counters	Study Progr. 23	VI
489	United Kingdom	Measures increasing the utility of the 26 Mc/s broadcasting band during years of high solar activity—Draft resolution	—	Plenary Assembly

No.	Submitted by	Title	Subject	Study Group
490	Working Gr. VI B.1	Practical uses and reliability of ionospheric propagation data—Draft report	Question 50	VI
491	Working Gr. VI B.2	Basic prediction information for ionospheric propagation—Draft study programme	Question 50	VI
492	Working Gr. VI B.2	Basic propagation prediction charts—Draft recommendation	Recomm. 53	VI
493	Working Gr. VI B.2	Use of special modulation on the standard-frequency transmissions for assessing the reliability of propagation forecasts—Draft study programme	—	VI
494	Working Gr. VI B.2	Usage and meaning of M.U.F.—Draft recommendation	—	VI
495	Sub Gr. VIII A	Summary record of the 3rd meeting (18 September, 1953)	—	VIII
496 ³	Study Gr. III	Summary record of the 4th meeting (18 September, 1953)	—	III
497	Study Gr. VII	Summary record of the 2nd meeting (18 September, 1953)	—	VII
498 ¹	Study Gr. XII	Summary record of the 2nd meeting (15 September, 1953)	—	XII
499	German Democratic Republic	Letter from the Government of the German Democratic Republic	—	Plenary Assembly
500	Secretariat of C.C.I.R.	List of documents issued (451 to 500)	—	—
501	Sub-Gr. II C	Summary record of the 5th meeting (18 September, 1953)	—	II
502 ⁵	Sub-Gr. X B	High-frequency broadcasting—Directive antenna systems—Draft report	Question 23	X
503 ⁸	Sub-Gr. IV C	Report by Sub-Group IV C	Question 49	IV
504	Study Gr. IV	Summary record of the 4th meeting (18 September, 1953)	—	IV
505	Study Gr. V	Summary record of the 4th meeting (21 September, 1953)	—	V
506	Hungarian People's Republic	Statement	—	Plenary Assembly
507	Drafting Committee	Field-strength measurements—Merits of a standards noise generator as the source of the locally-generated signal	Report 6	V

No.	Submitted by	Title	Subject	Study Group
508	Drafting Committee	Watch on the radio-telephony, distress frequency of 2182 kc/s—Draft recommendation	—	IX
509	Sub-Gr. VI E	Study of fading—Draft study programme	Questions 51 & 52 Study Progr. 24	VI
510	Study Gr. VIII	Accuracy of field-strength measurements by monitoring stations—Draft study programme	—	VIII
511	Study Gr. VIII	Accuracy of field-strength measurements by monitoring stations—Draft recommendation	—	VIII
512	Study Gr. XIV	Summary record of the 3rd meeting (16 September, 1953)	—	XIV
513	Sub-Gr. III A	Reduction of occupied bandwidth and transmitted power in radiotelephony—Draft recommendation	—	III
514	Sub-Gr. II B	Summary record of the 5th, 6th and 7th meetings (17, 18 and 21 September, 1953)	—	II
515	Working Group II C.2	Protection against keyed interference signals—Draft text for Study Programme 7	Study Progr. 7	II
516*	Sub-Gr. III B	Draft texts proposed for consideration by Study Group III	Recomm. 46 Question 48	III
517	Drafting Committee	Selectivity of receivers	Study Progr. 6	II
518	Drafting Committee	Advantages to be obtained from consideration of polarization in the planning of broadcasting services in the VHF and UHF bands (television and sound)	New question	XI
519	Drafting Committee	Tropospheric wave propagation	Study Progr. 18	V
520	Drafting Committee	Best methods for expressing field strength for pulse transmissions	Recomm. 62	V
521 ¹	Drafting Committee	Field-strength measurement—Influence of local conditions on interpretation and accuracy of measurements of field strength	Recomm. 66	V
522	Drafting Committee	Field-strength measurement—Types of wave collector and equipment for use in each frequency band	Recomm. 64	V
523	Drafting Committee	Automatic monitoring of channel occupancy—Draft question	—	VIII
524	Drafting Committee	Frequency measurements above 50 Mc/s by monitoring stations—Draft question	—	VIII

No.	Submitted by	Title	Subject	Study Group
525 ^a	Drafting Committee	Alarm signal for use on the maritime radio-telephony distress frequency (2182 kc/s)	Recomm. 71	IX
526	Sub-Gr. XIV A	Summary record of the 3rd meeting (18 September, 1953)	—	XIV
527	Sub-Gr. III B	Report to the C.C.I.T. in respect of Question 43	Question 43	III
528	Sub-Gr. III B	Voice-frequency telegraphy on radio circuits—Draft recommendation	—	III
529	Sub-Gr. XIV A	Draft recommendation concerning Question 73	Question 73	XIV
530	Sub-Gr. XIV A	Summary record of the 4th meeting (22 September, 1953)	—	XIV
531	Drafting Committee	Standards of sound recording for the international exchange of programmes	Recomm. 81	X
532	Drafting Committee	Standards of sound recording for the international exchange of programmes—Lateral-cut recording on disc	Recomm. 86	X
533	Drafting Committee	Decimal classification	Question 72	XIV
534	Sub-Gr. IV B	Temporal variation of ground-wave field strengths	Study Progr. 12	IV
535	Sub-Gr. IV B	Ground-wave propagation over mixed paths	Study Progr. 13 & 15	IV
536	Sub-Gr. VI C	Ionospheric propagation of waves in the range 30 to 300 Mc/s	Report 7	VI
537	Sub-Gr. III A	Summary report of the work of Sub-Group III A	—	III
538	Sub-Gr. VI A	Pulse transmission tests at oblique incidence	Recomm. 58	VI
539	Study Gr. XIII	Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships	New question	XIII
540	Audit Group	Report	—	Budget Commission
541	Sub-Gr. VII A	Draft question and study programme	Question 54 Study Progr. 25	VII
542	Sub-Gr. I B	Draft study programme to replace Study Programme 4	Study Progr. 4	I
543	Drafting Committee	Power relationship for modulated emissions	Question 59	IX

No.	Submitted by	Title	Subject	Study Group
544	Drafting Committee	Methods of specifying the power supplied to an antenna by a radio transmitter	Question 60	IX
545	Sub-Gr. I B	Draft proposal	Question 46	I
546	Sub-Gr. VII A	Standard-frequency transmissions and time signals	Recomm. 18 & 70 Study Progr. 25	VII
547	Sub-Gr. I A	Bandwidth measurement of emissions in actual traffic—Draft study programme	Recomm. 37	I
548	United States of America	The organization of the Study Groups of the C.C.I.R.	—	Plenary Assembly
549	Study Gr. II	Choice of intermediate frequency and protection against undesired responses of superheterodyne receivers	Recomm. 42	II
550	Secretariat of C.C.I.R.	List of documents issued (501 to 550)	—	—
551	Sub-Gr. VI D	Draft recommendation on the reservation of frequencies for radio astronomical measurements—Draft recommendation	Recomm. 56	VI
552	Sub-Gr. X B	Draft letter from the Chairman of Study Group X to the Chairman of Study Group VI	Question 37	X, VI
553	Sub-Gr. X B	Single-sideband broadcasting—Draft recommendation	Question 62	X
554	Sub-Gr. X B	Use of synchronised transmitters—Draft recommendation	Study Progr. 30	X
555	Sub-Gr. X B	Use of synchronized transmitters	Study Progr. 30	X
556	Study Gr. I	Telegraphic distortion—Draft recommendation	Question 18	I
557	Study Gr. I	Telegraphic distortion—Draft report	Question 18	I
558	Study Gr. I	Arrangement of channels in multi-channel telegraph systems for long-range radio circuits—Draft question	Question 43	I
559	Sub-Gr. VI F	Choice of a basic index for ionospheric propagation	Question 53	VI
560	Sub-Gr. VI D	Revision of atmospheric noise data—Draft recommendation	Study Progr. 23	VI
561	Sub-Gr. IX B	Report of Sub-Group IX-B regarding Question 17, Study Programme 26 and Recommendation 79	Question 17 Study Progr. 26 Recomm. 79	IX
562	Study Gr. IV	Extension of the C.C.I.R. propagation curves below 300 kc/s—Draft resolution	—	IV

No.	Submitted by	Title	Subject	Study Group
563	Study Gr. IV	Publication of ground-wave propagation curves between 30 and 300 Mc/s—Draft resolution	Question 6 Study Progr. 16	IV
564 ¹⁵	Sub-Gr. XI D	Circuit characteristics for the transmission of television signals over long distances	Study Progr. 32 Report 15	XI
565	Study Gr. X	Summary record of the 2nd meeting (18 September, 1953)	—	X
566	Study Gr. I	Summary record of the 3rd meeting (21 September, 1953)	—	I
567	Study Gr. II	Summary record of the 4th meeting (21 September, 1953)	—	II
568	Finance Committee	Summary record of the 1st meeting (4 September, 1953)	—	Finance Committee
569	Sub-Gr. VI G	Reliability computations. MUF and LUF (Docs. 345 and 188)—Draft report	Question 50 Recomm. 69A	VI
570	Sub-Gr. VI G	Questions submitted by the I.F.R.B. (Doc. 346)—Draft report	Question 50 Recomm. 69A	VI
571	Sub-Gr. IV B	Ground-wave propagation over irregular terrain	Study Progr. 14	IV
572	Study Gr. XI	Revision of Report 15	Report 15	XI
573	Study Gr. IV	Summary record of the 5th meeting (23 September, 1953)	—	IV
574	Study Gr. IX	Summary record of the 6th meeting (21 September, 1953)	—	IX
575 ³	Study Gr. II	Noise and sensitivity of receivers. New text proposed	Recomm. 41	II
576 ¹⁵	Sub-Gr. XIV A	Unit systems—Draft recommendation	—	XIV
577	Sub-Gr. X A	Report to C.C.I.F. with respect to Questions 14 and 15 of C.C.I.F.	Questions 14 & 15 of C.C.I.F.	X
578	Study Gr. X	Standards of sound recording for the international exchange of programmes	Question 42 Study Progr. 31	X
579 ¹	Working Gr. X A.1	Standards of sound recording for the international exchange of programmes (Single-track magnetic recording on tape) —Draft recommendation	Recomm. 81	X
580	Study Gr. II	Undesired emissions from receivers	New question	II
581	Working Gr. VI B.3	Preparation of short-term forecasts of ionospheric disturbances—New Recommendation	Recomm. 59	VI

No.	Submitted by	Title	Subject	Study Group
582	Working Gr. VI B.3	Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings—Draft report	Recomm. 59	VI
583	Study Gr. IV	Presentation of antenna radiation data—Draft recommendation	Question 49	IV
584	Sub-Gr. VI D	Measurement of atmospheric noise	Study Progr. 23	VI
585	Sub-Gr. VI D	Measurement of atmospheric noise	Study Progr. 23	VI
586	Study Gr. I	Summary record of the 4th meeting (23 September, 1953)	—	I
587	Drafting Committee	Standardization of photo-telegraph apparatus for use on combined radio and metallic circuits—Draft recommendation	Question 58	IX
588	Drafting Committee	Standardization of photo-telegraph apparatus for use on combined radio and metallic circuits—Draft recommendation	Question 58	IX
589	Drafting Committee	Facsimile transmission of documentary matter over combined radio and metallic circuits—Draft question	—	IX
590	Drafting Committee	Transmission of half-tone pictures over radio circuits—Draft question	—	IX
591	Drafting Committee	Pulse transmission for radio direction-finding—Draft recommendation	Question 61	IX
592 ¹	Drafting Committee	Use of radio circuits in association with 5-unit start-stop telegraph apparatus—Draft report	—	IX
593	Drafting Committee	Use of radio circuits in association with 5-unit start-stop telegraph apparatus	Question 19	IX
594	Drafting Committee	Use of radio circuits in association with 5-unit start-stop telegraph apparatus—Draft study programme	Question 19	IX
595	Study Gr. XI	Summary record of the 3rd meeting (18 September, 1953)	—	XI
596	Study Gr. X	High-frequency broadcasting : The modification of receivers to permit closer frequency-spacing between carriers of broadcast transmissions—Draft question	Question 62	X
597	Sub-Gr. IV B	Ground-wave propagation over irregular terrain—Draft report	Study Progr. 74	IV
598	Sub-Gr. VI C	Radio propagation at frequencies below 1500 kc/s—Draft recommendation	Study Progr. 21	VI
599	Sub-Gr. III B	Voice-frequency telegraphy on radio circuits	Study Progr. 9	III

No.	Submitted by	Title	Subject	Study Group
600	C.C.I.R. Secretariat	List of documents issued (551 to 600)	—	—
601	Study Gr. VI	Summary record of the 4th meeting (17 September, 1953)	—	VI
602	Study Gr. XIII	Summary record of the 1st meeting (22 September, 1953)	—	XIII
603	Study Gr. VII	Summary record of the 3rd and last meeting (24 September, 1953)	—	VII
604	Sub-Gr. VI E	Fading of high-frequency and medium-frequency signals propagated by the ionosphere	Question 51 Question 52 Study Progr. 24	VI
605	Study Gr. XII	Design of aerials for tropical broadcasting	Question 70	XII
606	Study Gr. XII	Design of aerials for tropical broadcasting	Question 70	XII
607	Sub-Gr. VI E	Investigation of circular-polarised waves in the decameter wave band—Draft recommendation	—	VI
608	Study Gr. I	Bandwidth of emissions	Recomm. 36	I
609	Study Gr. VIII	Summary record of the 3rd meeting (22 September, 1953)	—	VIII
610	Study Gr. VI	Summary record of the 5th meeting (21 September, 1953)	—	VI
611 ¹	Study Gr. XII	Summary record of the 3rd meeting (21 September, 1953)	—	XII
612	Study Gr. X	Standards of sound recording for the international exchange of programmes. Cine-type spools—Draft resolution	—	X
613	Study Gr. V	Summary record of the 5th meeting (24 September, 1953)	—	V
614 ⁵	Study Gr. IX	Collaboration with the C.I.S.P.R.	Recomm. 27	IX
615	Sub-Gr. VI A	Pulse transmission tests at oblique incidence	Recomm. 58	VI
616	Study Gr. X	High-frequency broadcasting. Conditions for satisfactory reception—Draft study programme	Question 39	X
617	Study Gr. X	High-frequency broadcasting: Justification for use of more than one frequency per programme	Question 37	X

