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XIIth GENERAL ASSEMBLY

General Organization

(*Excerpt from the booklet issued by the U.S.A. General Arrangements Committee-First announcement*).

1. — General

By invitation of the U.S.A. National Committee of the International Scientific Radio Union (U.R.S.I.) and the National Academy of Sciences, the XIIth General Assembly of U.R.S.I. will be held at Boulder, Colorado, August 22 to September 5, 1957. Local hosts will include the University of Colorado, the Boulder Laboratories of the National Bureau of Standards, the High Altitude Observatory, and the City of Boulder. Headquarters for the Assembly and rooms for the technical sessions will be in the Memorial Center of the University of Colorado. Facilities will also be provided in the Boulder Laboratories of the National Bureau of Standards.

2. — Program of the Meeting

See tentative schedule of events at end of this announcement. The first Plenary session will be Monday morning, August 26, featuring high official recognition of the U.R.S.I. and of this occasion, and also special recognition of the beginning phase of the International Geophysical Year.

The closing Plenary session will be Thursday morning, September 5.

The Executive Committee of the Union will meet before the Assembly on August 22. The Coordinating Committee (President, Secretary General, Commission Chairmen, and the General Arrangements Committee) will meet on August 23, and the Commissions (official members) later the same day.

3. — Technical field trips and tours

There will be opportunity for visits to nearby scientific field laboratories doing work in radio propagation, cosmic rays, and solar physics. These trips will go through some of the best scenic country in the Rocky Mountains. No technical sessions will be held while these visits are in progress.

4. — Participation

Participation in the Assembly, including attendance at technical sessions and special features, is open to representatives officially designated by the National Committees of the member countries. Persons in any country who may wish to attend should explore the possibility of such designation by their National Committee. If they may wish financial assistance, immediate action is needed along the lines explained in Section 8 below.

All events during the meeting are of course optional and will be without cost to the participants.

By separate communication later National Committees will be requested to act during 1956 on the appointemnt of delegates. It will be desirable that the names of all participants (delegates and wives or others to accompany them) be sent officially to the U.R.S.I. 1957 General Arrangements Committee, National Academy of Sciences, 1101 Constitution Avenue, Washington 25, D. C., U.S.A., not later than January 1, 1957.

5. — Housing

Comfortable accommodations for both individuals and families will be available on the campus of the University of Colorado. Meals will be served at the University Memorial Center. It is expected that most delegates will prefer to make use of these facilities. Room and meals will come to about $ 8.00 a day. Hotels and motels (hotels for motorists just outside the center of the city) offer somewhat more elaborate accommodations for those who may desire them. The daily rates for hotels (room only) are : room for one, $ 2.50 to $ 5.00 ; room for two, $ 3.50 to $ 12.00. The motel rates are near the higher figure.

6. — Entertainment and special events

On Tuesday evening, August 27, a chuck wagon dinner will be given on the top of Flagstaff Mountain, overlooking Boulder. This is served in typically « Western Ranch » style, picnic fashion, around a campfire.

An evening at Central City will feature a play at the Opera House.

An excursion to Rocky Mountain National Park will leave Boulder in the early afternoon on August 24, arriving at Estes Park in time for dinner.

Other diversions will be one or more evenings of musical entertainment, and opportunities for industrial plant trips, sightseeing and excursions in the local area, which is rich in places of cultural, scientific, and scenic interest.

Official receptions are scheduled by Federal, State, and Municipal officials, as well as by scientists of Boulder and perhaps Denver. Complete details have not been worked out for these receptions, but will be announced later.

7. — Ladies program

A full program of events for the wives and immediate families of delegates will be conducted under the auspices of a ladies program. Wives and immediate families are especially invited to accompany the delegates.

8. — Opportunities for financial assistance

It will be possible to provide financial assistance to a limited number of delegates who may qualify. In a few cases it is anticipated that this may be direct aid or its equivalent for travel and subsistence. In most cases, a short-time appointment as visiting professor, research worker, lecturer, or consultant may be negociated. Arrangements will vary with the requirements and qualifications of each candidate.

Persons who may be interested in obtaining financial aid for attending the meeting should write immediately to Professor William E. Gordon, School of Electrical Engineering, Cornell University, Ithaca, New York. When writing to Professor Gordon it will be helpful to give the following data : (1) name ;

(2) year and place of birth ; (3) nationality ; (4) mailing address ; (5) professional education ; (6) number of years devoted to radio work ; (7) present position ; (8) major publications ; (9) radio specialization (s) ; (10) kind and amount of aid needed ; (11) references in the United States. Those applying for teaching or lecture appointments may add ; (12) ability to lecture in English (excellent, good, or fair) ; (13) length of time they can remain in the United States (approximate dates).

9. — Excursions after the Meeting

These are available to all participants, but not gratis ; it is expected they will be available to overseas participants at half actual cost.

10. — How to reach Boulder, Colorado

Boulder, Colorado, is situated at the foot of the Rocky Mountains 25 miles from Denver (less than an hour by bus). Excellent airline, railroad, and bus services make Denver easily reached from Atlantic and Pacific ports and from the larger cities of the United States, Canada, and Mexico.

Tentative schedule

(Not including social events)

August 13-16. See below regarding Joint Commission Meetings.

Thursday, August 22 —

Morning : Executive Committee.
Afternoon : Executive Committee.

Friday, August 23 —

Morning : Coordinating Committee.
Afternoon : Official Members of Commissions.

Monday, August 26 —

Morning : Opening Plenary Session.
Afternoon : Technical Sessions.

Tuesday, August 27 —

Morning : Tour N.B.S. Boulder Laboratories, Commission I
Technical Sessions.
Afternoon : Technical Sessions.

Wednesday, August 28 —

Morning : Tour, N.B.S. Boulder Laboratories, Commission II
Technical Sessions.
Afternoon : Technical Sessions.

Thursday, August 29 —

Morning : Tour, N.B.S. Boulder Laboratories, Commission III
Technical Sessions.

Friday, August 30 —

Morning : Tour, N.B.S. Boulder Laboratories, Commission IV
Technical Sessions.
Afternoon : Technical Sessions.

Saturday, August 31, and Sunday, September 1 —

Excursions.

Monday, September 2 —

Morning : Tour, N.B.S. Boulder Laboratories, Commission V
Technical Sessions.
Afternoon : Technical Sessions.

Tuesday, September 3 —

Morning : Tour, N.B.S. Boulder Laboratories, Commission VI
Technical Sessions.
Afternoon : Technical Sessions.

Wednesday, September 4 —

Morning : Tour, N.B.S. Boulder Laboratories, Commission VII
Technical Sessions.

Thursday, September 5 —

Morning : Final Plenary Session.

Friday, September 6 —

Start of Grand Canyon and Yellowstone Park excursions.

Related Meetings

August 14-16, *New-York University, New-York, N. Y.*

Joint Commission on the Ionosphere.

Joint Commission on Radio Meteorology.

* * *

Copies of the First Announcement are available at the U.R.S.I. National Committees and at the General Secretariat of U.R.S.I.

NATIONAL COMMITTEES

Morocco

The Morocco National Committee reached the following decisions at a meeting held last November.

1. Three new members were appointed, the membership of the Committee is for the time being : MMrs : ARZELIES, BIDAULT, BOSVILLE, CUNY, DANO, GALLARD, GOURE, HAUBERT, LEGRAND, LIOUVILLE, MERCIER, PASQUALINI, RANDET, VALET.

2. Were appointed as official Members of the Commissions :

Commission I : Mr. ARZELIES.
Commission II : Mr. BIDAULT.
Commission III : Mr. HAUBERT.
Commission IV : Mr. LEGRAND.
Commission V : Mr. VASY.
Commission VI : Mr. MERCIER.
Commission VII : Mr. VALET.

3. Were appointed as Members of Commissions :

Commission I : Mr. HACOT.
Commission III : Mr. GOURE.
Commission VI : Mr. CUNY.

COMMISSIONS

Colloquium on the Present Problems of Wave Propagation

An International Colloquium on the present problems of wave propagation will be organized in Paris from September 17 to 22, 1956, by the French National Committee of U.R.S.I. and the « Société des Radioélectriciens » under the sponsorship of U.R.S.I. Commissions II, III, IV and VI.

The main topics included in the work of the colloquium are as follows :

1. Ultra short wave propagation (metre, decimetre and centimetre wavelengths) well behind the horizon.

2. Ground effect and particularly of the surface on wave radiation and propagation.

3. Ionosphere and wave propagation.

4. Various topics, and particularly very long wave propagation (frequencies lower than 20 kc/s).

The program will includes papers on the above topics or related to them.

Those wishing to take part to the Colloquium are requested to apply for registration and further information to the « Société des Radioélectriciens » (Colloque Propagation) 14, Avenue Pierre Larousse, Malakoff, Seine, France.

Authors wishing to submit a paper to the Colloquium are requested to send a summary (not over 200 words) preferably in French and in English, before June at the above address.

The membership of the Organization of the Committee, under the Chairmanship of Mr. B. Decaux, President of the French National Committee of U.R.S.I., is as follows :

MMrs :

G. Lehmann, Past President of the French National Committee ;
E. Picault, Past President of the Société des Radioélectriciens ;

A. FLAMBARD, Assistant General Secretary of the Société des Radioélectriciens,
J. VOGE, Secretary General of the French National Committee of U.R.S.I. ;
F. du CASTEL, Telecommunication Engineer, Centre National d'Etudes des Télécommunications,
J. C. SIMON, Engineer, Cie Générale de T.S.F. ;
R. CABESSA, Engineer, Société le Matériel Téléphonique ;
P. CLAVIER, Engineer, Cie Française Thomson Houston.

Commission II

ACTIVITIES OF THE POLISH NATIONAL COMMITTEE IN THE FIELD OF COMMISSION II

by S. MANCZARSKI, Official Member of the Commission

(*Translation*)

In Poland, the interest in the field of ground and tropospheric wave propagation goes to the following topics.

1. Measurement of the field of the ground wave (with respect to medium wavelength broadcasting) over an anisotropic ground, particularly over sea coasts. The results are compared with theoretical formulas.

2. Recording of arrival angles of atmospherics on long wavelengths. Such recordings are carried out continuously at the Meteorological Observatory of Legionowo near Warsaw. The results obtained are useful for analysing the propagation conditions of long wavelengths.

3. Study of troposheric wave propagation for various ground patterns and for links over visible paths or beyond the horizon.
We are also investigating the correlation between the received field and the meteorological conditions, particularly between the fields and the drifts of atmospheric fronts.

4. Observations concerned with the reception of signals transmitted on tropospheric waves by very distant stations. It has been found that various foreign transmitters, e.g. London, Berlin, Vienna (wavelength of the order of 3 m) can be received in Poland

under certain conditions. The propagation mechanism which plays an important part in this feature is under investigation.

5. Study of turbulence areas, particularly of the shifting effect of the turbulent layers on the laminar layers.

6. Study of the statistical distribution of signals received on troposheric waves. Conditions for which the field variations follow the Rayleigh's law are investigated. Until now it was found that generally this feature occurs for small field values.

7. Observation or directional fluctuations of waves in the troposhere. This matter is of importance with respect to the limitations of electric parameters of directive antennas (particularly for what concerns radio astronomy).

