Bulletin N° 93 September-October 1955

International Scientific Radio Union

U. R. S. I.

CONTENTS

XI^th GENERAL ASSEMBLY

Proceedings

The following parts are out of press ; copies have been sent to National Committees for distribution.

Supplementary copies are available at the General Secretariat of U.R.S.I. at the following prices.

Part 1. — Work of Commission I	: Belgian Fr 60, £ 0.8.8, $ 1.20.
Part 3. — Work of Commission III	: Belgian Fr 200, £ 1.9.0, $ 4.0.
Part 4. — Work of Commission IV	: Belgian Fr 60, £ 0.8.8, $ 1.20.
Part 8. — Administrative proceedings	: Belgian Fr 100, £ 0.14.6, $ 2.0.

NATIONAL COMMITTEES

India

SYMPOSIUM ON IONOSPHERIC DRIFTS

A symposium on « Ionospheric Drifts » was held at the National Physical Laboratory of India, New Delhi on 30th July under the sponsorship of the Radio Research Committee of the Council of Scientific and Industrial Research, with Sir K. S. Krishnan in the chair.

Dr. A. P. Mitra, Secretary, Indian National Committee for the U.R.S.I., gave an account of the meeting on « Movements and Irregularities in the Upper Atmosphere » during the XIth General Assembly of the U.R.S.I., in which ionospheric drift measurements made in England, Australia and the U. S. A. by means of extra-terrestrial radiation were discussed.

After an initial survey of the various visual and radio methods that have been used to study horizontal drifts in the ionosphere, Mr. S. N. Mitra described in detail the spaced receiver technique of measuring drift in the ionosphere, originally developed by him in Cambridge. Evidence of a steady horizontal drift was detected utilising this method and a velocity of the order of 50 m/s was obtained. Similar methods have been used by Dr. Ramachandra Rao in Andhra and Dr. Ramanathan in Ahmadabad, the former using the frequencies 2.5 Mc/s and 5.9 Mc/s and the later 2.5 Mc/s and 5 Mc/s. Andhra measurements gave velocities in the range 30 m/s to 110 m/s for the E region, 50 to 120 m/s for the E*s* region and 30 to 150 m/s for the F2 region.

Study of fading in its relation to ionospheric drifts was discussed in two papers. In the first, entitled « Fading and Random Motion of Ionospheric Irregularities » by S. N. Mitra and R. B. L. Srivastava Mr. Mitra described the statistical analysis of some fading curves obtained at Delhi on medium wave transmissions from Lucknow on 1020 kc/s. Such analysis gave for the r. m. s. velocity in the line of sight of the random motion of the ionospheric irregularities values between 4 and 25 m/s. In the second paper on fading, communicated by Dr. S. R. Khastgir, vertical drift velocities have been obtained from Doppler-beat type fading of medium and short waves, on the assumption that the beat effect comes from the singly and doubly reflected waves from the vertically moving layer. Vertical velocity ranging between 2 to 5 m/s for the E region and between 1 to 4 m/s for the F region have been obtained.

The third phase of the symposium concerned the drift effects observable in ionospheric records. Mr. Bhargava of the India Meteorological Department described some of these effects, observed at Kodaikanal. These fall into three principel categories :

1) unidirectional drifts associated with formation of lunar layers ;

2) similar drifts associated with solar eclipse effects, and

3) movements of an oscillatory nature.

The lunar tidal effects at Kodaikanal have also been described in a paper communicated by Mr. M. V. Sivaramakrishna of the India Meteorological Department.

Finally the effect of vertical ion-transport on layer shape was discussed by Dr. A. P. Mitra with particular reference to the lower ionospheric ionization at night, and some low frequency ionospheric data. It appears that the normal vertical drift velocity in the lower E region has an amplitude of 1-5 km/hr. The possible effect of drift in the occasional « breaking » of the E layer, observed at 150 kc/s, and in the formation of nighttime sporadic E in low latitudes was discussed.

Japan

SYMPOSIUM ON IONOSPHERIC STORMS

The proceedings of the symposium on Ionospheric Storms held in Tokyo in May 1953 has been published in « Report of Ionospheric Research in Japan, Vol. VIII, n° 1, 1954 (Maruzen Co, Ltd, Tokyo).

The following topics were submitted and discussed :

Ionospheric Storms in Middle and Low Latitudes, H. Uyeda.

The Morphology of Ionospheric Disturbances in the F2 region, D. F. Martyn.

Seasonal Variation of Ionospheric Disturbance, N. Fukushima.

On the Development of Ionospheric Storm, T. Obayashi.

On the Characteristics of F2 Layer Variations Associated with Geomagnetic Storms, K. Sinno.

Disturbances in the Ionosphere during the Geomagnetic Storm of April 13, 1951, H. Kamiyama.

Characteristics of Ionospheric Disturbance during a Severe Magnetic Storm, K. Miya.

Ionospheric Storms in High Latitudes, T. Nagata.

COMMISSIONS

Commission III

ON IONOSPHERIC RADIO

SYMPOSIA

Symposium on Ionospheric Storms, see pp. 4-5.
Symposium on Ionospheric Drifts, see pp. 5-6.

CENTRALISING AGENCIES FOR THE RAPID EXCHANGE OF INFORMATION ON PROPAGATION

(C.C.I.R. - Report nº 28)

The following have been designated by their respective countries as the official agencies for the reception, co-ordination, liaison and exchange of information relating to radio propagation.

Federal German Republic : Fernmeltechnisches Zentralamt (Arbeitgemeinschaft Ionosphäre), Rheinstrasse, 110, Darmstadt, Germany. Telegraphic address : Ionosphäre, Darmstadt.

Australia : Officer in Charge, International Section, P. M. G. Dept., Treasury Gardens, Melbourne C2, Australia. Telegraphic address : Gentel Melbourne.

Belgium : Chef du Service du Rayonnement, Institut Royal Météorologique, 3, avenue Circulaire, Uccle, Bruxelles, Belgium.

Spain : Departamento de Servicios Técnicos de Telecommunicación, Dirección General de Correos y Telecommunicacion, Madrid, Spain.

United States of America : Central Radio Propagation Laboratory. National Bureau of Standards, Boulder, Colorado, U. S. A.

France: Bureau Ionosphérique Français, 196, rue de Paris, Bagneux, Seine, France. Telegraphic address : Gentelabo Paris.

Italy : Istituto Nazionale di Geofisica, Cittá Universitaria, Rome. Telegraphic address : Geofisica Roma. Note : All messages should begin with the word « Ionosphere ».

Japan : Radio Research Laboratories, Kokubunji P. O. Kitatama-Gun, Tokyo, Japan.

New Zealand : The Secretary, Department of Scientific and Industrail Research, P. O. Box 18, Government Buildings, Wellington, New Zealand.

Netherlands : Afdeling « Ionosfer en Radio-Astronomie » P. T. T., Sceveningsweg, 6, The Hague, Netherlands.

United Kingdom : Director, Directorate of Radio Research, Radio Research Station, Slough, Bucks, England. Telegraphic address : Radsearch Slough.

Switzerland : Laboratoire de Recherches et d'Essais, Direction Générale des P. T. T. Speichergasse, 6, Bern, Switzerland.

Union of South Africa : Telecommunications Research Laboratory, C.S.I.R. Department of Electrical Engineering, University of the Whitwatersrand, Johannesburg, Union of South Africa.

SUB COMMISSION III*a*.

ON IONOSPHERIC OBSERVATIONS AND REDUCTION OF DATA

Membership

The attention of National Committees is called to the fact that the membership in Subcommission III*a* is intended to be comprised of individuals named by the National Committee by each country concerned. Subcommission III*a* is charged with the coordination and reduction of vertical ionospheric sounding observations, and has many important tasks to perform in this connection. The undersigned who was designed chairman of the Subcommission by the XIth General Assembly, would appreciate receiving the names of members from National Committees of all countries who desire to be represented on the Subcommission.

A. H. SHAPLEY,
National Bureau of Standards
Boulder Colorado, U.S.A.

SUB-COMMISSION III*c*.

ON STUDY OF PROPAGATION TIME OF RADIO SIGNALS

Letters to Members of the Sub-Commission

Torino, February 24th, 1955.

Dear Sir,

The first series of experiments for the measurements of propagation time of time signals carried out in December 1954 can be considered to have given yet satisfactory results, taken on account it was the first tentative of a world wide set of contemporary measurements by duplex transmissions on the *same* frequencies and that the ionospheric propagation conditions were very bad in that month.