No.	Submitted by	Title	Subject	Study Group
618	Study Gr. I	Bandwidth of emissions	Study Progr. 1 Question 1a Recomm. 36	I
619	Drafting Committee	Effects of tropospheric refraction on frequencies below 10 Mc/s	Study Progr. 11	IV
620	Drafting Committee	Tropospheric propagation curves for distances well beyond the horizon—Draft study programme	Recomm. 55	V
621	Drafting Committee	Tropospheric wave propagation curves	Recomm. 55	V
622	Drafting Committee	Prediction of solar index—Draft recommendation	Recomm. 69	VI
623	Drafting Committee	Choice of basic solar index for ionospheric propagation—Draft study programme	Question 53	VI
624	Drafting Committee	Identification of precursors indicative of short-term variations of ionospheric propagation conditions—Draft study programme	—	VI
625 ^s	Drafting Committee	Use of radio circuits in association with 5-unit start-stop telegraph apparatus—Draft question	Question 19	IX
626	Drafting Committee	Use of radio circuits in association with 5-unit start-stop telegraph apparatus—Draft question	Question 19	IX
627	Working Group I A.3	Harmonics and parasitic emissions—Frequency stabilization of transmitters	Recomm. 38 Study Progr. 2	I
628	Study Gr. II	Stability of receivers—Draft question	Study Progr. 5	II
629	Study Gr. II	Selectivity of television receivers	Recomm. 42	II
630	Drafting Committee	Lay-out of the volume of Recommendations, Questions, etc.	—	Plenary Assembly
631	Study Gr. III	Summary record of the 5th meeting (23 September, 1953)	—	III
632	Drafting Committee	Accuracy of field-strength measurements by monitoring stations—Draft recommendation	—	VIII
633	Drafting Committee	Accuracy of field-strength measurements by monitoring stations—Draft study programme	—	VIII
634	Drafting Committee	Wide-band radio systems operating in the VHF, UHF and SHF bands Sub-control stations—Draft recommendation	—	IX

No.	Submitted by	Title	Subject	Study Group
635	Drafting Committee	Wide-band radio systems operating in the VHF, UHF and SHF bands—Draft report	Study Progr. 28	IX
636	Drafting Committee	Artificial reference circuit for wide-band radio systems—Draft question	—	IX
637	Drafting Committee	Propagation data required for wide-band radio systems—Draft question	—	IX
638	Drafting Committee	Maintenance procedure for wide-band radio systems—Draft question	—	IX
639	Drafting Committee	Standardization of multi-channel radio systems using time-division multiplex—Draft question	—	IX
640	Drafting Committee	Standardization of multi-channel radio systems using frequency-division multiplex—Draft question	—	IX
641	Drafting Committee	Signal amplitudes in individual channels of multi-channel systems—Draft question	—	IX
642	Drafting Committee	Transmission characteristics of line systems—Draft question	—	IX
643	Drafting Committee	Measurement of the quality of television pictures—Draft study programme	Question 65	XI
644	Drafting Committee	Resolving power and differential sensitivity of the human eye—Draft study programme	Question 68	XI
645	Sub-Gr. III B	The effect of atmospheric noise on radio reception—Draft question	—	III
646	Sub-Gr. III B	The effect of atmospheric radio noise on radio communication operation—Draft study programme	—	III
647	Study Gr. II	Sensitivity and noise figure	Question 47	II
648	Study Gr. XII	Minimum permissible protection ratio to avoid interference in the bands shared with tropical broadcasting	Recomm. 50 Question 4	XII
649	Study Gr. XII	Interference in the bands shared with tropical broadcasting	Question 4	XII
650	Secretariat of C.C.I.R.	List of documents issued (601 to 650)	—	—
651	Study Gr. XII	Minimum permissible protection ratio for broadcasting services operating in the tropical zone in the shared bands—Draft study programme	Recomm. 50 Question 4	XII
652	Study Gr. XII	Maximum power for short-distance high-frequency broadcasting in the tropical zone—Draft report	Study Progr. 38	XII

No.	Submitted by	Title	Subject	Study Group
653	Study Gr. XII	Design of aerials for tropical broadcasting	Question 70	XII
654	Study Gr. XII	Design of aerials for tropical broadcasting	Question 70	XII
655	Study Gr. XII	Maximum power for short-distance high-frequency broadcasting in the tropical zone	Question 27	XII
656	Drafting Committee	Frequency-shift keying—Draft study programme	—	I
657	Drafting Committee	Methods of measuring emitted spectra in actual traffic—Draft study programme	—	I
658	Drafting Committee	Arrangement of channels in multi-channel telegraph systems for long-range radio circuits—Draft question	—	I
659	Drafting Committee	Arrangement of channels in multi-channel transmitters for long-range radio circuits—Draft recommendation	Question 46	I
660	Drafting Committee	Telegraphic distortion—Draft recommendation	Question 18	I
661	Drafting Committee	Frequency-shift keying	Recomm. 39	I
662	Drafting Committee	Bandwidth required at the receiver output—Draft recommendation	—	III
663	Drafting Committee	Communication theory—Draft recommendation	—	III
664	Drafting Committee	Channel separation—Draft recommendation	Recomm. 1	III
665	Drafting Committee	Investigation of multipath transmission through the troposphere—Draft study programme	—	V
666	Drafting Committee	Standard-frequency transmissions and time signals	Recomm. 70 Question 54	VII
667	Drafting Committee	Standard-frequency transmissions and time signals	Question 54	VII
668	Drafting Committee	Standard-frequency transmissions and time signals—Draft study programme	Question 54	VII

No.	Submitted by	Title	Subject	Study Group
669	Drafting Committee	Ratio of the wanted signal to the unwanted signal in television—Draft report	Question 67	XI
670	Drafting Committee	Measurement of field strength in the neighbourhood of obstacles—Draft question	Recomm. 66	V
671	Drafting Committee	Standard-frequency transmissions and time signals—Draft report	Question 54	VII
672	Drafting Committee	Protection against keyed interfering signals—Draft study programme	Recomm. 36 & 48	II
673	Study Gr. I	Summary record of the 5th meeting (25 September, 1953)	—	I
674	Study Gr. IX	Summary record of the 7th meeting (24 September, 1953)	—	IX
675	Study Gr. IX	Summary record of the 8th meeting (25 September, 1953)	—	IX
676	Sub-Gr. III A	Proposed amendments to Annex 1 of Recommendation 44	Recomm. 44	III
677	Sub-Gr. III A	The effect of interference on the separation between frequencies in adjacent channels—Draft report	Study Progr. 8 & 27	III
678	Sub-Gr. III A	Proposal for the text of a study programme to replace the study programme proposed in Doc. 516 and TEMP/III—Draft study programme	Study Progr. 8 Recomm. 46	III
679	Study Gr. III	Fading allowances for the various classes of service—Draft recommendation	Study Progr. 8 & 24 Recomm. 44	III
680	United States of America	Information given by the U.S.A. Delegation on a paper by Dr. Otto H. Schade entitled "Image gradation, graininess and sharpness in television and motion picture systems"	—	XI
681	Sub-Gr. III A	Channel separation achieved in practice—Draft recommendation	Question 3	III
682	United States of America	Identification of radio stations—Draft recommendation	Question 17 Study Progr. 26	IX
683	Study Gr. IV	Summary record of the 6th meeting (25 September, 1953)	—	IV
684	Study Gr. VI	Summary record of the 6th meeting (24 September, 1953)	—	VI
685	Study Gr. XIII	Summary record of the 2nd meeting (24 September, 1953)	—	XIII
686	Study Gr. XIV	Summary record of the 4th meeting (25 September, 1953)	—	XIV

No.	Submitted by	Title	Subject	Study Group
687	United States of America	Marine identification device—Draft question	—	Plenary Assembly
688	Drafting Committee	Local lightning-flash counters—Draft recommendation	Study Progr. 23	VI
689	Drafting Committee	Non-linear effects in the ionosphere—Draft study programme	Question 5	VI
690	Drafting Committee	Practical uses and the reliability of ionospheric propagation data—Draft report	Question 50	VI
691	Study Gr. IX	Representation of C.C.I.R. at forthcoming meeting of Study group 5 of the C.C.I.F. in connection with Study Programme 28	Study Progr. 28	Plenary Assembly
692	Study Gr. IX	Report of the Chairman of Study Group IX on consideration of Administrative Council Resolution 247	—	Plenary Assembly
693	Study Gr. VI	Summary record of the 6th meeting (25 September, 1953)	—	VI
694	Study Gr. IV	Summary record of the 7th meeting (29 September, 1953)	—	IV
695	C.I.R.M.	Use of the 152-162 Mc/s band—Draft question	—	P.A.
696	United Kingdom	Distribution of work among study groups	—	Plenary Assembly
697	United States of America	Proposal for organisation of the C.C.I.R. study groups	—	—
698	Drafting Committee	Stability of receivers—Draft question	—	II
699	Drafting Committee	Undesired emissions from receivers—Draft question	—	II
700	C.C.I.R. Secretariat	List of documents issued (651 to 700)	—	—
701	Drafting Committee	Choice of intermediate frequency and protection against undesired responses of superheterodyne receivers—Draft question	Recomm. 42	II
702	Drafting Committee	Ionospheric propagation of waves in the band 30 to 300 Mc/s—Draft study programme	—	VI
703	Drafting Committee	Study of fading—Draft study programme	Question 51 & 52 Study Progr. 24	VI
704	Drafting Committee	Basic prediction information for ionospheric propagation—Draft study programme	Question 50	VI

No.	Submitted by	Title	Subject	Study Group
705	Drafting Committee	Use of special modulation on the standard-frequency transmissions for assessing the reliability of propagation forecasts—Draft study programme	Question 50	VI
706	Drafting Committee	Presentation of basic propagation prediction charts—Draft recommendation	Recomm. 53	VI
707	Drafting Committee	Clarification of definition of MUF—Draft resolution	Recomm. 57 para. 1	VI
708	Drafting Committee	Standards of sound recording for the international exchange of programmes—Draft study programme	Question 42	X
709	Drafting Committee	High-frequency broadcasting : Modification of receivers for closer spacing between carrier frequencies—Draft question	Question 62	X
710	Drafting Committee	Use of synchronized transmitters—Draft study programme	Study Progr. 30	X
711 ⁵	Drafting Committee	Use of synchronized transmitters—Draft recommendation	Study Progr. 30	X
712	Drafting Committee	Single-sideband sound broadcasting—Draft recommendation	Question 62	X
713	Drafting Committee	Questions 14 and 15 of C.C.I.F.	—	X
714	Drafting Committee	High-frequency broadcasting: Justification for use of more than one frequency per programme—Draft study programme	Question 37	X
715	Drafting Committee	High-frequency broadcasting : Directive antenna systems—Draft report	Question 23	X
716	Drafting Committee	High-frequency broadcasting : Conditions for satisfactory reception—Draft study programme	Question 39	X
717	Drafting Committee	Standards of sound recording for the international exchange of programmes—Cine type spools—Draft resolution	—	X
718	Drafting Committee	Bandwidth of emission measurements made near the transmitter	Question 1a	I
719	Study Gr. X	Summary record of the 3rd meeting (25 September, 1953)	—	X
720	Study Gr. VI	Summary record of the 8th meeting (29 September, 1953)	—	VI
721	Secretariat of C.C.I.R.	Proposals for lay-out of Volume I of Recommendations, etc.	—	Plenary Assembly

No.	Submitted by	Title	Subject	Study Group
722	Study Gr. II	Summary records of the 5th and 6th meetings (24 and 30 September, 1953)	—	II
723	Study Gr. XII	Summary record of the 4th meeting (24 September, 1953)	—	XII
724	Study Gr. XII	Summary record of the 5th and last meeting (29 September, 1953)	—	XII
725	Study Gr. III	Summary record of the 6th and last meeting (27 September, 1953)	—	III
726	Study Gr. I	Summary record of the 6th and last meeting (29 September, 1953)	—	I
727	Study Gr. XI	Summary record of the 4th meeting (23 September, 1953)	—	XI
728	Study Gr. XI	Summary record of the 5th meeting (25 September, 1953)	—	XI
729	Study Gr. XIV	Summary record of the 5th meeting (29 September, 1953)	—	XIV
730	Drafting Committee	Selectivity of receivers—Draft recommendation	—	II
731	United States of America	Proposal concerning the definition of "Report"	—	Plenary Assembly
732	Drafting Committee	The responses of radio receivers to quasi-impulsive interference—Draft question	—	II
733	Drafting Committee	Stability of receivers—Draft recommendation	—	II
734	Drafting Committee	Presentation of data in studies of tropospheric wave propagation—Draft recommendation	Study Progr. 17 & 18	V
735	Drafting Committee	Addition to Appendix 9 of the Radio regulations	Recomm. 85	XIII
736	Drafting Committee	Publication of service codes in use in the international telegraph service—Draft resolution	—	XIII
737	Drafting Committee	Bandwidth measurement by monitoring stations—Draft study programme	—	VIII
738	Drafting Committee	Telegraphic distortion	Question 18	I
739	Drafting Committee	Nomenclature of the frequency and wavelength bands used in radiocommunication—Draft recommendation	Question 73	XIV
740	"Ad hoc" Gr. Study Gr. IX	Long-distance wide-band radio relay systems	—	IX

No.	Submitted by	Title	Subject	Study Group
741	Drafting Committee	Sensitivity and noise figure—Draft question	Recomm. 41	II
742	Drafting Committee	Bandwidth of emissions	Recomm. 3	I
743	Study Gr. IV	Summary record of the 8th and last meeting (30 September, 1953)	—	IV
744	"Ad hoc" Gr. Study Gr. IX	Bearing and position classification for HF and VHF direction-finding	—	IX
745	"Ad hoc" Gr. Study Gr. IX	Frequency-modulated VHF maritime equipment	—	IX
746	Drafting Committee	Protection of frequencies used for radio-astronomical measurements	Recomm. 56	VI
747	Drafting Committee	Pulse transmission tests at oblique incidence—Draft study programme	—	VI
748	Drafting Committee	Preparation of short-term forecasts of ionospheric disturbances—Draft recommendation	—	VI
749	Drafting Committee	Measurement of atmospheric noise—Draft recommendation	Study Progr. 23	VI
750	Secretariat of C.C.I.R.	List of documents issued (701 to 750)	—	—
751	Sweden	International exchange of picture/sound programmes on film—Draft question	—	Plenary Assembly
752	Drafting Committee	Measurement of atmospheric radio noise—Draft study programme	Study Progr. 23	VI
753	Drafting Committee	Investigation of circular polarized emitted waves in the HF band—Draft resolution	—	VI
754	Drafting Committee	Radio propagation at frequencies below 1500 kc/s—Draft study programme	—	VI
755	Drafting Committee	Questions submitted by the I.F.R.B.—Draft report	—	VI
756	Drafting Committee	Choice of a basic index for ionospheric propagation—Draft report	Question 53	VI
757	Drafting Committee	Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings—Draft report	Recomm. 59	VI
758	Drafting Committee	Reduction of occupied bandwidth and transmitter power in radiotelephony—Draft recommendation	—	III
759	Drafting Committee	Directivity of antennae at great distances—Draft recommendation	—	III