Commissions II and III

(Excerpt from the *Telecommunication Journal*, nº 2, Feb. 1956)

THE « SCATTER », PRINCIPLE FOR TRANSMISSION OVER LONG DISTANCES

A new technique which use the « scatter » principle for transmission over long distances, known as « forward scatter », was the subject of a symposium recently held in Washington (1).

Mr. Edward M. Webster, Commissioner of the Federal Communications Commission, in his keynote address at the Symposium on Communications by Scatter Technics, referred to the new development that makes possible « extremely reliable communication circuits » over distances of 100 to 100 miles, as one this would « undoubtedly have a great impact upon future communication circuits between fixed points ».

Mr. Webster classified the papers to be presented at the symposium as those discussing both ionospheric and tropospheric scatter. Ionospherics scatter will be useful in the approximate 25 Mc/s to 60 Mc/s frequencies, over distances up to 1000 miles or more ; tropospherics scatter, over a wide band of frequencies from 100 Mc/s to 500 Mc/s, but limited in distance to a few hundred miles.

(1) *Telecommunicaton Journal,* 1955, p. 205*f.*

The implementation of scatter may require that adjusment be made in the Commission's table of frequency alloction.

In a prophetic mood, Mr. Allen B. Dumont, President of Allen B. Dumont Laboratories, Inc., predicated that the important potential for using scatter transmission must be in areas where is impractical or impossible to use microwave or cable and came to the conclusion thet « this new method makes transoceanic television possible ». Other applications foreseen by Mr. Dumont included international communications, the military, pipelines, and railroad.

Commission III

REPORT OF THE JAPANESE NATIONAL COMMITTEE TO COMMISSION III

by S. Namba, Chairman, Committee III

1. — General remarks

1.1. — *Ionosphere Research Committee, Science Council of Japan* (Chairman : Y. Hagihara)

Almost all of the scientists who belong to universities and laboratories dealing with ionosphere and ionospheric propagation research participate in this committee. Results of observations and researches are discussed at the meeting held regularly once a month.

1.2. — *Society of Terrestrial Magnetism and Electricity of Japan* (President : M. Hasegawa)

The plenary assembly is held twice a year in spring and autumn.

1.3. — *Publications*

Publications principally concerned with ionosphere and ionospheric propagation are as follows :

(1) *Report of Ionosphere Research in Japan* (*R.I.R.J.*), quarterly, English text, Ionosphere Research Committee.

(2) *Catalogue of Disturbances*, irregular, English text, Ionosphere Research Committee.

(The same materials are also published in the R.I.R.J. from 1956 onwards).

(3) *Journal of Geomagnetism and Geoelectricity* (*J.G.G.*), quarterly, English text, Society of Terrestrial Magnetism and Electricity of Japan.

(4) *Journal of the Radio Research Laboratories*, quarterly, English text, Ministry of Postal Services.

(5) *Quarterly Review of the Radio Research Laboratories*, quarterly, Japanese text, Ministry of Postal Services.

1.4. — *Ionosphere observing stations*

Ionospheric observations have regularly been carried out at the following four stations :

Wakkanai (45° 23.6′ N, 140° 41.1′ E).
Akita (39° 43.5′ N, 140° 03.2′ E).
Kokubunji (35° 42.4′ N, 139° 29.3′ E).
Yamagawa (31° 12.5′ N, 130° 37.7′ E).

The results of observations are shown in the « Ionospheric Data in Japan », published by the Radio Research Laboratories, Ministry of Postal Services.

2. — General view of research progress

2.1. — *Contributions to the International Meetings*

Out of the results of research, the summaries of which are given in this report (2.2 and downwards), the Japanese National Committee presented, after selection, several papers to the International Conferences held during 1954 :

Meeting of the Mixed Commission on the Ionosphere,
Eleventh Assembly of the U.R.S.I.,
Conference on Ionosphere Physics.

The papers presented are :

1. M. Hasegawa. — Geomagnetic distortion in region F2, its nature and origin.
2. K. Maeda. — Geomagnetic distortion in the F2 layer, its nature and origin.

3. T. Nagata, T. Obayashi and K. Sinno. — Morphology of ionospheric storms.
4. S. Matsushita. — Some studies on the E*s* region, disturbance variations of the E*s* region and the current system for the S*d* field.
5. Y. Aono. — Note on the continuous observation of *h'* and *fc* of the ionosphere on using a « *sweep frequency* » technique.
6. Y. Nakata, M. Kan and H. Uyeda. — Simultaneous measurements of sweep frequency *h't* and *fct* of the ionosphere.
7. Y. Nakata. — Sunrise effect in the F2 region existence of negative ions.
8. K. Sinno and T. Obayashi. — Further notes on morphology of ionospheric storms.
9. T. Yonezawa. — A consideration on the mechanism of electron removal in the F2 layer of the ionosphere.

Papers (1) to (5) are published in the « Mixed Commission on the Ionosphere, Proceedings of the Fourth Meeting held in Brussels, from August 16 to 18, 1954 ».

2.2. — *Observation technique*

Sweep frequency *h't* measurement (so-called *sh't*) has already been developed by Nakata, Kan and Uyeda. Then the continuous measurement of critical frequency *fct* has been developed in succession by the same investigators (2.1). From the records of these two kinds of observations, it has been made possible to find the continuous variation of the lowest height of the ionosphere and that of the critical frequency. These records have given, in addition, some contributions to the investigations on the sunrise effect of the F2 layer (2.2), inclination and drifting velocity of the layer (2.3), three-dimensional configuration of the equi-electron-density surface, and the mechanism of occurrence of selective fading (2.4).

Continuous recording of the fractional variation of the virtual height of the ionosphere has been made by Yuhara, Koseki and Aono (2.5), using an improved method of J. W. Findlay.

2.3. — *Geomagnetic and ionospheric storms*

It has already been shown by Sinno that the variation of *fo*F2 and *h*'F2 during ionospheric storm which accompanies a magnetic storm can be statistically separated into D*st*(F2) and S_D(F2). Further study has been made on the relation between the intensity of magnetic storm and magnitude of D*st*(F2) and S_D(F2) (3.1). According to the result obtained by Sinno, both D*st*(F2) and S_D(F2) usually increase with the increase of ΣKp (i.e., value of summation of individual value of Kp), only with the exception of D*st*(F2) during winter; whereas the phase of S_D(F2) lags with decline of the solar activity.

The process of the growth of individual ionospheric storms has been examined by Obayashi (3.2).

The disturbance variation D(F2) seems to be connected with the average pattern of magnetic storms, and not only its range but also its phase are controlled by the geomagnetic storm-time. It seems probable that the phase of the S_D(F2) during the active stage of a magnetic storm is almost dependent on local time, but after the activation subsides, it is not fixed to the sun, but the pattern of the disturbance moves with the rotation of the earth.

It has been shown by Matsushita (3.3), after being examined statistically the variation of *f*E*s*, *fo*F2 and *h*'F2 during magnetic storms, that the amplitude of S_D variation of the E*s* layer at middle latitudes is estimated to be 0.5 Mc/s and its phase goes oppositely with that of the F2 layer, whereas at the equator the phase of S_D variation of the E*s* and F2 layer and that of D*st* variation of *fo*F2 have somewhat different characteristics when compared with those quantities at middle latitudes. The S_D variation of the earth's magnetic field at the equator also shows some peculiarities to those at middle latitudes. Dynamo-theoretical calculations have been made by Matsushita (3.3) and Fukushima (3.4) of the current system for the S_D field, taking into account the anisotropic conductivity of the medium.

According to Kamiyama (3.5), variation of *h*'F2 during the magnetic storm of April 18, 1951 has started coincidently with the commencement of the main phase of the storm at every latitude, with the increase of *h*'F2 during the main phase. This amount of increase is smaller at the equator and becomes greater with the latitude. The electron density also begins to change at the commencement of the main phase of the storm at every latitude, but its variations are somewhat complicated.

In connection with the severe magnetic storm of May 9, 1948, investigations have been made by Miya (3.6) of the spreading area of the ionospheric disturbance over the earth's surface, and of the relationship between the relative intensity of the disturbance and the local time of the S. C. at every observing station. The area of disturbance has reached maximum at fifteen hours after the S.C.

A possible explanation has been given by Nagata (3.7) that the reason for the occurrence of ionosphere storm accompanied with magnetic storm at the auroral zone is attributed to the combined effect of the ionizing action of incoming corpuscles into the atmosphere, temperature rise of the atmosphere caused by collisions and the ionization due to sunlight.

2.4. — *Stationary characteristics of the ionosphere and geomagnetism*

D-layer. — A model of the D-E layer, the lowest part of the ionosphere, has been introduced by Aono and Kobayashi (4.2). Calculations have been made of the amount of absorption in the D and E layers, using the results of measurements carried on 1.85 Mc/s waves (in use as LORAN service).

The distribution of electron density with height in the D-E layer has been determined so that the wave absorption calculated at 1.85 Mc/s on the basis of the assumed distribution of electron density might be in agreement with the results obtained from the measurements of LORAN waves. It can be said from the result that the density distribution thus determined nearly accords with that of a Chapman layer.

F2-*layer.* — A co-operative work on the investigation on the geomagnetic distortion in the ionosphere has been carried out by K. Maeda, Hirono and H. Maeda (4.3). Latitudinal distributions and diurnal variations of the E, F1 and F2 layers for the period 1953-1954 have been studied by H. Maeda. Harmonic analysis of the S*q* variation of the earth's magnetic field has also been made. The vertical and horizontal drift of electrons in the ionosphere and their effect on the electron density of the F2 layer have been theoretically studied by K. Maeda, based on the S*q* variation of geomagnetism and the anisotropic conductivity of the ionosphere. Comparing the result of calculation with observations, the important effect of the vertical drift upon geomagnetic distorsion has been confirmed. The diurnal variation of electron densities of the F2 layer at the magnetic equator has been studied by Hirono and H. Maeda from the standpoint of drift. By using values of electric field at the upper atmosphere previously obtained (4.4), an explanation has been given for the variation of *fo*F2 at Huancayo at the period of sunspot maximum and minimum respectively. The effect of gravity and gradient of ionization pressure has been studied by Hirono in connection with the drift in the F2 layer. It was pointed out that the upward drift might be suppressed by the effect of gravity at the upper part of the F2 layer (except in the equatorial zone).

It has been shown by Sato (4.5) from the result of observations that the geomagnetic distorsion in the F2 layer caused by the effect of drifts is most predominant in the vicinity of the magnetic equator. Effort was made to explain the fact that at every zone except magnetic equator the characteristic feature of the layer is considerably different from that of the Chapman-like layer, in spite of the weak drift action.

Calculations were made by H. Maeda (4.4) on the vertical distribution of conductivity in the ionosphere together with the integrated value of it. Diurnal variation of conductivity in the ionosphere has also been derived from that of the geomagnetic field (4.6).

In order to clarify the world-wide distribution of the height of the F2 layer, it is considered not to be appropriate to use the value of *h'*F2. Study has been made by Shimazaki to derive *hp*F2 from M-3000-F2. According to his investigation on the daily variation of *hp*F2, the existence of the solar (or thermal) effect in the diurnal variation and the tidal effect in the semi-diurnal variation have been confirmed (4.7). A discussion is given theoretically of the effects of solar tide and temperature variation of *fo*F2 and *hp*F2 (4.8).