Satisfactory numbers of measurements have been made at Teddington (by the N. P. L.) and at Abinger (by the Royal Greenwich Observatory) on WWV and IBF signals in comparison with MSF 60 kc/s signals; at Torino (by the I.E.N.) on MSF and WWV signals; at Boulder, Colorado (by the N.B.S.) on WWV and WWVH signals; at Maui, Hawai (by the N.B.S.) on WWV and JJY signals (only few) in comparison with local WWVH signals. It is expected that measurements have been made at Tokyo on WWVH signals at least, in comparison with local JJY signals. Some results are also expected from Washington, D. C.

Measurements have been made at Entköping by the Swedish Board of Telecommunications, on MSF, IBF, WWV, IAF (7,570 kc/s) and FYA3 signals and measurements are expected to have been made at Leidshendam by the Nederlands P.T.T. Centraal Laboratorium. No measurements could be made at Paris by the L.N.R. and in Germany by the P.T.B. and German Post, due to very poor ionospheric propagation conditions and high level of interference.

Unfortunately the results obtained at Boulder are not directly utilizable for determination of propagation time between WWV and WWVH stations as Boulder is at about one third of the way from WWV to WWVH. But the being of Boulder on the great circle between the two stations is a favorable circumstance for the utilization of the results there obtained, particularly if they can be helped by only *some* measurements made at Washington, within the range of the ground-wave from WWV.

In a general way measurements made in localities far from high precision time signals transmitting stations can be very helpful and must be encouraged when they can be correlated with direct duplex measurements between couples of stations, so that the time delay between different signals at the emission point could very accurately be known at every moment, owing to the high stability of time signals of the modern type. Only the differences in propagation time of the signals from various transmitting station to each receiving and measuring station can be detected in this way. But this supplementary information can give an appreciable contribution to the study of the phenomena.

It seems to me whorty to be considered in further experiments whether it is possible to include 60 kc/s MSF time signals in the measurements. They are very succesfully utilized at Abinger and Teddington, of course, but it is possible they could be usefully received at much more distance from Rugby, in Europe at least. From the informations I received from Abinger it results that the signals are well shaped and there seems to be no noticeable difference between the appearance of the 60 kc/s signals and good ones on 5 Mc/s. There is still some incertitude on the existence of differential lags between the emission of MSF 60 kc/s and those on 5 and 10 Mc/s, due to differences in the transmitters. But I know the Electronics Laboratory of the

Royal Greenwich Observatory has in program to clarify this point by means of measurements in a site near the transmitters and precise data will be probably available in the next future.

The next series of experiments for the measurements of propagation time of time signals I propose should be effectued at the end of March. In order to reduce the amount of work involved with the experiments and to facilitate their repetition at every third month, they could be tentatively limited to two days and I propose the 23rd and 25th of March from 00.00 UT to 24.00 UT. The program should be the same as in the experiments of December (please see my letter of Sept. 22nd [1]), except IBF stations will transmit from minute 00 to minute 10 on 5 Mc/s and from minute 15 to minute 25 on 10 Mc/s, at every third hour. I hope JJY could kindly arrange for special transmissions as in December.

I suggest informations so much detailed as possible on the equipments used for the experiments would be exchanged between laboratories. At this purpose I send you in Appendix the list of the Members of the Sub-Commission and the organizations interested in the experiments.

Your very sincerely.

The Chairman of Sub-Commission IIIc
(*sgd*) M. Boella

Torino, May 17th 1955.

Dear Sir,

According to a suggestion I received from Prof. Koga (Japan) I propose the program for the experiments on propagation time of radio signals be defined for the whole year and the following days be choosed : Wednesday and Friday after the 3rd Sunday of June, September and December, i. e. : June 22nd and 24 th, September 21st and 23rd, December 21st and 23rd.

The general program for the experiments shall be unchanged, i. e. comparison between time signals at every third hour (about from half hour before to half hour behind) beginning with 00 h UT and ending at 21 h UT of each selected day.

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(1) See *Inf. Bull.*, **90**, 56-58.

The program of special transmissions from IBF (Torino, Italy) shall be the same as in the experiments of March, i. e. time signals on 5 Mc/s from ... h 05 m to ... h 15 m and on 10 Mc/s from about ... h 18 m to ... h 30 m at every third hour as before. I remember that in IBF pulse transmissions the identification of the beginning of each minute is made by means of a group of 7 pulses at the second 00 instead of the suppression of 59th pulse of the minute.

The program of special transmissions from JJY (Tokyo, Japan) on 5 and 10 Mc/s will be distributed by the responsible authority together with a program of signal transmission by commercial waves.

Yours very sincerely,

The Chairman of Sub-Commission IIIc
(*sgd*) M. Boella

IONOSPHERIC STATIONS

Publication of the results of S.P.I.M. stations

We are informed that the monthly medium values of the ionospheric measures of SPIM stations will be henceforth distributed on separate sheets to all who currently receive the SPIM-O-bulletins so as to accelerate the publication of the aforesaid measures.

The SPIM-O will shortly be issued again in a different form.

URSIGRAMS

To Ursigrams auditors

(*Translation*)

Since 1952 various modifications were brought to the broadcasting of Ursigrams.

1° *On July 1st*, 1952, standardized codes common for Ursigrams from Federal Germany, Austria, France, Marocco and South Algeria came into effect.

2° *On January 1st*, 1953, considerations for a better working on radio links led to a modification in the short wave-lengths used ; waves being transmitted successively and no more simultaneously, such change helped to set up a supplementary broadcast in the middle of the U.T. day.

3° *Since February* 1953, each broadcast (noon or ovening) includes the repetition of the preceeding broadcast.

4° *Since November* 1953, Ursigrams drafted in Japan reach the Bureau Ionospherique Français via Darmstadt and The Hagen. On the other hand, since December 10th, 1953, C.R.P.L. also sends to the Bureau Ionosphérique Français (due to the kindness of the R.C.A. of New-York) a message of 30 daily groups. Such American and Japanese observations are included in the Pontoise broadcast, either in their original Codes or translated in European Codes when feasible.

5° At last, *since July* 1955, the Ursigram message starts with a choice of special phenomena : SID (PIDB) solar bursts and outbursts, etc. The interest of this addition recommended by the Ursigram Committee of U.R.S.I. to provide a shortened audition for agencies using only these data, is often reduced due to delays in the transmission of data.

Schemes for the future

1. The fact that for the time being the broadcasting of Ursigrams use radiotelegraphy is a hindrance to a greater use. Scientific organizations have not always an individual able to detect the transmission by sound reading. Some help might be perhaps brought to such organizations by means of broadcasts emitted at other times with the Siemens-Hell Radioteletype (1) which automatically detects and records the messages with a velocity three times greater than radiotelegraphy.

2. Times of present broadcasts could be arranged to include three daily broadcasts instead of one ; this would allow the broadcastings of some data with a gain of time of 4 to 5 hours on the present schedule.

Conclusion

It is well known that Ursigrams broadcast at the present time have some gaps, that some observations are duplicated and that the messages are sometimes rather long (which is due to the irregular arrival of data which overload further broadcasts) while on other days the Ursigrams are particularly short.

The Ursigram Committee of U.R.S.I. will meet in a few weeks in view of considering means to improve the present broadcasts and, if needed, to consider their extension during the International Geophysical Year, it seems therefore, useful to consult before the users in order to be informed of their needs. This is the aim of a questionary sent to the main organizations using Ursigrams ; copies of the questionary are available at the Bureau Ionospherique Français, 196, rue de Paris, Bagneux, Seine, France.

The time schedule of the Ursigram broadcast is given on page 16.

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(1) The price of the receiver-translator isa about 200 000 French Francs (about 570 $).

Time Schec

The world wide transmissions of Ursigrams take place according to

Time U.T.	Sender	Call Sign	Frequency Mc/s	Wavelength	Wave typ
12.00	Tokyo	JJD	8 000	37.5	A1
12.00	Pontoise (France)	FYP TQC9	90.9 10 775	3 300.3 27.84	A1 A1
12.30 (1)	Hamburg	DGE36	5 360	55.97	A3
13.08	Pontoise	FYP TOG5	90.9 13 873	3 300.3 21.62	A1 A1

(1) Not on Sundays and holidays.

