Bulletin N° 94 November-December 1955

International Scientific Radio Union

U. R. S. I.

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XI[th] GENERAL ASSEMBLY

Proceedings

ERRATUM TO PART 3

On page 50, delete the two last lines.
On page 51, first line, delete « are ».
On page 52, fourth line, delete « this ».

XIIth GENERAL ASSEMBLY

Announcement

LETTER TO NATIONAL COMMITTEES

27 October, 1955.

Dear Mr. President,

I have to inform you that I forwarded to the usual address of your Committee a few copies of a booklet issued by the General Arrangements Committee for the XIIth General Assembly of U.R.S.I. which, as previously announced, will be held, at Boulder, Colorado.

I call your special attention to sections 4 and 8 of the booklet and to the need to appoint, as soon as possible, the delegates of your National Committee to this Assembly and particularly those who would want to use the advantages described in section 8.

Copies of the First Announcement have been sent by the U.S. General Arrangements Committee to various U.R.S.I. personalities : Chairmen of Commissions and Sub-Commissions, Official Members of Commissions, etc. Should you want some extra copies, please let me know.

New recommendations on the submission of reports and papers have been drafted and will be issued very shortly.

Yours truly,
The Secretary General
(*sgd*) HERBAYS.

Readers wishing to obtain the above mentioned booklet may apply to their National Committee or to the Secretary General of U.R.S.I.

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Associated Editors are kindly request to co-operate to the drafting of the Information Bulletin by providing information on National Committee activities in the various fields of U.R.S.I.

NATIONAL COMMITTEES

Germany

MEMBERSHIP OF THE NATIONAL COMMITTEE

The membership of the German National Committee given in *Information Bulletin* nº 87, pp. 18-19 has to be modified as follows.

Secretary : instead of Dipl. Ing. W. MENZEL, read : Dr. H. FLEISCHER, Fernmeldetechnische Zentralamt der Deutschen Bundepost, Darmstadt.

MEETING

On October 20-22, a meeting of the Arbeitsgemeinschaft Ionosphäre was held at Tübingen with the assistance of Commissions II, III, IV and V of the German National Committee of U.R.S.I. Topics discussed were : propagation measurement at oblique incidence ; tropospheric propagation of VHF and meteorologic conditions ; absorption of the radio waves in the ionosphere.

Yugoslavia

NIKOLA TESLA'S CENTENARY

We are informing our readers that in August 1956, a memorial ceremony will be held in Yugoslavia for the centenary of Nikola Tesla's birthday.

At this occasion, besides the unveiling of a monument to Nikola Tesla and the laying of a commemorative pannel in the Nikola Tesla Museum, a meeting of foreign and Yugoslavian scientists will be held at Beograd from July 10 to 14, during this meeting scientific and technical lectures will be given, this lectures will be followed by technical and sight-seeing trips in Yugoslavia.

COMMISSIONS

Members designated by National Committees

See Information Bulletin **92**, 6-10

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COMMISSION VII

Germany : Prof. Dr. MALSCH, Dr. H. SALOW.

Poland : Prof. J. GROSZKOWSKI, Member of the Polish Academy of Science, Eng. B. PASZKOWSKI.

Commission I

TIME SIGNALS

Circular-lettre from Mr. B. DECAUX, Chairman of C.C.I.R. Study Group nº VII, to all participants in the work of the Study Group.

National Radio Laboratory

196, rue de Paris, Bagneux (Seine)

Reference :125/C.C.I.R./VII

Bagneux, 29th September, 1955.

The next C.C.I.R. Plenary Assembly is to meet, as you know, on 23rd August, 1956, in Warsaw. Since my report should reach the Director, C.C.I.R., at least four months in advance, I should be much obliged if, in accordance with Recommendation 33, you would let me have contributions from your Administration before 15th February, 1956. Copies of these contributions should also be sent to the Director, C.C.I.R., for translation and mimeographing. If any of such documents have already appeared as articles in technical journals, they will not be mimeographed, but short extracts therefrom should be submitted, with detailed references

to the original articles. It would also be well if a number of copies were available at the Plenary Assembly, for distribution to those interested. I would recall, in this connection, the recommendation made by the Director, C.C.I.R., at the Plenary Assembly in London (Annex I).

* * *

About a year ago, I sent you Circular-Letter 112/C.C.I.R./VII, outlining the progress made with the various studies we had undertaken. In what follows, you will find a general account of such new facts as have come to my notice, and I have brought out the main points likely to be examined in Warsaw.

Additional Administrations and recognized private operating agencies have announced their participation in the activities of Study Group VII, the membership of which is now as follows :

Australia.
China.
The United States.
France
India.
Italy.
Japan.
Pakistan.
The Netherlands.
Poland.
The Federal German Republic.
The Federal People's Republic of Yugoslavia.
The Rumanian People's Republic.
The United Kingdom of Great Britain and Northern Ireland.
Sweden.
Switzerland.
Czechoslovakia.
Overseas Territories of the French Republic.
The Union of Soviet Socialist Republics.
British Broadcasting Corporation.
Compagnie générale de T.S.F.
International Marine Radio Corporation.
M.I.M.C.C.
Radio Corporation of America.

International Time Bureau.
International Broadcasting Organisation.
International Scientific Radio Union.

* * *

During the past year there have been some changes in existing emissions, and other changes are announced. Moreover, several new emissions have either been started or are planned. Here are some details about these new developments.

Rugby. — In accordance with Recommendation 122, paragraph 5, the full minute has not, since August last, been indicated in MSF emissions by suppression of the 59° signal, but by prolongation of the signal 0 ; this signal lasts 100 ms and is readily recognizable, even when reception is bad.

Tokyo. — A new emission by JJY on 15 Mc/s is announced from 1st January, 1956, and will take place every day from 2100 to 1100 hours U.T. The time schedule will be the same as for the present emission on 2.5 Mc/s. Further, from this same date, all emissions will have additional interruptions (with announcements) at minutes 4-5, 14-15, 24-25, 44-45 and 54-55.

Turin. — Emissions, still on 5 Mc/s, have been effected daily since 1st January, 1955, from 0700 to 0730 and from 1100 to 1130 U.T. (week-days). The previous emissions on Tuesday have been deleted.

Washington. — Emissions continue on the normal time schedule and do not include the modulation interruptions recommended in Recommendation 122, paragraph 6.

New emissions

The International Time Bureau informs me that new emissions are being effected by Buenos Aires and Moscow.

The Buenos Aires emissions take place every day with the call sign LOL, and a power of 3 kW, from 1100-1200 hours, from 1400-1500 hours, and from 1700-1800 hours U.T. on the frequencies 5, 10, and 15 Mc/s. The time schedule is the same as that of WWV. I have not heard any monitoring reports on these emissions.

Moscow transmits every week-day from 0715 to 1745 U.T. on 10 Mc/s even days and on 15 Mc/s odd ones. The wave is

unmodulated, but from 0715 to 0718 hours and from 0743 to 0745 hours it is keyed in the form of time signals each of which lasts 0.1 sec., the minute peak signal being prolonged. Reception in Paris is exceedingly strong.

Emissions planned

The Swiss Administration has informed me that it intends to organise emissions, probably on 2.5 and 5 Mc/s.

I have also learned that experimental emissions are being studied in Germany, Australia, and France, more particularly with an eye to preparations for the International Geophysical Year, 1957-58.

Deviation and adjustemnt tables

The tables mentioned in Annex III to Recommendation 122 are published quarterly for MSF, WWV, WWVH, and ZUO. It often happens that these tables are circulated only six months after the end of the quarter.

Special modulations

In my letter N° 122, I drew the attention of Study Group VII to the question of special modulations for the study of propagation, as mentioned in paragraph 6 of Study Programme 68 and in Study Programme 62. The latter, assigned in London to Study Group VI, has now, in accordance with a suggestion by the Director, C.C.I.R., been confided to Study Group VII.

The problem, as you know, is to characterize each standard frequency transmitter by a high-frequency modulation (or by a shifted carrier) transmitted successively by the various transmitters. This procedure would enable these transmitters to be individually observed on the automatic field strengh recordings.

In accordance with a proposal by Dr. Dellinger, Chairman, Study Group VI, I am submitting the draft recommendation appearing in Annex II hereinafter and I would be grateful to have your comment on it. It would also be useful if tests could be undertaken in time to obtain some experimental data before the Warsaw Assembly.

You may be interested to learn that prolonged recordings undertaken in France on the normal modulations of existing

transmitters have shown that the transmitters can be identified by means of these normal modulations. They could also suffice for field strength measurements, provided the modulation characteristics of the transmitters are exactly known, which is not the case at present. It would be useful if the Administrations operating transmitters considered the possibility of publishing these characteristics.

Areas covered

I should much appreciate any comments and reports on the reception conditions of standard frequency transmissions. There is still some uncertainty as regards the extent of the areas covered in some parts of the world, especially in the Southern Hemisphere and Asia.

Interference in the standard frequency bands

Despite repeated complaints (see, especially, Recommendation 122, paragraph 15), the standard-frequency bands are still interfered with by innumerable emissions foreign to this service. Serious interference results, which substantially reduces the usefulness of the standard frequencies. This point ought to be discussed afresh at Warsaw ; in the meantime, it would be well if Administrations would consider this problem and draw the appropriate conclusions.

I would point out, in this connection, that the International Astronomical Union, meeting in Dublin in August, 1955, stressed the desirability of the standard-frequency bands being cleared for studies in solar radio astronomy. Some observatories, in fact, tune their receivers to these bands, hoping to be free of interference. In view of the great value of such studies from the point of view of forecasting ionospheric phenomena, I feel that this constitutes yet another argument in favour of clearing these bands.

With the same ends in view, the International Astronomical Union would also like to see a generalisation of the simultaneous interruptions in standard-frequency transmissions mentioned in Recommendation 18, paragraph 13. The interruptions, already being made by JJY and MSF, are very helpful from many points of view.

VARIOUS USES OF THE EMISSIONS

Besides the main purposes for which they are intended, i. e. measurement of frequencies and of time, standard-frequency transmissions are being more and more used in other fields, and are proving to be very useful indeed.