2.5. — *Physical process in the ionosphere*

It has been shown by Yonezawa that, out of possible factors which might affect the variation of electron densities in the F2 layer during nighttime, the variation of temperature plays the most important role. Further it has been pointed out that the rate of electron decay is of the attachment type. Studies have also been made on the value of the coefficient of attachment and the rate of its decrease with the increase of height (5.1). The effect of diffusion of electrons and ions upon the electron density and height of the ionized layer during nighttime has been studied and it was concluded that the ionized layer with the Chapman distribution would not change the form of distribution of electrons and ions, but the entire layer might move downward as it stands (5.2).

After examination of the observational data of *fct* and *sh't* during winter, it was found by Nakata (5.3) that a new layer might appear above the F2 layer two hours before ground sunrise. This new layer might be created by the release of electrons from negative ions, after being excited by low-frequency ultraviolet light which has just reached to the upper atmosphere at sunrise.

Studies on the distribution of nitrogen in the upper atmosphere and on the formation of the E layer have been made by Sato (5.4) (5.5).

2.6. — *Movement of the ionosphere*

Study on the movement of the E layer at night in Japan has been made by Obayashi (6.1), using a number of fading patterns observed on broadcast waves of medium wavelength. Diurnal and seasonal variations of velocity and direction of the movement have been studied. The velocity was estimated 50-150 m/sec and the direction predominantly westward in the evening and eastward in the morning.

An example of the ionospheric movement has been given by Uyeda and Nakata (6.2) by use of *sh't* records. The F2 layer during nighttime is in the form of wavy spreading, the wavelength of which has been estimated as 300 km and the whole spreading moves with velocity of 100 m/sec during night until dawn. After sunrise the movement ceases. Considering from the results of investigations it may be imagined without difficulty that during *h'f* observations usually made at vertical incidence such a wavy ionosphere would frequently be met with. Then the values of the minimum height estimated from the *h'f* records might frequently be contaminated with erratic values caused by oblique reflections.

2.7. — *Ionospheric radio wave propagation*

Assuming that the ionosphere is a three-layered concentric sphere (outer layer with infinite conductivity, middle layer with uniform index of refraction and inner layer with uniform absorption; all layers are concentrically arranged with respect to the earth's surface), calculation has been given by Miya (7.1) of the relation between incident angle and field strength at a receiving station, with respect to every possible mode of high-frequency wave propagation. Further calculations have been made on the delay of the transit time for every mode of propagation. Comparing the results of calculation with observations, the final conclusion showed that for a mode of high-frequency propagation over 3000 km, the M-type reflection is most important among possible modes, whereas the long distance propagation carried solely by the E*s* layer reflection is hardly possible.

Mechanism of long distance propagation of high-frequency waves has been dealt with by Miya and Kanaya (7.2). It was found that the forward scattering of waves at the surface of the earth plays a very important role, and it was succeeded to make calculations of the field strengths at a receiver, taking into account the effect of scattering. Thus the prediction of field strength has been much improved.

Calculations on the three components (X, Y, Z) of radio field strength have been made by Uyeda and others (7.3), taking into account that the strength, direction and phase of a wave reflected from the ionosphere varies in consequence of the shape of the surface of the ionosphere, index of refraction and distance of transmission. Estimation has also been given for the period of fading which would be observed when such a train of clouds move in succession.

Investigations have been made by Echizenya, Katano and Ogata (7.4) on the waves vertically reflected more than ten times from the ionosphere. The results show that only waves with O-component solely remain with strength, the O-components sometimes separate again, the virtual height successively decreases with the increase of the number of reflections and no correlation with the strenght of obliquely transmitted waves.

It has been shown by Nakagami and others (7.12) that « m-distribution » representing the empirical formula of time distribution of rapid fading can be also derived theoretically as the problem of random phase. The effectiveness of diversity reception has also been studied (7.13) on waves subjected to fading of m-distribution.

2.8. — *Solar eclipse*

Examining the observed results of the E*s* ionization during the partial eclipse on Feb. 14, 1953, it was found by Nakata (8.1.) that the ionization varies in proportional to the product of the intensity of solar radio emission at 200 Mc/s observed at the Hiraiso Radio Wave Observatory and cos χ (χ : zenith distance of the sun). It might be probable that the E*s* ionization has some correlation with the solar radio emission at 200 Mc/s. In connection with the solar eclipse under discussion, the solar effective radius for the radiation of this kind has been estimated to be 45 % greater than that of the visible disc of the sun.

From the observational data heretofore obtained, an estimation has been made by Nagata, Nakata, Rikitake and Yokoyama (8.2) of the conductivity of the ionosphere during the period of the solar eclipse with regard to the extent of decrease of conductivity and its spreading area. Theoretical calculations have then be made by the same investigators on the effect which might be expected to appear in the geomagnetic diurnal variation. The result shows possibility of explaining more reasonably geomagnetic observations obtained heretofore.

2.9. — *Solar phenomena*

The relation between K-index and solar activity during years of minimum solar activity (1951-1953) has been pursued by Hatanaka (9.1).

Comparing average field strength of the solar radio waves observed at 2.800 Mc/s in Ottawa 1951-1953 with sunspot numbers, a close relation has been found by Kawabata (9.2) between the increase of field strength of the solar wave and sunspot groups of E, G and H type.

Comparison has been made by Shimazaki (9.3) between the 27 day period of magnetic activity which occurs at minimum solar activity covering several periods of the rotation of the sun and that of corona during the same period. It was found by Shimazaki that the variation of intensity of corona in the zonal region just faced with the earth and that of the earth's magnetic field show approximately the same tendency. More positive correlation appears two weeks or more after the first appearance of corona at the east limb of the sun, whereas negative correlation appears two or three days after the central meridian passage of the corona. With regard to the corona in the other zonal region, not directed to the earth, it is hardly possible to find any definite correlation.

2.10. — *Night air-glow*

The photoelectric observations made during 1946-1948 were reported by Huruhata (10.1). Besides the variation of the emitting layers, daily and seasonal intensity variations of main emission lines have been studied.

Since 1953 the all sky survey of 5577 Å green light has been carried out by Huruhata and others (10.2) by using photoelectric photometers at two stations. Drifting of the air-glow has usually been recognized during the observation. The height of the layer is estimated to be nearly 300 km by triangulation and seems to have close correlation with the electron density of the F2 layer.

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ACTIVITIES OF THE POLISH NATIONAL COMMITTEE IN THE FIELD OF COMMISSION III

by S. Jasinski, Official Member of the Commission.

(*Translation*)

In the field of ionospheric wave propagation the following topics are considered in Poland.

1. *Study of statistical time distribution of short wave radio signals.* — It was found that for small values of the field strength the short period variations, e. g. of a few minutes, fairly agree

with Rayleigh's law, while stronger signals do not agree due perhaps to the propagation mechanism of waves more or less concentrated in the ionosphere.

2. *Study of the wave scattering in the ionosphere.* — Analysis based on theoretical considerations were made of the possibilities of using the ionospheric scatter effect to improve radio communications on decimetre wavelengths. For this purpose, a special antenna was built which in some cases, gives good results.

3. Statistical data are collected to deduce considerations on the propagation process of short wavelengths.

4. *Study of decametre wavelength propagation beyond the horizon.* — Observational results are collected, mainly from broadcasting in order to find the physical explanation of this phenomenon.

5. *Daily index for evaluating radio conditions.* — Attempts are made to find the most suitable index to give the correlation between factors as sunspots, solar corona, magnetic index, etc., and the conditions of the wave propagation.

6. *Case of the huge concentration of electromagnetic Waves in the ionosphere.* — The field strength is considered which exceeds that calculated even without losses. We are investigating the conditions of occurrence of this effect and their probability.

7. *Doppler effect due to the motion of the ionospheric layers.* — The Telecommunication Institute of Warzaw is carrying out theoretical and practical investigations on the importance of this effect on radiocommunications.

SUB-COMMISSION IIId ON MAGNETO-IONIC NOMENCLATURE

The lists printed in *Information Bulletin*, n° 90, p. 11 and n° 94, p. 18 should be replaced by the following :

N : number density of electrons.

e : charge on electron (*e* represents a negative number in the case of the electron).

m : mass of electron.

H : earth's magnetic field.

H_L : longitudinal component of H, *i. e.* the component along the direction of the wave-normal.

H_T : transverse component of H, i.e. the component perpendicular to the wave-normal.
ν : frequency collision of electrons with heavy particles.
μ (or n) : real part of refractive index.
$\varkappa$: attenuation constant, defined so that a wave is attenuated like $E = E_0 \exp(-\varkappa x)$.
c : velocity of light in free space.
ω_0^2 : $4\pi Ne^2/\varepsilon_0 m$.
ω_H : $-\mu_0 e H/m$.
ω_L : $-\mu_0 e H_L/m$.
ω_T : $-\mu_0 e H_T/m$.
X : ω_0^2/ω^2.
Y : ω_H/ω.
Y_L : ω_L/ω.
Y_T : ω_T/ω.
Z : ν/ω.

With these symbols the results of the magneto ionic theory for plane waves travelling in a uniform medium are given by :

$$(\mu - ic\varkappa/\omega)^2 \text{ or } (n - ic\varkappa/\omega)^2$$

$$= 1 - \frac{X}{1 - iZ - \frac{1}{2}Y_T^2/(1 - X - iZ) \pm \sqrt{1/4\, Y_T^4/(1 - X - iZ)^2 + Y_L^2}}$$

Commission VI

REPORT OF COMMISSION VI OF JAPANESE NATIONAL COMMITTEE

by Kiyoshi MORITA, Chairman

According to the resolution of the XIth General Assembly, study programs for the VIth Committee in Japan are rearranged in the following three groups.

VI. 1. Communication and Information Theory.

VI. 2. Circuit Theory.

VI. 3. Electromagnetic Theory.

Much emphasis was laid on item C (Technical resolutions) and item D (Proposals for future) in pursuing the works here. Twice Committee meetings were held under joint Commissions IV and VI to explore the problem underlying. Nature of atmospherics and their measurements were discussed, methods of approach to find the way of distinguishing signals almost embeded among noise are also discussed.

Three technical committees were newly established on our recommendation and under the sponsorship of the Institute of Electrical Communication Engineers of Japan, that is :

(*a*) Information Theory (Chief, Hiedo Seki).

(*b*) Linear Circuit Theory (Chief, Masamitsu Kawakami).

(*c*) Transmission of Microwaves (Chief, Hideo Iwakata).

These technical committees are now co-operating with the corresponding Committees of U.R.S.I. above mentioned to meet the problems described in item D.

The review of the works done for each sub-groups is summarized as follows.

Information theory

About fifteen new papers have been presented to the Study Committee of Information Theory during a year. Nearly equal number of foreign papers were introduced and discussed.

On 27th of November 1954, a General Meeting on Cybernetics was held in Tokyo. The lecturers were MMrs. H. Takahashi, K. Kunisawa, M. Toda, H. Otsuka and H. Katsuki. They discussed the problem respectively from the physical, mathematical, psychological, linguistic and physiological points of view.