Broadcast

›wing chronological order :

	Transmitted Observations	Codes used
	Japanese Observations	
SUN	General activity	French CHROM, January 1949
SUN	Chromospheric flares	French CHROM, January 1949
SUN	Corona	Japanese COSOL, December 1951
SUN	Radio energy	European SOLER, July 1952
SUN	Cosmic rays	Japanese CORAY, December 1951
	Atmospheric enhancements	Japanese SPIDE, December 1951
	Sudden fadings	Japanese SPIDE, December 1951
	F2 critical frequencies	Japanese IONOS, December 1951
	Terrestrial magnetism	French MAGNE, September 1950

1st part : Last observations received : European, C.R.P.L. or Japanese.
2nd part : Repetition of the preceding day broadcast
(see 20.08 and 21.08 U.T.)

	Transmitted Observations	Codes used
	German Observations	
SUN	General activity	European CHROM, July 1952
SUN	Location of activity centers	European CHROM, July 1952
SUN	Chromospheric flares	European CHROM, July 1952
SUN	Corona	European CORON, July 1952
SUN	Radio Energy	European SOLER, July 1952
SUN	Cosmie Rays	European CORAY, July 1952
	Atmospheric enhancements	European PERTU, July 1952
	Sudden fadings	European PERTU, July 1952
	Terrestrial magnetism	European MAGNE, July 1952
	F2 critical frequency	European FODEU, July 1952
	Es critical frequency	European ESFRE, July 1952

The groups are given figure by figure in English language.

1st part : Last observations received.
2nd part : Repetition of the preceding day broadcast.

Time U.T.	Sender	Call Sign	Frequency Mc/s	Wavelength	Wave type
14.00	New Delhi	VVD3	5 205	57.64	A2
			7 580	39.58	A2
			13 100	22.90	A2
			17 650	17.00	A2
15.00	Tokyo	JJD	8 000	37.5	A1
17.00	Tokyo	JJD	8 000	37.5	A1
19.00	Tokyo	JJD	8 000	37.5	A1
20.08	Pontoise	FYP	90.9	3 300.3	A1
		TQC9	10 775	27.84	A1
21.00	Hamburg	From April 1 to September 30			
		DGD62	4 625	64.86	A3
		From October 1 to March 31			
		DGD27	90.9	3 300.3	A3
21.08	Pontoise	FYP	90.9	3 300.3	A1
		FYA3	7 428	40.39	A1
23.30	Tokyo	JJD	9 175	32.7	A1

	Transmitted Observations	Codes used
SUN	General activity Location of activity centers Chromospheric flares	French CHROM, January 1949
	Terrestrial magnetism	French MAGNE, January 1949
	Same observations as on 12.00 U.T.	
	Same observations as on 12.00 U.T.	
	Same observations as on 12.00 U.T.	
	Observations from Germany, France, Netherlands, Morocco (Casablanca) and South Algeria (Tamanrasset)	
SUN	General activity Location of activity centers Chromospheric flares	European CHROM, July 1952
SUN	Corona	European CORON, July 1952
SUN	Radio energy	European SOLER, July 1952
	Atmospheric enhancements Sudden fadings	European PERTU, July 1952
	Terrestrial magnetism	European MAGNE, July 1952
	F2 critical frequency	European FODEU, July 1952
	E*s* critical frequency	European ESFRE, July 1952
	Broadcast of Washington and Tokyo Ursigrams.	

The message delivered in radio telephony is generally the same as the radiotelegraphic message of Pontoise on 20.08 U.T.

Groups are mentionned figure by figure in English language.

Repetition of the Pontoise message on 20.08 U.T.

Same observations as on 12.00 U.T.

INTERNATIONAL GEOPHYSICAL YEAR

Resolution of WMO

The congress,

Noting Resolution P.2 (EC-VI),
Resolution 9 (EC-IV).

The Resolution, concerning the meteorological programme for the International Geophysical Year, adopted by the Special Committee of the International Council of Scientific Unions; and

considering that the International Geophysical Year is a project of the utmost importance and capable of leading to valuable progress in the science of meteorology;

decides :

(1) To note with approval the decision by the Executive Committee that the World Meteorological Organization shall participate along with other international organizations in the preparations for the International Geophysical Year,

(2) To give support to the meteorological programme recommended by the Special Committee for the International Geophysical Year,

(3) To invite Members and to encourage the Meteorological Services of non-Members to participate to the greatest possible extent in this programme; and

directs the Executive Committee :

(1) To continue its study of the detailed meteorological programme for the International Geophysical Year, and to keep all concerned informed of developments,

(2) To work out and arrange for the implementation of a detailed plan whereby the WMO Secretariat would act as an international centre for the essential meteorological observation data and for

meteorological bibliography and documentation for the International Geophysical Year,

(3) To arrange for the preparation of standard forms on which the surface and upper air meteorological data of the International Geophysical Year are to be entered. In this connection the proposals of the Special Committee for the International Geophysical Year should be taken into account,

(4) To take such other steps as may be considered necessary to ensure that the WMO plays its full part in collaborating with other international organizations in the International Geophysical Year arrangements and that Members derive maximum benefit from the entire meteorological programme.

C.C.I.R

The effect of hills and other obstacles in diffracting waves in either the horizontal or the vertical plane

CONTRIBUTION BY THE FEDERAL GERMAN REPUBLIC TO THE WORK OF C.C.I.R. STUDY GROUP IV

Question N° 6, para. 2 and Study Programme N° 54, paras. 1 and 5

GENERAL

It is shown in this paper that the propagation of VHF waves over irregular terrain can be described with an adequate degree of approximation by the application of a few simple laws which allow of easy numerical evaluation. These laws have been studied and confirmed by field strength measurements over terrain with different profiles, in the frequency range 100 to 200 Mc/s. The electric properties of the ground and the angle of incidence of the waves on the ground are generally of a magnitude which justifies the assumption of a reflexion coefficient of-1 for horizontal polarization. This assumption greatly simplifies calculation. The following cases have been studied experimentally and compared with the calculations :

1. Decrease in field strength with distance over an ideally flat earth ;

2. Recording of the field strength of a transmitter on the Grosser Feldberg (Taunus), along the motor highway Kassel-Karlsruhe, as an example of propagation over averagely uneven earth ;

3. Variations in field strength over uneven earth ;

4. Diffraction at a mountain emerging from a flat terrain in the form of a knife-edge ;

5. Diffraction at the edge of a plateau, coverage of a valley as a result of diffraction.

To calculate the field strength, the basis is the well-known Fresnel integral for diffraction at a knife-edge. The waves reflected near the transmitter and the receiver by a mirror effect of the transmitting and receiving antennas on the ground are considered and the resulting reception field is determined as the field of interference of the direct wave and the reflected waves. In an absolutely general way, the following simple method of calculation can be taken as a basis in each case of propagation (fig. 1). The transmitting antenna and the receiving antenna

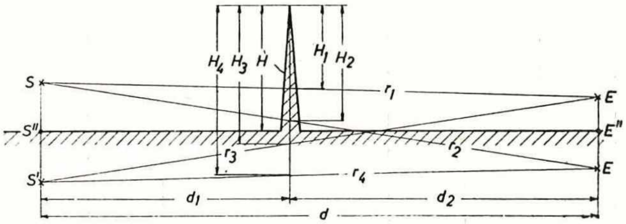

FIG. 1. — Diffraction of a knife-edge profile.

are first reflected at the surface of the ground at their site (S-S′; E-E′). Straight lines SE, SE′, S′E, S′E′ are drawn, and

(*a*) the differences of path Δr_n or these lines in respect of the horizontal line $d = r_0$ (S″ — E″) between the transmitter and the receiving point are determined, together with

(*b*) the heights H_n of the diffractive ridge above each of these lines. Expression (1) below is then valid in a general way for the relation between the field strength $\mathcal{E}$ at the reception point E and the field strength $\mathcal{E}_0$ which would have been measured at E in case of propagation in free space.

$$\sqrt{\pi}\,|\,\mathcal{E}/\mathcal{E}_0\,| = |\,f(u_1)\,.\,e^{-jk\Delta r_1} - f(u_2)\,.\,e^{-jk\Delta r_2} - f(u_3)\,.\,e^{-jkr\Delta r_3} + f(u_4)\,.\,e^{-jk\Delta r_4}\,| \qquad (1)$$

The function $f(u)$ is defined by the Fresnel integral :

$$f(u) = \int_u^{\infty} e^{-jx^2} dx \qquad (2)$$

$f(u)$ can be found in tables, e. g., those of Jahnke-Emde [1]. For practical calculation, it is more useful to work with a representation of $f(u)$ which divides this function into a factor $F(u)$