No.	Submitted by	Title	Subject	Study Group
760	Drafting Committee	Directivity of antennae at great distances—Draft question	—	III
761	Drafting Committee	Use of directional antennae—Draft recommendation	—	III
762	Drafting Committee	Voice-frequency telegraphy on radio circuits—Draft recommendation	Question 43	III
763	Drafting Committee	Voice-frequency telegraphy on radio circuits—Draft report	Question 43	III
764	Drafting Committee	Voice-frequency telegraphy on radio circuits—Draft study programme	Question 43	III
765	Drafting Committee	Interference effects of atmospheric noise on radio reception—Draft question	—	III
766	Chairman of the Plenary Assembly	The appointment of C.C.I.R. study group chairmen	—	Plenary Assembly
767	Director of C.C.I.R.	Names of the candidates for vice-chairmen of C.C.I.R. study groups	—	Plenary Assembly
768	Finance Committee	Summary record of the 2nd meeting (25 September, 1953)	—	Plenary Assembly
769	Drafting Committee	Interference effects of atmospheric noise on radio reception—Draft study programme	—	III
770	Drafting Committee	Signal-to-interference protection—Draft recommendation	Question 3 Study Progr. 8	III
771	Drafting Committee	Channel separation achieved in practice—Draft recommendation	—	III
772	Drafting Committee	Effect of interference and noise on quality of service—Draft study programme	Question 3	III
773	Audit Group	Second report	—	Plenary Assembly
774 ^a	Secretariat of C.C.I.R.	Minutes of the 2nd Plenary meeting (28 September, 1953)	—	Plenary Assembly
775	Drafting Committee	Bandwidths and signal-to-noise ratios in complete systems—Draft recommendation	Question 3	III
776	Drafting Committee	Improvement obtainable from the use of directional antennae—Draft study programme	Recomm. 46 Question 48 Study Progr. 8	III
777	Drafting Committee	Fading allowances for the various classes of service—Draft recommendation	Study Progr. 8	III
778	Drafting Committee	Noise and sensitivity of receivers—Draft recommendation	—	II

No.	Submitted by	Title	Subject	Study Group
779	Drafting Committee	Bandwidths and signal-to-noise ratios in complete systems—Draft study programme	Question 3	III
780	Drafting Committee	Fading of high-frequency and medium-frequency signals propagated by the ionosphere—Draft report	Question 51 & 52 Study Progr. 24	VI
781	Drafting Committee	Means of expression—terms, definitions, graphical and letter symbols and their conventional usage—Draft recommendation	Recomm. 5	XIV
782	Drafting Committee	Bandwidth of emissions—Draft study programme	Question 1a Recomm. 36	I
783	Drafting Committee	Unit systems—Draft recommendation	Recomm. 6	XIV
784	Drafting Committee	Harmonics and spurious emissions—Draft recommendation	Question 1b	I
785	Drafting Committee	Harmonics and spurious emissions—Draft report	Question 1b Study Progr. 2	I
786	Drafting Committee	Frequency stabilization of transmitters—Draft recommendation	Question 1c	I
787	Drafting Committee	Frequency stabilization of transmitters—Draft report	Question 1c Study Progr. 3	I
788	Drafting Committee	Rapid exchange of information on propagation—Draft report	Recomm. 11 para. 1	VI
789	Drafting Committee	Standards of sound recording for the international exchange of programmes—Draft recommendation	Question 42 & 63	X
790	Drafting Committee	Design of aerials for tropical broadcasting—Draft recommendation	Question 70	XII
791	Drafting Committee	Minimum permissible protection ratio to avoid interference in the bands shared with tropical broadcasting—Draft recommendation	Question 4	XII
792	Drafting Committee	Design of aerials for tropical broadcasting—Draft report	Question 70	XII
793	Drafting Committee	Interference in the bands shared with broadcasting—Draft question	Question 4	XII
794	Drafting Committee	Interference in the bands shared with broadcasting—Draft study programme	Recomm. 50 Question 4	XII
795	Drafting Committee	Maximum power for short-distance high-frequency broadcasting in the tropical zone—Draft report	Question 27 Study Progr. 38 Recomm. 84	XII
796	Drafting Committee	Design of aerials for tropical broadcasting—Draft recommendation	Question 70 para. 3	XII

No.	Submitted by	Title	Subject	Study Group
797	Drafting Committee	Maximum power for short-distance high-frequency broadcasting in the tropical zone—Draft question	—	XII
798	Drafting Committee	Identification of radio stations—Draft recommendation	Question 17	IX
799	Drafting Committee	Identification of radio stations—Draft study programme	Question 17	IX
800	Secretariat of C.C.I.R.	List of documents issued (751 to 800)	—	—
801	Drafting Committee	Identification of radio stations—Draft question	—	IX
802	Drafting Committee	Design of aerials for tropical broadcasting—Draft question	Question 70	XII
803	Drafting Committee	Temporal variation of ground-wave field strength—Draft study programme	Question 6	IV
804	Drafting Committee	Temporal variation of ground-wave field strength—Draft report	Question 6	IV
805	Drafting Committee	Ground-wave propagation over irregular terrain—Draft study programme	Questions 6 & 7	IV
806	Drafting Committee	Presentation of antenna radiation data—Draft recommendation	Question 49	IV
807	Secretariat of C.C.I.R.	Minutes of the Third Plenary meeting (30 September, 1953)	—	Plenary Assembly
808	Secretariat of C.C.I.R.	Minutes of the Fourth Plenary meeting (1st October, 1953)	—	Plenary Assembly
809	Drafting Committee	Extension of the C.C.I.R. propagation curves below 300 kc/s—Draft resolution	—	IV
810	Drafting Committee	Ground-wave propagation over mixed paths—Draft recommendation	Question 6	IV
811	Drafting Committee	Ground-wave propagation over mixed paths—Draft study programme	Question 6	IV
812	Drafting Committee	Ground-wave propagation over irregular terrain—Draft report	Question 6	IV
813	Drafting Committee	Publication of ground-wave propagation curves between 30 and 300 Mc/s—Draft resolution	Question 6 Study Progr. 16	IV
814	Drafting Committee	Marine identification device—Draft question	—	Plenary Assembly
815	Drafting Committee	Frequency-modulation broadcasting in the VHF band—Draft question	—	X

No.	Submitted by	Title	Subject	Study Group
816	Drafting Committee	Use of the 26 Mc/s broadcasting band—Draft resolution	—	X
817	Drafting Committee	International wide-band radio relay systems operating on frequencies above about 30 Mc/s—Draft question	—	Plenary Assembly
818	Drafting Committee	International wide-band radio relay systems operating on frequencies above about 30 Mc/s—Transmission of telephony and television on the same system—Draft question	—	Plenary Assembly
819	Sweden	Propagation data required for wide-band radio systems	—	IX
820	Sub-Gr. XIV B	Means of expression—General account of the work of Sub-Group XIV B	Resolution 5	XIV
821 ⁵	Finance Committee	Report to the VIIth Plenary Assembly	—	Plenary Assembly
822	Drafting Committee	Identification of radio stations—Draft resolution	—	Plenary Assembly
823	Drafting Committee	Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships—Draft question	—	XIII
824	Drafting Committee	Determination of the maximum interference levels tolerable in complete systems—Draft study programme	Question 3	Plenary Assembly
825	Drafting Committee	Communication theory—Draft study programme	Question 44	III
826	Secretariat of C.C.I.R.	List showing the chairmen of the C.C.I.R. study groups and the candidates nominated for the vice-chairmanship of these study groups	—	Plenary Assembly
827	Secretariat of C.C.I.R.	Proposed assignment to the study groups of the findings of the VIIth Plenary Assembly	—	Plenary Assembly
828	Drafting Committee	Revision of atmospheric radio noise data—Draft recommendation	Study Progr. 23	VI
829	Drafting Committee	Sound recording on TV films for the international exchange of picture/sound programmes—Draft question	—	Plenary Assembly
830	Drafting Committee	Interference to radio services—Draft recommendation	—	IX
831	Secretariat of C.C.I.R.	Minutes of the 5th Plenary meeting (2 October, 1953)	—	Plenary Assembly
832	Secretariat of C.C.I.R.	Minutes of the 6th Plenary meeting (5 October, 1953)	—	Plenary Assembly

No.	Submitted by	Title	Subject	Study Group
833	Secretariat of C.C.I.R.	Minutes of the 7th Plenary meeting (6 October, 1953)	—	Plenary Assembly
834	Secretariat of C.C.I.R.	Minutes of the 8th Plenary meeting (7 October, 1953)	—	Plenary Assembly
835	Finance Committee	Report of the 3rd Plenary meeting (5 October, 1953)	—	Plenary Assembly
836	Secretariat of C.C.I.R.	List of addenda, corrigenda and revised documents	—	Plenary Assembly
837	Organisation Committee	Report of 1st meeting (16 September, 1953)	—	Plenary Assembly
838	Organisation Committee	Report of 2nd meeting (22 September, 1953)	—	Plenary Assembly
839	Secretariat of C.C.I.R.	List of documents issued (801 to 839)	—	—