Among the people who have presented papers to the Committee were MMrs. J. Hori, S. Muroga, Y. Nakagome, K. Miyawaki, H. Mine, Y. Kasahara, K. Maeda, H. Kato, T. Utsunomiya, H. Miyagawa, K. Kawakami, S. Sekiguchi, Z. Kiyasu, K. Udagawa and G. Tokuyama. General tendency of studies were not concentrated to a single topic, but dispersed to various items. For example, channel capacity, coding, psychology, noise problem, sonagraph applications and modulation systems.

Mr. Muroga solved the equations of Shannon's channel capacity both in discrete and continuous cases. MMsr. Utsunomiya and

Miyagawa developed a new modulation system, denominated as « slope modulation ». Mr. Sekiguchi showed a sonagraph record of Japanese sounds. Mr. Miyawaki discussed the information theory from the psychological aspect and developed an apparatus which has learning ability. Dr. Maeda and Mr. Sakae proposed a new machine which can produce quasi-informations. Mr. Kawakami showed a method of discriminating random from impulsive noise on automatic recording paper.

Jun-ichi HORI. — Information Theory and Irreversible Thermodynamics. *Research Rep. on Properties of Matter*, nº 74, May 1954.

Hidetoshi TAKAHASHI. — General Considerations in Cybernetics. *J.I.E.C.E.J.*, Vol. 38, nº 1, Jan. 1955.

Kiyonori KUNISAWA. — Communication and Learning in Task Oriented Groups. *J.I.E.C.E.J.*, Vol. 38, nº 1, Jan. 1955.

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Haruo O-OTSUKA. — Written Language in Japan and Cybernetics. *J.I.E.C.E.J.*, Vol. 38, nº 2, Feb. 1955.

Yasuji KATSUKI. — Basic Mechanisms of Hearing. *J.I.E.C.E.J.*, Vol. 38, nº 2, Feb. 1955.

Yukio NAKAGOME. — Errors occurring in the Start-stop Teletypewriter System when a Start or Stop Element is disturbed. *J.I.E.C.E.J.*, Vol. 38, nº 4, April 1955.

Kazuo MIYAWAKI. — Visual Communication and Its Application to Psychology. Read before the S.G. of I.T. on Jan. 28, 1955.

Hisashi MINE. — Transformation of Coordinate of Distribution Function in Continuous Channel and Its Application to Some Non-linear Systems. Read before the S.G. of I.T. on Jan. 28, 1955.

Yoshiro KASAHARA. — Representation of Communication Channel Capacities by Means of Electrical Network. *J.I.E.C.E.J.*, Vol. 37, nº 11, Nov. 1954.

Ken-ichi MAEDA, Toshiyuki SAKAE. — On the Generation of Quasi-Information. *National Conv. of E.E.J.*, p. 35, April 1955.

Hiroshi SATO. — Statitics of Code Channel. *Rep. University of Elec. Com.*, nº 6, Dec. 1954.

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Kazuo MIYAWAKI. — Communication Apparatus which can Learn. Read before the S.G. of I.T. on June 23, 1955.

Kiyasu, K. UDAGAWA, G. TKUYAMA. — Mathematical Analysis in Operations Research. *J.I.E.C.E.J.*, Vol. 38, nº 5, May 1955.

Hideo SEKI. — A New Method of Telephone Bandwith Compression, FASIT. *Nat. Conv. of E.E.J.*, p. 832, April 1955.

NON-LINEAR CIRCUITS

The researches on the non-linear circuits have become more and more active, and the main methods of treatment in the researches are the perturbation, the stroboscopic and the topological ones.

An abstract of the researches made in Japan during last year are as follows.

(I) For the differential equation :

$$x'' + \varepsilon r x' + cx + dx^3 = E\cos\omega t$$

where r, c and d are positive constants, the parameter ε is small, the solution of the differential equation can be precisely approximated in terms of elliptic functions and Mathieu functions. By using the solution, the current jump phenomena and the appearance of higher harmonic oscillations in non-linear circuits are made very clear (1) (2).

(II) The stroboscopic method presented by Minorsky is a very useful method to treat the second order differential equations corresponding to the forced oscillations. The stroboscopic method has been extended to the following two :

(i) the first and third differential equations corresponding to the forced oscillations,

(ii) the differential equations corresponding to the self-excited oscillations.

By using the extended stroboscopic method, the non-linear circuit including the saturated iron core reactor and the Colpitz type oscillation circuits have been treated (3).

(III) As the researches using the topological method there are those on the third order differential equations. Paper (4) is on the existence of periodic solution of the differential equation with two non-linear functions. Paper (5) is on the system that consists of the second and third order differential equations with constant coefficients, and gives, as an example, Hartley, Colpitz and tuning grid circuit oscillators with the vacuum tube having the broken-line characteristics.

(IV) The problems of the mutual interaction among the several systems are very difficult to treat. In paper (6) is treated the mutual interaction between the two self-excited oscillators of tuning anode type. In paper (7) the combined system of the harmonic and the relaxation systems have been treated (8).

(V) In the above-mentioned papers the methods treating the nonlinear circuits are orthodox. In addition to these orthodox methods there is a method in which exact characteristics of non-linear elements are replaced by simpler ones. By this method only the qualitative properties will be understood (9).

1. Tatsujiro SHIMIZU. — The Approximate Solution of Differential Equation for the Non-linear Electric Circuit. *Semi-annual Joint Meeting of the Inst. Elec. Engrs., Inst. Elec. Com. Engrs. and Illum. Eng. Soc.*, May 1954.
2. Tatsujiro SHIMIZU. — The Theory of Higher Harmonic Oscillations in the Non-linear Electrical Circuits. *Semi-annual Joint Meeting of the Inst. Elec. Engrs., Inst. Elec. Com. Engrs. and Illum. Eng. Soc.*, May 1955.
3. Koiti FUJITA. — On the Analysis of Non-linear Electrical Circuits Having the Periodic Solutions. *Inst. Elec. Commu. Japan*, 37, 485-489 (1954).
4. Ryoiti TADENUMA. — Periodic Solution of a Third Order Non-linear Differential Equation. *Bull. Electrotechnical Lab. Japan*, 18, 852-855 (1954).
5. Koiti FUJITA. — Analysis of Oscillatory System Represented by Third Order Non-linear Differential Equation. *Semi-annual Joint Meeting of the Inst. Elec. Engrs., Inst. Elec. Com. Engrs. and Illum. Eng. Soc.*, May 1955.
6. Koiti FUJITA. — On the Couple of Two Non-linear Vibration Systems. *Semi-annual Joint Meeting of the Inst. Elec. Engrs., Inst. Elec. Com. Engrs. and Illum. Eng. Soc.*, May 1954.
7. Jiniti NAGUMO. — On the Modes of Non-linear Vibrations. I. *Semi-annual Joint Meeting of the Inst. Elec. Engrs., Inst. Elec. Com. Engrs. and Illum. Eng. Soc.*, Oct. 1954.

8. Jiniti NAGUMO. — On the Modes of Non-linear Vibrations. II. *Semi-annual Joint Meeting of the Inst. Elec. Engrs., Inst. Elec. Com. Engrs. and Illum. Eng. Soc.*, May 1955.

9. Atsushi WATANABE, Tsutomu GOMI. — On the Approximate and Exact Solutions in the Forced Vibration of a Non-linear System with Hysteresis Characteristics. *Trans. Soc. Mech. Eng. Japan*, 20, 766-770 (1954).

LINEAR NETWORK THEORY IN JAPAN

We have had some progress in the network theory this past year, though it may not be particularly remarkable. Research works which are to criticize, complement or systematize the theories in the past, have been conducted, while attempts to develop new fields were made.

In the RC network theory, first, necessary and sufficient conditions for its transfer function to be realized were carried out, and a new method of synthesis which could be calculated with simple numerical routine, was found (1). Next, in the theory of a distributed constant network, a necessary condition was made more precise for the requirement that a network with transmission lines of electrical unit length as its elements which had been developed particularly in Japan can be synthesised as a configuration of a tree without negative elements (2). Also a necessary and sufficient condition was obtained in a form with admittance parameters for the requirement that a prescribed reactance four-pole can be extracted from a two-pole network, similarly as Brune-process in the network synthesis (3).

A systematic classification of elementary networks to which a general network, active and passive, are reduced, was studied, mentioning of their mutual relations (4), and moreover a new equivalent circuit for a transistor was introduced by means of ideal voltage amplifiers and ideal current amplifiers which were defined in the reference (4), instead of the conventional method by resistances and electromotive forces (5).

1. H. OZAKI. — Necessary and sufficient conditions of RC transfer functions. *J. of Inst. of Elec. Comm. Engrs. of Japan*, **38** (Jan. 1955), 44.

2. H. OZAKI, OGASAWARA. — Negative elements in distributed constant networks. *Joint conference of Kansai Section of Inst. of Elec. Comm. Engrs. of Japan* (Oct. 1954), 17.

3. H. Ozaki. — On partition theorem. *Joint conference of Kansai Section of Inst. of Elec. Comm. Engrs. of Japan* (Oct. 1954), 18.
4. M. Kawakami. — Some properties of elementary networks. *J. of Inst. of Elec. Comm. Engrs. of Japan*, **38** (April 1955), 320.
5. M. Kawakami. — Sourceless equivalent circuit of transistors. *J. of Inst. of Elec. Comm. Engrs. of Japan*, **37** (Aug. 1954), 525.

Antenna and diffraction of waves

Y. Nomura (1) developed formulas for calculating current distribution on a single antenna. The formulas come from the solution of integral equation which has infinite number of terms representing Fourier harmonic voltages due to current distribution assumed. They gives more easy way for calculation than those of Hallen.

S. Uda (2) presented many calculation charts for designing Yagi-Array of 3 elements, and T. Sekiguchi (3) gave a formula for computing the value of dielectric constant of pseudo-dielectrics consisting of infinite number of short parasite dipoles, giving the results that the maximum available constants amounts to 3 to 5.

K. Matsumoto (4) developed a new method of iris arrangement for a horn of wide band character which serves as a primary exciter for a paraboloid. V.S.W.R. of 1.03 for range of 3850 to 4520 Mc/s was obtained.

M. Suzuki (5) and N. Moriguchi (6) solved various problems concerning radiation from rectangular slot cut in a wide metallic shield. Assuming the intensity of incoming primary field and taking advantage of successive approximation in solving integral equation they gave formulas for slot admittance.

H. Uchida (7) developed a multiple horn antenna excited from a wave guide having extremely wide H plane.

Calculations of spiral circuit taking into account its space harmonics were given by J. Hirano (8) and T. Hosono (9). Especially the latter gave the solution in the form of three component waves, one with light velocity along spiral, nother with low velocity also along spiral, and the last one contributing to the radiation.

Y. Nomura and S. Karura (10) worked out the diffraction problems from the circular hole in infinite large conducting plate by the method of expansion in the hypergeometric polynomial. Y. Oba and N. Kawai (11) studied the calculation of directional patterns from a small dipole backed with a semi-infinite perfect conducting sheet by applying the modified Sommerfeld solution.