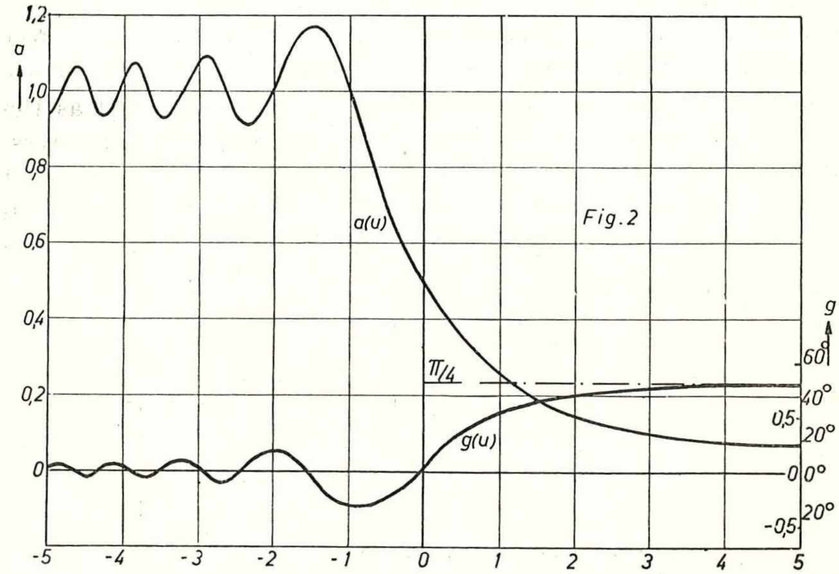

FIG. 2. — The Fresnel integral $f(u)$.

with slowly variable amplitude and phase and a factor e^{-ju^2} with constant amplitude but rapidly variable phase (fig. 2).

$$f(u) = \sqrt{\pi} \,.\, a(u) \,.\, e^{-j(g(u) + \pi/4)} \,.\, e^{-ju^2} = F(u) \,.\, e^{-ju^2} \tag{3}$$

The parameter u is linked to the distances and heights by the expression :

$$u_n = \sqrt{\frac{kd}{2d_1d_2}} \,.\, H_n \qquad \text{with} \quad k = \frac{2\pi}{\lambda} \tag{4}$$

A similar expression is found, for instance, in Ortusi [2].

The first member of the sum in (1) corresponds to the direct wave. The second has a single reflection near S with reflection

(1) JAHNKE-EMDE, Funktionstafeln, Leipzig, 1938.

(2) J. ORTUSI, La propagation des ondes métriques et centimétriques. *Annales de Radioélectricité*, IX, nº 37, July 1954.

coefficient —1, which explains the negative sign. The third member of the sum has also a single reflection near E, while the fourth member of the sum is again positive because it corresponds to a double reflection of the wave S′-E′. This formula has been applied to the cases of propagation mentioned under 1 to 5 and compared with field strength measurements.

Concerning 1

Figure 3 shows the result of a recording trip on smooth earth. The thick curve corresponds to the well-known reflection formula,

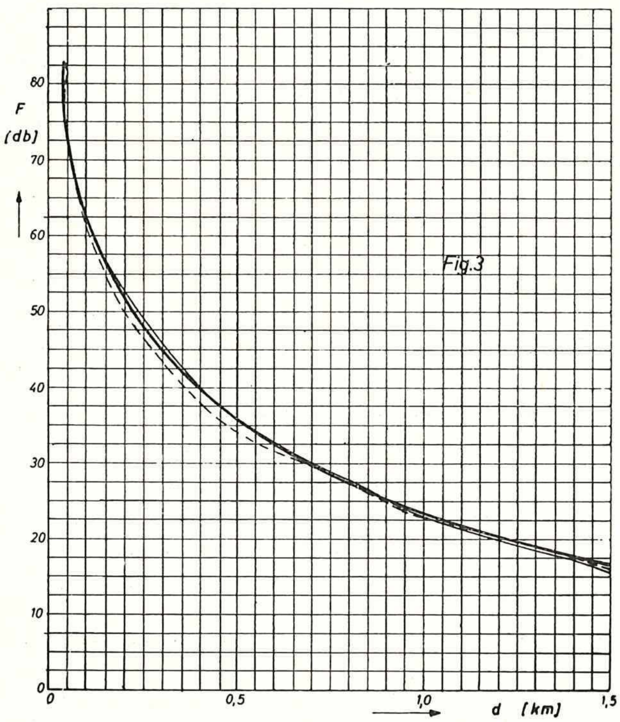

FIG. 3. — Field strength recording on flat earth.
$f = 96$ Mc/s, horizontal polarization.
———————— Theoretical curve $1/d^2$.
———————— Measurement made on a trip from the transmitter.
— — — — — — Measurement made on a trip towards the transmitter.

which also emerges from formula (1) for $H = O = u$. This gives the formula :

$$\mathcal{E} = \mathcal{E}_0 \,.\, 2 \sin \left(\frac{2\pi}{\lambda} \,.\, \frac{d_2 - d_1}{2} \right) \qquad (5)$$

This formula (5), if the condition :

$$\frac{h_s + h_e}{d} \leqq 0{,}2 \qquad (6)$$

be retained, takes the simpler form :

$$\mathcal{E} = \mathcal{E}_0 \,.\, 2 \sin \frac{2\pi}{\lambda} \,.\, \frac{h_s h_e}{d} \cong \mathcal{E}_0 \frac{4\pi h_s h_e}{\lambda d} \qquad (7)$$

in which $\mathcal{E}_0 = \frac{60 \,.\, J_0}{d}$ is the field strength in free space, J_0 the current in the transmitting dipole $\lambda/2$ in amperes, d the distance in metres and h_s and h_e the heights of the transmitting and receiving antennas above the ground. Agreement between theory and experiment is always very close on smooth earth.

Concerning 2

Figure 4 shows the field strength variations of a transmitter situated on the Grosser Feldberg (Taunus) along the Kassel-Karlsruhe motor-highway (the distance figures along the abscissa show kilometres along the motor-highway). The theoretical curve marked in broken lines is calculated from (7). In each case the height of the transmitting antenna has been taken as the height above ground at the reception point. The figures above the curve in broken lines show the distance of the transmitter in kilometres. For great distances from the transmitter allowance was made for the curvature of the earth by subtracting the height $h' = \frac{d_2}{2\,ka}$ from the height of the transmitting antenna. Even this approximate calculation gives, at least at first, an approximate idea of the field strengths to be expected. But also in this case of propagation over a particularly hilly terrain a sufficiently exact prior determination of the field strengths is possible if the reflections and diffractions occurring in existing sections of terrain are considered in the manner described in the following paragraphs. The sharp drops a and b are produced by projection of the shadow of mountains in the immediate vicinity of the place of transmission and reception, the others by attenuation of the diffraction on smaller obstacles such as hills, banks on roads, woods, etc... Diffractions and reflections from buildings, bridges and isolated trees, which have only a short-distance effect, are not shown on the curve, the values being to a large extent averages extracted

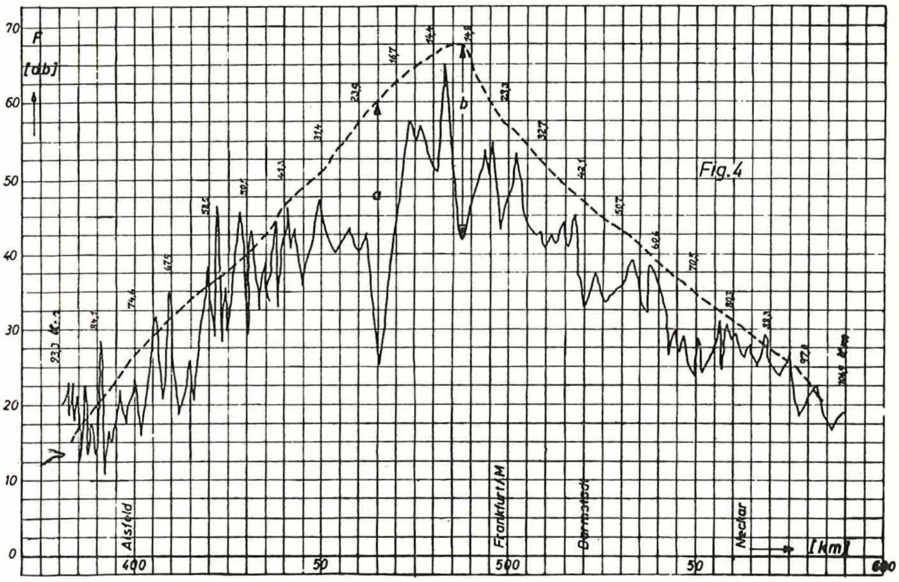

FIG. 4. — Field strength recording on the road Kassel-Karlsruhe. $f = 40$ Mc/s, vertical polarization, $h_e = 2.3$ m ; $\mathcal{E} = 10$.

from recording tapes. The fact that calculated values are occasionally less than the measured field strengths is due to the fact that the road partly passes along mountain slopes inclined in the direction of the transmitter. By the reflection points situated in the valley effective antenna heights are produced which are greater than in the approximate calculation applied here.