In the first place might be mentioned the experiments organised by the U.R.S.I. on the initiative of Professor Boella, Vice-Chairman of Study Group VII, for determination of the propagation time of time signals. These experiments take place every three months and use the time signals emitted by the standard-frequency stations. They have already yielded some exceedingly valuable information. In addition, a good many observations on reception conditions have been obtained during these tests.

In this connections, some of the resolutions adopted in Dublin by the International Astronomical Union might well be stressed :

(1) « The I.A.U. recommends that all changes in the programme » of radio time-signal transmissions be communicated to the » Central Office for Astronomical Telegrams, Copenhagen, and » published in the circulars issued by that Office. »

This recommendation bears more especially on signal transmissions of the classical type, the characteristics of which often change. I do think, however, that changes or innovations in standard-frequency emissions, comprising time signals, ought to be published. The Central Office in Copenhagen is organised to diffuse such information speedily. Consideration might perhaps be given to publishing such information in an I.T.U. organ as well, such as the Telecommunication Journal.

(2) « Considering the high degree of accuracy obtained in inter- » comparison of time and frequency, and in the measurement » of propagation time variations, by means of experimental » standard-frequency emissions on the frequency 60 kc/s, a degree » of accuracy which cannot be obtained on any of the frequencies » allocated by the C.C.I.R. for standard-frequency emissions, » the I.A.U. wishes to draw the attention of the C.C.I.R. to the » importance of allocating frequencies to continue and extend » standard-frequency emissions on frequencies below 100 kc/s. »

In fact, the Atlantic City Conference called on the C.C.I.R. only to study the standard-frequency emissions in the bands

allocated to this service between 2.5 and 25 Mc/s. Things being as they are, it would seem difficult to suggest to the forthcoming Radio Conference that a band of this kind be allocated in the frequency ranges 4 and 5. However, the problem had already been raised at the C.C.I.R. Assembly in Stockholm in 1948 (see, for example, Stockholm Documents 30, 37, 46, and 137). Recent experiments, based on phase measurements, have shown that with the emissions now being made by MSF on 60 kc/s (and also with GBR telegraphic transmissions on 16 kc/s), it is possible, at distances in excess of 5000 kilometres, to obtain an accuracy of 1.10^{-9} in the comparison of frequencies. That represents a considerable step forward in relation to the comparisons effected by means of the emissions existing in band 7, the accuracy of which, on reception, is often 100 times less, because of propagation phenomena. Hence it would seem interesting to consider this problem, and to examine the possibility of emissions in bands 4 and 5, the characteristics of which would be such that they could serve as standard frequencies.

The special Committee for the International Geophysical Year, 1957-58, meeting in Brussels in September, 1955, confirmed its 1954 resolutions, and in particular recommended that : « The » importance of setting up other stations, permanent or provisional, » transmitting signals of the new kind (1) in all areas at present » insufficiently covered (especially the U.S.S.R., India, South » Africa, Australia, New Zealand and South America) should » be brought to the notice of the governments concerned, either » through the C.C.I.R., or directly by the National Committees » of the I.G.Y., or by any other means. »

Points to be considered at the Warsaw Assembly

I should be glad if you would let me have your suggestions as to the points which should be considered in Warsaw, apart from any technical information likely to assist our discussions.

At present I feel that the following subjects might be considered :

— the present extent of the areas covered or not covered, and the subsequent conclusions to be drawn as regards the setting-up of new stations.

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(1) Signals superposed on the standard frequencies.

— reduction in mutual interference, and clearance of the standard-frequency bands.
— time schedules and interruptions.
— new types of time signals.
— suitable methods of facilitating field strength measurements.
— the speedy diffusion of new emissions or modifications in the characteristics of existing emissions.

B. DECAUX,
Chairman, C.C.I.R. Study Group VII.

Attached :

— Recommendations on documents for submission to the Plenary Assembly.
— Draft Recommendation on Study Programme 62 and Study Programme 68, paragraph 6.

N. B. : You will shortly be receiving, from the Director, C.C.I.R., copies of this letter, in English or French, corresponding to your request.

Recommendations by the Director, C.C.I.R. about documents for submission to the Plenary Assembly

IN GENERAL

1. Documents for submission to the Plenary Assembly should bear a clear indication to that effect.

2. Each document should deal with one single question, study programme, etc.

3. Questions, study programmes, etc., should not be quoted in full when a mere reference to the number of the question, study programme, etc., would suffice.

4. With a view to translation and mimeographing, three additional copies of each document for submission to the Plenary Assembly should be sent directly to : The Director, C.C.I.R., Palais Wilson, Geneva, Switzerland.

TEXTS

1. Texts should be typewritten, on one side of the paper only.

DRAWING, etc.

1. To save money, the use of photographs and other half-tone reproductions should as far as possible be avoided.

2. Diagrams and line drawings should be submitted on transparent paper so that contact prints can be made. The following considerations should also be borne in mind :

(*a*) Diagrams and line drawings should contain no text, except for brief indications such as « Fig. 1 », « Mc/s », etc. The accompanying texts should be submitted on a separate sheet, to facilitate presentation of these texts in several languages.

(*b*) The overall dimensions of diagrams, etc., should not exceed 6 ½″ by 10″, in view of the standard paper which is used.

Draft Recommendation

STUDY PROGRAMME 62 (VI) AND
STUDY PROGRAMME 68 (VIII), PARAGRAPH 6

The C.C.I.R.,

considering :

(*a*) that measurements of radio propagation, by automatic recording of the field strength of continuous-wave emissions, require a spectrum space comparatively free of interference ;

(*b*) that, for such measurements, it would be desirable to have transmitters at a number of different places ;

(*c*) that, as regards study of propagation, recordings of the field strengths of standard-frequency stations are rendered difficult by simultaneous operation, on the same carrier, of several standard-frequency stations ;

(*d*) that the interference caused in the standard-frequency bands by other stations hinders the use of standard-frequency stations for propagation measurements ;

(*e*) that the recording equipment mentioned in *a*) requires a passband of some 1000 c/s ;

(*f*) that Study Programmes 62 (VI) and 68 (VII) mention, for propagation measurements, special emissions in the standard-frequency bands, each station transmitting in turn for a few minutes every hour or half-hour ;

decides :

1. that a special continuous wave should be emitted, for propagation measurements, in each standard-frequency band, by a single standard-frequency station at any one time ;

2. that the frequencies so emitted should be : 5004 kc/s, 10 004 kc/s, 15 008 kc/s, and 20 008 kc/s ;

3. that the frequencies 4996 kc/s, 9996 kc/s, 14 992 kc/s, and 19 992 kc/s might also be used for this purpose ;

4. that the accuracy of each frequency emitted should be the same as that required for standard-frequency emissions ;

5. that a programme of time apportionment for the emission of each of these frequencies by the world's various standard-frequency stations, in periods of five minutes in half-an-hour, should be drawn up by Study Group VII.

SUGGESTED APPORTIONMENT FOR SPECIAL FIELD-STRENGTH MEASUREMENT EMISSIONS

	Hourly schedule	
Minutes	0 to 5 and 30 to 35	WWV
	5 to 10 and 35 to 40	MSF
	10 to 15 and 40 to 45	IBF
	15 to 20 and 45 to 50	WWVH
	20 to 25 and 50 to 55	ZUO
	25 to 30 and 55 to 60	JJY

Commission III

SUB-COMMISSION IIIc

Propagation Time of Radio Signals

Letter from the President to Members of the Sub-Commission

Sept. 7th, 1955.

Dear Sir,

For the experiments on propagation time of radio waves to be made in September (21 and 23) and December (21 and 23)

the transmissions from IBF shall definitively be scheduled as follows :

from .. h 05 m to .. h 10 m on 5 Mc/s ;
from .. h 15 m to .. h 20 m on 10 Mc/s ;
from .. h 25 m to .. h 30 m on 10 Mc/s.
Transmission shall be effectued at every third hour.

The breaking of IBF transmissions in periods of 5 minutes has been suggested by the following remarks. In Torino it is impossible to utilise for measurements WWV and MSF signals during the local transmissions, as receiver and transmitter are close to each other. With the program used in previous experiments, measurements made in Torino before and behind each transmission period, lasting to about ½ hour, often showed remarkable difference evidently due to changements in ionosphere. With the new program measurements in Torino can be made just before and behind the local transmission on the same frequency. Thus a better correlation between the results obtained at the two ends of the radio circuit is hoped to be obtained.

Yours very sincerely.

The Chairman of Sub-Commission IIIc of the U.R.S.I.,
M. Boella

SUB-COMMISSION IIId

On Magneto-ionic nomenclature

The list printed in *Information Bulletin* nº 90, p. 11 has to be replaced by the following :

N : number density of electrons.
e : charge on electron (e representents 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 of collision of electrons with heavy particles.
μ (or n) : real part of refractive index.

K : attenuation constant, defined so that a wave is attenuated like $E = E_0 \exp(-Kx)$.
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 : v/ω.

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

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

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

Commission V

I.A.U. SYMPOSIUM ON RADIO ASTRONOMY

Held at Jodrell Bank, 25-27 August 1955

Some 110 delegates attented, by invitation, the symposium on Radio Astronomy held at the University of Manchester Experimental Station of Jodrell Bank, Cheshire, England, from 25 to 27th August 1955.

The meeting of this highly successful symposium took place in the new control building immediately adjacent to the partially completed 250 ft. radio telescope, and the constructional work occasionally provided suitable sounds effects to accompany the delivery of the various communications. The three days alloted for the symposium were tightly packed with a programme of very considerable interest, and, although all the communications were delivered in the alloted time, it would have been advantageous to have had more time for discussion.

The programme was divided under the following heading :

I) The hydrogen line.

II) Point sources, individual studies and physical theory.

III) Galactic and extra-galactic structure, statistical studies of point source.

IV) The quiet and active sun.

V) Meteors and plannets.

All the contributions presented were of considerable interest though the following brief review has had to be restricted to summarise a representative few.