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 one addendum.*

⁴ *documents having three addenda.*

⁵ *documents which have been revised.*

⁶ *documents having an amendment.*

B. By Study Groups

No.	Subject	Submitted by	Reference	Other Study Group concerned
STUDY GROUP No. I				
17	A note on the theory of repeated automatic-sweep radio-spectrum analysers	Belgium	Question 1a	—
78	Bandwidths of emissions	United States of America	Study Progr. 1 Question 1a	—
79 *	Measurement of bandwidth of emissions	United States of America	Question 1a	—
80 *	Harmonic and parasitic emissions	United States of America	Question 1b Study Progr. 2	—
81 *	Frequency stabilization of transmitters—Report	United States of America	Question 1c Study Progr. 3	—
82	Telegraphic distortion	United States of America	Report 1 Question 18	—
83	Frequency-shift keying	United States of America	Question 20 Study Progr. 4	—
84	Arrangement of channels in multi-channel transmitting for long range circuits	United States of America	Question 46	—
101* ³	Report of Chairman of Study Group I	Chairman Study Group I	—	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
120	Arrangement of channels in multi-channel transmitters for long-range circuits. Arrangement and designation of channels on multi-channel radio-telephone systems	United Kingdom	Question 46	—
124*	Reduction of harmonics and combined waves from high-power broadcasting transmitters	Belgium	Question 1.b Study Progr. 2	—
126	Proposal on arrangement of channels in multi-channel SSB transmitters	Japan	Question 46	—
127*	Report on bandwidth of emissions	Japan	Study Progr. 1	—
128	Report on measurement of bandwidth of emissions	Japan	Study Progr. 1	—
129	Report on bandwidth of class A2 emissions	Japan	Study Progr. 1	—
130*	Power measurement of the higher harmonics of transmitters	Japan	Study Progr. 2	—
131*	Frequency stabilization of transmitters—Proposal	Japan	Study Progr. 3	—
136*	Spectrum analyser	Netherlands	Question 1b	—
168*	A radio-frequency spectrum analyser for the HF band	United Kingdom	Study Progr. 1	—
191*	Measurement of bandwidth of emissions. Description of a frequency analyser	Switzerland	Recomm. 37	—
193*	Frequency stabilization of transmitters	Netherlands	Study Progr. 3	—
199*	Measurement of the spectra of A1 telegraphy emissions	Italcable	Recomm. 36 Study Progr. 1	—
228	What is the best way of arranging and designating the channels in multi-channel transmitters for long-range circuits ?	Federal German Republic	Question 46	—
254	List of technical terms used in the work of Study Group I	Federal German Republic	Resolution 5	XIV
274*	Measurement of bandwidth of emissions	Austria	Recomm. 37	IV, VI
288*	Report on the application of statistical analysis to measurements of the frequency stability of radio transmitters and of the accuracy of frequency-measuring equipment	Japan	Study Progr. 3	—
314	Telegraphic distortion	Secretariat of C.C.I.R.	Plenary Assembly C.C.I.T.	—
331*	Frequency stabilization of transmitters	Federal German Republic	Study Progr. 3	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
340*	Filtering of short-wave transmitter harmonics	U.S.S.R.	Study Progr. 2	—
349 *	Description of a spectroscope	France	Question 1a Study Progr. 1 Recomm. 37	—
351	Report	Netherlands	Study Progr. 1 & 3	—
364	Bandwidth of emissions—Draft recommendation	Austria	Recomm. 36	—
367*	Proposal	Netherlands	Study Progr. 3	—
372*	Frequency stabilization of transmitters—Stability of receivers	Union of South Africa	Question 1c Study Progr. 5	II
388	Summary record of the 1st meeting (4 September, 1953)	Study Group I	—	—
472	Summary record of the 2nd meeting (16 September, 1953)	Study Group I	—	—
484	Frequency-shift keying—Draft recommendation	Sub-Gr. I-B	Recomm. 39 Question 20	—
542	Draft study programme to replace Study Programme 4	Sub-Gr. I-B	Study Progr. 4	—
545	Draft proposal	Sub-Gr. I-B	Question 46	—
547	Bandwidth measurement of emissions in actual traffic—Draft study programme	Sub-Gr. I-A	Recomm. 37	—
556	Telegraphic distortion—Draft recommendation	Study Group I	Question 18	—
557	Telegraphic distortion—Draft report	Study Group I	Question 18	—
558	Arrangement of channels in multi-channel telegraph systems for long-range radio circuits—Draft Question	Study Group I	Question 43	—
566	Summary record of the 3rd meeting (21 September, 1953)	Study Group I	—	—
586	Summary record of the 4th meeting (23 September, 1953)	Study Group I	—	—
608	Bandwidth of emissions—Draft amendments to Recommendation 36	Study Group I	Recomm. 36	—
618	Bandwidth of emissions	Study Group I	Study Progr. 1 Question 1a Recomm. 36	—
627	Harmonics and parasitic emissions—Frequency stabilization of transmitters	Working Group I A.3	Recomm. 38 Study Progr. 2 Question 1b	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
656	Frequency-shift keying—Draft study programme	Drafting Committee	—	—
657	Methods of measuring emitted spectra in actual traffic—Draft study programme	Drafting Committee	—	—
658	Arrangement of channels in multi-channel telegraph systems for long-range radio circuits—Draft question	Drafting Committee	—	—
659	Arrangement of channels in multi-channel transmitters for long-range radio circuits—Draft recommendation	Drafting Committee	Question 46	—
660	Telegraphic distortion—Draft recommendation	Drafting Committee	Question 18	—
661	Frequency-shift keying	Drafting Committee	Recomm. 39	—
673	Summary record of the 5th meeting (25 September, 1953)	Study Group I	—	—
718	Bandwidth of emission measurements made near the transmitter—Draft recommendation	Drafting Committee	Question 1a	—
726	Summary record of the 6th and last meeting (29 September, 1953)	Study Group I	—	—
738	Telegraphic distortion—Draft report	Drafting Committee	Question 18	—
742	Bandwidth of emissions—Draft recommendation	Drafting Committee	Recomm. 3	—
782	Bandwidth of emissions—Draft study programme	Drafting Committee	Question 1a Recomm. 36	—
784	Harmonics and spurious emissions—Draft recommendation	Drafting Committee	Question 1b	—
785	Harmonics and spurious emissions—Draft report	Drafting Committee	Question 1b	—
786	Frequency stabilization of transmitters—Draft recommendation	Drafting Committee	Question 1c	—
787	Frequency stabilization of transmitters—Draft report	Drafting Committee	Question 1c Study Progr. 3	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
STUDY GROUP No. II				
98* ³	Selectivity of receivers (excluding television receivers)	United Kingdom	Study Progr. 6	—
99 *	Selectivity of receivers (television receivers)	United Kingdom	Study Progr. 6	—
102*	Report of Chairman of Study Group II	Chairman, Study Group II	—	—
116* ³	Sensitivity and noise figure of receivers. The measurement of sensitivity and noise figure of television receivers	United Kingdom	Question 47	—
117*	Sensitivity and noise figure of receivers. Measurement of noise figure of receivers above 30 Mc/s	United Kingdom	Question 47	—
118* ³	Sensitivity and noise figure of receivers	United Kingdom	Question 47	—
119*	Sensitivity and noise figure of receivers. Measurement of sensitivity of frequency-shift telegraphy receivers	United Kingdom	Question 47	—
121*	Noise and sensitivity of receivers—Report	United States of America	Question 47	—
122*	Stability of receivers—Report	United States of America	Study Progr. 5	—
123*	Selectivity of receivers—Report	United States of America	Study Progr. 6	—
132*	Proposal on stability of receivers	Japan	Study Progr. 5	—
133*	Noise figure and sensitivity. Present position in Japan	Japan	Question 47	—
166*	Selectivity of receivers. The measurement of selectivity of television receivers	United Kingdom	Study Progr. 6	—
167*	Stability of receivers	United Kingdom	Study Progr. 5	—
178*	Broadcasting and television receivers	Italy	Recomm. 41 & 42 Question 47 Study Progr. 5 & 6	XI
197*	Sensitivity and noise figure of receivers	France	Question 47	—
235*	Noise figure of an F.M. receiver	Netherlands	Question 47	—
236*	Two-signal selectivity measurements	Netherlands	Study Progr. 6 & 7	—
237*	Stability of receivers	Netherlands	Study Progr. 5	—
238*	Sensitivity and noise figure	Federal German Republic	Question 47	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
239*	Selectivity of receivers	Federal German Republic	Study Progr. 6	—
240*	Stability of receivers	Federal German Republic	Study Progr. 5	—
290*	Report on selectivity of receivers	Japan	Study Progr. 6	—
323*	On the choice of intermediate frequency for domestic supersonic-heterodyne broadcast receivers	European Broadcasting Union	—	—
324*	On the choice of intermediate frequencies for television receivers and associated questions	European Broadcasting Union	Question 47 Study Progr. 5 & 6	—
372*	Frequency stabilization of transmitters—Stability of receivers	Union of South Africa	Question 1c Study Progr. 5	—
390	Summary record of the 1st meeting (7 September, 1953)	Sub-Group II A	—	—
403	Summary record of the 1st meeting (7 September, 1953)	Sub-Group II B	—	—
407	Summary record of the 1st meeting (4 September, 1953)	Study Group II	—	—
410	Summary record of the 2nd meeting (9 September, 1953)	Sub-Group II B	—	—
428	Summary record of the 1st meeting (8 September, 1953)	Sub-Group II C	—	—
429	Summary record of the 2nd meeting (10 September, 1953)	Sub-Group II C	—	—
430	Summary record of the 3rd meeting (11 September, 1953)	Sub-Group II C	—	—
434	Summary record of the 3rd meeting (11 September, 1953)	Sub-Group II B	—	—
447	Summary record of the 2nd meeting (14 September, 1953)	Study Group II	—	—
451	Revision of text of Study Programme 6—Selectivity of receivers	Sub-Group II B	Study Progr. 6	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
461	Summary record of the 4th meeting (15 September, 1953)	Sub-Group II C	—	—
468 ⁴	New text for Recommendation 42. Selectivity of receivers (first part only)	Study Group II	Recomm. 42	—
476	Summary record of the 4th meeting (15 September, 1953)	Sub-Group II B	—	—
478 ^{1,3}	Text for new recommendation on stability of receivers	Sub-Group II C	Study Progr. 5 part. 1	—
481	Summary record of the 2nd meeting (16 September, 1953)	Study Group II	—	—
501	Summary record of the 5th meeting (18 September, 1953)	Sub-Group II C	—	—
514	Summary record of the 5th, 6th and 7th meetings (17, 18 and 21 September, 1953)	Sub-Group II B	—	—
515	Protection against keyed interference signal—Draft text for Study Programme 7	Working-Group II C.2	Study Progr. 7	—
517	Selectivity of receivers	Drafting Committee	Study Progr. 6	—
549	Choice of intermediate frequency and protection against undesired responses of superheterodyne receivers	Study Group II	Recomm. 42	—
567	Summary record of the 4th meeting (21 September, 1953)	Study Group II	—	—
575 ³	Noise and sensitivity of receivers	Study Group II	Recomm. 41	—
580	Undesired emissions from receivers	Study Group II	New question	—
628	Stability of receivers—Draft question	Study Group II	Study Progr. 5	—
629	Selectivity of television receivers (annex to new text of Recommendation 42)	Study Group II	Recomm. 42	—
647	Sensitivity and noise figure	Study Group II	Question 47	—
672	Protection against keyed interfering signals	Drafting Committee	Recomm. 36 & 42	—
698	Stability of receivers—Draft question	Drafting Committee	—	—
699	Undesired emissions from receivers—Draft question	Drafting Committee	—	—
701	Choice of intermediate frequency and protection against undesired responses of superheterodyne receivers	Drafting Committee	Recomm. 42	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
722	Summary record of the 5th and 6th meetings (24 and 30 September, 1953)	Study Group II	—	—
730	Selectivity of receivers—Draft recommendation	Drafting Committee	—	—
732	The responses of radio receivers to quasi-impulsive interference—Draft question	Drafting Committee	—	—
733	Stability of receivers—Draft recommendation	Drafting Committee	—	—
741	Sensitivity and noise figure—Draft question	Drafting Committee	Recomm. 41	—
778	Noise and sensitivity of receivers—Draft recommendation	Drafting Committee	—	—
STUDY GROUP No. III				
2	Bandwidth and signal-to-noise ratios in complete systems	United States of America	Question 3 Study Progr. 8	—
3	Presentation of the results of atmospheric radio noise measurements for the requirements of operational services	United States of America	Question 11	—
4	Application of atmospheric radio noise measurements to the requirements of operational services	United States of America	Question 11	—
5 *	Voice-frequency telegraphy on radio circuits	United States of America	Question 43 Study Progr. 9	—
6	Theory of communication and its practical applications	United States of America	Question 44 Study Progr. 10	—
7	Directivity of antennae at long distances and pulse transmission at oblique incidence	United States of America	Recomm. 46 & 58 Question 48	—
103	Report of Chairman of Study Group III	Chairman, Study Group III	—	—
134	Report on communication theory and its practical applications	Japan	Study Progr. 10 Question 44	—
137	References of communication theory in Japan	Japan	Study Progr. 10	—
179	Presentation of the results of atmospheric radio noise measurements for the requirements of operational services	United Kingdom	Question 11	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
204	Bandwidth and signal-to-noise ratios in complete systems	France	Question 3 Study Progr. 8	—
205*	Voice-frequency telegraphy on radio circuits	France	Question 43 Study Progr. 9	—
206*	Directivity of antennae at great distances	France	Question 48	—
249	Theory of communications and its practical applications	U.R.S.I.	Study Progr. 10	—
255	Means of expression used in questions, study programmes, recommendations and documents with which Study Group III is concerned	Federal German Republic	Resolution 5	XIV
273*	Voice-frequency telegraphy on radio circuits	United Kingdom	Study Progr. 9	—
286*	Note on "Diversity reception"	Secretariat of C.C.I.R.	Study Progr. 8, 18 & 24	V, VI
318	Voice-frequency telegraphy on radio circuits	Secretariat of C.C.I.R.	Plenary Assembly of C.C.I.T.	—
361	Directivity of antennae at great distances—Report	United States of America	Question 48	—
375	Summary record of the 1st meeting (7 September, 1953)	Study Group III	—	—
389	Summary record of the 1st meeting (9 September, 1953)	Sub-Group III A	—	—
399	Summary record of the 2nd meeting (9 September, 1953)	Study Group III	—	—
411	Summary record of the 2nd meeting (9 September, 1953)	Sub-Group III A	—	—
416	Use of the 152-162 Mc/s band	I.R.M.C.	—	—
418	Proposal submitted by Sub-Group III A for the consideration of Study Group III, to replace Recommendations 1 & 43	Sub-Group III A	Recomm. 1 & 43	—
431	Minimum requirements for satisfactory service	Federal German Republic	Study Progr. 8	—
443*	Allowances for fading (replaces Doc. 34, London)	United States of America	Study Progr. 24 Question 52	VI
444	Communication theory—Draft study programme	Sub-Group III B	Question 44	—
445	Communication theory—Draft recommendation	Sub-Group III B	Question 44	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
467	Summary record of the 3rd meeting (16 September, 1953)	Study Group III	—	—
471	Bandwidth required at the receiver output—Draft recommendation	Sub-Group III A	—	—
496 ^a	Summary record of the 4th meeting (18 September, 1953)	Study Group III	—	—
513	Reduction of occupied bandwidth and transmitted power in radio telephony	Sub-Group III A	—	—
516*	Draft texts proposed for consideration by Study Group III	Sub-Group III B	Recomm. 46 Question 48	—
527	Report to C.C.I.T. in respect of Question 43	Sub-Group III B	Question 43	—
528	Voice-frequency telegraphy on radio circuits—Draft recommendation	Sub-Group III B	—	—
537	Summary record on the work of Sub-Group III A	Sub-Group III A	—	—
599	Voice-frequency telegraphy on radio circuits	Sub-Group III B	Study Progr. 9	—
631	Summary record of the 5th meeting (23 September, 1953)	Study Group III	—	—
645	The effect of atmospheric noise on radio reception—Draft question	Sub-Group III B	—	—
646	The effect of atmospheric radio noise on radio communication operation—Draft study programme	Sub-Group III B	—	—
662	Bandwidth required at the receiver output—Draft recommendation	Drafting Committee	—	—
663	Communication theory—Draft recommendation	Drafting Committee	—	—
664	Channel separation—Draft recommendation	Drafting Committee	Recomm. 1	—
676	Proposed amendments to annex 1 of Recommendation 44	Sub-Group III A	Recomm. 44	—
677	The effect of interference on the separation between frequencies in adjacent channels	Sub-Group III A	Study Progr. 8 & 27	—
678	Proposal for the text of a study programme to replace the study programme proposed in Doc. 516 and TEMP/111	Sub-Group III A	Study Progr. 8 Recomm. 46	—
679	Fading allowances for the various classes of service	Study Group III	Study Progr. 8 & 24 Recomm. 44	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
681	Channel separation achieved in practice	Sub-Group III A	Question 3	—
725	Summary record of the 6th and last meeting (27 September, 1953)	Study Group III	—	—
758	Reduction of occupied bandwidth and transmitter power in radiotelephony—Draft recommendation	Drafting Committee	—	—
759	Directivity antennae at great distances—Draft recommendation	Drafting Committee	—	—
760	Directivity antennae at great distances—Draft question	Drafting Committee	—	—
761	Use of directional antennae—Draft recommendation	Drafting Committee	—	—
762	Voice-frequency telegraphy on radio circuits—Draft recommendation	Drafting Committee	Question 43	—
763	Voice-frequency telegraphy on radio circuits—Draft report	Drafting Committee	Question 43	—
764	Voice-frequency telegraphy on radio circuits—Draft study programme	Drafting Committee	Question 43	—
765	Interference effects of atmospheric noise on radio reception—Draft question	Drafting Committee	—	—
769	Interference effects of atmospheric noise on radio reception—Draft study programme	Drafting Committee	—	—
770	Signal-to-interference protection—Draft recommendation	Drafting Committee	Question 3 Study Progr. 8	—
771	Channel separation achieved in practice—Draft recommendation	Drafting Committee	—	—
772	Effect of interference and noise on quality of service—Draft study programme	Drafting Committee	Question 3	—
775	Bandwidths and signal-to-noise ratios in complete systems—Draft recommendation	Drafting Committee	Question 3	—
776	Improvement obtainable from the use of directional antennae—Draft study programme	Drafting Committee	Recomm. 46 Question 48 Study Progr. 8	—
777	Fading allowances for the various classes of service	Drafting Committee	Study Progr. 8	—
779	Bandwidths and signal-to-noise ratios in complete systems—Draft study programme	Drafting Committee	Question 3	—
825	Communication theory—Draft study programme	Drafting Committee	Question 44	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
STUDY GROUP No. IV				
1 ¹	Presentation of antenna radiation data	Italy	Question 49	—
8	Effect of tropospheric refraction on frequencies below 10 Mc/s	United States of America	Study Progr. 11	—
9	Presentation of antenna radiation data	United States of America	Question 49	—
10 *	Ground-wave propagation	United States of America	Question 6, para. 2	—
11 *	Effects of irregular terrain on ground-wave propagation	United States of America	Study Progr. 14	—
45	Review of publications on propagation	United States of America	Report 3	V, VI
93	Revision of the 1937 C.C.I.R. propagation curves and their possible extension to higher frequencies	United Kingdom	Study Progr. 16	—
94	Measurement of the phase changes along a ground-wave path at low frequencies	United Kingdom	Study Progr. 15	—
95 *	Effects of irregular terrain on ground-wave propagation	United Kingdom	Study Progr. 14	—
96* ³	Temporal variations of ground-wave field strengths	United Kingdom	Study Progr. 12	—
97	Effects of tropospheric refractions on frequencies below 10 Mc/s	United Kingdom	Study Progr. 11, para. 1	—
104* ²	Report of Chairman of Study Group IV	Chairman, Study Group IV	—	—
138	List of publications on radio propagation	Japan	Recomm. 14	V, VI
139*	Report on ground-wave propagation research in Japan	Japan	Study Progr. 13, 14 & 15	—
140*	Estimation of medium-wave field strength over mixed paths—Report	Japan	Study Progr. 13, 14 & 15	—
141	New method of calculating ground-wave field strengths over mixed paths	Japan	Study Progr. 13, para. 3	—
154*	Ground-wave propagation	United Kingdom	Question 6	—
162	The evaluation of ground-wave fields for short distances	Netherlands	Study Progr. 16	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
207	Use of cymomotive force for the presentation of antenna radiation data	France	Question 49	—
222	Presentation of antenna radiation data	Italy	Question 49	—
242*	Effects of irregular terrain on ground-wave propagation	Netherlands	Study Progr. 14 Question 6, paras. 2, 3, 4 Question 7, para. 1	—
243* ¹	Ground-wave propagation over mixed paths	Netherlands	Question 6, para. 1 Study Progr. 13	—
246*	Ground-wave propagation. Methods of calculating the conductivity of inhomogeneous ground	Yugoslavia	Question 6	—
260*	Revision of the 1937 propagation curves and their possible extension to higher frequencies	Italy	Study Progr. 16	—
261	Ground-wave propagation over mixed paths	United Kingdom	Study Progr. 13, paras. 1 & 2	—
274*	Measurement of bandwidth of emissions	Austria	Recomm. 37	I, VI
287*	Revision of propagation curves and their possible extension to higher frequencies	Italy	Study Progr. 16	—
329	Report on ground-wave propagation	Austria	Question 6	—
335*	Temporal variations of ground-wave field strengths	Switzerland	Study Progr. 12	—
336 ¹	Summary of contributions and proposals submitted to Study Group IV	Chairman, Study Group IV	—	—
348*	Ground-wave propagation over mixed paths	Netherlands	Question 6, para. 1 Study Progr. 13	—
365	Summary record of the 1st meeting (4 September, 1953)	Study Group IV	—	—
386	Presentation of antenna radiation data—Report	United States of America	Question 49	—
405 ¹	Summary record of the 2nd meeting (8 September, 1953)	Study Group IV	—	—
446	Summary record of the 3rd meeting (14 September, 1953)	Study Group IV	—	—
503 ⁵	Report by Sub-Group IV C	Sub-Group IV C	—	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
504	Summary record of the 4th meeting (18 September, 1953)	Study Group IV	—	—
534	Temporal variation of ground-wave field strengths	Sub-Group IV B	Study Progr. 12	—
535	Ground-wave propagation over mixed paths	Sub-Group IV B	Study Progr. 13 & 15	—
562	Extension of the C.C.I.R. propagation curves below 300 kc/s—Draft resolution	Study Group IV	—	—
563	Publication of ground-wave propagation curves between 30 and 300 Mc/s—Draft resolution	Study Group IV	Question 6 Study Progr. 16	—
571	Ground-wave propagation over irregular terrain—Draft study programme	Sub-Group IV B	Study Progr. 14	—
573	Summary record of the 5th meeting (23 September, 1953)	Study Group IV	—	—
583	Presentation of antenna radiation data—Draft recommendation	Study Group IV	Question 49	—
597	Ground-wave propagation over irregular terrain—Draft report	Sub-Group IV B	Study Progr. 74	—
619	Effects of tropospheric refraction on frequencies below 10 Mc/s	Drafting Committee	Study Progr. 11	—
683	Summary record of the 6th meeting (25 September, 1953)	Study Group IV	—	—
694	Summary record of the 7th meeting (29 September, 1953)	Study Group IV	—	—
743	Summary record of the 8th and last meeting (30 September, 1953)	Study Group IV	—	—
803	Temporal variation of ground-wave field strength—Draft study Programme	Drafting Committee	Question 6	—
804	Temporal variation of ground-wave field strength—Draft report	Drafting Committee	Question 6	—
805	Ground-wave propagation over irregular terrain—Draft study programme	Drafting Committee	Questions 6 & 7	—
806	Presentation of antenna radiation data—Draft recommendation	Drafting Committee	Question 49	—
809	Extension of the C.C.I.R. propagation curves below 300 kc/s—Draft resolution	Drafting Committee	—	—
810	Ground-wave propagation over mixed paths—Draft recommendation	Drafting Committee	Question 6	—
811	Ground-wave propagation over mixed paths—Draft study programme	Drafting Committee	Question 6	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
812	Ground-wave propagation over irregular terrain—Draft report	Drafting Committee	Question 6	—
813	Publication of ground-wave propagation curves between 30 and 300 Mc/s—Draft resolution	Drafting Committee	Question 6 Study Progr. 16	—
STUDY GROUP No. V				
12	Tropospheric propagation curves	United States of America	Study Progr. 17	—
13	Field-strength measurement—Influence of local conditions on interpretation and accuracy of measurements of field strength	United States of America	Study Progr. 19 Question 8, para. A 5	—
14	Field-strength measurement—Best methods for expressing the field strength of unmodulated continuous-wave transmissions	United States of America	Study Progr. 19 Question 8 para. A 1a	—
15	Field-strength measurement—Best methods for expressing field strength for pulse transmissions	United States of America	Study Progr. 19 Question 8, para. A 1c	—
16	Field-strength measurement—Desirable and attainable accuracy of field-strength measurement for each frequency band	United States of America	Study Progr. 19 Question 8, para. A 4	—
18	Field-strength measurement—Merits of a standard noise generator as the source of the locally-generated signal	United States of America	Study Progr. 19 Question 8, para. A 7	—
19	Measurement of field strength—Merits of a standard noise generator as the source of the locally-generated signal	United States of America	Report 6	—
20	Tropospheric propagation curves for distances well beyond the horizon	Federal German Republic	Study Progr. 17	—
21 ¹	Tropospheric wave propagation	Federal German Republic	Study Progr. 18	—
45	Review of publications on propagation	United States of America	Report 3	IV, VI
105	Report of Chairman of Study Group V	Chairman, Study Group V	—	—
138	List of publications on radio propagation	Japan	Recomm. 14	IV, VI
142	Report on tropospheric propagation research in Japan	Japan	Study Progr. 17 & 18	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
159	Propagation of ultra-short waves beyond the Alps	Switzerland	Study Progr. 17	—
160*	Propagation formulae and calculating nomograms for VHF and UHF over mountains	Japan	Study Progr. 17 & 18	—
161	Propagation formulae and calculating nomograms for VHF and UHF over the smooth earth	Japan	Study Progr. 17 & 18	—
195	Tropospheric propagation	Italy	Study Progr. 17 & 18	—
201	Tropospheric propagation curves for distances well beyond the horizon	United States of America	Study Progr. 17	—
202	Propagation formulae and calculating nomograms for VHF and UHF over the smooth earth (supplement to Doc. 161)	Japan	Study Progr. 17 & 18	—
208	Publications on (tropospheric) propagation issued in France since 1950	France	Report 3	—
209	Tropospheric propagation curves for distances well beyond the horizon	France	Study Progr. 17	—
210	Tropospheric propagation curves for distances well beyond the horizon	France	Study Progr. 17	—
229	Investigation of transmission conditions on metric waves (1.6 m) in the relations Stockholm-Marieham	Sweden	Study Progr. 18	—
251	Xth General Assembly, Sydney, 1952	International Radio Scientific Union (U.R.S.I.)	Study Progr. 18 & 19 Report 4	—
259	Microwave propagation studies for overseas paths in Denmark	Denmark	Study Progr. 17 & 18	—
282	Field-strength measurements at the headquarters of the C.C.I.R.	Secretariat of C.C.I.R.	Study Progr. 17	—
286*	Note on " Diversity reception "	Secretariat of C.C.I.R.	Study Progr. 8, 18 & 24	III, VI
291	Report on general characteristics of microwave signal variations caused by formation of radio ducts	Japan	Study Progr. 18	—
292	Report on method of measuring k_e and p_e by means of continuous recording of field intensity	Japan	Study Progr. 18	—
293	Report on formation of radio ducts in Japan	Japan	Study Progr. 18	—
294	Report on general aspects of k-type fading	Japan	Study Progr. 18	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
295	Report on distribution function of microwave field intensity	Japan	Study Progr. 18	—
383	Summary record of the 1st meeting (8 September, 1953)	Study Group V	—	—
385	Measurement of field strength of radio signals.	United States of America	Study Progr. 19	—
402	New question proposed by Study Group V (submitted by Sub-Group V C) : Field measurement in the neighbourhood of obstacles	Study Group V	Recomm. 66	—
422	Draft revision of Recommendation 55. Tropospheric wave propagation curves	Study Group V	Recomm. 55	—
427	Summary record of the 2nd meeting (10 September, 1953)	Study Group V	—	—
466	Revised draft Study Programme 17. Tropospheric propagation curves for distances well beyond the horizon	Sub-Group V A	Study Progr. 17	—
469	Summary record of the 3rd meeting (15 September, 1953)	Study Group V	—	—
486	Investigation of multipath transmission through the troposphere	Sub-Group V B	—	—
487 ^s	Presentation of data in studies of tropospheric wave propagation	Sub-Group V B	Study Progr. 17 & 18	—
505	Summary record of the 4th meeting (18 September, 1953)	Study Group V	—	—
507	Field measurements—Merits of a standard noise generator as the source of the locally-generated signal	Drafting Committee	Report 6	—
519	Tropospheric wave propagation	Drafting Committee	Study Progr. 18	—
520	Best methods for expressing field strength for pulse transmissions	Drafting Committee	Recomm. 62	—
521 ¹	Field-strength measurement—Influence of local conditions on interpretation and accuracy of measurements of field strength	Drafting Committee	Recomm. 66	—
522	Field-strength measurement. Types of wave collector and equipment for use in each frequency band	Drafting Committee	Recomm. 64	—
613	Summary record of the 5th meeting (24 September, 1953)	Study Group V	—	—
620	Tropospheric propagation curves for distances well beyond the horizon	Drafting Committee	Recomm. 55	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
621	Tropospheric propagation curves	Drafting Committee	Recomm. 55	—
665	Investigation of multipath transmission through the troposphere	Drafting Committee	—	—
670	Measurement of field strength in the neighbourhood of obstacles	Drafting Committee	Recomm. 66	—
734	Presentation of data in studies of tropospheric wave propagation	Drafting Committee	Study Progr. 17 & 18	—
STUDY GROUP No. VI				
22 *	Study of fading	Federal German Republic	Study Progr. 24	—
23 *	Severity of fluctuation in field at reception	Federal German Republic	Question 51	—
24 *	Allowances for fading	Federal German Republic	Question 52	—
25 *	Practical uses of radio propagation data	New Zealand	Question 50	—
26 *	The application of high-frequency predictions to the Tasman region	New Zealand	Question 50, para. 3	—
27 *	Allowances for fading	New Zealand	Question 52	—
28	Choice of a basic index for ionospheric propagation—Report	New Zealand	Question 53	—
29	Measurement of atmospheric radio noise—Report	New Zealand	Study Progr. 23, para. 7 & 8	—
30	Study of fading—Report	New Zealand	Study Progr. 24, para. 3 & 4	—
31	Exchange of information for forecasts and warnings—Report	United States of America	Recomm. 59	—
32	Atmospheric noise data—Report	United States of America	Recomm. 67	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
33	Prediction of solar index—Report	United States of America	Recomm. 69	—
34	Allowances for fading—Report	United States of America	Question 52	—
35	Choice of a basic index for ionospheric propagation	United States of America	Question 53	—
36	Non-linear effects in the ionosphere	United States of America	Study Progr. 20	—
37* 8	Radio propagation at frequencies below 1500 kc/s	United States of America	Study Progr. 21	—
38	Ionospheric propagation of waves in the range of 30 to 300 Mc/s	United States of America	Study Progr. 22	—
39 *	A review of VHF ionospheric propagation	United States of America	Study Progr. 22	—
40	World-wide atmospheric radio noise measurement programme	United States of America	Study Progr. 23	—
41	World-wide allocation of certain frequencies	United States of America	Study Progr. 23	—
42	Measurements of atmospheric radio noise	United States of America	Study Progr. 23	—
43	Study of fading	United States of America	Study Progr. 24	—
44	Pulse transmission at oblique incidence—Report Working Group VI J	Netherlands	Recomm. 58	—
45	Review of publications on propagation	United States of America	Report 3	—
46	Long distance propagation of waves of 30 to 300 Mc/s by way of ionization in the E and F regions of the ionosphere	United States of America	Report 7	—
47	Rapid exchange of information on propagation	United States of America	Report 10	—
91	Non-linear effects in the ionosphere	United Kingdom	Study Progr. 20	—
92	Choice of a basic index for ionospheric propagation	United Kingdom	Question 53	—
106	Report of Chairman of Study Group VI	Chairman, Study Group VI	—	—
138	List of publications on radio propagation	Japan	Recomm. 14	IV, V