1. Y. Nomura, T. Hatta. — Linear Antenna Theory. *Jour. the I.E.C. Japan*, Vol. 36, nº 10, Oct. 1953.
2. S. Uda. — Design of V.H.F. Antenna Array. *Jour. the I.E.C. Japan*, Vol. 36, nº 7, July 1953.
3. T. Sekiguchi. — Equivalent Refraction Index of a pseudo-dielectric made of an Array of Conducting Rods. *Jour. the I.E.C. Japan*, Vol. 38, nº 2, Feb. 1955.
4. K. Matumoto. — Broad band Triangular Primary Radiator of Paraboloidal Antenna. *Jour. the I.E.C. Japan*, Vol. 37, nº 7, July 1954.
5. M. Suzuki. — Diffraction of Plane Electromagnetic Wave by a Rectangular Aperture. *Jour. the I.E.C. Japan*, Vol. 36, nº 6, June 1953.
6. N. Moriguchi. — Theory of a Slotted Antenna on a Sidewall of Rectangular Waveguide. *Jour. the I.E.C. Japan*, Vol. 38, nº 7, July 1955.
7. H. Uchida, N. Hirano. — Multiple Horn Antenna for Microwaves. *Jour. the I.E.C. Japan*, Vol. 36, nº 9, Sept. 1953.
8. J. Hirano. — Spatial Harmonics of Electromagnetic Waves on Helical Lines. *Jour. the I.E.C. Japan*, Vol. 37, nº 3, March 1954.
9. T. Hosono. — Radio Wave Propagation Along a Helical Circuit. *Jour. the I.E.C. Japan*, Vol. 38, nº 1, Jan. 1955.
10. Y. Nomura, S. Katura. — Diffraction of Electromagnetic Waves by Circular Plate and Circular Hole. *Jour. the Phy. Soc. Japan*, Vol. 10, nº 4, April 1955.
11. Y. Oba, N. Kawai. — Directional Characteristics of Doublet Antenna with Ribbon-Shaped Reflector (I). *Jour. A.P. Japan*, Vol. 24, nº 8, Aug. 1955.

A SYMPOSIUM ON RADIO AT CIECKONICEK (POLAND)

(*Translation*)

A national symposium organized by the Institute of the Main Technical Problems of the Polish Academy of Sciences was held at Cieckonicek from September 11 to 22, 1955.

The work of the symposium was made by two groups devoted to the following matters :

1. Problems on electromagnetic field connected to antenna and wave guide theories.

2. Problems on electric circuit synthesis.

Besides reports on scientific research, the symposium included lectures on the relationships between the matters discussed and the various fields of radiotechnique. Such works were related mostly to synthesis problems.

During the symposium some monographic lessons have been organized on problems of application of mathematical techniques to the analysis of the problems discussed.

Most of the papers submitted to the symposium will be published in the periodicals of the Polish Academy of Sciences, and particularly in :

Bulletin of the Polish Academy of Science, third and fourth sections, *Archiwum Elektrotechniki*.

The reports on scientific research submitted to the symposium were the following :

R. Gajewski. — Radiation of a dipole in waveguide in transitory operation.

P. Szulkin. — Interaction of a resonator and an electron beam.

K. Bochenek, J. Plebanski. — Heterogeneous optics (scalar approach).

B. Konorski. — Critical angles in the electrostatic field of two spheres.

L. Kiernozycki, E. Pelzner. — Equiphase surfaces of the horn radiated field and their effective centers.

S. Manizarski. — Simple model of high directivity antenna.

A. Trautman. — On the possibilities of changes in radiation curves by means of slight distorsions of the reflector.

F. Baranski. — Application of the summation method and of the Bessel's functions to the solution of the mixed problem for the wave equation.

J. Lankowski. — Measurement of the quality of band filters Tchebycheff characteristic.

J. Fabijanski. — Wide band piezoelectric filters with Tchebycheff effective damping characteristic.

A. Smolinski, W. Golde. — Methods of calculation of wide band pulse amplifiers.

A. Filipkowski, Z. Gniewinski. — Methods of calculation of feedback selective systems.

R. KULIKOWSKI. — Problems on signal-noise ratios and optimal filter.

J. LANKOWSKI. — Application of the approximation in L2 space to lattice filters.

SUB-COMMISSION VIa
ON INFORMATION THEORY

List of Members

Chairman :

Prof. Dr Balth. VAN DER POL, Director, C.C.I.R., Palais Wilson, Geneva.

Prof. Dr BLANC-LAPIERRE, Faculté des Sciences, Alger.

Dr D. GABOR, Imperial College of Science and Technology, City and Guild College, Exhibition Road, London, S. W. 7.

Lt-Colonel LOCHARD, Directeur Technique du G.C.R., Mont Valérien, Suresnes (Seine).

Mr. J. LOEB, c/o Société de Prospection Electrique, 42, rue St-Dominique, Paris.

Prof. Dr W. MEYER-EPPLER, Universität Bonn, Bonn.

Dr FRANS L. H. M. STUMPERS, Philips Research Laboratories, Nachtegaallaan, 7, Eindhoven.

Prof. Dr VILLE, 3, rue Campagne Première, Paris 14e.

Prof. Dr WIESNER, Massachussetts Institute of Technology, Cambridge (Mass.).

Letter to the Members of the Sub-Commission

7th February, 1956.

Gentlemen,

1) For your information I enclose herewith an up-to-date list of the members of U.R.S.I. Sub-Commission VI*a* (Information Theory ».

2) Part of the work of our group concerns current bibliographies of papers on communication/information theory.

In connection therewith I recall the following U.R.S.I. comment (on C.C.I.R. Recommendation N° 107), which runs as follows :

« It is suggested that the American papers be reviewed by a member of the American delegation and other papers by a member of the Netherlands delegation. Cooperation could consist in sending a list of papers before the 1st of March each year to the respective delegate, together with a note on their place in the theory, and where possible an abstract. It is suggested that the American delegation publish the combined list, and the secretariat of C.C.I.R. publish the abstracts that have a more direct bearing on communication (1). »

You will remember that it was agreed that the collecting of the different articles and reviews would be done separately, on the one hand for the American papers and on the other hand for the European and other papers.

The American part was going to be looked after by Dr. W. G. Tuller who, as you know, was killed in an air accident when going home from the U.R.S.I. meeting (The Hague, 1954).

Assistant Professor P. Elias (M.I.T. Cambridge) has now been kind enough to promise to supply us with the American part.

The European part was to be taken care of by Dr. F. L. H. M. Stumpers, who has communicated to me that his next list will probably be available in the course of next March.

3) I am glad to be able to let you know that C.C.I.R. Supplement Nº 3 of the Bibliography on Communication Theory is now in the course of preparation. As soon as it has been published I shall be glad to send a complimentary copy to each of our members.

4) I shall be glad to receive any proposals, from our members, concerning the committee for the U.R.S.I. General Assembly, which is to take place in *Boulder, Colorado, in August* 1957.

5) As you probably know, the next C.C.I.R. Plenary Assembly will take place in Warsaw (Poland) from 9th August to 13th September inclusive, where I am sure that any U.R.S.I. contribution on « Information Theory » would be discussed.

With my best regards,

Yours sincerely,

(*sgd*) Prof. Dr Balth. van der Pol,
Chairman, U.R.S.I. Sub-Commission VIA
« Information Theory »

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(1) See *U.R.S.I.* Proceedings of the XIth General Assembly, volume X, Part 8, Administrative Proceedings.

SUB-COMMISSION VIc ON ELECTROMAGNETIC THEORY (ANTENNAS AND WAVEGUIDES)

Letter to the Members of the Sub-Commission

16 February, 1956.

Dear Colleague,

It is now time to give some thought to the planning of the technical sessions for U.R.S.I. Sub-Commission VI-*c* at the XIIth General Assembly to be held at Boulder, Colorado, U.S.A., in August 1957. I am writing to ask for suggestions as to the best procedure to follow in organizing the sessions, and for suggestions as to suitable topics for discussion.

At the last General Assembly, held at the Hague in 1954, there was a divergence of opinion on the question of the best procedure to follow to make the meetings most effective. Some felt that a symposium type of meeting with a program of invited papers is the most suitable form, while others felt that formal meetings should be avoided and discussion groups arranged instead. In the latter case, a group of papers would be needed to form a starting point for the discussion. Would you please express your preference for one or the other type of meeting, or perhaps a combination of the two ?

I would like to receive your comments on the topics which should be discussed at the meetings of the next General Assembly, Could you please send me a list of several possible topics ? In the Proposals for Future Work given at the last General Assembly, the following topics were listed :

1. Theory of broad-band antennas.
2. Study of the transition from Maxwell's Equation to circuit theory and to geometrical optics.
3. Guided waves, including surface waves and transmission through anisotropic media.

You might consider the possibility of sessions on some or all of these subjects as well.

Another suggestion I have been considering is the possibility of a technical session devoted to the problems of antenna design for radio telescopes. There are quite a few new radio astronomical observatories being constructed throughout the world so there may be some interest in such a discussion.

I hope to hear from you in the near future.

Yours truly,

(*sgd*) George SINCLAIR,
Chairman Sub-Commission VI-C,
Department of Electrical Engineering,
University of Toronto,
Toronto 5, Canada

IONOSPHERIC STATIONS

Italy

Since December 1955 an automatic ionospheric station (Freiburg S.P.I.M. type) is operated on Monte Capellino (700 m) in the vicinity of Genoa.

Sweden

From the 1st of January, 1956, the routine ionospheric work at the Kiruna Ionospheric Observatory has been taken over by the Research Institute of National Defence, Stockholm 80.

INTERNATIONAL GEOPHYSICAL YEAR

First Report to U.R.S.I.-I.G.Y. Committee by U.R.S.I. Subcommission IIIa Special Committee on High Latitudes

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First Report to U.R.S.I.-I.G.Y. Committee by U.R.S.I. Subcommission IIIa Special Committee on High Latitudes

Production, Reduction and Presentation of results of high latitude ionospheric soundings

1. — Introduction

The U.R.S.I. Special Committee on High Latitudes of U.R.S.I. Subcommission III*a* was charged by the Xth General Assembly with bringing forth specific plans for the production, reduction and presentation of results of ionospheric soundings at stations in *high geomagnetic latitudes.* The Special Committee was directed to make a report to the U.R.S.I.-I.G.Y. Committee at its September 1955 meeting in Brussels. This report concerns the plans; an album of ionograms, a most important phase of the Committee's work, is still in preparation.

It is apparant that rather few ionospheric phenomena are unique to high latitudes; the unusual recordings are encountered perhaps rather more often at high latitude stations and the unusual character may be more obvious. Therefore, it is essential that the procedures recommended for high latitude stations be compatible with those for middle and low latitudes, and that they ensure continuity with past data as far as meaningful characteristics are concerned.

The U.R.S.I. Xth General Assembly, in establishing the Special Committee, thereby took cognizance of the widespread opinion that the systematic reduction of high latitude ionograms falls very short of adequately representing the observations. An important reason for this is that certain phenomena — badly spread echoes, variety of E*s* types, blackout, G-conditions, etc. — are comparatively common at high latitudes whereas the scaling procedures were most strongly influenced by conditions encountered at low latitudes. These well-established scaling procedures have not been re-examined in detail since the time that such a large effort has been put into high latitude soundings programs.