I. — Hydrogen Line

Prof. van de Hulst, who originally suggested the possibility of dectecting of the 21 cm line, gave the introductory lecture and pointed out how its origin is now clearly understood. The Dutch group has completed a survey of the inner and outer part of the Galaxy. They find from calculations of self-absorption that the kinetic temperature of the gas is 125°. The thickness of the inner part is 220 parsecs to half-density points. The outer spiral arms are inclined to the galactic plane.

The Sydney Group under J. L. Pawsey are continuing the mapping of the southern Galaxy. Preliminary comparisons with the northern survey do not verify Edmondson's non-circular model of Galactic rotation.

A survey with a 15 kc/s bandwidth from $l = 60°$ to 135° by the Harvard group under B. J. Bok, reveals fine structure features within spiral arms. A localised region in Orion showed asymmetrical profiles which may be explained in terms of gas expanding radially from this point.

The neutral hydrogen absorption spectra of sources have been used by R. D. Davies and D. R. Williams to indicate the distance of the sources. The Cassiopeia source appears to be at least within the second spiral arm at 2.5 kiloparsecs which is at variance with the optical result, while the Sagittarius source was found to be at 3 kiloparsecs where there is an aggregate of O and B stars. The N.R.L. group at Washington, with greater receiver sensitivity and a 5 kc/s bandwidth have made detailed absorption measurements and agree with these conclusions.

The remarkable observations of the 91.6 cm deuterium was reported by Getmanzev, Stankevitch and Troitsky of the Gorky Institute. A temperature of 3° K was observed in absorption in the Galactic centre.

II. — Point sources, individual studies and physical theory

The introductory lecture was given jointly by Prof. J. L. Greenstein and Dr. R. Minkowski. Prof. Greenstein elucidated some of the difficulties in the theory of origin of radio emission from the point sources and pointed out that the mechanisms invoking nuclear energy could only rival the available kinetic energy in collisional mechanisms at velocities of 5000 km/sec when the nuclear energy is taken over the volume of one cubic persec. Dr. Minkowski followed by discussing the photographic identification of point sources and illustrated his talk with many slides taken at the 200" and 48" Schmidt telescopes.

The introductory lectures were followed by a series of papers covering the spectrum of radiation from the discrete sources in the range from 16 to 10 000 Mc/s. There was some controversy over the discrepancy shown in these papers between individual measurements in the range 300-1400 Mc/s. It was apparent that more careful measurements of the flux from the source in Cassiopeia would be required to resolve the nature of the spectrum over this range of frequencies.

Further papers in this session were concerned with the visual emission and polarisation of the Crab Nebula ; novae and supernovae and hydrogen emission nebulae as radio sources. The session concluded with two papers concerning interferometer measurements of the diameter of the radio sources. Dr. R. C. Jennison described a new phase sensitive interferometer and quoted preliminary results giving the flux and amplitude of the Cygnus and Cassiopeia transforms at spacings of up to 3000 ; these results confirmed the bifurcation of the Cygnus source. Finally there was a paper by Dr. Palmer describing sensitive interferometer measurements of the angular diameter of sources at spacing up to 6000.

III. — Galactic and extra galactic structure ; statistical studies of point sources

In his introduction lecture Mr. Hanbury Brown discussed previous surveys of the distribution of radio noise and showed how these led to elementary models of galactic structure. In the earlier models of the distribution of radio sources within the Galaxy it had been necessary to assume the presence of an isotropic background radiation of 600° K. Mr. Hanbury Brown pointed out that this anomaly might now be attributed to sources within a spherical corona similar to that predicted by Shklovsky and implied from Baldwin's measurements on the Andromeda nebula.

In the following papers there was some amicable controversy over the relative merits of interferometers and pencil beam techniques for the measurement of the spatial distribution of radio stars ; the preliminary results of the survey with the Mills cross aerial in Australia did not appear to agree with the log N/log I relation deduced by Ryle from the survey with the Cambridge interferometer.

The remaining papers in this session were devoted to theories of the origin of the radio noise and cosmic rays. Though most of them referred to the mechanism of the acceleration of relativistic electrons in the magnetic fields within the Galaxy, it was some what refreshing to hear Prof. Unsold revive the hypothesis of origin in faint dwarf stars.

IV. — The quiet and active sun

Prof. C. W. Allen outlined the wide field of radio research on the sun. Although the quiet sun level appears to change very little with the sunspot cycle and the observed radio minimum occurs well before sunspot minimum, radio results suggest that the electron density in outer corona is higher than was originally thought. Dr. J. P. Hagen's 8 mm eclipse results indicate that the corona is composed of cooler spicules. Dr. R. N. Thomas pointed out that chromospheric observations are best fitted by a two temperature model. Polar flattening is indicated by many results between 10 cm and 8 m whereas limb brightening exists between 8 mm and 1.5 m.

The importance of correlating the slowly varying component with Ca plage activity rather than sunspots was stressed by

Miss Helen Dodson. This is borne out by the Sydney results at 21 cm.

J. P. Wild stated that the dynamic spectra of bursts were of two types. Type III bursts, which occur at the time of a flare, suggest a solar disturbance moving at 60 000 km/sec. These are sometimes followed by type II bursts associated with solar material moving at 500 km/sec. Some sporadic bursts show first and second harmonics with the former cut off at the lower end. These results indicate an origin in the non linear longitudinal oscillations.

The discussion on the mechanism of solar burst radiation indicated that this field is still far from clearly understood.

V. — Meteors and planets

Dr. F. L. Whipple reported the remarkable result that the density of meteor material is of the order of 0.05 gr/cc as obtained from optical measurements on persistent meteor trails. Dr. J. G. Davies concluded from the orbit determinations by radio of 2000 sporadic meteors that many have short periods and that inclinations are broadly distributed with peaks at 60° and 120°.

Dr. B. F. Burke reported his discovery with Franklin of low frequency radio emission from Jupiter. In Sydney 18 Mc/s records obtained in 1950/51 were reanalysed and showed that the radiation from Jupiter came from a localised region.

The symposium ended with papers on the lunar occultation of radio stars, and a report of some radio work at Jodrell Bank, on the reflection of radio waves from the lunar surface.

R. C. Jennison,
R. D. Davies.

(Reprint from *I.C.S.U.Quaterly Bull.*, n° 51, July-Sept. 1955).

U. R. S. I. = A. G. I. COMMITTEE

Brussels Meeting — September 8-10, 1955

Report of the U.R.S.I.-A.G.I. Committee Meeting

BRUSSELS 8-10 SEPTEMBER 1955

1. THE FOLLOWING MEMBERS AND OBSERVERS WERE PRESENT :

Members : Sir EDWARD APPLETON (*Chairman*),
Father P. LEJAY,
Dr. M. LAFFINEUR,
Mr. A. H. SHAPLEY,
Professor M. BOELLA,
Mr. D. LEPECHINSKY,
Col. E. HERBAYS,
Dr. W. J. G. BEYNON (*Secretary*).

Observers : Dr. R. L. SMITH-ROSE,
Dr. M. G. MORGAN,
Dr. K. RAWER,
Dr. N. C. GERSON,
Dr. N. V. PUSHKOV,
Dr. R. E. MUSTEL,
Dr. S. D. VORUBYOV,
Dr. R. J. SLUTZ,
Dr. L. HARANG,
Dr. N. HERLOFSEN,

Capt. E. L. Diaz,
Dr. Y. Aono,
Dr. A. H. de Voogt,
Dr. B. W. Currie,
Professor H. C. Webster,
Mr. A. H. Sheffield,
Mr. K. Bullough,
Mr. J. Mawdsley.

2. Two main working parties were established.

(i) The first working party (Chairman Dr. R. L. Smith-Rose) considered the world distribution of IGY ionospheric stations and also discussed matters concerning other types of ionospheric observation, drifts, terrestrial noise etc. Maps and lists, originally prepared by the Working Party on Ionosphere at the Rome meeting of C.S.A.G.I. (1954), were revised and brought up to date in the light of the latest information contained in National Committee Reports. A comprehensive list of all ionospheric stations is being compiled by the Secretaries of U.R.S.I. (Herbays) and of the Mixed Commission on the Ionosphere (Beynon) and will be made available to C.S.A.G.I. at the earliest possible date. During the I.G.Y. there will be at least 150 vertical sounding stations, Absorption measurements will be made at 25 to 30 stations and drift observations at 15 to 20 stations. It would be desirable to have drift measurements at many more stations and it is hoped that further stations will be established in time for the I.G.Y. The working party received the interim report prepared by Dr. Beynon and Mr. Piggott on a recent intercomparison of absorption measurements at a number of European stations and recommended that further tests of this kind be made in the near future. The possibility of an intercomparison of drift measurements was also considered and Dr. K. Rawer was invited to arrange such an experiment between certain European groups. The working party also discussed other I.G.Y. ionospheric measurements viz., atmospheric noise, whistlers and the radio observations of aurorae. Resolutions concerning such measurements are given in Appendix II of this report (p. 31).

(ii) The second working party, under the joint chairmanship of Mr. Shapley and Dr. Rawer, considered procedure for the uniform scaling of $h'f$ records, the interchange of data and the publi-

cation of ionospheric characteristics during the I.G.Y. The working party recommended that the revision of the procedures for the production, reduction and presentation of ionograms and ionosphere characteristics be the responsibility of a special committee with the following membership : — Mr. A. H. Shapley (Chairman), Mr. Y. Aono, Dr. K. Rawer, Mr. W. R. Piggott, Dr. Mednicova and Professor H. Webster. This Committee will invite detailed suggestions from members of the U.R.S.I. Sub-Commission III*a* and from other interested parties and will prepare a report including illustrative examples. This report will be submitted to the U.R.S.I.-A.G.I. Committee by 1st June 1956. This special committee will also be responsible for the preparation of sections on this subject in the manual on vertical incidence *h'f* measurements (see Section 3 below).

Meanwhile the following suggestions are made by the working party concerning the interchange of ionosphere characteristics.