No.	Subject	Submitted by	Reference	Other Study Group concerned
143	Report on ionospheric propagation research in Japan	Japan	Recomm. 14	—
144*	Report on practical uses of radio propagation data	Japan	Question 50	—
145*	The mechanism and distribution of short-period fading under conditions of ionospheric turbulence	Japan	Study Progr. 24, para. 1 & 3	—
146*	Report on study of fading of broadcasting waves (540-1600 kc/s)	Japan	Study Progr. 24, para. 1	—
147	Study of long-distance propagation of VHF waves by sporadic E ionization	Japan	Study Progr. 22	—
148	Report on sweep-frequency pulse tests at oblique incidence	Japan	Recomm. 9	—
149	Electromagnetic field standards at high frequencies	Japan	Question 8, para. A 4	—
155	Measurement of atmospheric noise—Report	United Kingdom	Study Progr. 23	—
175	Studies made in the United Kingdom of HF radio wave propagation across the North Atlantic	United Kingdom	Study Progr. 24	—
176	Measurements of the propagation time of time signals in May, 1951	Italy	Recomm. 70 Question 54 Study Progr. 25	—
196 ¹	Radio noise measurement	Italy	Study Progr. 23	—
211	Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings	France	Recomm. 5	—
212	Draft resolution on the preparation of short-term forecasts of ionospheric disturbances	France	—	—
213 ¹	Choice of a basic index for ionospheric propagation—A solar radio index—Report	France	Question 53	—
214 ¹	Draft resolution	France	Question 53	—
220 ¹	Presentation of the lower limiting frequency of a radio circuit and of the predicted signal-to-noise ratio	Netherlands	Question 50	—
221 ¹	Production and reduction of ionospheric data standards, symbols and conventions	Netherlands	Recomm. 57	—
224*	Practical uses of radio propagation data	United States of America	Question 50	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
230	Preliminary results obtained by two different methods for measuring atmospheric radio noise	Sweden	Study Progr. 23	—
231 *	Report on reliability of MUF prediction (continuation of Doc. 144)	Japan	Question 50	—
232	Report of studies on estimation of medium-wave field strength over mixed paths	Japan	Study Progr. 13	—
233*	Choice of a basic index for ionospheric propagation (information additional to the report on Question 53, Doc. 30, Stockholm, 1952)	Spain	Question 53	—
247	Measurement of atmospheric radio noise—Proposal	Netherlands	Study Progr. 23	—
248*	Comparative study of frequencies actually used and those predicted by the C.R.P.L.	Switzerland	Question 50 para. 3	—
252	Xth General Assembly, Sydney, 1952	U.R.S.I.	Question 53 Study Progr. 20, 21 & 23 Recomm. 56, 57, 59 & 69 Draft Rec. (green sheet, Vol. I, C.C.I.R., 1951)	—
253	Report on World symposium on atmospherics (W.M.O.)	Secretariat of C.C.I.R.	Study Progr. 23	—
257*	Observations on the reception in Melbourne of the Anglo-Australian beam telegraph circuit	Australia	Question 50	—
274*	Measurement of bandwidths of emissions	Austria	Recomm. 37	I, IV
280*	Choice of a basic index for ionospheric propagation	Spain	Question 53	—
281*	FOT prediction at any distance according to the Spanish method	Spain	Question 53	—
286*	Note on "Diversity reception"	Secretariat of C.C.I.R.	Study Progr. 8, 18 & 24	III, V
303*	Practical uses of radio propagation data	Switzerland	Question 50	—
306*	Allowances for fading	France	Question 52	—
308	Draft recommendation concerning Question 50	France	Question 50	—
309*	Comparison of ionospheric predictions with actual propagation conditions	France	Question 50	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
327 ¹	First results of a campaign of field-strength observations	European Broadcasting Union	Study Progr. 21	—
332*	Radio propagation at frequencies below 1500 kc/s	Federal German Republic	Study Progr. 21 Question 5	—
333	Study of fading	Federal German Republic	Study Progr. 24 Question 14c	—
345*	Nomogram and chart for reliability computations of radio circuits, via the ionosphere	Italy	Doc. 86 of Study Group X Washington, 1950	—
353	Measurement of atmospheric radio noise—Report	France	Study Progr. 23, para. 3, 4, 5 & 6	—
355	The prediction of sunspot numbers	Australia	Recomm. 69	—
356	Short critique of solar index prediction methods	Australia	Recomm. 69	—
357	Some experiments on the prediction of sunspot numbers	Australia	Recomm. 69	—
360	Proposed new recommendation : Co-ordination of international tests	United States of America	Recomm. 58	—
362	Lightning-stroke counters	United States of America	Study Progr. 23, para. 6	—
370	Multi-frequency ionospheric sounding equipment for oblique incidence	Federal German Republic	Study Progr. 29 Question 56	—
393	Summary record of the 1st meeting (4 September, 1953)	Study Group VI	—	—
415	Summary record of the 1st meeting (9 September, 1953)	Sub-Group VI A	—	—
423	Summary record of the 2nd meeting (7 September, 1953)	Study Group VI	—	—
424	Summary record of the 3rd meeting (9 September, 1953)	Study Group VI	—	—
433	Ionospheric propagation of waves in the range 30-300 Mc/s	Sweden	Study Progr. 22	—
443*	Allowances for fading (replaces Doc. 34)	United States of America	Study Progr. 24 Question 52	—
457	Comparison between predicted cut-off frequency values and actual ionospheric conditions	Austria	Question 50	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
458 ^s	Non-linear effects in the ionosphere	Sub-Group VI C	Study Progr. 20	—
459	Summary record of the 2nd meeting (15 September, 1953)	Sub-Group VI A	—	—
460	Summary record of the 1st meeting (14 September, 1953)	Sub-Group VI F	—	—
464	Pulse transmission tests at oblique incidence—Draft recommendation	Sub-Group VI A	Recomm. 58	—
473	Identification of precursors indicative of short-term variations of ionospheric propagation conditions	Sub-Group VI F	Question 53	—
474	Prediction of solar index—Draft recommendation	Sub-Group VI F	Recomm. 69	—
475	Choice of a basic solar index for ionospheric propagation—Draft study programme	Sub-Group VI F	Question 53	—
488	Report and recommendations regarding the design of local lightning-flash counters	Sub-Group VI D	Study Progr. 23	—
490	Practical uses and reliability for ionospheric propagation	Working Group VI B.1	Question 50	—
491	Basic prediction information for ionospheric propagation	Working Group VI B.2	Question 50	—
492	Basic propagation prediction charts	Working Group VI B.2	Recomm. 53	—
493	Use of special modulation on the standard frequency transmissions for assessing the reliability of propagation effects	Working Group VI B.2	—	—
494	Usage and meaning of MUF	Working Group VI B.2	—	—
509	Study of fading—Draft study programme	Sub-Group VI E	Questions 51 & 52 Study Progr. 24	—
536	Ionospheric propagation of waves in the range 30 to 300 Mc/s	Sub-Group VI C	Report 7	—
538	Pulse transmission tests at oblique incidence	Sub-Group VI A	Recomm. 58	—
551	Draft recommendation on the reservation of frequencies for radio astronomical measurements	Sub-Group VI D	Recomm. 56	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
552	Draft letter from Chairman of Study Group VI to the Chairman of Study Group X	Sub-Group X B	Question 37	X
559	Choice of a basic index for ionospheric propagation	Sub-Group VI F	Question 53	—
560	Revision of atmospheric noise data	Sub-Group VI D	Study Progr. 23	—
569	Reliability computations MUF and LUF (Doc. 345 & 188)—Draft report	Sub-Group VI G	Question 50 Recomm. 69 A	—
570	Questions submitted by the I.F.R.B. (Doc. 346)—Draft report	Sub-Group VI G	Question 50 Recomm. 69 A	—
581	Preparation of short-term forecasts of ionospheric disturbances	Working Group VI B.3	Recomm. 59	—
582	Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbances warnings	Working Group VI B.3	Recomm. 59	—
584	Measurement of atmospheric noise	Sub-Group VI D	Study Progr. 23	—
585	Measurement of atmospheric noise	Sub-Group VI D	Study Progr. 23	—
598	Radio propagation at frequencies below 1500 kc/s	Sub-Group VI C	Study Progr. 21	—
601	Summary record of the 4th meeting (17 September, 1953)	Study Group VI	—	—
604	Fading of high-frequency and medium-frequency signals propagated by the ionosphere	Sub-Group VI E	Questions 51 & 52 Study Progr. 24	—
607	Investigation of circular polarized waves in the decameter wave-band—Draft recommendation	Sub-Group VI E	—	—
610	Summary record of the 5th meeting (21 September, 1953)	Study Group VI	—	—
615	Pulse transmission tests at oblique incidence	Sub-Group VI A	Recomm. 58	—
622	Prediction of solar index—Draft recommendation	Drafting Committee	Recomm. 69	—
623	Choice of a basic solar index for ionospheric propagation—Draft study programme	Drafting Committee	Question 53	—
624	Identification of precursors indicative of short-term variations of ionospheric propagation conditions—Draft study programme	Drafting Committee	—	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
684	Summary record of the 6th meeting (24 September, 1953)	Study Group VI	—	—
688	Local lightning-flash counters—Draft recommendation	Drafting Committee	Study Progr. 23	—
689	Non-linear effects in the ionosphere—Draft study programme	Drafting Committee	Question 5	—
690	Practical uses and the reliability of ionospheric propagation data—Draft report	Drafting Committee	Question 50	—
693	Summary record of the 7th meeting (25 September, 1953)	Study Group VI	—	—
702	Ionospheric propagation of waves in the band 30 to 300 Mc/s—Draft study programme	Drafting Committee	—	—
703	Study of fading—Draft study programme	Drafting Committee	Questions 51 & 52 Study Progr. 24	—
704	Basic prediction information for ionospheric propagation—Draft study programme	Drafting Committee	Question 50	—
705	Use of special modulation on the standard frequency transmissions for assessing the reliability of propagation forecasts—Draft study programme	Drafting Committee	Question 50	—
706	Presentation of basic propagation prediction charts—Draft recommendation	Drafting Committee	Recomm. 53	—
707	Clarification of definition of MUF—Draft resolution	Drafting Committee	Recomm. 57, para. 1	—
720	Summary record of the 8th meeting (29 September, 1953)	Study Group VI	—	—
746	Protection of frequencies used for radio-astronomical measurements	Drafting Committee	Recomm. 56	—
747	Pulse transmission tests at oblique incidence—Draft study programme	Drafting Committee	—	—
748	Preparation of short-term forecasts of ionospheric disturbances—Draft recommendation	Drafting Committee	—	—
749	Measurement of atmospheric noise—Draft recommendation	Drafting Committee	Study Progr. 23	—
752	Measurement of atmospheric noise—Draft study programme	Drafting Committee	Study Progr. 23	—
753	Investigation of circular polarized emitted waves in the HF band—Draft resolution	Drafting Committee	—	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
754	Radio propagation at frequencies below 1500 kc/s—Draft study programme	Drafting Committee	—	—
755	Questions submitted by the I.F.R.B.—Draft report	Drafting Committee	—	—
756	Choice of a basic index for ionospheric propagation—Draft report	Drafting Committee	Question 53	—
757	Exchange of information for the preparation of short-term forecasts and the transmission of ionospheric disturbance warnings—Draft report	Drafting Committee	Recomm. 59	—
780	Fading of high-frequency and medium-frequency signals propagated by the ionosphere—Draft report	Drafting Committee	Questions 51 & 52 Study Progr. 24	—
788	Rapid exchange of information on propagation	Drafting Committee	Recomm. 11, para. 1	—
828	Revision of atmospheric radio noise data—Draft recommendation	Drafting Committee	Study Progr. 23	—