Concerning 3

On hilly ground, a whole series of ground-reflected waves may arrive from the transmitter to the receiver in addition to the direct wave corresponding to propagation in free space. The possible reflection pointes emerge from the lines of some difference of propagation time, i. e., ellipses with foci S and E. In all cases where an ellipse touches the profile of the terrain there is a reflection point. The following consideration will show whether such a reflection point can be considered an « effective reflection point » making an appreciable contribution to the reception field. In the case of a reflecting surface of infinite extent and grazing incidence, the field in free space and the reflected field have the same amplitude at the point of reception and their phase differences give the known interference field. It may then be asked what should be the size of a surface not of infinite extent to provide roughly the same field at the reception point as that which would be received if the surface were of infinte extent. This critical surface F is found to be inversely proportional to the angle of elevation ψ and becomes smaller as the reflection point approaches the transmitter or the receiver :

$$F = \frac{\lambda}{\psi} \cdot \frac{d_1 d_2}{d} \qquad (8)$$

For a distance $d = 5\,000$ metres, for instance, a surface situated in the middle of the transmission path should be 25 times larger than a surface situated 50 metres from the transmitter or the receiver to produce the same interference field. For cases which occur in practice, it will thus be amply sufficient to make allowance in the calculations for only those reflection points which are near the transmitter or receiver. All the other reflection points, when there are slight uniform irregularities in the ground, supply negligibly small components for building up the reception field.

The total field strength at the reception point then results from the field strength in free space and the waves reflected at the reflection point near the transmitter or receiver. It is :

$$\mathcal{E} = \mathcal{E}_0 \,.\, 2 \sin\left(\frac{2\pi}{\lambda d} h_{s_1} h_{e_1}\right) 2 \sin\left(\frac{2\pi}{\lambda d} h_{s_2} h_{e_2}\right) \cong \mathcal{E}_0 \frac{4\pi}{\lambda d} h_{s_1} h_{e_1} \frac{4\pi}{\lambda d} h_{s_2} h_{e_2} \qquad (9)$$

According to figure 5, the antenna heights are in each case heights above the tangents at the reflection point. This formula has been used to calculate theoretical propagation curves for a series of land profiles on the motor-highway and compared with measured values. They have given an astonishingly close quantitative agreement up to transitions from single to double reflection.

As an example, figure 6 shows a recording made on the motor-highway on hilly ground. The difference already mentioned

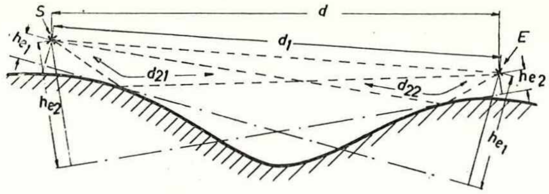

FIG. 5. — Antenna heights in case of double reflection.
——— · ——— Tangents at the reflection points.

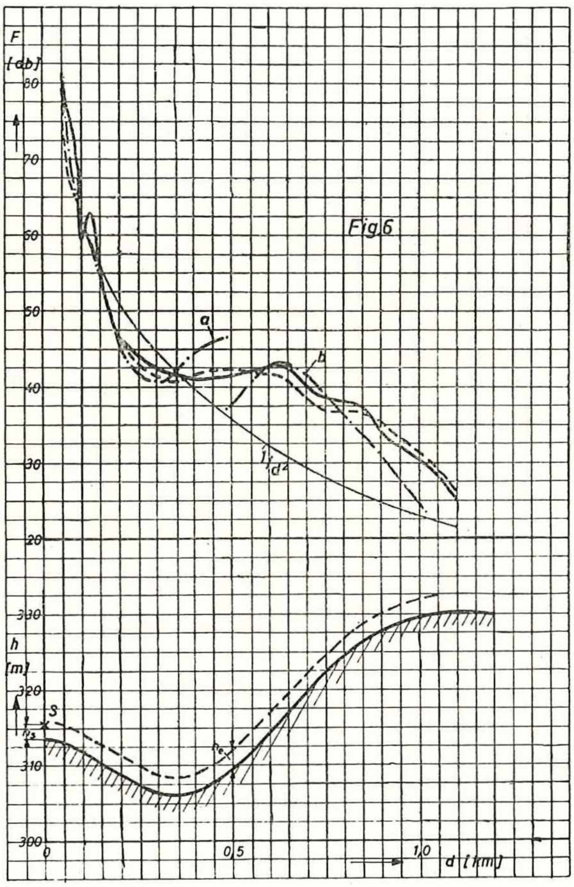

FIG. 6. — Field strength recording on hilly ground.
$f = 96$ Mc/s, horizontal polarization.
——— · ——— Theoretical curve.
a = formula for single reflection (7).
b = formula for double reflection (9).
————— Recording trip from the transmitter.
— — — — — — Recording trip towards the transmitter.

between calculation and measurement at the point of transition from single to double reflection and the difference at $d = 1$ km (transition point between double reflection and diffraction) are explained by the focusing or divergence of the waves at the curvature of the earth. The required critical surface (8) at the reflection point near the receiver is not reached. Exact calculation of the field strength at these points would involve too complicated formulae. In practice it suffices to find the average of the final values existing at such points of junction of two propagation mechanisms.

Concerning 4

For diffraction at a knife-edge mountain chain, the following generally valid formula is obtained from (1), provided that φ_1 and φ_2 are small in respect of 1 :

$$\left|\mathcal{E}/\mathcal{E}_0\right| = 2\varphi_1\varphi_2 \frac{1}{\sqrt{\pi u}} \cdot \left|\frac{1}{u}\,\mathrm{F}(u) + 1\right| = \frac{4}{\sqrt{\pi}} \cdot \varphi \left|u + \mathrm{F}(u)\right| \quad (10)$$

or expressed in *db* :

$$20 \log \mathcal{E} = 20 \log \mathcal{E}_u + 20 \log (u + \mathrm{F}(u)) + 1 \text{ db above } 1\,\mu\mathrm{V}/m \quad (11)$$

in which :

$$\varphi_1 = \frac{2\pi}{\lambda} \cdot \frac{h_s\mathrm{H}}{d_1}\,; \quad \varphi_2 = \frac{2\pi}{\lambda} \cdot \frac{h_e\mathrm{H}}{d_2}\,; \quad \varphi = \frac{2\pi}{\lambda} \cdot \frac{h_s h_e}{d}\,; \quad \varphi_1\varphi_2 = 2u^2\varphi$$

$$u = \sqrt{\frac{kd}{2d_1d_2}} \cdot \mathrm{H}\,; \quad \mathrm{F}(u) = \sqrt{\pi}\,.\,e^{-j\pi/4}\,.\,d(u)e^{-j\vartheta(u)}$$

$\mathcal{E}_u = 2\varphi . \mathcal{E}_0$ is the undisturbed field strength in case of propagation over a flat earth. The field strength disturbed by the diffracting obstacle measured in db is thus $20 \log (u + \mathrm{F}(u)) + 1$ above the undisturbed field strength. For u large, this excess is :

$$\Delta = 20 \log u + 1 \text{ (db)}, \quad (12)$$

while for u small with $\mathrm{F}(u) = \frac{\sqrt{u}}{2}$, it approaches zero. Formula (12) applies only to $\varphi_1 = \varphi_2 < 1$, for example, to $\varphi_1 = \varphi_2 \leqq 0.2$. For the parameter u this represents maintenance of the condition :

$$u\sqrt{2\varphi} \leqq 0.2$$

or :

$$\frac{2\pi\mathrm{H}}{\lambda} \cdot \sqrt{\frac{h_s}{d_1} \cdot \frac{h_e}{d_2}} \leqq 0.2$$

For larger values of u, $\mathcal{E}$ can be represented by :

$$\mathcal{E} = \mathcal{E}_0 \,.\, 2 \sin \varphi_1 \sin \varphi_2 \frac{1}{\sqrt{\pi} \,.\, u} \tag{13}$$

or :

$$20 \log \mathcal{E} = 20 \log \mathcal{E}_u + 20 \log u + 1 + 20 \log \frac{\sin \varphi_1}{\varphi_1} \,.\, \frac{\sin \varphi_2}{\varphi_2} \text{ (db)} \tag{14}$$