The working party noted that the U.R.S.I. Sub-Commission III*a* had recently issued its report on « The production, reduction and presentation of results of high-latitude ionospheric soundings » and it agreed with the recommendation of that Sub-Commission that interchange of the characteristics (M1500)E, (M1500)F2, N'F1 should be discontinued. Consideration was given to the parameter *h'*E*s* and it was recommended that reconsideration be given to the interchange of *h'*E*s* if some success is achieved in the near future in the problem of classifying the different types of E*s* (further reference to E*s* is made below).

The working party strongly recommends the international interchange of hourly values of *f*oF2, *f*oF1, *f*oE, (M3000)F2, (M3000)F1, *h'*F, *h'*E, *f*E*s* and *f*min. The following comments are made on these proposals. The list given is consistent with that given in the U.R.S.I. Sub-Commission III*a* Report on high latitude soundings with the exception that for low and medium latitude stations *h'*F has been added. The (M3000) factor, apart from their use for prediction work, has been found valuable as an indication of layer height and these factors should regularly be measured with the standard transmission curve. Since three parameters are necessary to describe a stratified F region, *h'*F would appear to be the best virtual height characteristic to be included. *h'*E values are only useful if measured to about ± 1 km

and it is recommended that every effort be made to attain this order of accuracy. The values of *f*Es and *f*min clearly depend on characteristics of the measuring equipment and as such must only be considered as provisional. Greater precision could be given to these quantities if each station measured and published an « efficiency/frequency curve » for its ionosonde.

The working party recommends the introduction and international interchange of the following additional characteristics, *fb*Es and « type of Es ». The former is considered to be a very useful characteristic for Es ionisation. As far as Es itself is concerned, it is felt it would be useful to have some distinction between fundamentally different types of Es on the one hand and on the other some classification of the most common type according to its intensity. The proposals made in the report for high latitude stations are not considered to be suitable for adoption by medium and low latitude stations and for these new proposals should be considered.

It is recognised that values of *h*'F2 may often be misleading since they are greatly influenced by retardation in the F1 layer. However since long series of data on this parameter exist and are found useful for certain research studies it may be desirable to continue, at least for the time being, the publication of *h*'F2. It is recommended that the special committee nominated above should later reconsider this question.

3. Preparation of Instruction Manuals. — The U.R.S.I.-A.G.I. Committee proposes the following arrangements for the production with the next few months, of instruction manuals covering all the principal I.G.Y. ionospheric studies.

The first manual will deal with vertical incidence *h'f* recordings. For this Volume the Central Radio Propagation Laboratory (U.S.A.) is invited to prepare a chapter dealing with instructions to operators etc., and the Special Committee under Mr. Shapley (paragraph 2 above) is invited to prepare a chapter on the scaling etc., of vertical incidence *h'f* records.

Subsidiary manuals will deal with more specialised studies such as absorption, drifts, back scatter, terrestrial atmospheric noise, whistlers. The Committee recommends that the following be invited to prepare the chapter named.

Ionospheric absorption :

(*a*) Method using vertical reflection of radio waves to be prepared by the appropriate U.R.S.I. Sub-Committee (Chairman Dr. W. J. G. BEYNON).

(*b*) Method using galactic noise sources : Dr. C. G. LITTLE.

Ionospheric drifts :

(*a*) Spaced receiver fading method : Mr. J. A. RATCLIFFE.

(*b*) Meteor method : Professor L. G. H. HUXLEY.

Back scatter measurements : Dr. A. M. PETERSON (Stanford).

Atmospheric Noise : Mr. F. HORNER.

Whistlers : Dr. M. G. MORGAN.

Radio detection of Aurorae : Dr. L. Harang in collaboration with Dr. P. A. FORSYTHE and Professor A. C. B. LOVELL.

General Editor : Dr. W. J. G. BEYNON.

Sir Edward Appleton was invited to write an introductory preface to the ionospheric station manual.

M. Lepechinsky was invited to deal with the preparation of a French translation of the manuals and Dr. Pushkov undertook to arrange that a Russian translation will be made in the Soviet Union. It is understood that the cost of publication of these manuals will be borne by C.S.A.G.I.

4. PUBLICATION OF I.G.Y. IONOSPHERIC DATA. — The Committee discussed the question of publication of I.G.Y. ionospheric data and specific proposals for dealing with this aspect of I.G.Y. studies are given in Appendix I of this report. A general resolution on the question of publication is also included in the Resolutions (Appendix II).

5. U.R.S.I. REPRESENTATION ON C.S.A.G.I. — The Committee discussed the representation of U.R.S.I. on C.S.A.G.I. and formulated the following recommendation : Having regard (i) to the vital importance of radio communication during the I.G.Y., (ii) to the need for rapid distribution of geophysical data, (iii) to the wide ambit of radio geophysical studies, the U.R.S.I.-A.G.I. Committee strongly feels that U.R.S.I. should have two additional representatives on C.S.A.G.I. Accordingly the Committee recommends that, subject to the agreement of the I.C.S.U. Bureau,

Father P. Lejay and Mr. A. H. Shapley be immediately added to the C.S.A.G.I. membership.

(This recommendation was later accepted by C.S.A.G.I.)

6. Consultants. — The Committee expressed its appreciation of the valuable advice and assistance given by many workers both before and during the Brussels meeting and recommended that the following be invited to assist in consultative capacities in the future work of the Committee : Dr. M. G. Morgan, Dr. N. C. Gerson, Dr. R. L. Slutz, Mr. Y. Aono, Dr. K. Rawer, Dr. W. Dieminger, Mr. W. R. Piggott, Dr. N. Pushkov, Mr. P. Herrinck.

7. Geomagnetic Variographs. — Dr. J. Bartels called attention to the fact that a geomagnetic variograph with a warning device (as recommanded by the C.S.A.G.I. Rome Resolution 9.16) had now been developed and was available commercially.

8. Future of U.R.S.I.-A.G.I. Committee. — It is proposed to maintain the U.R.S.I.-A.G.I. Committee in being during the foreseeable future to coordinate all I.G.Y. activities in the radio field.

The Committee will meet again next year, probably in Brussels.

W. J. G. Beynon.
Secretary.

APPENDIX I

Proposals concerning the publication, circulation, etc... of IGY ionospheric characteristics

(1) Four Regional Centres shall be established by C.S.A.G.I. in the longitudes of America, Western Europe, Russia and Japan/Australia. The principal functions of these centres will be :

(i) to collect all I.G.Y. ionospheric tabulations and copies of selected ionograms (see 4 below) ; these to be available to research workers at the Centres ;

(ii) to meet requests from bona fide users for purchasing microfilm copies of tabulations or ionograms ;

(iii) to maintain a complete index of all these ionospheric data.

(2) Organisations responsible for ionospheric stations should make adequate arrangements beforehand for ensuring that there

is regular preliminary publication of all tabulations from each station from the start of the I.G.Y. To this end it is recommended that organisations appoint the necessary staff before the I.G.Y. commences.

(3) Each organisation will prepare monthly tables of hourly values and summaries and where appropriate graphs, containing all the I.G.Y. vertical incidence *h'f* ionospheric data for each of its stations and within two months make these available to its Regional Centre and if possible to all other groups on the lines of the existing reciprocal exchange basis.

(4) Each organisation will regularly send to its Regional Centre microfilm reproductions at a minimum of all ionograms taken on Regular World Days, during Special World Intervals or such intervals as may later be specified by the World Day Organisation. The Regional Centre concerned will be responsible for supplying copies to the other three Centres. Requests for copies for other days will be forwarded through the Regional Centre concerned.

(5) Tabulations of ionospheric data should be made in a standard form. This standard form, together with full details of the ionospheric parameters required will be presented in the ionospheric instruction manuals to be produced within the next few months.

(6) The final publication will be based on the preliminary reports, as may be organised by C.S.A.G.I.

(7) The Secretariat of C.S.A.G.I. shall designate the specific Regional Centres and work out with the organisations concerned the details of initiating the data exchange. It is strongly recommended that exchange of tabular data be started as far in advance of the A.G.I. as feasible.

(8) The above proposals refer specifically to vertical incidence *h'f* date. Such data form the major part of ionospheric work. However similar arrangements will need to be made for other ionospheric measurements such as drifts, absorption, atmospheric noise, back scatter etc. The Regional Centres for such data will not necessarily be those designated for the vertical incidence *h'f* data.

APPENDIX II

Resolutions submitted to the full session of C.S.A.G.I.

1. World Network of Ionospheric Stations. — The U.R.S.I.-A.G.I. Committee notes with satisfaction the proposed network of IGY sounding stations but calls attention to the fact that many are still in the planning stage and it strongly recommends that these shall be put into operation as far in advance of the IGY as possible.

2. Proposed station at Bogota, Colombia. — The U.R.S.I.-A.G.I. Committee strongly supports the proposal to establish an ionospheric station at Bogota, Colombia as an alternative to Quito, Equator. Such a station would fill an important gap in the 75° W meridian chain and could make a valuable contribution to equatorial ionospheric studies.

3. Ionospheric Station at Marion Island. — The U.R.S.I.-A.G.I. Committee strongly recommends the South African National Committee to establish an ionospheric station at Marion Island. Measurements at this site would materially help to fill the almost complete absence of ionospheric data for this part of the world.

4. Ionospheric Station in Java. — The U.R.S.I.-A.G.I. Committee again calls attention to resolution 8.1.10 of the Rome Meeting of C.S.A.G.I. concerning the need for an ionospheric station in Java.

5. Ionospheric Observations near the Auroral Zone. — The U.R.S.I.-A.G.I. Committee strongly endorses the Canadian plan for ionospheric soundings at new locations near the auroral zone.

6. Ionospheric Measurements in the Longitude Zone 60°-120° E. — The U.R.S.I.-A.G.I. Committee calls attention to the need for additional ionospheric studies in the longitude zone 60°-120° E and expresses the hope that the U.S.S.R. and China will consider undertaking measurements of ionospheric drift, absorption, atmospheric noise and radio auroral studies in this zone.

7. Information on Ionospheric Stations in China. — The U.R.S.I.-A.G.I. Committee notes the lack of definitive information on IGY ionospheric measurements in China and expresses the hope that this information will be available in the near future.