STUDY GROUP No. VII

48	Standard frequency transmissions and time signals	United States of America	Question 54 Study Progr. 25	—
90	Standard frequency transmissions and time signals	United Kingdom	Study Progr. 25	—
107	Report of Chairman of Study Group VII	Chairman, Study Group VII	—	—
151	Standard frequency transmissions and time signals	Japan	Study Progr. 25	—
157 ³	Reception of standard time signal transmissions from WWV in the Netherlands	Netherlands	Question 54 Study Progr. 25	—
158	Reception of standard frequency and time signal transmissions from WWV in the Netherlands	Netherlands	Question 54 Study Progr. 25	—
176	Measurements of the propagation time of time signals in May, 1951	Italy	Recomm. 70 Question 54 Study Progr. 25	VI
177	Standard frequency transmissions and time signals	Italy	Question 54 Study Progr. 25	—
181	Standard frequency transmissions and time signals	Overseas Territories of French Republic	Study Progr. 25	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
182	Standard frequency and time signal transmissions	International Time Bureau	Recomm. 70 Study Progr. 25	—
183	Standard frequency transmissions and time signals	International Scientific Radio Union	Recomm. 70 Question 54 Study Progr. 25	—
198	Standard frequency transmissions and time signals	France	Recomm. 70 Question 54 Study Progr. 25	—
304	Standard frequency transmissions and time signals	United Kingdom	Question 54 Study Progr. 25	—
342	Supplementary note on time signals	International Time Bureau	Study Progr. 25	—
343	Standard frequency transmissions and time signals —Addition to Chairman's report	Chairman, Study Group VII	—	—
401	Summary record of the 1st meeting (8 September, 1953)	Study Group VII	—	—
413	Corrigendum to documents concerning Study Group VII	Study Group VII	—	—
439 ^a	Remarks and supplementary proposals in connection with the Chairman's report	Netherlands	Question 54 Study Progr. 25	—
470	Standard frequency transmissions and time signals —Draft recommendation	Sub-Group VII A	—	—
497	Summary record of the 2nd meeting (18 September, 1953)	Study Group VII	—	—
541	Draft Question and Study Programme	Sub-Group VII A	Question 54 Study Progr. 25	—
546	Standard frequency transmissions and time signals	Sub-Group VII A	Recomm. 18 & 70 Study Progr. 25	—
603	Summary record of the 3rd and last meeting (24 September, 1953)	Study Group VII	—	—
666	Standard frequency transmissions and time signals	Drafting Committee	Recomm. 70 Question 54	—
667	Standard frequency transmissions and time signals	Drafting Committee	Question 54	—
668	Standard frequency transmissions and time signals —Draft study programme	Drafting Committee	Question 54	—
671	Standard frequency transmissions and time signals —Draft report	Drafting Committee	Question 54	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
STUDY GROUP No. VIII				
49	Accuracy of field-strength measurements by monitoring stations	United States of America	Question 55 Recomm. 21	—
89	Automatic monitoring of channel usage— Proposed new question	United Kingdom	—	—
108	Report of Chairman of Study Group VIII	Chairman, Study Group VIII	—	—
152 ¹	Bandwidth measurement by monitoring stations —Report	Japan	Question 16	—
170	Accuracy of field-strength measurement by monitoring stations	United Kingdom	Question 55	—
194	Accuracy of field-strength measurement by monitoring stations	Italy	Recomm. 21 Question 55	—
241	Accuracy of field-strength measurement by monitoring stations	Australia	Question 55	—
397	Summary record of the 1st meeting (8 September, 1953)	Sub-Group VIIIA	—	—
398	Automatic monitoring of channel occupancy— Draft new question	Sub-Group VIIIA	—	—
417	Summary record of the 1st meeting (7 September, 1953)	Study Group VIII	—	—
420	Frequency measurements above 50 Mc/s by monitoring stations—Draft study programme	Sub-Group VIIIA	—	—
421	Summary record of the 2nd meeting (11 September, 1953)	Sub-Group VIIIA	—	—
479	Summary record of the 2nd meeting (16 September, 1953)	Study Group VIII	—	—
482	Letter from the Chairman of Study Group VIII to the Chairman of Study Group IX	Study Group VIII	—	IX
483	Bandwidth measurement by monitoring stations —Draft study programme	Sub-Group VIIIA	—	—
495	Summary record of the 3rd meeting (18 September, 1953)	Sub-Group VIIIA	—	—
510	Accuracy of field-strength measurements by monitoring stations—Draft study programme	Study Group VIII	—	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
511	Accuracy of field-strength measurements by monitoring stations—Draft recommendation	Study Group VIII	—	—
523	Automatic monitoring of channel occupancy—Draft question	Drafting Committee	—	—
524	Frequency measurements above 50 Mc/s by monitoring stations—Draft question	Drafting Committee	—	—
609	Summary record of the 3rd meeting (22 September, 1953)	Study Group VIII	—	—
632	Accuracy of field-strength measurements by monitoring stations—Draft recommendation	Drafting Committee	—	—
633	Accuracy of field-strength measurements by monitoring stations—Draft study programme	Drafting Committee	—	—
737	Bandwidth measurement by monitoring stations—Draft study programme	Drafting Committee	—	—