2. — General considerations

In making recommendations on procedures, we have been guided by the following general considerations :

(1) There is a dual purpose in making ionospheric soundings, first, to provide basic data for radio propagation predictions, and, second, to study some aspects of the physics of the upper atmosphere. For many scientific studies there is no satisfactory alternative to examination of the original records. A chief purpose of tabulated data is, therefore, radio propagation predictions.

(2) The main purpose of scaling ionograms is to describe some of the essential features of the ionosphere overhead. However, the data must not be misleading in the cases of those records, common in high latitudes, which cannot be described completely in terms of critical frequencies and virtual heights. It must be remembered that the results of soundings are extensively used by workers who are not acquainted with the type of *h'f* records obtained at high latitudes. It is the opinion of the Committee that some of the present tables are misleading and inconvenient to those interested in studying the electrical structure of the upper atmosphere.

(*a*) *The E region.* — The outstanding problem associated with the E region is the occurrence of different forms of E*s* (sporadic E). In the past, E*s* phenomena have been described in terms of *f*E*s*, *fb*E*s*, and *h'*E*s*. The result has been to group together a number of independent phenomena and deal statistically with tabulations of a polyglot « characteristic ». At most high latitude stations the occurrence of a night E layer, which is often indistinguishable from the daytime E layer, is common and must be recognized.

(*b*) *The F region.* — The chief problem here is the scaling of critical frequencies and heights of the F2 layer. The former are often inaccurate, indeterminate or unmeasureable due to spread or the presence of more than the *o*, *x* and *z* critical frequency traces. The tabulated critical frequencies give us no idea of the degree of uncertainty, either statistically or individually. Taken as they are from individual ionograms, these are subject to very large errors on account of spread echoes and unsuitable gain settings. As to the tabulated data on equivalent heights it is felt that under conditions which generally exist at high latitudes, many are of little value since they are strongly dependent on the degree of group retardation.

(3) The procedures recommended by the Committee should form a stardardised background on the basis of which the regular monthly reports are composed for interchange purposes.

(4) Only a few ionospheric sounding stations are manned by research scientists; therefore the carrying out of the systematic observations, reductions and reports cannot require the experience and judgment of the specialist.

(5) Tabulations of data in standard form are not by themselves a satisfactory end-product of an ionospheric sounding program. There is no point to interchanging data unless they can clearly and unambiguously be evaluated from the information provided. For high latitude data, hourly values are not very helpful for many phenomena which change significantly in ten minutes' time. There is a body of opinion which holds that non-statistical analyses are needed, more for high latitude studies than for middle and low latitudes, for improving the understanding of ionospheric phenomena.

(6) There should be a mechanism for observers at ionospheric sounding stations to indicate points not obvious from data tabulations, when appropriate, of the measurements which they report to other stations.

(7) The expenses of installing and operating an ionospheric sounding station at high latitudes are usually very considerable. Thus the most important consideration is that the observations yield results comparable to the investment. Only a secondary consideration is that the observing, reduction and reporting procedures require as little of the observer's time as possible. The time required, under present station routines, for calibration, ionogram reduction and report preparation, should be only a rough guide for deciding on the practicality of any new recommendations which may greatly enhance the value of a station's existence.

(8) The observing procedures and the recorded notes on operating conditions of the equipment are as important as the reduction

and reporting procedures. This is particularly the case at high latitude stations, where changes in gain, power, etc..., can significantly change the appearance of the ionogram.

(9) It is recognized that ionograms are almost never remeasured in as much detail as the first reductions at the station itself; consequently the reductions and reports by the station must be considered the final comprehensive results of the observations, and the procedures planned accordingly.

(10) There should be consideration of the accuracy of measurements in deciding on reduction procedures; thus if, for instance *fo*E is to be measured to 0.01 Mc/s the time of observation must be known to about half a minute.

(11) The Committee recognizes that its recommendations must take account of the practicalities of the operation of ionospheric sounding stations and networks. Thus there are stations which now run on a part-time or unmanned basis and there are stations limited in their program by local radio interference problems; further, all networks have economic limitations. This situation applies to some stations of all networks. However, it seems best to set goals which can reasonably be reached by the stations without extreme limitations, with the expectation that the others will make as few compromises as possible with the practicalities of their situation.

3. — General Description of Recommended Procedures

(*a*) For some characteristics measurements are to be made from all available ionograms, not merely the hourly ionograms.

(*b*) Some additional soundings are desirable to be taken on a schedule designed to get the best possible information for the hourly value — for instance, soundings five minutes before and after to establish continuity, and soundings ½ to 1 minute before and after at high and low gain.

(*c*) The basic reductions consist of a daily plot of frequency measurements as well as a smaller number of tables of hourly values than at present. Dropped are some M-factors and some height measurements, the former because they are apparently not being used and the latter because they seem to misrepresent the observations.

(*d*) Hourly values for critical frequencies are taken from the daily frequency plots (hereafter referred to as the frequency plot or *f*-plot) ; research workers, however, should use the graphs together with the tables. The *f*-plots should be prepared directly from measurements of the ionograms, without any intermediate steps.

(*e*) In addition to numerical measurements, qualitative judgments of the hourly records are recommended to be made separately for the D, E and F regions. These should help one judge from tables the predominant features of the ionograms. A tentative 3-step scale is included in the appendix ; this needs to be tested further before recommendation.

(*f*) For E*s*, it seems best to record the occurrence on each available ionogram of four categories : three distinctive types and an « all other » type. Misleading though it is, the characteristic *f*E*s* is to be scaled until consistent quantitative procedures are agreed to.

(*g*) Monthly summaries of hourly values are to include the median, the quartile range and the number of observations involved.

(*h*) Data to be interchanged or published include tables of hourly values, monthly summaries, and the daily frequency plots (*f*-plots) for at least some and preferably all the days of the month.

4. — Equipment Operation

A. — *Discussion*

For accurate and consistent scaling of ionograms, the first requirement is good photographic records. Since the interpretation of ionospheric records depends to a considerable extent on the state of the sounding equipment, it is desirable to maintain the equipment at a constant high level of efficiency and necessary to take any deviation into account in making the reductions.

The appearance of ionograms, especially when echoes are spread, can be greatly changed by adjustement of the effective gain of the ionosonde. It is very difficult for an observer to determine and maintain the optimum adjustment in the face of changing ionospheric conditions common in high latitudes. In fact, there are different optimum settings for different characteristics, and some characteristics — *f-min* and *f*E*s* — are clearly gain-sensitive. However, first priority should go to interpretation and scaling of *fo*F2, and the gain adjustment should insofar as possible be kept optimum for that characteristic. Further, additional soundings should be taken just before and just after the hourly soundings at receiver gain settings appreciably higher and appreciably lower than the estimated optimum. This should assure a high confidence in the interpretation of the hourly sounding. (See, for instance, Fig. 63 DRTE (Canada) Report No R-2, May 1953).

The rapid changes which ionospheric phenomena undergo in high latitudes make it hard to differentiate slowly varying from transient phenomena. To help clarify the situation with respect to hourly values, it is proposed to invoke conditions of continuity, for which sounding sweeps 5 minutes before and 5 minutes after the hourly sounding are required.

B. — *Recommendations*

(i) Sweep time should be no longer than 30 seconds, whenever possible, owing to the rapidly changing nature of the ionosphere at high latitudes.

(ii) *Sweep and gain schedules* for *fast* sweep ionosondes, as a minimum observing routine : 00, 01, 05, 15, 30, 45, 55 and 59 minutes after each hour, or equivalent. The gain setting should be optimum for scaling *fo*F2 on all sweeps *except* low gain on 59 minute sweep and high gain on 01 minute sweep.

(iii) *Sweep and gain schedules* for *slow* sweep ionosondes should come as close as is practical to the schedule in (ii) ; for instance, the schedule for NPL Recorder MK 11 (5-minute sweep for full frequency range) could be : 58-02, 03-08, 13-18, 28-33, 43-48 and 53-57. The three runs 53-08 could be taken as continuous full range records centred around 3.0 Mc/s at 55, 00, 05 with low, normal and high gain settings respectively. The other runs are centred around 3.0 Mc/s at 15, 30, 45 and with normal gain settings for scaling *fo*F2. It is recognized that radio interference problems may be encountered with such a schedule ; it would seem that the gainvarying sweeps have highest priority.

(iv) *Equipment efficiency*. — It is felt that, where possible, information regarding the variation with frequency of equipment should be supplied.

(v) *Height scale.* — The accuracy of the height scale should allow measurement of h'E to $\pm$ 1 km. It is desirable to obtain one sweep per hour with an expanded height scale to aid the scaling of h'E. Allowance should be made, if possible, for the apparent variation of equivalent height with echo amplitude and for the position of the ground pulse.

(vi) *Frequency scale.* — It is presumed that the frequency scale is accurate to 0.5 % and is checked at least monthly.

(vii) *Timing of soundings.* — It is presumed that the beginning time of soundings is at the stated time of observation to within a minute; any deviations from this practice should be noted on data sheets interchanged among stations. In the case of *slow* sweep ionosondes the stated time should refer to the recording time on the 3.0 Mc/s sounding frequency. On NPL Recorders MK 11, for instance, the sweep starts on 0.68 Mc/s, 1 m 50 sec before the stated time.

(viii) *Continuous runs.* — The above schedules are minimum recommended observing routines; 5-minute or continuous runs throughout 24 hours or more are recommended to be made as often as possible. On some of the Regular World Days such runs should be taken synchronously at all stations.

5. — Characteristics to be Tabulated

A. — *Recommendations*

(i) Hourly values of the following characteristics are recommended for interchange :

*fo*F2	(M3000)F2	*f*E*s*
*fo*F1	(M3000)F1	type of E*s*
*fo*E	h'E	(E*sr*, E*sm*, E*sl*, E*su*)
fmin		

(ii) Hourly values of *fo*F2, *fo*F1, *fo*E and *fmin* should be taken from the daily frequency plot (see Sec. 6 below) and not from the individual hourly ionograms alone.

(iii) The hourly values of (M3000)F2 and (M3000)F1 obtained from the standard transmission curves are to be tabulated both for their use in prediction work and as indications of the heights of the respective layers.

(iv) The hourly values of h'E are to be scaled and tabulated only if they can be measured to ± 1km. They might be tabulated, for instance, to the nearest kilometer.

(v) The type of E*s* occurring each hour should be entered in a table with a legend which clearly sets forth the criteria used.

(vi) Until better quantitative methods for observing and scaling E*s* are agreed to, the scaling and tabulation of hourly values of *f*E*s* according to present procedures are reluctantly recommended.

(vii) Tabulation of the following characteristics is not recommended for international interchange : h'F2, h'F1 (M1500)E, (M1500)F2, h'E*s*.

B. — *Discussion of Scaling Difficulties*

(i) *Critical Frequencies.* — Difficulties in measuring critical frequencies arise from absorption, blanketing, stratification, spread echoes, forks, obliques, etc. Methods for obtaining hourly values for tabulation purposes are detailed in Section 6.