8. Ionospheric Drift Observations. — The U.R.S.I.-A.G.I. Committee notes that ionospheric drift measurements are planned at a number of stations but emphasises that drift observations at additional stations are needed if adequate world coverage is to be achieved. The Committee again stresses the need for intercomparison studies between neighbouring stations and between different methods before the commencement of the IGY.

9. Intercomparison of Absorption Measurements. — The U.R.S.I.-A.G.I. Committee notes that an intercomparison of ionospheric absorption measurements at European stations has recently been carried out and endorses the plan for further experiments in the near future.

10. Atmospheric Noise Measurements. — The U.R.S.I.-A.G.I. Committee notes that only a few equatorial stations propose atmospheric noise measurements during the IGY and the Committee strongly recommends that additional stations consider making this type of measurement.

11. Radio Observations of Aurorae. — The U.R.S.I.-A.G.I. Committee has discussed radio reflection observations of the aurorae and recommends that such observations should always be made on two or more frequencies and furthermore that in reporting the results of such measurements the polar diagrams of the aerials used for this work should be specified.

12. Whistler Type Atmospherics :

(i) The U.R.S.I.-A.G.I. Committee recommends that attempts be made to study the polarisation of whistler type atmospherics since measurements of this kind might be valuable in checking the theory of such atmospherics.

The Committee also calls the attention of workers in this field to other naturally occurring audio frequency radio phenomena and recommends that work on those phenomena be pursued during the I.G.Y.

(ii) The U.R.S.I.-A.G.I. Committee strongly recommends that stations suitably placed in Europe, the U.S.S.R., Australia and Japan should collaborate in experiments on whistlers.

(iii) The U.R.S.I.-A.G.I. Committee strongly supports the French proposal for experiments on whistlers at Poitiers and Kerguelen.

13. Calculation of Solar Zenith Angles. — The U.R.S.I.-A.G.I. Committee recommends that C.S.A.G.I. invites one or more central computing body to undertake the calculation of the solar zenith angle χ for I.G.Y. ionospheric stations as recommended in resolution 9.2 of the Rome Meeting of C.S.A.G.I.

14. Accuracy of Ionospheric Measurements. — The U.R.S.I.-A.G.I. Committee urges on all I.G.Y. ionospheric stations the need for ensuring maximum accuracy in all measurements and in particular it is recommended that the timing of measurements such as vertical incidence critical frequencies should be accurate to within one minute.

15. Report on Scaling of High Latitude Ionograms. — The U.R.S.I.-A.G.I. Committee endorses the proposals contained in the report of the U.R.S.I. Special Committee on High latitude Ionograms and recommends the adoption of the proposals by the ionospheric stations concerned at the beginning of 1956, so as to ensure that adequate experience is fixed in the uniform interpretation of such records before the start of the I.G.Y.

16. Propagation Time of Signals. — The U.R.S.I.-A.G.I. Committee recommends that experiments on the propagation time of radio signals commenced in December 1954 should continue so that adequate data can be accumulated concerning the actual possibilities of comparing, during the I.G.Y., the time standards established in different countries.

17. Ionospheric Observations from Aircraft. — The U.R.S.I.-A.G.I. Committee is gratified to learn of progress made in the U.S.A. with ionospheric soundings from aircraft. It is strongly recommended that, as soon as possible, details of these experiments be made available to other workers.

It recommends too that attention be given to the possible use of aircraft for calibrating and standardising equipment used for vertical incidence absorption studies.

18. Publication of I.G.Y. Data. — In considering the question of publication of I.G.Y. observations the U.R.S.I.-A.G.I. Committee has naturally been impressed with the magnitude of the task and the volume of the material. Nevertheless having regard to the fact that the principal objective in the work of the I.G.Y.

is to gain physical insight into natural phenomene, the actual observations only being a means to that end, it urges on C.S.A.G.I. the adoption of a most liberal publication policy, in spite of the considerable cost, in order that this corpus of unique material may be readily available to scholars everywhere.

19. Publication and Circulation of I.G.Y. Ionosphere Characteristics. — The U.R.S.I.-A.G.I. Committee proposes that the publication and circulation of I.G.Y. ionospheric data be carried out according to the scheme outlined in Appendix I of the report of the meeting held on 8-10 september 1955.

20. Ionospheric I.G.Y. Manuals. — The U.R.S.I.-A.G.I. Committee proposes the preparation and publication of a series of C.S.A.G.I. manuals for use in the ionospheric I.G.Y. programme. The suggested manuals will relate to :

(*a*) vertical incidence *h'f* recordings ;

(*b*) more specialized studies such as ionospheric absorption, drift, back-scatter, terrestrial atmospheric noise, etc...

The Committee proposes that W. J. G. Beynon be the General Editor of these manuals and the authors of the several sections be as indicated in the Committee report.

Documents submitted to the Meeting

The following papers were distributed for the meeting of the U.R.S.I./A.G.I. Committee :

1. The accurate timing of ionospheric critical frequency determination, Sir Edward Appleton (p. 35).

2. The determination of ionospheric drift velocities from three-receiver fading records, Cavendish Laboratory, Cambridge (1).

3. Observations at Cambridge of ionospheric drifts at points separated by 7.5 km, B. H. Briggs (1).

4. Preliminary report on absorption intercomparison experiments made between 5th April and 5th May 1955, W. J. G Beynon and W. R. Piggott (1).

5. High latitude ionospheric observations using extra-terrestrial radio-waves, C. Gordon Little (p. 36).

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(1) To be published in a next issue of the Bulletin.

The Accurate Timing of Ionospheric Critical Frequency Determinations

by Sir Edward Appleton (Great Britain)

(1) The radio sounding of the ionospheric layers was a new technique introduced in the work of the 2nd International Polar Year of 1932-33. During the I.G.Y. of 1957-58 this work will be greatly increased in accuracy and world coverage. In this note I draw attention to a simple matter, which, if generally attended to at all ionospheric recording stations, can greatly enhance the value of the vast mass of ionospheric material, when its physical significance comes to be subsequently studied.

(2) In a study of E Layer phenomena, conducted at Edinburgh University, Harvard College Observatory and Swansea University a number of divergences from simple layer formation have been identified. These have been outlined, briefly, in the *Report of the 4th Meeting of the Mixed Commission on the Ionosphere*, pp. 14 to 32.

In the course of this work it has become clear that the value of the experimental ionospheric data for theoretical interpretation would be greatly enhanced if the *exact local time* were known at which each critical frequency (e. g. *f*E, *f*F1 or *f*F2) had been made.

(3) As an illustration of the kind of difficulty which arises I may quote the case of noon phenomena in the E Layer. Simple theory shows that N_m (the spatial maximum of electron density) should reach a maximum in time after noon, the delay being equal to $(2\alpha\ N_m)^{-1}$, where α is the recombination coefficient. The magnitude of this delay is, however, only a few minutes, so it is clear that it cannot be determined accurately without special care in the timing of critical frequency determinations.

(4) It is therefore suggested that every ionospheric recording station should be invited to furnish, with its results, a graph relating *recording radio frequency to accurate local time* relative to the particular hour used in tabulation. The *accurate local time* should be specified after allowing for the longitude displacement of the recording station from the particular meridian used for standard time.

(5) It will be seen that this proposal refers to the same matter I raised in my Circular Letter to Ionospheric Stations of 26th February, 1954, (U.R.S.I. *Inf. Bull.*, **84**, 12) but puts the burden of estimating the time correction on the ionospheric recording station.

(6) It will thus be seen that, if action is taken as proposed above, each ionospheric station will be invited to furnish the following *Station Characteristics* :

(*a*) A graph relating *recording radio frequency* to *accurate local time.*

(*b*) Values of the *solar zenith distance*, appropriate to the station location, determined for the 15th day of each month, at hourly intervals from sunrise to sunset, due consideration being allowed for the equation of time. It would be preferable for these quantities to be calculated for the *exact* hours in *local time.* (See Resolution 2 of the Mixed Commission on the Ionosphere, 1954, Report, p. 77).

High Latitude Ionospheric Observations Using Extra-Terrestrial Radio Waves [1]

by C. Gordon Little, Geophysical Institute College, Alaska.

The scintillation of localized extra-terrestrial radio sources (1, 2, 3) and the absorption of the diffuse background of extra-terrestrial (4) radio waves have been used by various workers to investigate the ionosphere at temperate latitudes. This letter describes some preliminary observations of the effect of the ionosphere upon the incoming radio waves at College, Alaska, situated approximately 275 km south of the auroral maximal zone as defined by Vestine.

The apparatus used in this investigation consisted of a stable, high-gain receiver and a directional antenna, the output of the receiver being recorded continuously by a pen recording instrument. The antenna, a twin Yagi array with beam widths between half power points of approximately 26° and 50° in the two principal planes, was directed at azimuth 215° East of True North and

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[1] This work has in part been financed by the National Science Foundation.

elevation 70°, the beam being oriented so that it was narrow in azimuth and broad in elevation.

Owing to the rotation of the earth, the beam swept out each day a broad strip of the sky which included the localized sources in Cassiopeia and Cygnus (declinations +58°31′ and +40°34′ respectively). The stability of the receiver gain was monitored by switching the receiver from the antenna into a dummy antenna every half hour for a period of 20 seconds — in this way, any drifts due to changes in the gain of the receivers (drifts which might otherwise be attributed to changes in the received antenna power) were revealed by corresponding drifts in the positions of these periodic reference levels.

The records obtained in this way over a two-month period commencing 1954, March 16, have been inspected for two main effects : (*a*) absorption of the diffuse background of extra-terrestrial radio waves and (*b*) scintillation of the intense localized radio sources in Cassiopeia and Cygnus.