STUDY GROUP No. IX

51	Watch on the radiotelephone distress frequency of 2182 kc/s	United States of America	Question 57	—
52	Proposal relating to the standardization of radio-photo and telephoto equipment	United States of America	Question 58	—
53	Power relationships for modulated emissions—Report	United States of America	Question 59	—
54	Preferred methods of specifying power supplied to an antenna by a radio transmitter	United States of America	Question 60	—
55	Relating to pulse transmission for radio direction-finding	United States of America	Question 61	—
56 *	Identification of radio stations	United States of America	Question 17 Study Progr. 26	—
57	5-unit radio teleprinter	United States of America	Question 19 Study Progr. 27	—
58	Wide-band radio systems operating in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands	United States of America	Study Progr. 28	—
59	Alarm signal for use on the maritime radio telephony distress frequency 2182 kc/s	United States of America	Recomm. 71 Study Progr. 29	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
71	5-unit radio teleprinter	Belgium	Question 19	—
72	5-unit radio teleprinter	United Kingdom	Study Progr. 27 Question 19	—
73	Identification of radio stations	United Kingdom	Study Progr. 26	—
74	Pulse transmission for radio direction-finding	United Kingdom	Question 61	—
75	Preferred methods of specifying power supplied to an antenna by radio transmitters	United Kingdom	Question 60	—
76	Power relationships for modulated emissions	United Kingdom	Question 59	—
77	Watch on the radio telephony distress frequency of 2182 kc/s	United Kingdom	Question 57	—
87 ^a	Alarm signal for use on the maritime radio telephony distress frequency 2182 kc/s	United Kingdom	Study Progr. 29	—
88	Wide-band radio systems operating in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands	United Kingdom	Study Progr. 28	—
109	Report of Chairman of Study Group IX	Chairman, Study Group IX	—	—
125	Standardization of radiophoto and telephoto equipment	United Kingdom	Question 58 Report 11	—
153	Standardization of radiophoto and telephoto equipment	Japan	Question 58	—
174	Alarm signal for use on the maritime radio telephony distress frequency 2182 kc/s	France	Study Progr. 29	—
180	Watch on the radio telephony distress frequency of 2182 kc/s	France	Question 57	—
190	5-unit radio teleprinter—Proposed new study programme	United States of America	Question 19 Study Progr. 27	—
234	Identification of radio stations	Netherlands	Question 17 Study Progr. 26	—
244*	Relating to pulse transmission for radio direction-finding	United States of America	Question 61	—
245	Relating to identification of radio stations	United States of America	Question 17 Study Progr. 26	—
284	Identification of radio stations	Federal German Republic	Question 17	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
285	5-unit teleprinter	Federal German Republic	Question 19	—
289 ¹	Report on FM distortion of radio repeater	Japan	Study Progr. 28	—
286 ¹	Report on the effect of antenna aperture on the reflection coefficient of the earth	Japan	Study Progr. 28	—
297	Report on problems concerning the reliability of microwave relay links	Japan	Study Progr. 28	—
312	Report by the Director of the C.C.I.R. on the work of the Joint committee C.C.I.T.-C.C.I.R.	Secretariat of C.C.I.R.	Question 58 Questions V 8a & V 8c of C.C.I.T.	—
317	5-unit radio teleprinter and co-operation between synchronous and start-stop systems	Secretariat of C.C.I.R.	Findings of C.C.I.T. Plenary Assembly	—
320	The merits of the several possible systems of modulation and multiplexing in respect of the effective integration of line and radio systems	Federal German Republic	Study Progr. 28, para. 3.2	—
321 ¹	The addition to and withdrawal of channels from a relay system at intermediate stations	Federal German Republic	Study Progr. 28, para. 3.3	—
322 ¹	Monitoring and basic principles of maintenance and reliability of radio relay links integrated into the general network	Federal German Republic	Study Progr. 28, para. 3.6	—
328 ⁵	Use of A.C.E.C. teleprinters (Coquelet system) summary of present position (annex to Doc. 71)	Belgium	Question 19	—
338	Study of the assigning of the separate calling frequency and the especially reserved distress frequency for radiotelephone in the band 2000-2850 kc/s	Sweden	Study Progr. 29 Questions 56 & 57	—
339	5-unit code for teleprinters	Belgium	Study Progr. 27 Question 19	—
358	Summary record of the 1st meeting (4 September, 1953)	Study Group IX	—	—
368	Draft recommendation proposed by Sub-Group IX A in answer to Question 57	Sub-Group IX A	Question 57	—
369	Summary record of the 1st meeting (7 September, 1953)	Sub-Group IX B	—	—
371	Draft recommendation from Sub-Group IX A concerning Question 56 and Study Programme 29	Sub-Group IX A	Study Progr. 29 Question 56	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
376	Summary record of the 2nd meeting (7 September, 1953)	Study Group IX	—	—
381	Summary record of the 1st meeting (7 September, 1953)	Sub-Group IX C	—	—
384 ³⁵	Wide-band radio systems operating in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands	Sub-Group IX C	Study Progr. 28	—
391	Draft recommendation proposed by Sub-Group IX D in answer to Question 59	Sub-Group IX D	Question 59	—
392	Draft recommendation proposed by Sub-Group IX D in answer to Question 60	Sub-Group IX D	Question 60	—
408	Summary record of the 2nd meeting (10 September, 1953)	Sub-Group IX C	—	—
409	Summary of information on C.C.I.F. "circuit fictif de référence"	Sub-Group IX C	—	—
414	Summary record of the 3rd meeting (10 September, 1953)	Study Group IX	—	—
432	Results of measurements of directivity of antennae at great distances	Federal German Republic	Question 48	—
440	Summary record of the 3rd meeting (14 September, 1953)	Sub-Group IX C	—	—
441	Report of Sub-Group IX B regarding Question 58, Recommendation 25 and Report 11	Sub-Group IX B	Question 58 Recomm. 25 Report 11	—
442	Report of Sub-Group IX B regarding Question 19 and Study Programme 27	Sub-Group IX B	Question 19 Study Progr. 27	—
453	Summary record of the 4th meeting (14 September, 1953)	Study Group IX	—	—
465	Draft recommendation prepared by Sub-Group IX D on Question 61	Sub-Group IX D	Question 61	—
480	Summary record of the 5th meeting (17 September, 1953)	Study Group IX	—	—
482	Letter from the Chairman of Study Group VIII to the Chairman of Study Group IX	Study Group VIII	—	VIII
485	Report of Sub-Group IX D	Sub-Group IX D	Recomm. 72, 73, 74, 75, 76, 77 & 78	—
508	Watch on the radio telephony distress frequency of 2182 kc/s	Drafting Committee	—	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
525 ^a	Alarm signal for use on the maritime radio telephony distress frequency of 2182 kc/s	Drafting Committee	Recomm. 71	—
543	Power relationship for modulated emissions	Drafting Committee	Question 59	—
544	Methods of specifying the power supplied to an antenna by a radio transmitter	Drafting Committee	Question 60	—
561	Report of Sub-Group IX B regarding Question 17, Study Programme 26 and Recommendation 79	Sub-Group IX B	Question 17 Study Progr. 26 Recomm. 79	—
574	Summary record of the 6th meeting (21 September, 1953)	Study Group IX	—	—
587	Standardization of photo-telegraph apparatus for use on combined radio and metallic circuits	Drafting Committee	Question 58	—
588	Standardization of photo-telegraph apparatus for use on combined radio and metallic circuits—Draft recommendation	Drafting Committee	Question 58	—
589	Facsimile transmission of documentary matter over combined radio and metallic circuits	Drafting Committee	—	—
590	Transmission of half-tone pictures over radio circuits	Drafting Committee	—	—
591	Pulse transmission for radio direction-finding	Drafting Committee	Question 61	—
592 ¹	Use of radio circuits in association with 5-unit start-stop telegraph apparatus	Drafting Committee	Question 19	—
593	Use of radio circuits in association with 5-unit start-stop telegraph apparatus	Drafting Committee	Question 19	—
594	Use of radio circuits in association with 5-unit start-stop telegraph apparatus	Drafting Committee	Question 19	—
614 ⁵	Collaboration with the C.I.S.P.R.	Study Group IX	Recomm. 27	—
625 ⁵	Use of radio circuits in association with 5-unit start-stop telegraph apparatus	Drafting Committee	Question 19	—
626	Use of radio circuits in association with 5-unit start-stop telegraph apparatus	Drafting Committee	Question 19	—
634	Wide-band radio systems operating in the VHF (metric), UHF (decimetric) and SHF (centimetric) bands—Draft recommendation	Drafting Committee	—	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
635	Wide-band radio systems operating in the VHF, UHF and SHF bands—Draft report	Drafting Committee	Study Progr. 28	—
636	Artificial reference circuit for wide-band radio systems—Draft question	Drafting Committee	—	—
637	Propagation data required for wide-band radio systems—Draft question	Drafting Committee	—	—
638	Maintenance procedure for wide-band radio systems—Draft question	Drafting Committee	—	—
639	Standardization of multi-channel radio systems using time-division multiplex—Draft question	Drafting Committee	—	—
640	Standardization of multi-channel radio systems using frequency-division multiplex—Draft question	Drafting Committee	—	—
641	Signal amplitudes in individual channels of multi-channel systems—Draft question	Drafting Committee	—	—
642	Transmission characteristics of line systems	Drafting Committee	—	—
674	Summary record of the 7th meeting (24 September, 1953)	Study Group IX	—	—
675	Summary record of the 8th meeting (25 September, 1953)	Study Group IX	—	—
682	Identification of radio stations	United States of America	Question 17 Study Progr. 26	—
691	Representation of C.C.I.R. at forthcoming meeting of Study Group 5 of the C.C.I.F. in connection with Study Programme 28	Study Group IX	Study Progr. 28	—
740	Long-distance wide-band radio relay systems	"Ad hoc" Group (Study Group IX)	—	—
744	Bearing and position classification for HF and VHF direction-finding	"Ad hoc" Group (Study Group IX)	—	—
745	Frequency-modulated VHF maritime equipment	"Ad hoc" Group (Study Group IX)	—	—
798	Identification of radio stations—Draft recommendation	Drafting Committee	Question 17	—
799	Identification of radio stations—Draft study programme	Drafting Committee	Question 17	—
801	Identification of radio stations—Draft question	Drafting Committee	Question 17	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
819	Propagation data required for wide-band radio systems	Sweden	—	—
830	Interference to radio services—Draft recommendation	Drafting Committee	—	—
STUDY GROUP No. X				
61	Standards for sound recording for the international exchange of programmes	New Zealand	Question 63	—
62	Standards for sound recording for the international exchange of programmes	New Zealand	Question 63	—
63	High-frequency broadcasting. Conditions for satisfactory reception	New Zealand	Question 39	—
110	Report of Chairman of Study Group X	Chairman, Study Group X	—	—
135	Standards for sound recording for the international exchange of programmes	Denmark	Question 63	—
165	High-frequency broadcasting. Directive aerial systems	United Kingdom	Question 23	—
169	High-frequency broadcasting. Common frequency operation	United Kingdom	Question 37 Study Progr. 30	—
184	The reception of high-frequency broadcasting with synchronized transmitters—Report	United States of America	Study Progr. 30	—
185*	High-frequency broadcasting. Conditions for satisfactory reception—Proposed study programme	United States of America	Question 39	—
186	High-frequency broadcasting. Directive antenna systems—Proposed report	United States of America	Question 23	—
187	Standards of sound recording for the international exchange of programmes	United States of America	Study Progr. 31	—
188*	High-frequency broadcasting. Justification for use of more than one frequency per programme	United States of America	Question 37	—
192	Standards of sound recording for the international exchange of programmes	United Kingdom	Question 63 Study Progr. 31	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
215	High-frequency broadcasting. Justification for use of more than one frequency per programme	France	Question 37	—
216	Weighting curves of psophometers	France	Question 15 of C.C.I.F.	—
217	Reply by the Radiodiffusion Française to C.C.I.F. Question 14	France	Question 14 of C.C.I.F.	—
218	Recording : draft technical vocabulary	France	Resolutions 4 & 5	XIV
219	Standards of sound recording	France	Question 63	—
225	Proposed changes to Doc. 24 of the meeting of Study Group X, Geneva, 1952	United Kingdom	Recomm. 86	—
226	Standards of sound recording for the international exchange of programmes	United Kingdom	Question 63	—
227	Frequency characteristic in magnetic recording	United Kingdom	Question 63	—
275	Proposed amendments to Recommendation 81—Standards of sound recording for the international exchange of programmes	United States of America	Question 63	—
276	Proposed changes to Study Group X Doc. 24, resulting from the Geneva 1952 meeting, relating in particular to magnetic tape recording	United States of America	Question 63 Resolution 4 Recomm. 86	—
277	Reading of volume of peaks of broadcast transmission. Psophometer for broadcast transmission	United States of America	Questions 14 & 15 of C.C.I.F.	—
298	Note by Director of the C.C.I.R. Comments from Australia, New Zealand, Netherlands, Switzerland and Union of South Africa	Secretariat of C.C.I.R.	Questions 14 & 15 of C.C.I.F.	—
299	Note by Director of the C.C.I.R. and brief comments by Canada	Secretariat of C.C.I.R.	Questions 37 & 39 Study Progr. 30	—
305*	Single-sideband broadcasting	United Kingdom	Question 62	—
310	Standards of sound recording for the international exchange of programmes	Switzerland	Question 63	—
311	Measurement of speed variations and flutter	Switzerland	Question 31	—
325	The Hamburg recording convention	European Broadcasting Union	Question 63 Resolution 4 Study Progr. 31	—
326	Technical terminology	European Broadcasting Union	Resolution 5	XI, XIV