(ii) E*s*. — The Committee considered in detail the present classifications of types of E*s* and examined a large number of ionograms from middle and high latitudes from this point of view. There was frequent doubt or disagreement when attempting to apply every detailed classification scheme to ionograms from a number of high latitude stations. It was recognized that this failure of any single detailed scheme to be universally applicable was in some measure on account of the different equipments and observing practices at the different stations.

At high latitude stations, the solar-controlled E layer behaves in much the same way as at low latitude stations. However, the irregular E ionization reported *in lump* under E*s* may frequently obscure the identification of solar-controlled E. It appears that within the complex E region ionization, which is characteristic for high latitude stations, a solid E layer is produced which often is indistinguishable from the solar-controlled E. This is most frequently recorded during nocturnal hours, but may well extend into the day hours. The layer has sometimes been referred to as « Nite E ».

It is now recommended that this phenomenon be tabulated with solar-controlled E. Therefore the criterion for scaling *fo*E is : a totally reflecting layer showing group retardation with group retardation also showing in a higher layer.

For the remainder, a simplified classification of types which appear to have clearly defined characteristics is recommended as follows :

E*sr*. — Non-blanketing E*s* with group retardation.

(Note : This covers all cases where there is evidence of a thick layer of ionization, but no or unsatisfactory evidence from F region traces to classify it as the normal E layer ; see above and appendix.)

E*sm*. — E*s* with one or more multiples.

(Note : This will include most cases of highly reflecting E*s* ; blanketing E*s* will usually show at least a small trace of a multiple echo). (Note by Chairman, see Section 7 of the Appendix.)

E*sl*. — E*s* below 100 km.

(Note : Such low E*s* traces are usually weak, transparent, spread and are often recorded at the high-sensitive part of the frequency range of the ionosonde. In the rare cases where multiples of such echoes show, the classification should be E*sm*.)

E*su*. — Unclassified ; all other E-region sporadic traces.

There were several strong opinions expressed from outside the Committee in favour of retaining the present tabulation of *f*E*s* and this was reluctantly agreed to. It was felt, however, that *f*E*s* as scaled at the present time is very misleading and there are strong arguments for abandoning the characteristic :

(*a*) The tabulations include a number of types of E*s* whose characteristics are quite different. These types are not identified, nor perhaps identifiable, and any statistical study with these tabulations therefore tends to be meaningless.

(*b*) *f*E*s* depends upon the sensitivity of the ionosonde equipment at various frequencies and on the characteristics of different equipments ; therefore *f*E*s* cannot be reliably compared among stations.

(iii) *Representative Heights.* — In coming to the recommendation that M3000 should be the only characteristic for representing the height of the F1 and F2 layers, as far as international interchange of high latitude data is concerned, the Committee arrived at the following conclusions. The reasoning behind the recommendation that *h'*E be scaled, tabulated and interchanged is also given.

(*a*) *hp* was considered to be better than *h'* since it is less affected by group retardation in the underlying layer. However, M3000 is related to *hp* and is already widely interchanged. It has been used as an indicator of representative height in many researches. Contrary to present practice, M3000 can often be measured to ± 0.05. In order to achieve uniformity, the standard transmission curve should be used at all high latitude stations.

(*b*) All F2 height indicators suffer when *fo*F1 and *fo*F2 are nearly equal. It is suggested that the height indicator M3000 should be qualified by the symbol U when *fo*F2 minus *fo*F1 is less than 0.5 Mc/s.

(*c*) *h'*E seems preferable to *hp*E since the cusp at *fo*E is often blanketed or incomplete ; however, *h'*E has not been found useful unless measured with high relative precision. It is believed that *h'*E can be measured to 2 km with most ionosondes, although sweeps with expanded height scales are to be preferred. It is believed that the routine measurements of *h'*E will be useful despite the uncertainties of ledging and the errors arising from varying echo amplitudes.

(iv) *Absorption.* — Change in *f-min* is considered to be a useful indicator of D region absorption. This characteristic is therefore recommended for a minimum ionospheric sounding program. *fmin* from one station should not be compared quantitatively with *fmin* at another.

6. — Presentation of Data by Stations

A. — *Discussion*

The single most difficult problem in reducing high latitude ionograms is to follow an echo trace or characteristic from one sounding to the next in the face of rapidly changing conditions, obliques and spread echoes. This is difficult to accomplish by eye and such interpretations are not subject to check by other observers with more or different experience. It is common practice at many high latitude stations to attempt to solve a difficult sequence of ionograms by plotting all critical frequencies which appear on all available ionograms on a frequency-time graph. When spread echoes occur, the range of possible values of the critical frequency is plotted. Thus the graph is preparad without prejudging for a complex ionogram which is the *o*-, *x*- or *z*-trace, or which is an overhead echo and which an oblique. It is usually possible to sketch the time variation of *fo*F2 amidst the dots and lines of the plot.

It is the systematic application of this technique which seems to give promise for obtaining the most reliable hourly values of critical frequencies, when they are measurable at all. This representation also gives the range of possible values when no critical frequency is observable and further indicates the degree of variation between hourly values.

It is realized that this change in procedure will increase somewhat the time required for reduction of records. It is felt that this is necessary if a significant improvement in accuracy and representativeness of data is to be achieved.

The station report (this includes also technical characteristics about the sounding equipment) then would consist of :

(i) Graphical representation of the time variation of certain frequency characteristics including critical frequencies associated with the normal layers (E, F1 and F2), which it is suggested be made directly from the ionograms without recourse to a prior tabulation.

(ii) Tabulation of hourly values of certain characteristics which are sufficiently unambiguous and therefore useful for eventual publication and international exchange.

B. — *Graphical Representation* (1)

(i) The graphical representation — *f*-plot — contains the following information :

(*a*) all F2 critical frequencies or ranges of possible critical frequencies.

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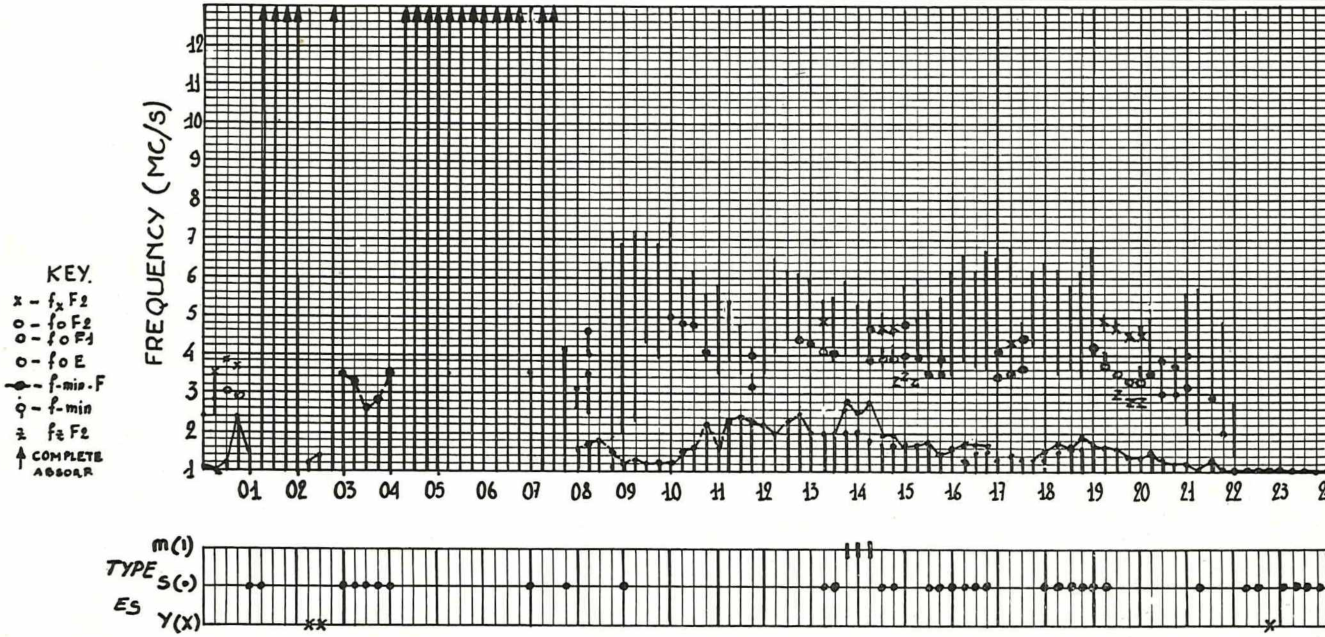
(1) The attached figure is a *sample*, not a *model*.

FREQUENCY PLOT OF IONOSPHERIC DATA

STATION : GODHAVN
DATE : January 19, 1955

SCALED BY : SCG/RWK.
MERIDIAN TIME 45°W



UNPLOTTED HOURLY VALUES				
HR	F2 M-3000	F1 M-3000	h'E	fEs
00	3.1			E
01	A			2.7
02	B			B
03	B			6.1
04	B			10.2
05	B			B
06	B			B
07	B			4.5
08	2.6			B
09	F			3.1
10	2.9			E
11	F	Q	B	B
12	F	Q	B	B
13	3.2	Q	B	B
14	F			8.2
15	3.2			B
16	F			3.2
17	3.0			E
18	F			1.8
19	3.2			1.8
20	3.1			E
21	3.1			E
22	F			E
23	A			2.5

(*b*) *fo*F1, *fo*E, *fmin* and, when appropriate, *fmin*F (the lowest frequency of F-region echoes).

(*c*) type of E*s* observed (in four categories).

(ii) The *f*-plot should be in the form of a conventional size graph with frequency as the ordinate and time as the abcisse (see sample attached). Critical frequencies when clearly identifiable and full weight are denoted as follows :

*fo*E, *fo*F1, *fo*F2	open circles
*fx*F2	small *x's*
*fz*F2	small *z's*

Critical frequencies not clearly identified or doubtful are recorded as dots. Spread echoes are represented by a line indicating a range of frequencies. (Similarly a line indicates range in uncertainty of *fo*E). All spreads and critical frequencies of F2 should be shown, even when there is doubt as to whether *o*, *x* or *z*, or even when it is supposed that the echo is oblique. Additional information may be added if it appears to be of help, e. g. *fz*E.

(iii) *fmin* is plotted as a filled circle (necessarily the lowest point on the frequency scale of the graph). *fmin*F is plotted as a filled circle when it does not coincide with *fo*E.

(iv) The E*s* type may be entered on the same scale in an appropriate place on the graph.

(v) For convenience, the *f*-plot sheet may contain a table for recording those characteristics which are tabulated directly from the hourly ionograms but not plotted (i.e., (M3000)F2, (M3000)F1, *h'*E, *f*E*s*). At the end of a days scaling, these characteristics, in addition to the hourly values of the frequency characteristics read or interpolated from the graph, are transferred to the daily tabulation sheet.

(vi) All ionograms should be considered when preparing the *f*-plot. Four or five points per hour, when available, will usually suffice.

C. — *Daily Tabulation of Hourly Values*

(i) The hourly values of *fo*F2, *fo*F1, *fo*E and *f min* are read directly from the *f*-plot. If hourly values are missing, interpolation in accordance with U.R.S.I. conventions should be made using all the pertinent data on the graph. If the hourly value is doubtful and adjacent values are full weight, the hourly value tabulated should be a smoothed value and must be marked doubtful.