A. — *Absorption*

In the absence of ionospheric effects, the intensity of the extra-terrestrial radio waves received by a fixed antenna at a given frequency is a function only of sidereal time. The degree of

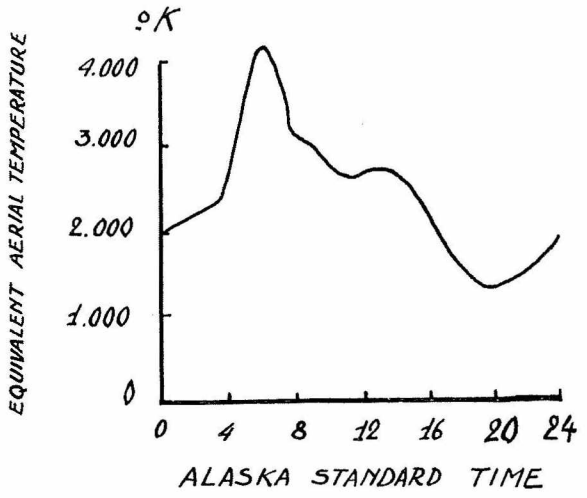

Fig. 1. — Diurnal variation of received extra-terrestrial radio power. (The time marks are those for 1954, May 10).

absorption of the diffuse background of extra-terrestrial radio waves may therefore be determined from the ratio of the signal actually received to the signal received at the sidereal time under conditions of negligible ionospheric absorption. The curve showing the sidereal variation of extra-terrestrial radio power for this equipment is shown in Fig. 1 and was obtained by averaging seven records taken on days when ionospheric sounding equipment, and equipments monitoring distant radio stations, showed that ionospheric absorption was unusually low. The scatter between the records on quiet days was small (R.M.S. deviation of signal power at a given sidereal time less than 2 %) ; it is considered that any residual absorption of 65 Mc/s signal on these days was less than 1 %.

The degree of absorption was measured every half hour throughout the two-month period by comparing each day's record in turn with the standard no-absorption record obtained as above.

The frequency of occurrence of strong absorption at 65 Mc/s (absorption in excess of 10 %) is plotted in Fig. 2 as a function

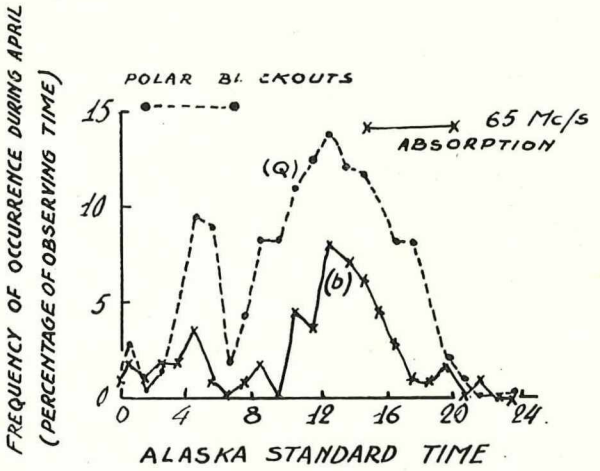

FIG. 2. — Diurnal variation of (*a*) occurrence of polar blackouts and (*b*) of strong (i.e. greater than 10 %) absorption of extra-terrestrial radio waves.

of the time of day. It will be seen that such absorption is most common at midday, and occurs least frequently during the late evening. This 65 Mc/s absorption was found to be strongly

correlated with no-echo conditions (polar blackouts) on the C-3 Ionospheric Sounding Equipment, the two phenomena showing a similar diurnal variation (Fig. 2), and similar day-to-day variations (Fig. 3).

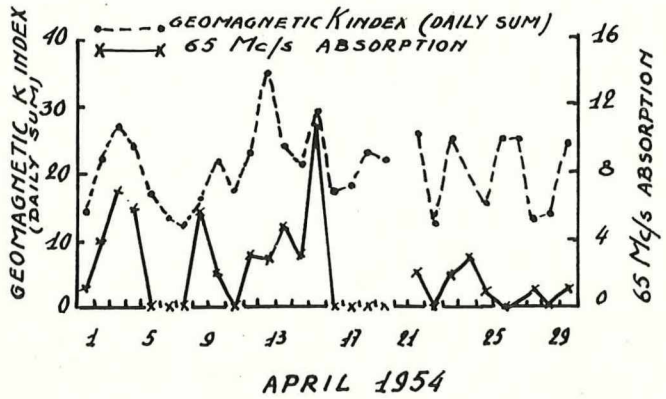

FIG. 3. — Daily frequency of detection of polar blackouts (120 observations per day) and strong 65 Mc/s absorption (48 observations per day) during April 1954.

In Figure 4, the daily sum of the three-hour Geomagnetic K indices for College, Alaska, is compared with the number of half-hourly 65 Mc/s observations per day showing absorption greater

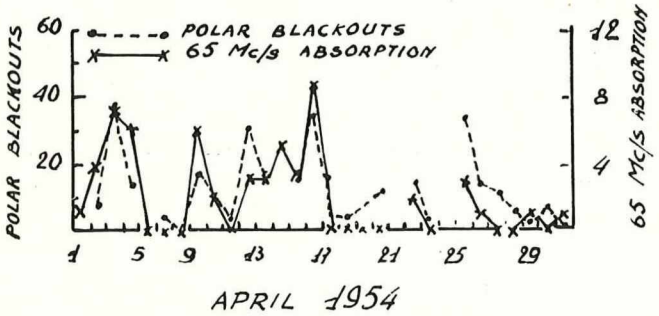

FIG. 4. — Comparison of daily sum of three-hour Geomagnetic K indices for College, Alaska, and number of half-hourly 65 Mc/s observations per day showing absorption greater than 10 %.

than 10 %. The correlation coefficient between the two phenomena was 0.48, indicating a strong link between ionospheric absorption and the variability of the earth's magnetic field.

B. — *Scintillation*

The scintillation work described here, although limited to two month's observations at high angles of elevation, is sufficient to indicate that marked differences exist between the scintillation phenomena in England and Alaska. Thus, scintillations are more common in Alaska than in England and apparently do not show the same diurnal variation of activity. (In England, zenithal fluctuations are found to be a night-time phenomenon and are rarely observed after 08 h 00 G.M.T. ; in Alaska, the fluctuations occurred with equal frequency during the four hours preceding, as in the four hours immediately following, 08 h 00 Alaska Standard Time). Another difference was the variability of the high latitude fluctuations, whose characteristics usually changed considerably during a three-hour transit period ; on several occasions the transit of a source was undisturbed except for one (or occasionally two) short bursts of fluctuations.

One point of considerable interest is that scintillations were always observed whenever polar blackouts or marked 65 Mc/s absorption occurred during the transits of the localized radio sources through the aerial beam. Since « radio star » scintillations are caused by the presence of localized irregularities in the electron density of the ionospheric layers, this must mean that the lateral distribution of ionization during periods of absorption is non-uniform. It should therefore be possible, by applying existing techniques to the study of these scintillations, to obtain information about the size, shape, stability, and movement of the ionospheric irregulatities, during periods of heavy absorption when ionospheric echo-sounding techniques are unusable owing to the heavy attenuation of the reflected wave.

It is proposed to extend the present range of the experiments in order to investigate more fully the absorption and scintillation of extra-terrestrial radio waves. The use of these extra-terrestrial radio waves for ionospheric studies at high latitudes appears to have many advantages over normal echo-sounding techniques, e.g. the absence of the need to build and operate expensive radio transmitters ; the use of higher frequencies enabling directional antennas to be built and hence permitting the investigation of a wide area of the ionosphere from a single station ; the simplification of the results owing to the small effect of the earth's magnetic

field on radio wave propagation at frequencies well above the gyro-frequency; the possibility of obtaining information about regions of the ionosphere above the level of maximum electron density; and the opportunity of studying ionospheric irregularities at times when frequencies below the critical frequency are heavily absorbed.

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URSIGRAMS

Draft of Broadcasting of observations during the A.G.I. (1)

(*Translation*)

The U.R.S.I. Ursigram Committee has been entrusted with the planning of geophysical and solar data broadcasting during the A.G.I.

The following remarks are to be noted :

1. A distinction should be made between immediately usable information and information that may be delayed during one week. For each group a different transmission mode should be considered.

2. Solar and geophysical informations have to be transmitted in principle by the observatories to coordinating centers which will transmit the information to the interested bodies. It may, nevertheless, be considered that some important phenomena should be transmitted immediately and directly from observatories to interested bodies. This can be considered only for rather rare phenomena interesting only few bodies.

Solar Data

A. — *Information immediately usable*

It seems that only major flares (<3) and large radio bursts preceeded by a precursor burst, have immediate interest.

Observatories which would record such bursts, should immediately informe the centralizing bodies, and observatories which would request beforehand such information, this transmission, however, should only be made when it can be issued in a delay less than a half hour.

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(1) Submitted to C.S.A.G.I. meeting (Brussels, 8-14 Sept., 1955).

The centralizing bodies should inform the interested observatories having expressed the wish of such special transmissions, conditions of transmission should be arranged between centralizing bodies and observatories.

It does not seems useful to arrange intercontinental transmissions for such phenomena.

It is desirable that observatories or laboratories wanting to be informed of important flares or of bursts with precursors should send a request of this purpose to the neighbouring observatories or to the centralizing bodies.

B. — *Information broadcast with a delay of a few hours*

All the information ought to be rapidly transmitted in a few hours in order to be at the disposal of the interested bodies, and particularly of the World Days prediction services which must inform the coordinating centers of the various continents as quickly as possible. These centers will inform directly, if possible, the main interested bodies asking for such informations and will broadcast several times a day summaries of the observations.

Besides, the continental coordinating centers will exchange directly their information.

It is understood that for such transmissions rapidity is more important than accuracy. The coordinating centers should make a choice among the received data, e. g. ; in drafting a priority list, and should not transmit similar data provided by various observing stations.

There is no doubt that the short time alloted to the coordinating centers will sometimes generate inaccuracy or even errors. Documents transmitted in such way will be considered as *provisional.*

Coded messages will be similar to the present Ursigrammes which will be gradually modified before the A.G.I. in order to fullfil the above mentioned conditions.

Solar data to be transmitted should include the major flares, the activity center changes, the major radio bursts of the sun and the principal coronal characteristics on the East side of the solar limb.

C. — *Information broadcast with a delay of several days.*

Information which may be broadcast with a delay of several days should be transmitted by post. Generally such information will be a repetition of urgent data of the preceeding section amplified, checked and associated to a daily map of the sun including a maximum of data, bursts, activity centers, filaments, radio activity centers, corona, etc.