No.	Subject	Submitted by	Reference	Other Study Group concerned
330 ³	Programme meters	United Kingdom (B.B.C.)	Question 14 of C.C.I.F.	—
359	Summary record of the 1st meeting (4 September, 1953)	Study Group X	—	—
373	Standards of sound recording for the international exchange of programmes	France	Recomm. 86	—
426	Modifications proposed to Doc. 24 of the Study Group X meeting in Geneva, 1952	Federal German Republic	Question 63 Recomm. 86	—
437	Proposal concerning the terms of reference of Study Group X	Netherlands	—	—
454	Standards of sound recording for the international exchange of programmes—Draft recommendation	Sub-Group X A	Question 42	—
455 ¹	Standards of sound recording for the international exchange of programmes. Lateral-cut recording on disc	Sub-Group X A	Question 42	—
502 ⁵	High-frequency broadcasting. Directive antenna systems—Draft report	Sub-Group X B	Question 23	—
531	Standards of sound recording for the international exchange of programmes	Drafting Committee	Recomm. 81	—
532	Standards of sound recording for the international exchange of programmes. Lateral-cut recording on disc	Drafting Committee	Recomm. 86	—
552	Draft letter from the Chairman of Study Group X to the Chairman of Study Group VI	Sub-Group X B	Question 37	VI
553	Single-sideband broadcasting—Draft recommendation	Sub-Group X B	Question 62	—
554	Use of synchronized transmitters—Draft recommendation	Sub-Group X B	Study Progr. 30	—
555	Use of synchronized transmitters—Draft study programme	Sub-Group X B	Study Progr. 30	—
565	Summary record of the 2nd meeting (18 September, 1953)	Study Group X	—	—
577	Report to C.C.I.F. with respect to Questions 14 & 15 of C.C.I.F.	Sub-Group X A	Questions 14 & 15 of C.C.I.F.	—
578	Standards of sound recording for the international exchange of programmes—Proposed study programme	Study Group X	Question 42 Study Progr. 31	—
579 ¹	Standards of sound recording for the international exchange of programmes. Single track magnetic recording on tape—Draft recommendation	Working Group X A.1	Recomm. 81	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
596	High-frequency broadcasting. The modification of receivers to permit closer frequency-spacing between carriers of broadcast transmissions—Draft question	Study Group X	Question 62	—
612	Standards of sound recording for the international exchange of programmes. Cine type spools—Draft resolution	Study Group X	—	—
616	High-frequency broadcasting. Conditions for satisfactory reception—Draft study programme	Study Group X	Question 39	—
617	High-frequency broadcasting. Justification for use of more than one frequency per programme	Study Group X	Question 37	—
708	Standards of sound recording for the international exchange of programmes—Draft study programme	Drafting Committee	Question 42	—
709	High-frequency broadcasting. Modification of receivers for closer spacing between carrier frequencies—Draft question	Drafting Committee	Question 62	—
710	Use of synchronized transmitters—Draft study programme	Drafting Committee	Study Progr. 30	—
711 ⁵	Use of synchronized transmitters—Draft recommendation	Drafting Committee	Study Progr. 30	—
712	Single-sideband sound broadcasting—Draft recommendation	Drafting Committee	Question 62	—
713	Report from Study Group X on Questions 14 & 15 of C.C.I.F.	Drafting Committee	Questions 14 & 15 of C.C.I.F.	—
714	High-frequency broadcasting. Justification for use of more than one frequency per programme—Draft study programme	Drafting Committee	Question 37	—
715	High-frequency broadcasting. Directive antenna systems—Draft report	Drafting Committee	Question 23	—
716	High-frequency broadcasting. Conditions for satisfactory reception—Draft study programme	Drafting Committee	Question 39	—
717	Standards of sound recording for the international exchange of programmes. Cine type spools—Draft resolution	Drafting Committee	Question 63	—
719	Summary record of the 3rd meeting (25 September, 1953)	Study Group X	—	—
789	Standards of sound recording for the international exchange of programmes—Draft recommendation	Drafting Committee	Questions 42 & 63	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
815	Frequency-modulation broadcasting in the VHF band—Draft question	Drafting Committee	—	—
816	Use of the 26 Mc/s broadcasting band—Draft resolution	Drafting Committee	—	—

STUDY GROUP No. XI

64	Ratio of the wanted to the unwanted signal in television	United States of America	Question 67	—
65 *	Disturbances in television receivers resulting from harmonics and other non-essential radiations from radio transmitters	United States of America	Recomm. 83	—
66	Final report of "ad hoc" Committee of N.T.S.C. on dot-interlace and dot-arresting for black-and-white television	United States of America	Study Progr. 37	—
67	Revised specifications for field-test of N.T.S.C. compatible color television	United States of America	Study Progr. 37	—
68	Narrow-band transmission of the N.T.S.C. color signal	United States of America	Study Progr. 37	—
69	Colorimetry in color television	United States of America	Study Progr. 37	—
70	Color-carrier reference phase synchronization accuracy in N.T.S.C. color television	United States of America	Study Progr. 37	—
86	Polarization advantage in the planning of television and VHF sound broadcasting services	United Kingdom	New question	—
111	Report of Chairman of Study Group XI	Chairman, Study Group XI	—	—
163	Requirements for the transmission of television over long distances—Report	United States of America	Study Progr. 32	—
171	Colour acuity	United Kingdom	Questions 65 & 68	—
172	Colour acuity. Further work	United Kingdom	Questions 65 & 68	—
173	A note on the definition of visual acuity	United Kingdom	Questions 65 & 68	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
178*	Broadcasting and television receivers	Italy	Recomm. 41 & 42 Question 47 Study Progr. 5 & 6	II
189	A recommended specification of the resolution of television picture signal generators	Australia	Question 65	—
278	Report on assessment of the quality of television pictures	Japan	Question 65	—
279	Report on resolving power and differential sensitivity of the human eye	Japan	Question 68	—
301	International television : the Coronation transmissions	Netherlands	Study Progr. 36	—
302	A line converter using the image iconoscope	Netherlands	Study Progr. 36	—
324*	On the choice of intermediate frequencies for television receivers and associated questions	European Broadcasting Union	Question 47 Study Progr. 5 & 6	—
326	Technical terminology	European Broadcasting Union	Resolution 5	X, XIV
334*	Requirements for the transmission of television over long distances	Federal German Republic	Study Progr. 32	—
337	Conversion of a television signal from one standard to another	United Kingdom	Study Progr. 36	—
341	Picture sharpness and degree of contrast required in television	U.S.S.R.	Study Progr. 37	—
374	Report of Sub-Group XI B	Sub-Group XI B	—	—
378	Synopsis of results of measurements of sensitivity of human eye using different variables	France	Questions 65 & 68	—
379*	Conversion of television standards. Arrangements for relaying Coronation	France	Study Progr. 36	—
380	Experimental determination of the ratio of the wanted to the unwanted signal for the protection of an 819-line television picture against a pure carrier or a carrier modulated by a square signal	France	Question 67	—
396	Ratio of the wanted to the unwanted signal in television—Report	Sub-Group XI A	Question 67	—
404	Summary record of the 1st meeting (7 September, 1953)	Study Group XI	—	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
435*	Circuit characteristics for the transmission of television signals over long distances	France	Study Progr. 32	—
438 ¹	Summary record of the 2nd meeting (9 September, 1953)	Study Group XI	—	—
452	Report	Sub-Group XI C	Questions 65 & 68	—
518	Advantages to be obtained from consideration of polarization in the planning of broadcasting services in the VHF and UHF bands (television and sound)	Drafting Committee	New Question	—
564 ¹⁵	Circuit characteristics for the transmission of television signals over long distances	Sub-Group XI D	Study Progr. 32 Report 15	—
572	Revision of Report 15	Study Group XI	Report 15	—
595	Summary record of the 3rd meeting (18 September, 1953)	Study Group XI	—	—
643	Measurement of the quality of television pictures	Drafting Committee	Question 65	—
644	Resolving power and differential sensitivity of the human eye	Drafting Committee	Question 68	—
669	Ratio of the wanted to the unwanted signal in television	Drafting Committee	Question 67	—
680	Information given by the U.S.A. Delegation on a paper by Dr. Otto H. Schade, entitled : " Image gradation, graininess and sharpness in television and motion picture systems "	United States of America	—	—
727	Summary record of the 4th meeting (23 September, 1953)	Study Group XI	—	—
728	Summary record of the 5th meeting (25 September, 1953)	Study Group XI	—	—
STUDY GROUP No. XII				
112 ¹	Report of Chairman of Study Group XII	Chairman Study Group XII	—	—
164	Tropical broadcasting—Report	Overseas Territories of French Republic	Study Progr. 38 Questions 4 & 27	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
262 ¹	A practical examination of the provisional power limits recommended in C.C.I.R. Recommendation 84	India	Study Progr. 38 para. 2	—
263	Statistical analysis of field strength of All India Radio regional transmitters	India	Study Progr. 38 para. 4	—
264 ¹	Best method of calculating sky-wave field intensity produced by a transmitter working in the tropical zone	India	Question 69	—
363 ¹	Tropical broadcasting	United Kingdom	Question 70 Study Progr. 38	—
377	A practical examination of the provisional power limits recommended in C.C.I.R. Recommendation 84	India	Study Progr. 38 para. 2	—
394	Summary record of the 1st meeting (8 September, 1953)	Study Group XII	—	—
498 ¹	Summary record of the 2nd meeting (15 September, 1953)	Study Group XII	—	—
605	Design of aerials for tropical broadcasting	Study Group XII	Question 70	—
606	Design of aerials for tropical broadcasting	Study Group XII	Question 70	—
611 ¹	Summary record of the 3rd meeting (21 September, 1953)	Study Group XII	—	—
648	Minimum permissible protection ratio to avoid interference in the bands shared with tropical broadcasting	Study Group XII	Recomm. 50 Question 4	—
649	Interference in the bands shared with tropical broadcasting	Study Group XII	Question 4	—
651	Minimum permissible protection ratio for broadcasting services operating in the tropical zone in the shared bands	Study Group XII	Recomm. 50 Question 4	—
652	Maximum power for short-distance high-frequency broadcasting in the tropical zone	Study Group XII	Study Progr. 38	—
653	Design of aerials for tropical broadcasting	Study Group XII	Question 70	—
654	Design of aerials for tropical broadcasting	Study Group XII	Question 70	—
655	Maximum power for short-distance high-frequency broadcasting in the tropical zone	Study Group XII	Question 27	—
723	Summary record of the 4th meeting (24 September, 1953)	Study Group XII	—	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
724	Summary record of the 5th and last meeting (29 September, 1953)	Study Group XII	—	—
790	Design of aerials for tropical broadcasting—Draft recommendation	Drafting Committee	Question 70	—
791	Minimum permissible protection ratio to avoid interference in the bands shared with tropical broadcasting—Draft recommendation	Drafting Committee	Question 4	—
792	Design of aerials for tropical broadcasting—Draft report	Drafting Committee	Question 70	—
793	Interference in the bands shared with broadcasting—Draft question	Drafting Committee	Question 4	—
794	Interference in the bands shared with broadcasting—Draft study programme	Drafting Committee	Recomm. 50 Question 4	—
795	Maximum power for short-distance high-frequency broadcasting in the tropical zone—Draft report	Drafting Committee	Question 27 Study Progr. 38 Recomm. 84	—
796	Design of aerials for tropical broadcasting—Draft recommendation	Drafting Committee	Question 70 paragr. 3	—
797	Maximum power for short-distance high-frequency broadcasting in the tropical zone—Draft question	Drafting Committee	Question 27 Study Progr. 38 Recomm. 84	—
802	Design of aerials for tropical broadcasting—Draft question	Drafting Committee	Question 70	—
STUDY GROUP No. XIII				
113	Report of Chairman of Study Group XIII	Chairman Study Group XIII	—	—
316	Publication of codes in use in international telegraph services	Secretariat of C.C.I.R.	Findings of C.C.I.T. Plenary Assembly	—
352	Proposal concerning SINPO signal reporting code	Netherlands	Recomm. 85	—
539	Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships	Study Group XIII	New question	—
602	Summary record of the 1st meeting (22 September, 1953)	Study Group XIII	—	—
685	Summary record of the 2nd meeting (24 September, 1953)	Study Group XIII	—	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
735	Addition to Appendix 9 of the Radio regulations	Drafting Committee	Recomm. 85	—
736	Publication of service codes in use in the international telegraph service—Draft resolution	Drafting Committee	—	—
823	Testing of 500 kc/s radiotelegraph auto-alarm receiving equipment on board ships	Drafting Committee	—	—
STUDY GROUP No. XIV				
60	Classification of the frequency and wavelength bands used in radio communication	United States of America	Question 73	—
85	Nomenclature of frequency bands	United Kingdom	Question 73	—
114	Report of Chairman of Study Group XIV	Chairman, Study Group XIV	—	—
156	Means of expression	United Kingdom	Resolution 5	—
218	Recording: draft technical vocabulary	France	Resolutions 4 & 5	X
223	Classification of the frequency and wavelength bands used in radio communication	Federal German Republic	Question 73	—
254	List of technical terms used in the work of Study Group I	Federal German Republic	Resolution 5	I
255	Means of expression used in questions, study programmes, recommendations and documents with which Study Group III is concerned	Federal German Republic	Resolution 5	III
265	First preliminary report by the Chairman of Study Group XIV	Chairman, Study Group XIV	Question 72	—
266	Second preliminary report by the Chairman of Study Group XIV	Chairman, Study Group XIV	Question 73	—
267	Third preliminary report by the Chairman of Study Group XIV	Chairman, Study Group XIV	Resolution 5	—
268	Classification of the frequency and wavelength bands used in radio communication	Australia	Questions 72 & 73	—
269*	Means of expression	Australia	Resolution 5	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
270	Decimal classification—Systems of units	United States of America	Question 72 Resolution 6	—
271	Contribution of the P.T.T. administration of the Federal German Republic to the work of Study Group XIV	Federal German Republic	Questions 72 & 73 Resolutions 5 & 6	—
272	Contribution to the work of Study Group XIV	Italy	Questions 72 & 73 Resolutions 5 & 6	—
315	Definitions, symbols, vocabulary	Secretariat of C.C.I.R.	Plenary Assembly of C.C.I.T.	—
326	Technical terminology	European Broadcasting Union	Resolution 5	X, XI
344	Classification of the frequency and wavelength bands used in radio communication	Italy	Question 73	—
354*	Suggestions and comments by the French administration on the programme of work of Study Group XIV	France	Questions 72 & 73 Resolutions 5 & 6	—
387	Summary record of the 1st meeting (4 September, 1953)	Study Group XIV	—	—
406*	Communication by the Director of the C.C.I.T. to the VIIth Plenary Assembly of the C.C.I.R. on universal decimal classification	C.C.I.T.	Recomm. 1-5 of C.C.I.T.	—
419	Summary record of the 2nd meeting (8 September, 1953)	Study Group XIV	—	—
425	Summary record of the 1st meeting (11 September, 1953)	Sub-Group XIVA	—	—
449	Draft report—Decimal classification	Sub-Group XIVA	Question 72	—
456	Summary record of the 2nd meeting (15 September, 1953)	Sub-Group XIVA	—	—
512	Summary record of the 3rd meeting (16 September, 1953)	Study Group XIV	—	—
526	Summary record of the 3rd meeting (18 September, 1953)	Sub-Group XIVA	—	—
529	Draft recommendation concerning Question 73	Sub-Group XIVA	Question 73	—
530	Summary record of the 4th meeting (22 September, 1953)	Sub-Group XIVA	—	—
533	Decimal classification	Drafting Committee	Question 72	—

No.	Subject	Submitted by	Reference	Other Study Group concerned
576 ¹⁵	Unit systems—Draft recommendation	Sub-Group XIVA	Recomm. 41	—
686	Summary record of the 4th meeting (25 September, 1953)	Study Group XIV	—	—
729	Summary record of the 5th meeting (29 September, 1953)	Study Group XIV	—	—
739	Nomenclature of the frequency and wavelength bands used in radio communication	Drafting Committee	Question 73	—
781	Means of expression. Terms, definitions, graphical and letter symbols and their conventional usage	Drafting Committee	Resolution 5	—
783	Unit systems	Drafting Committee	Resolution 6	—
820	Means of expression. General account of the work of Sub-Group XIV B	Sub-Group XIV B	Resolution 5	—

PLACE OF THE VIIIth PLENARY ASSEMBLY

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PLACE OF THE VIIIth PLENARY ASSEMBLY

During the eighth and last session, the C.C.I.R. VIIth Plenary Assembly accepted unanimously and by acclamation the invitation of the People's Republic of Poland to hold the VIIIth Plenary Assembly of the C.C.I.R. in Warsaw.