Figure 7 shows an example of almost ideal diffraction at a knife-edge profile. The diffracting obstacle is represented by

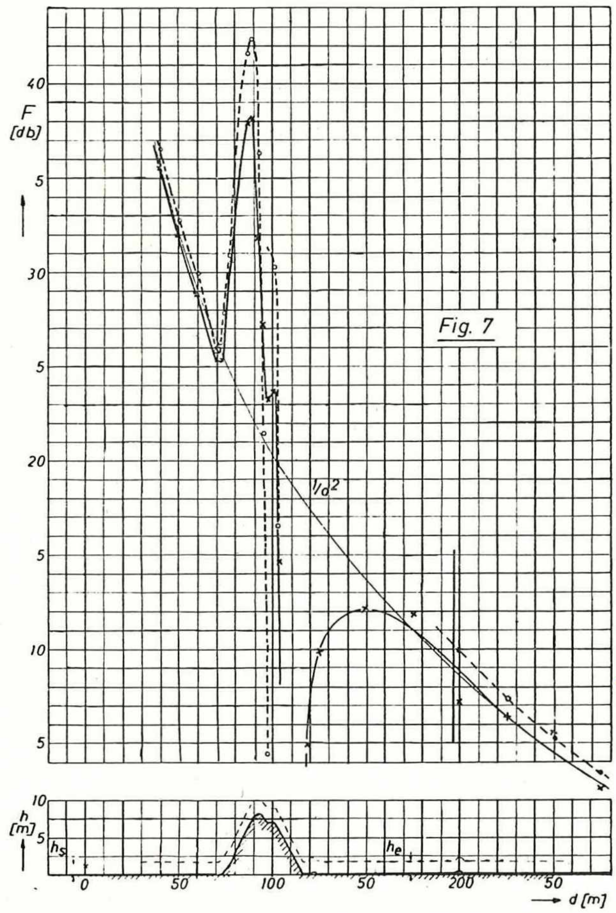

FIG. 7. — Example of almost ideal diffraction at a knife-edge profile
Horizontal polarization, $f = 99$ Mc/s.
x————————x Measured field.
o————————o Calculated field.

a roadside bank on an absolutely flat ground. The field strength was measured, not only before and behind the obstacle, but also on its forward and backward slopes. In front of the bank a strong increase in field is obtained on account of a second reflection from the slope in front of the bank. Calculation of the field strength by the double reflection process (see Concerning 3) gives very satisfactory agreement with measurements. Behind the bank, the diffraction formula (11) was applied. Agreement with measurements is satisfactory.

The measurement for horizontal polarization shown on figure 7 was repeated with vertical polarization and also gave satisfactory agreement with calculations.

Two other series of measurements were carried out on the same roadside bank to study the influence of the distance between the transmitter and the diffracting knife-edge. Measurement confirmed the course which could theoretically be expected from (10).

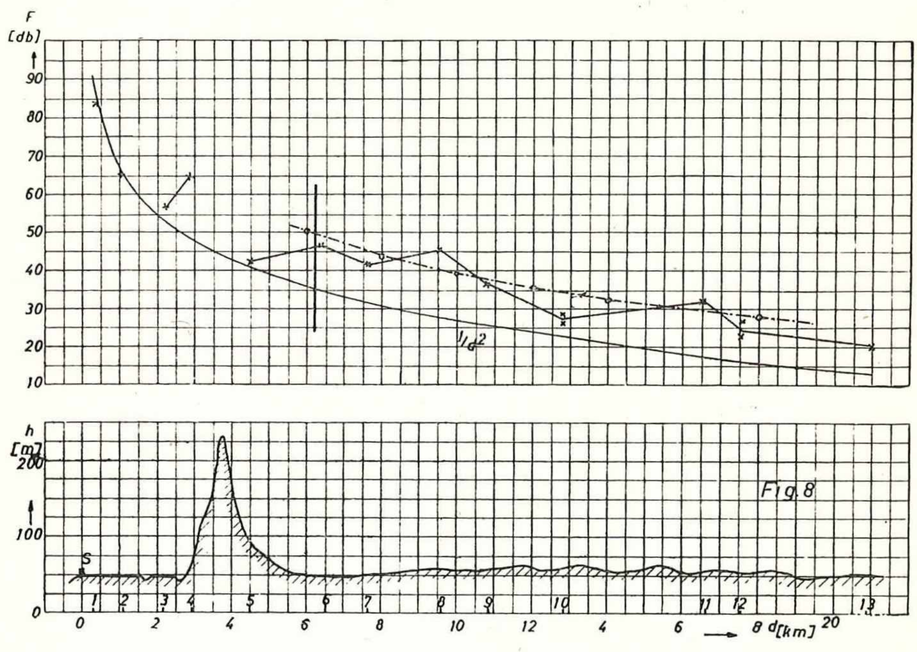

FIG. 8. — Diffraction at the Wiehengebirge.
Horizontal polarization, $f = 170$ Mc/s.
x————x Measured field.
o————o Calculated field.
———— Dependence of $1/d^t$.

Another diffraction measurement under service conditions is shown in figure 8. The measurement values differ slightly because reflections from houses, trees, overhead wires, etc., could not be entirely avoided in such a built-up area. In spite of that, the maximum difference between calculation and measurement is relatively slight. The vertical lines on figure 7 and figure 8 show the limit of the radius of validity of formulae (10) and (11).

Concerning 5

Figure 9 is a diagram of propagation paths for diffraction at the edge of a plateau. With the help of the calculation scheme

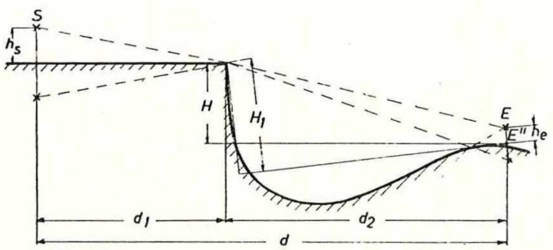

FIG. 9. — Diffraction at the edge of a plateau.

described above, the following expression is obtained for the field strength at the reception point :

$$20 \log \mathcal{E} = 20 \log \mathcal{E}_u + 1 + 20 \log \left| F(u) \left[\cos \alpha - j \left(\frac{H}{h} \sin \alpha - 2u^2 \cos \alpha \right) \right] + \frac{1}{2u} \left(\frac{H}{h} \sin \alpha - 2u^2 \cos \alpha \right) \right| \quad (15)$$

with :

$$\alpha = kh \left(\frac{H}{d_2} + \sin \Delta \right) \qquad u = \sqrt{\frac{kd_1}{2d_2 d}} \cdot H$$

The height of the receiver h_e and the height of the transmitter h_s can be assumed to be the same. (For $h_s \neq h_e$, the final formula will be slightly more complicated).

For u large, $F(u) = -\frac{2u}{j}$ and, consequently,

$$20 \log \mathcal{E} = 20 \log \mathcal{E}_u + 1 + 20 \log \frac{\cos \alpha}{2u} \quad (16)$$

For very great values of d_2, that is, at a great distance from the plateau, x also approaches O (when $\Delta = O$). Consequently, we have:

$$20 \log \mathcal{E} = 20 \log \mathcal{E}_u + 20 \log \left| 1 + 2H \frac{1}{\sqrt{\lambda d_1}} \cdot e^{j\pi/4} \right| \quad (17)$$

At a very great distance of the diffractive ridge, the field strength is thus $20 \log \left| 1 + 2h \frac{1}{\sqrt{\lambda d_1}} \cdot e^{j\pi/4} \right|$ db greater than the field strength that would be received if the plateau were of unlimited extent. The increase in field is the greater as the plateau is higher (H) and the transmitter is situated nearer the edge of the plateau (as d_1 is smaller).