It is suggested that such maps should be drafted by C.P.R.L., by Meudon and Pic du Midi observatories for European observations and by a Japanese observatory. Maps should be sent every week by the mentioned centers to each of the other centers and to the observatories applying for such service.

The maps of the various centers should be plotted for different hours ; Europe, 12 h. U.T...

D. — *Concentration of final results*

It is suggested that centers should be designated to gather all data in each field in order to publish them every three months.

All observatories should be invited to forward their detailled observations to these centers which after checking, should publish the final results, e. g. observations on the solar disk should be collected at Zurich, observations on the chromosphere at Meudon, observations on the corona at the Pic du Midi, etc.

MAGNETIC DATA

A. — *Information immediately usable*

Sudden commencements of magnetic storms (S.S.C.) visually observed at station suitably equipped should be immediately transmitted to the neighbouring bodies interested which could be reached within one half hour and, if possible, to the regional centralizing body.

B. — *Information broadcast with a delay of a few hours*

It should be desirable that three hourly world *provisional* indices should be transmitted twice a day by Ursigrammes.

Besides, sudden commencements, progressive commencements of magnetic storms and « crochets » should be transmitted as usual.

Coordinating centers should make a choice with the agreement of commissions IX and XI of I.A.G.A. and establish a list of regional priorities in order to avoid duplication of observations on the same phenomena originating from different sources. Phenomena particular to each region should be given separately.

Such data could be reproduced every week and broadcast by the coordinating centers.

C. — *Information broadcast with a delay of several days*

Moereover, index coordinating centers established by I.A.G.A. commissions IX and XI could transmitted to the Ursigram centres and to the interested centres applying for, a bi-monthly bulletin giving information on magnetic activity.

IONOSPHERE

1. It does not seems either useful or practical to broadcast instantaneous information relevant to the ionosphere. Only P.I.D.B. (Sudden commencement ionospheric perturbations) observed particularly by enhancement of atmospherics might be announced to some neighbouring laboratories asking for such information.

2. Information broadcast with a delay of a few hours should include P.I.D.B. and characteristics on the quality of radiocommunications. A regional broadcast of three hourly indices of f_oF2 might be of some use.

Other data could be transmitted, on request, for the coordinating centres (e. g. ionospheric data from high latitudes).

3. Weekly broadcast of three hourly ionospheric data should be made by post for the seven preceeding days by each centre for stations representing its region. Each of the selected stations should transmit daily such data to its regional centre P.I.D.B. and propagation indices should be reproduced in a weekly bulletin.

The present draft assumes a cooperation between the astronomical and magnetic observations of the ionospheric stations and coordinating centres and the transmitting agencies. The ways and means are still to be defined.

It should be desirable :

1° to draft the list of participating observatories and the observation programme they are going to follow ;

2° to define the transmitting means to be used to transmit information to the coordinating centres ;

3° to define the details of the broadcast schedules and of the codes ;

4° to designate definitively the centralizing observatories for weekly data ;

5° to give the list of agencies to which the observatories should transmit the weekly data.

N. B. — The care of designating agencies responsible for quarterly publications and for drafting the list of correspondants who should receive the publications lays on the interested C.S.A.G.I. working parties.

Meeting of the Ursigram Committee

MEETING HELD IN BAGNEUX (S.) FRANCE, ON SEPTEMBER 19, 20 AND 21, 1955

General Report

(1) The Ursigram Committee of U.R.S.I. held three sessions on September 19, 20 and 21, 1955 in the premises of the Laboratoire National de Radioélectricité, in Bagneux (S.) France, with Father P. Lejay in the chair.

The attendance was as follows :

Dr. Y. Aono, representing Mr. H. Uyeda (Japan) member of the Committee.

Dr. Beckmann (German fed. Rep).

Dr. A. H. de Voogt (Holland) member of the Committee.

Dr. W. Menzel (German fed. Rep.) member of the Committee.

Dr. A. H. Shapley (U.S. of America) member of the Committee.

Mr. Van Lohuizen (Holland).

Col. E. HERBAYS Secretary Gen. of U.R.S.I., member of the Committee.

MM. D. LEPECHINSKY and A. DELOUF (France).

Have participated at the 2-*d* session, Dr. d'AZAMBUJA and Dr. RUSCH (France).

(2) *Agenda.* — The Committee's objectives were :

(*a*) To organize, in response to the request of the C.S.A.G.I., a world-wide network for the transmission during the I.G.Y. of advices of « Alerts » and « Special World Intervals » as well as of solar and geophysical data to the Stations and Centers of the I.G.Y.

(*b*) To review the present state of the permanent Ursigram Network and to revise the Codes now in use, in view of an eventual extension and improvement of this network and of the unification of the Codes.

(3) *Results of the Meeting's work* :

(*a*) Regarding the I.G.Y. the following documents have been adopted by the Committee :

(1) A Report restating the problems submitted by the C.S.A.G.I. and defining the proposed division of the World into « Regions », the responsibility for each of which should be entrusted to a « Regional Center » ; every such Center having to organize and supervise the I.G.Y. network within its Region, with the collaboration of the National Committees of the Nations concerned. (See the « Report » — Annex A).

(2) Eight General Resolutions, regarding the general organization of the worldwide Ursigram network (See the « General Resolutions » — Annex B).

(3) Eighteen decisions, outlining the details of the plan elaborated by the Committee to meet the needs of the Geophysical Year (Kinds of information to be transmitted, time schedule codes to be used etc.).

(See the « Decisions » for the I.G.Y. — Annex C).

(*b*) Regarding the permanent Ursigram network, the organization of the european regional scheme has been discussed by the European Members of the Committee in a special meeting held on September 21st.

It has been agreed at this meeting that the Codes now in use should not be changed for the time being. On the other hand it has been found that the detailed setting up of the appropriate steps to be taken within the European region in view of the I.G.Y. necessitated a further careful study of the relevant problems. It has been therefore decided that the European Members of the Ursigram Committee would meet again in the nearest future probably in Germany.

Report of Ursigram Committee

1) *Responsibilities for A.G.I.* — The Ursigram Committee has been charged by C.S.A.G.I. with (*a*) the planning of the data collection network necessary for the calling of alerts and designation of special world intervals by the world warning Agency, (*b*) the planning of the world network and (*c*) the developing of codes and plans for distribution of short-time solar and geophysical data summaries.

There are at present these principal « Ursigram » regions and several subdivisions : America, Western Europe and Japan. It is proposed to actively encourage the establishment of an additional principal center in Eurasia and one or two in the southern hemisphere. It is proposed that the networks indicated under (*a*), (*b*) and (*c*), above, be built around these from regional centers and the associate centers.

(2) *The proposed world Regions.* — These are as follows :

(1) American Region : Both Americas, East and South Pacific Islands including Hawai and Tahiti.

(2) European Region : West Europe and Africa : incl. Belgium, Finland, France, East and West Germany, Great Britain, Greece, Holland, Italy, Danemark, Norway, Portugal, Spain, Sweden, Switzerland, Syria, Tchecoslovakia, Turkey, Yougoslavia.

(3) Eurasian Region : Including U.S.S.R., Poland, Hungaria, Roumania and China.

(4) Far Easterns Region : Australia, India, Indo China, Japan, Philippine islands, New Guinea, New Zealand.

It is also proposed that the Antarctic region will be under the responsibility of the American Center and that the Arctic stations

should be included in regions (1), (2), (3), (4) according to their geographical positions.

Detailed arrangements should be made between National Committees and the regional center concerned.

General Resolutions

OF THE URSIGRAM COMMITTEE
OF THE INTERNATIONAL SCIENTIFIC RADIO UNION (U.R.S.I.)

(1) The Ursigram Committee acknowledges with much appreciation the assistance and cooperation given by the communication companies and authorities cited hereinafter in making possible the speedy interchange of solar and geophysical data summaries among the centers for radio communication disturbance forecasting and scientific coordination, located at Paris, Darmstadt, the Hague, Belvoir (Washington), Anchorage and Tokyo. This assistance makes it possible for the radio forecaster and the scientist working on ionospheric and solar physics to be currently and systematically informed of the occurrence of solar flares and other evidences of solar activity even when observations are impossible on his own continent because of clouds or darkness. Such knowledge greatly aids his pratical and technical work.

The Committee has taken further steps at its present meeting to assure that only the most timely information is included in the telegraphic interchange, that superfluous details are excluded from the summaries, and that practical or scientific use is made of the information within a few hours of receipt.

The Committee sincerely hopes that in the overall balance, the communication services will find themvelves recompensed for the assistance and cooperation afforded both on account of the increasing reliability of forecasts of radio propagation conditions and through the improved understanding of the earths high atmosphere and its response to solar activity.

The Committee adresses its appreciation especially to the following companies and authorities :

— Administration Française des P.T.T.
— Alaska Communications System.
— Deutsches Bunderpost.
— Kokusai Denshin Denwa co Ltd (in Japan).

— Laboratoire National de Radioélectricité.
— R.C.A. Communications, Inc.
— Staatbedrijf P.T.T. (Nederlands).
— U.S. Signal Corps.

(2) The Ursigram Committee invites U.R.S.I. to inform the Director General of C.C.I.R. of the results of the Paris meeting and to ask him to take the necessary steps to facilitate as follows the interchange of data required for forecasting :

The various Administrations should be invited to facilitate the speedy distribution from every A.G.I. Center to every other A.G.I. Center and to associated Sub-Centers, twice daily of special short telegrams in code, containing the geophysical and solar information required for forecasting of Alerts and Special World Intervals, and if possible, to arrange for transmission of these messages without cost to the scientific laboratories.

(3) The Ursigram Committee strongly urges that : (1) Australia and Japan should be connected by a permanent telecommunications link for A.G.I. work ; (2) India should be connected by an permanent telecommunications link with one of the regional Centers designated for the I.G.Y.

(4) The Committee expresses the wish that a powerful transmitter should be established in Japan for the broadcasting of solar and geophysical summaries to distant places in order to facilitate the diffusion of this information. It is highly desirable that codes for this purpose should be unified.