(ii) *Continuity Conditions.* — There should be little change in *form* and *range* of echo traces over, say, a 10-minute period (i.e. 5 minutes before to 5 minutes after the hour) before the hourly critical frequency, height indicator or *f-min* is tabulated.

D. — *Predominant Features*

It is felt that some index of the predominant feature of the E, E and F regions would be useful for all applications of hourly values and *f*-plots. The index for the D-region might be based on degree of absorption, for the E region on characteristics of sporadic E, and the amount of spreadiness might determine the F-region index. A scheme which is being tested is outlined in the appendix.

E. — *Symbols*

It is recognized that a fuller description of difficult records is desirable but it is also recognized that the system of categorizing records must not be made too complicated. Therefore, the only change in the descriptive or qualifying symbols to be applied to hourly values recommended at this time is :

T : smoothed value determined from a diurnal graph, replacing a doubtful or clearly inconsistent observed value.

7. — Data Summaries and Distribution

(A) It is recommended that monthly tabulations of the hourly values of the following 9 characteristics be prepared and be available for interchange : *fo*F2, (M3000)F2 ; *fo*F1, (M3000)F1 ; *fo*E, *h*′E ; *f*E*s*, type of E*s* ; *fmin*.

(B) Monthly medians of these characteristics (except type of E*s*) should be calculated. In most cases in the past, however, the number of values used and a measure of their dispersion has not been available with the medians and therefore those concerned with predictions and others using these data have found it difficult to apply the proper statistical methods. For this reason, the monthly summary of hourly values should include :

(i) monthly median ;

(ii) The number of values used to calculate the median ;

(iii) the quartile range.

Note : In order to simplify the calculations of the upper and lower quartiles it is recommended that the following rule be followed : *Both for* $2n$ and $2n + 1$ *observations* the upper quartile is defined as the median value for the n greatest values and the lower quartile as the median for the n smallest values.

(C) The value of publication and exchange of unusual ionograms and series of ionograms cannot be overemphasized. This exchange of data is not only important from the scientist's ploint of view, but is a valuable check for the data reviewing centres and in particular it is educational for field station personnel.

(D) The daily *f*-plots provide a most useful summary of the condition of the ionized layers and give an insight into the problems of analyzing ionograms both during ordinary and disturbed periods. These graphs should be made available as far as practicable to interested workers on request, and at least the I.G.Y. World Days should be reproduced on a regular basis.

London, August 27, 1955.

By the Special Committee : A. H. Shapley (Chairman), C. G. Little, J. H. Meek, S. Olving, S. Skribeland.

Principal Consultants : K. Davies, R. W. Knecht, B. Landmark, W. R. Piggott, K. Rawer.

APPENDIX

The appendix includes comments and suggestions on the high latitude ionospheric problem which the Committee feels are valuable yet for one reason or another are not appropriate for recommendations at this time.

1. — Absorption

It seems desirable to have a better estimate than provided by *fmin* of the amount of ionospheric absorption. The number of multiple echoes recorded has been suggested as a useful indication ; however, this practice proves to be misleading : for instance it was often found that more multiples were present during the day than during the night. It was agreed to explore the feasability of a simple program of attenuation measurements by slight modifications to existing ionosonde equipment. The following is one possibility :

The amplitudes of ionospheric echoes may be estimated on an A-scan display, according to the instructions in Canadian Ionospheric Observer's Manual (1951). The following modifications to those instructions seem required :

(*a*) 30 spot measurements should be made rather than 15. More reliable results are obtained when such measurements are spread over relatively long periods of time e. g. a short run before and a short run after the nominal hour of observation.

(*b*) The method of conversion of measurements to a standard frequency should be reconsidered. It should be borne in mind that corrections for deviative absorption vary seriously with magnetic dip.

Auxiliary equipment necessary consists only of a standard signal generator and an oscilloscope for presenting the ionospheric echoes on an A-scan for a particular frequency. There is no point in using complicated equipment at the routine stations although it is realized that accurate measurements should continue to be made by special investigators.

The A-scan scope may be marked directly in decibels if the signal generator is fed into the receiver at the required levels. It is felt that this system will enable echo amplitudes to be estimated to within ± 5 db, which is considered sufficiently accurate. The receiver must be adapted to give an unambigeous reproduction of the amplitude of input signals whatever be their form ; this should hold for a widespread input amplitude range. Changes in transmitter power (save when a radio component is replaced) will probably not be very significant. In any event, the effective transmitter power can be checked from time to time when multiple echoes are observed at night.

For a minimum program, amplitude measurements may be made daily near noontime on at least one frequency, 2 Mc/s and on additional frequencies where possible. It is realized that this exact frequency may not be practical at all stations ; probably any frequency in the range 1.9 to 2.1 Mc/s sufficiently close to be used without correction for frequency departure. It is not known how to estimate the ground reflection coefficient for multiple reflections. Nevertheless, the relative values of absorption are quite reliable. Some measure of absorption is particularly important at high latitudes where even approximate values are lacking.

2. — *h'*F

The Committee and its correspondents agree that *h'*F (minimum virtual height of the F region) is almost always of doubtful significance.

3. — Estimates of electron density distribution

It would be desirable to have some simple estimate of the shape of *h'f* curves. This could be done either by :

(i) matching the *h'f* curve to a number of circles of different radii, or

(ii) matching the *h'f* curve to a number of parabolic layers.

4. — *h'min*

A potentially useful characteristic is *h'min*, defined as the lowest echo height on an ionogram. Further experiments at high latitude stations may lead to recommendations at a later time that *h'min* be scaled, tabulated and interchanged by the high latitude network of stations.

The characteristic *h'min* is highly gain-sensitive and present experience at a few stations indicates the following principal possibilities :

(*a*) A solid, blanketing E trace at the low end of the frequency range of the recorder, being therefore the height corresponding to *fmin*. At times, it may be the *z*-component of E trace and the descriptive symbol Z applies. The symbol F should never apply, overlooking the rare and trivial scatter phenomena.

(*b*) A diffuse, transparent echo, usually E*sl*. This may be recorded alone. There is no frequency preference for this type of echo. Symbol F will often apply.

The characteristic should always be taken from the highest-gain ionogram available, and there may be some merit in increasing the gain of slow-speed ionosondes over a small frequency interval (e. g. 2.5 to 2.6 Mc/s) to search for low echoes. Preliminary work suggests that exceptionally low *h'min* may be a precursor to blackout.

5. — Exchange of ionograms

It is felt that it would be useful to interchange ionograms among the various stations on a regular schedule, to indicate the general problems with which each are confronted. This interchange should be limited to Regular World Days or other suitable periods.

6. — Predominant features

A scheme has been suggested for indicating in a table the predominant features of high latitude ionograms. It provides for a three digit number or index : The units digit would describe the F region, the tens digit the E region and the hundreds digit the D region.

D-region :

1 = *fmin* $<$ 2 Mc/s.
2 = *fmin* $\geqslant$2 Mc/s.
3 = complete absorption.

E-region :

0 = not observed (absorption).
1 = no E*s* (or fails to meet continuity condition).
2 = E*s*, without definite multiples.
3 = E*s* with multiples.

F-region :

0 = not observed (absorption or blanketing).
1 = no spread.
2 = principal echo visible through spread.
3 = completely spread — no principal echo.

The resulting numbers would range from 111 for the most ordinary conditions to 300 for complete absorption. (Note : a 110 could result if the *fo*F2 were known to be below the lower limit of the ionosonde and no E*s* was present). The index might be tabulated for each hourly ionogram.

7. — Alternative Definition Proposed for E*sm*

Two of the Committee's correspondents strongly urged the adoption of the following definition for E*sm*, in place of that given in 5 B (ii) :

E*sm*. — Highly reflecting E*s*.

(*Note* : This may be seen from blanketing and/or from the presence of multiple echoes. Examples will be given in the album.)

* * *

Reprints of this report are available at the General Secretariat of U.R.S.I.

The concentration of recording apparatus for the Y.G.Y. in one station

by Ir. A. H. de Voogt

At the receiving station of Nederhorst den Berg (« Nera ») of the Netherlands PTT we have had the opportunity to concentrate a number of recording apparatus and of daily observations that will be of importance for the I.G.Y. The following continuous recorders are made :

1° Atmospheric noise at 27 kc/s in two directions SW and SE.

2° Field strength of the radio-communication on short waves from Washington (WWV), Karachi and Paramaribo (emission in FSK) in combination with the observation of SID's etc. in radio-electric traffic on all directions.

3° Solar noise to 200, 545, 3000 and 10 000 Mc/s with the possibility of quick-run-recording during the « bursts » and with analyzing-apparatus for circular polarization.

Moreover the recording;

4° On 250 Mc/s of the sun's meridian passage by using the interferometer-principle for the localization of the radio-electric active sunspots.

5° A recording of earth currents, made at the emitting station in Kootwijk-Radio in parallel with Nera, with E-W base of 52 km length.

6° Recording of echos around the earth (pulses emitted by Kootwijk-Radio in various directions) and recording of the « back-scattering ».

7° Recording of phase-anomaly phenomena on 80 kc/s (the transmitter situated in England) ; up to the present a provisional apparatus has been installed.

8° Visual observation of the sun in integrated light and in H_α (Lyot filter).

During the I.G.Y. photos in H_α will be made automatically.

In construction are at present : a « neutron-monitor-pile » for cosmic rays, an interferometrical system on 200 Mc/s with a base of 1200 m, and a spectroheliograph of modest dimensions for the photography of the sun in the light H and K of calcium.

In considering the fact that the station effectuates its communications and its Ursigrams on telex and on radio with many countries one may conclude that « Nera » is in a favourable position for international cooperation during the I.G.Y.

The concentration of measurements and various kinds of observations under one authority is undoubtedly a considerable advantage and may facilitate the survey of solar phenomena to a high degree.

Not only the time scales on the recorded diagrams are rigorously exact and mutually comparable but one might insert also an alarm system, simple of complex that gives an indication at the moment when the milliampere-meters show abnormal deflections.

The station has permanent telephonic connections with the magnetic station at Witteveen of the Royal Netherlands Meteorological Institute and with the Astronomical Observatory at Utrecht.

It seems desirable that also in other countries an effort may be made to concentrate the observations and measurements for the I.G.Y. on some special stations.

C.S.A.G.I.

As its fourteenth Meeting the Bureau of I.C.S.U. endorsed the appointment of Father Lejay and Mr. A. H. Shapley as additional representatives of U.R.S.I. on C.S.A.G.I.

It was also agreed that the C.C.I.R. should be invited to nominate two members to the Committee.

BIBLIOGRAPHY

International Electrotechnical Commission :

N° 50 (11). — Second Edition of the International Electrotechnical Vocabulary — Group 11 — Static convertors.

N° 72. — Second edition — Report on I.E.C. work on standard dimension for electric motors.

These publications are on sale at the Central Office of the I.E.C., 39, route de Malagnou, Geneva, Switzerland, at the price of Sw. Fr. 5 — per copy, plus postage, for Publication n° 50 (11), and Sw. Fr. 3 — per copy, plus postage, for publication n° 72.