Figures 10 to 12 show some examples of diffraction at the edge of the plateau. These examples roughly correspond to the

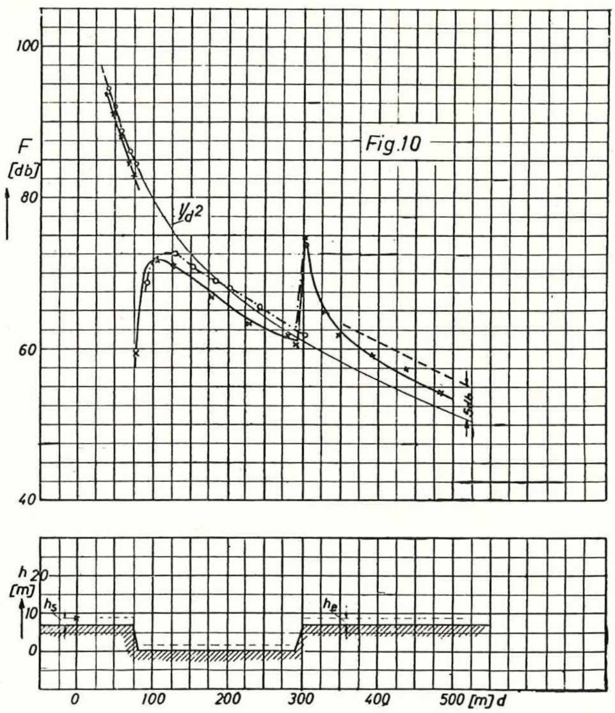

FIG. 10. — Example of diffraction at a plateau. Horizontal polarization, $f = 99$ Mc/s.

x——————x Measured field.

o——————o Calculated field.

coverage of a valley by a transmitter installed on the plateau. With a plateau height H = 7 metres and a distance between the transmitter and the edge of the plateau of 75 metres, the increase in field at a great distance from the transmitter would be $20 \log \left(1 + 2\,H \frac{1}{\sqrt{\lambda d_1}} \cdot e^{j\pi/4}\right) = 5$ db (fig. 10) against $20 \log \frac{H}{h} = 12.5$ db for a transmitter installed higher than H = 7 metres. Otherwise, the agreement between calculation and measurement can be regarded as satisfactory.

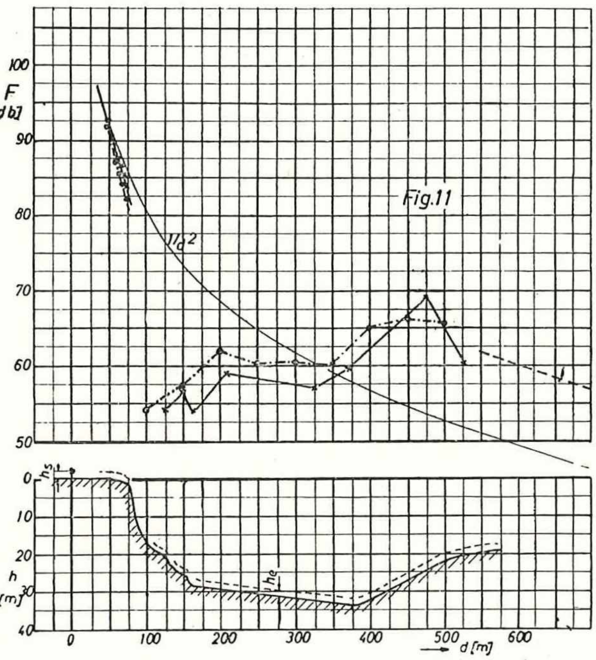

FIG. 11. — Example of diffraction at a plateau.
Horizontal polarization, $f = 99$ Mc/s.
x————x Measured field.
o————o Calculated field.

The curves in broken lines at greater distances in figures 10 to 12 represent field strengths for large values of d_2 according to formula (16), provided the terrain is horizontal after the final value shown.

In the case of figure 10 (crossing a valley), the field at the edge of the plateau (d = 300 m) situated opposite the transmitter can easily be calculated from (1) if the waves diffracted in the valley are neglected. The field at reception is in this case composed

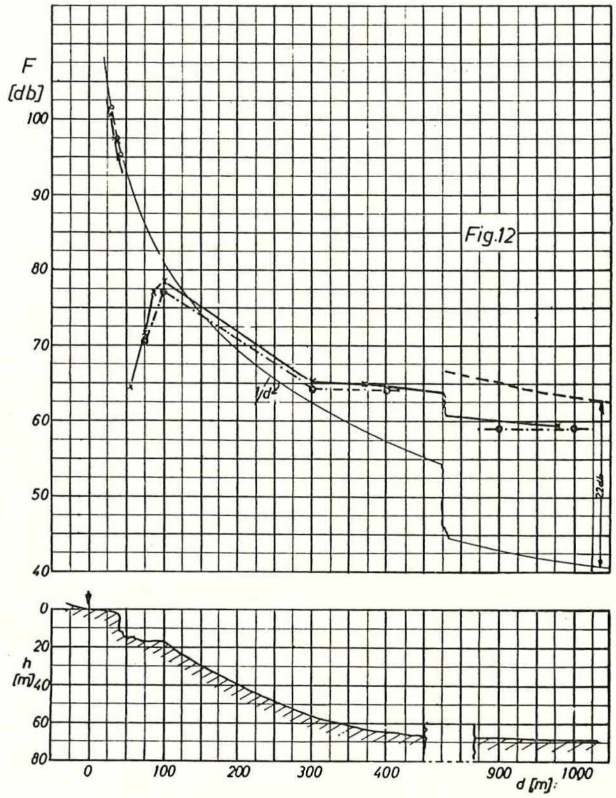

FIG. 12. — Example of diffraction at a plateau. Horizontal polarization, $f = 99$ Mc/s.
x————x Measured field.
o————o Calculated field.

of two waves only — the direct wave and the wave from the mirrored image of the transmitter. For the field strength at the edge of the plateau calculation gives :

$$20 \log \mathcal{E} = 20 \log \mathcal{E}_u + 20 \log \left(\frac{1}{h_s \sqrt{\pi}} \cdot \sqrt{\frac{d_2 d}{2 k d_1}} \right) \text{ (db)} \qquad (18)$$

Reception conditions are thus particularly good at the edge of the plateau. For the special case of figure 10 a field strength is obtained 13.4 db higher than in case of propagation over a flat earth.

Agreement with measurements is also very good in this case. But if the point of reception moves away from the edge of the plateau, double diffraction will inevitably occur. This can be solved in theory, but it entails considerable complication.

C.C.I.R. Study Group VI

The following papers amongst others sent by the Chairman of C.C.I.R. Study Group VI to all Participants, are related to some C.C.I.R. topics considered by U.R.S.I.

COMMISSION III

51.III.24. — Radio Propagation Prediction Considering Scattering wave on the Earth's Surface

by Ken-ichi Miya and Sumiwo Kanaya,
Kokusai Denshin Denwa Co., Ltd.

(Reprinted from *Report of Ionosphere Research in Japan*, vol. IX, n° 1, 1955)

Abstract

Control-point method is usually employed in the prediction of the behavior of radio-wave propagation in long-distance radio communication channels. For a particular channel, however, this method often gives results considerably discrepant with observation.

With the intention of improving the percentage of successful prediction, this paper deals with the investigation of the method of applying the scattering waves on the earth's surface to the prediction of radio-wave propagation conditions.

A new method called « control-line method » is proposed to determine the MUF with regard to the scattering waves from the land and from the earth's surface. The new and the old methods are applied to various radio communication channels and the theoretical and observed results are compared. It is found that for commercial short-wave bands below 20 Mc/s, only normal and land-scattered propagations can be taken into account for satisfactory prediction.

Next, the method of calculating the LUF is investigated. Numerous examples show that the new MUF and LUF give prediction that fits fairly good to radio circuits between Europe and Japan.

Finally, the method of the I. P. S. of Australia, which is aimed at correcting the errors of the prediction of propagation conditions, is discussed from the authors' point of view.

52.III.25. — Exchange of Information for the Preparation of Short-Term Forecasts and the Transmission of Ionospheric Disturbance Warnings

United States of America : draft report

(To supersede report nº 26) (1)

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

The regional centers from which details, codes, schedule, etc. may be obtained are :

(1) *Inf. Bull.*, **86**, 39-48.

(*a*) *United States of America* : Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado. North Atlantic Radio Warning Service, Box 178, Ft. Belvoir, Va. North Pacific Radio Warning Service, Box 1119, Anchorage, Alaska.

(*b*) *France* : Bureau Ionosphérique Français, 196, rue de Paris, Bagneux (Seine). France.

(*c*) *Federal German Republic* : Fernmeldetechniches Zentralamt, Darmstadt.

(*d*) *Japan* : Hiraiso Radio Wave Observatory, Radio Research Laboratories, Hiraiso.

(*e*) *New Zealand* : Carter Observatory, Wellington.

(*f*) *Netherlands* : P. T. T. Receiving Station, Nederhorst-den-Berg.

June 1955.

53.III.26. — Identification of Precursors Indicative of Short-Term Variations of Ionospheric Propagation Conditions

U. S. A. Report (Re Study Program 59) (1)

1. It is generally recognized that indexes suitable for long term propagation predictions (e.g. relative sunspot numbers) are not satisfactory for indicating short-term variations in the ionosphere, including disturbances.

2. Many disturbances seem to be attribuable to specific regions of activity on the solar disk rather than to activity of the whole disk ; therefore activity indexes should be specified together with heliographic coordinates of the region.

3. The kinds of observations that can be made relatively objective and which are relatively useful for short-term forecasts, include :

(*a*) sunspot areas (particularly useful when greater than 500 millionths) ;

(*b*) smoothed peak intensity of a longitudinal cross-section of coronal emission regions (defined as the average of the intensity

(1) *Inf. Bull.*, **86**, 45-46.

at latitude of maximum and of the intensity at 5° either side, in absolute units);

(*c*) area of flares and their maximum photometric intensity in the center of the H-alpha spectral line;

(*d*) specific intensity of solar radio frequency radiation in the vicinity of 200 Mc/s (1) or 3 000 Mc/s (1), taken for the whole disk, and taken for a specified period of time, say 3 hours; or for an individual short-lived burst or outburst;

(*e*) unusual increases of vertical magnetic intensity at subauroral stations.

4. The solar observations which cannot be reported objectively in time for short-term forecasts can nevertheless in many cases be reduced in descriptive or qualitative terms; these include flare importance, identification of « radio noise storms » at 200 Mc/s, plage areas, granulation concentrations, solar magnetic fields, and the like. Such observations are of significant value in short-term forecasting.

June 1955.

54.III.27. — Comparison of Short-term Forecasts with Observed Results

U. S. A. REPORT (RE RECOMMENDATION 59) (2)

1. Comparisons of short-term forecasts with the actual behavior of radio circuits are being made by C.R.P.L. and R.C.A. based upon the following scoring chart :

C.R.P.L. publishes results of each forecast by each category P, S, U, F respectively, for disturbed periods and for quiet periods. R.C.A. scores their forecasts by a percentage figure which is equivalent to :

$$\frac{\text{P S}}{\text{Total number}} \times 100\ \%$$

(1) The patrol frequencies recommended by the General Assembly, U.R.S.I., 1950.

(2) *Inf. Bull.*, **86**, 31-33.

FORECAST

	Word Quality		Ex.		Gd		Fr		Pr		Un
	Numerical Quality		9	8	7	6	5	4	3	2	1
OBSERVATION	Excellent	9	P	S	U	U	U	F	F	F	F
		8	S	P	S	U	U	F	F	F	F
	Good	7	U	S	P	S	U	F	F	F	F
		6	U	U	S	P	S	F	F	F	F
	Fair	5	U	U	U	S	P	S	U	U	U
		4	F	F	F	F	S	P	S	U	U
	Poor	3	F	F	F	F	U	S	P	S	U
		2	F	F	F	F	U	U	S	P	S
	Unusable	1	F	F	F	F	U	U	U	S	P

P = Perfect : forecast quality equal to observed.

S = Satisfactory : forecast quality one numerical grade different from observed.

U = Unsatisfactory : forecast quality two or more numerical grades different from observed when *both* forecast and observed were $\geqq 5$ or both $\leqq 5$.

F = Failure : Other times when forecast quality two or more numerical grades different from observed.

2. Typical results for 1954 follows :

(*a*) C.R.P.L. North Atlantic 6-hour forecasts (all periods) made one hour in advance ; scored against North Atlantic Radio Circuit Quality figures :

	P	S	U	F
Quiet periods	828	452	13	7
Disturbed periods	66	66	7	11
Total	894	518	20	18

(*b*) R.C.A. Central European forecasts for each of the six 4-hour periods, made once a day scored against evaluation of R.C.A.-Riverhead logs :

Successful forecasts = 91 %

3. The above scoring system, while giving an indication as to the reliability of the forecasts, should but does not include the following important considerations :

(*a*) The relatively great value of an accurate forecast of sudden ionosphere deterioration of circuit quality as compared to forecasting no change in circuit quality.

(*b*) Success in forecasting trends within one or two forecast intervals.

(*c*) Relative value of forecasts of normal, quiet and disturbed days.

(*d*) Among the possible scoring schemes would be a table as in (1) but on a numerical basis. The numbers indicating the relative worth of each possible forecast and outcome ; a further refinement would be one such table for use when conditions at the time the forecast was issued were normal ; another table when conditions at forecast time were disturbed.

55.III.28. — Prediction of Solar Indexes

United States of America draft study program

(Re Recommendation n° 117)

Considering :

(*a*) That the sun is the primary cause of many geophysical phenomena and in particular of the formation of the ionosphere and of most of its variations ;

(*b*) That the gradual waxing and waning of solar activity with the interval between maxima of approximately eleven years corresponds closely with many slowly-varying geophysical activity indices.

(*c*) That this component of solar and geophysical activity can be estimated from many solar activity indices based on optical and radio measurements and by geomagnetic and ionospheric sounding measurements.

(*d*) That reliable prediction of such parameters is of the utmost importance to radio propagation work.

(*e*) That the autocorrelation techniques of prediction have been studied with a view to this application by McNish and Lincoln (*Trans. A.G.U.*, 30, 673, 1949; **35**, 709, 1954), Moran (*J. Roy. Stat. Soc.*, B, *XVI*, 112, 1954), Woodbury (Unpublished, 1955) and others.

Decides that the following study should be carried out :

1. Predictions by all published autocorrelation or quasi-autocorrelation methods should be compared for recent years and on a current basis.

2. Further attention should be given to the suggestion of Moran that combinations of autocorrelation and empirical methods may yield more nearly optimum predictions.

June 1955.

COMMISSION IV

56.IV.7. — Progress report on implementation of C.C.I.R. Recommendation N° 120

(REVISION OF ATMOSPHERIC NOISE DATA) [1]

by F. HORNER (U. K.) and W. Q. CRICHLOW (U. S. A.)

In C.C.I.R. Recommendation n° 120, Study Group VI was charged with the task of revising existing atmospheric radio noise data and preparing charts and curves in a form suitable for C.C.I.R. requirements.

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[1] *Inf. Bull.*, **86**, 53-56.

It was decided that the implementation of this Recommendation would begin more quickly through joint work by representatives of the United Kingdom and the United States of America, the two countries most active in the project. Mr. F. Horner of the U. K. visited the Central Radio Propagation Laboratory, Boulder, Colorado, from February 17 to April 23, 1955 to work with Mr. W. Q. Crichlow and associates on the preparation of the charts and curves.

The objects of this collaboration were to review existing information on atmospheric radio noise and to reach agreement on its interpretation, to develop an agreed method of presenting the data, and to proceed as far as possible with the preparation of the data in the agreed form.

The interpretation of recent measurements proved to be a difficult task owing to the variety of the measurement techniques which had been used and to the uncertainty about the relative contributions of atmospheric and man-made radio noise in the results. However, agreement was reached on the weight to be attached to each set of measurements.

It was agreed that the presentation would follow general lines as follows :

(*a*) The basic parameter is the average radio noise power (or rms voltage) in a period of one hour. This is expressed as the ratio of the noise power available from an equivalent lossless short vertical antenna to the thermal noise power available from a passive resistance at a reference room temperature. This ratio is expressed in decibels and is given the symbol F*a*. It is independent of bandwidth. The corresponding values of the effective noise field strength are also given, this being the form in which the noise has hitherto been more commonly expressed. For this purpose a bandwidth of 11 Mc/s has been taken.

(*b*) The day is subdivided into six four-hour periods. It is assumed that the variations in a given four-hour period over a seasonal period of three months are mainly random while the variations from one four-hour period to another and from one season to another are largely systematic. The time represented by the succession of corresponding four-hour periods over a season is called a seasonal time block; hence there are twenty-four seasonal time blocks in the year. The presentation aims at showing the systematic changes from one time block to another and treating the variations within a time block in a statistical manner.

(*c*) The main quantity presented is the median value of the hourly average noise power for the 360 or so hours of a time block (i. e. four hours on each of about 90 days). Some indication is given also to the scatter of the hourly values within the time block.

(*d*) Charts are drawn which show the median values of Fa at 1 Mc/s for all places in the world and for each time block. Thus the noise at 1 Mc/s is read directly and the value represents, in effect, a noise grade for the particular station and time block.

(*e*) Noise at other frequencies is deduced from that at 1 Mc/s by use of a series of curves. It was found that two sets of curves — one for daylight at the receiving point and one for darkness — would adequately represent the frequency laws.

The preparation of the data in the agreed form was started during the February-April joint work and is continuing in the U.S. A. and U. K. Draft proposals will be circulated, for comment, to participants of Study Group VI.