(5) The Ursigram Committee recommends to U.R.S.I. the addition to its Members of MM. de Voogt and Beckmann, the latter in place of Mr. Menzel who now is in charge of special functions at the I.T.U. in Geneva. Nevertheless the Committee accepts the offer of Mr. Menzel to help eventually the Ursigram Committee in his relationships with the I.T.U.

The Ursigram Committee will thus be provisionnally formed as follows, up to the XIIth General Assembly of the U.R.S.I. :

R. P. Lejay, *Président* (France).
Beckmann (Allemange).
de Voogt (Holland).
Herbays (U.R.S.I.).

SHAPLEY (U.S.A.).
UYEDA (Japan).
MENZEL (U.I.T.) Consultative Member.

The Committee hopes that representatives will be nominated by Australia and the U.S.S.R. to serve as Members of the Committee.

(6) The Committee recommends that U.R.S.I. should invite the General Secretary to publish as an U.R.S.I. publication the Codes used by the various Ursigram Centers. This work should be done in collaboration by the General Secretary with the Ursigram Committee.

(7) The Ursigram Committee at his Paris conference (19 to 21 September 1955) having examined the organization of the present Ursigrams service and considered the improvements necessary to ensure this service in Europe during the Geophysical Year expresses the wish that modern equipment and in particular a complete teleprinter installation adapted for retransmission, should be available at the European center in Paris.

(8) The Ursigram Committee at its Paris conference (19 to 21 September 1955) having examined the organisation of the present Ursigram service and considered the improvements necessary to ensure this service in Japan during the Geophysical year, expresses the wish that modern equipment and in particular complete teleprinter installation adapted for retransmission should be available at the japanese center at Kokubunji.

Decisions of the Ursigram Committee

(for circulation among committee and subcommittee members)

DECISIONS

(1) It is decided that to avoid confusion amongst members of the committee and others directly concerned with Ursigrams, we will identify the various types of Ursigrams and codes in discussion and writing as follows :

Collection Ursigrams.
Interchange Ursigrams.
Distribution Ursigrams.

(2) The center-center interchange schedule should be ajusted so that the receiving center receives information at the time when it can be used to maximum advantage in forecasting or scientific experiments. The sending center should set its schedules insofar as possible to accommodate the receiving center.

(3) It appears that as soon as practical the number of interchange messages going towards the west should be increased from one to two. The first would be dispatched about local noon so that it is received at the western center at the very beginning of the working day. The second would be dispatched in the very late afternoon or early evening such that it is received at the western center before the normal afternoon forecast.

(4) Interchange messages going towards the east should be dispatched in the very late afternoon or early evening such that they are received at the eastern center at the very beginning of the working day.

(5) A model schedule for the interchange Ursigrams is as follows :

TABLE OF THE MOST APPROPRIATE TIMES OF TRANSMISSION

Direction	Circuit	Univ. Time	Local Time		
			At sender	At receiver	Delivery needel
Towards the East	America-Europe	05 (05)	00	06	08
	Japan-America	11 (08)	20	06	08
	Europe-Japan	19 (17)	20	04	08
Towards the West	Europe-America	13 (12) and 19	14 and 20	08 and 14	09 and 15
	America-Japan	19 (22) and 05	14 and 00	04 and 14	08 and 14
	Japan-Europe	05 (08) and 11	14 and 20	06 and 12	08 and 12

N. B. — 1. In brackets the present U.T. Times of transmission.

N. B. — 2. These times are to be adjusted $\pm$ 1 hour according to season and propagation conditions, taking into account the required delivery times.

(6) It is decided that Paris should explore the possibility of having the WASHPAR message routed automatically to Darmstadt and NERA, such that it will be available at these centers at the beginning of their working days without special handling at Paris. In the event that there may seem to be long delay in making these arrangements, Belvoir should direct the message to Darmstadt instead of to Paris.

(7) A working Subcommittee is designated composed of those persons in immediate charge of processing interchange messages at the six centers active at present, viz Delouf, Moore, Nason, Richter, Takiguchi, and Van Lohuizen (Chairman). The first task of this group will be make periodic spot checks on the time of transit of the interchange messages, so that the schedules can be made as effective as possible and the weak points corrected.

(8) The committee has reviewed the proposed codes for center-center interchange. It notes that some that of them, in particular SOR (Solar radio noise) will require further revision as new observing instruments come into use on a patrol basis. It is agreed to use for the time being the scheme proposed by Dr. de Voogt for the location of bursts sources on the Sun. The committee requests the C.R.P.L. to reproduce and circulate the revised codes to centers. Centers will be given one month to recommend changes they feel are necessary to make the explanations quite clear and anambiguous. After suitable editing by C.R.P.L., the codes should then be sent to U.R.S.I. and C.S.A.G.I. for publications as the interchange Ursigram codes.

(9) The center-center interchange codes may be put into effect by centers as soon as practicable. It is hoped that they will be in universal use by 1 Feb. 1956.

(10) The content of the center-center interchange messages should be SID, FLA, SOR, ADV, COR, MAG, SPO. The following restrictions are placed on these summaries :
FLA flares only of importance 2 or more.
COR east limb observations only.
SPO only activity centers of Brunner class A, B, C, D, E.

If the messages prove to average longer than 30 groupes, then an arbitrary cut should be made in the SPO reports while discussion are carried out with the communication authorities for expanding the messages. It is agreed that the messages should always

contain a definite number of code categories ; therefore on days of much activity the message will be quite long, but on days without activity the messages will be very short.

(11) Darmstadt is requested the consult with Dr. Bartels regarding the desirability of improving section *g* and *h* of the MAG code.

(12) The committee recognizes that the present plans and codes for quick interchange of data summaries among regional centers will continue to require revision as new observational techniques come into systematic use and as scientific advances are made in geophysics, solar physics and their interrelationships.

(15) The centers should prepare, or in any case, assist and encourage, the preparation of weekly mail data summaries. These are to be up-to date on the day of mailing in order to achieve their purpose. They should be composed of sketches, maps or tables, rather than be a reprinting of daily code messages, although the reports can still be quite simple. They should contain at a minimum the data headings under (10) above (except Advice) and any other information for which there is demand within the region or which regional centers may think appropriate.

(14) The distribution of mail summaries will in general be within the region of origin. The summaries should, however, be interchanged among regional centers.

(15) The committee has reviewed the schedule for issuing Alerts and S.W.I. notices during the A.G.I. which appeared in the C.S.A.G.I. Rome report. Factors which the Committee took into consideration were : (1) world-wide distribution of the notices within 3 hours now seems possible through W.M.O. ; (2) distribution would seem to be most convenient to the largest number of A.G.I. stations if the notice is given during night hours on the Pacific Ocean ; (3) the forecasts and S.W.I. selections will be most successful if made as few hours in advance as possible ; and (4) A.G.I. stations will already have been on the alert for possible S.W.I. and therefore advance notice by only about 6 hours would appear practical. The Committee therefore now recommends that the regular time for decision by the World Warning Agency on Alerts and S.W.I. should be 16 *hours U.T.* The Alerts would

take effect immediately and the S.W.I. *at* 00 *hours U.T.* of the day following.

(16) The Committee recommends that the format for the Alert and S.W.I. notices during the A.G.I. be in plain text and suggests the following :

AGI Geophysical Year Warning : *Alert starts immediately* 29/1600 (note : date-time is U. T. at which notice is issued).

AGI Geophysical Year Warning : *Alert finishes immediately* 02/1600.

AGI Geophysical Year Warning : *Special world interval starts* 30/0000.

AGI Geophysical Year Warning : *Special world interval continues* 31/0000.

AGI Geophysical Year Warning : *Special world interval finishes* 01/0000.

(17) It is decided that the « public resolution » by the Committee expressing appreciation to communication companies and authorities for their assistance and cooperation in the Ursigram project, should be sent with a covering letter by Col. Herbays as Secretary General of U.R.S.I. directly to the highest official of each of the companies and authorities mentioned and also should be published in the U.R.S.I. *Information Bulletin.*

(18) The Committee notes the following information on the present organization. Corrections and changes should be reported to the Secretary who should distribute a revised information sheet about every 6 months.

PRESENT ORGANIZATIONS OF URSIGRAMS

I. — *Europe*

Regional Collections : Paris (B.I.F.) ; Darmstadt (F.T.Z.) ; NERA.

Interchange :

Paris : from U.S.A.
Darmstadt : to U.S.A.
NERA : with Japan.

Regional Distributions :

Paris (Broadcast).
Darmstadt (Telex).
Darmstadt (Mail).

Forecasting centers :

Darmstadt (at 0900 and 1530 U.T. daily except Sunday).
NERA (at 1000 U.T. daily except Sunday).
Paris (at 1000 and 1500 U.T., disturbances only daily except Sunday).

Addresses :

(1) Paris :

Mail : Bureau Ionosphérique Français, 196, rue de Paris, Bagneux (Seine), France.
Telegrams : GENTELABO, Paris (Telex : 20055).
Supervisory : P. LEJAY.
Immediate charge : A. DELOUF.

(2) Darmstadt :

Mail : Ionosphere Darmstadt, West Germany.
Telegrams : FTZ Darmstadt.
Supervisory : Bruno BECKMANN.
Immediate charge : Herr RICHTER.

(3) NERA :

Mail : General Direction P.T.T., Room C 113, Kortenaerkade 11, The Hague, Netherlands.
Telegrams : PTT Receiving Station, NERA (Telex : 183595 (day), 183598 (night).
Supervisory : A. H. DE VOOGT.
Immediate charge : H. P. Th. VAN LOHUIZEN.

II. — *Japan*

Regional Collections : Kokubunji.
Interchange : Kokubunji.
Regional Distributions :

Kokubunji (broadcast).
Kokubunji (mail).

Forecasting center : Hiraiso (at 0800 and 1900 U.T.).

Addresses :

(1) Kokubunji.

Mail : Radio Research Laboratories, Kokubunji P. O., Kita-tama-gun, Tokyo, Japan.

Telegrams : Dempa, Kokubunji, Tokyo.

Immediate charge : T. TAKIGUCHI.

(2) Hiraiso :

Mail : Hiraiso Observatory, Hiraiso-machi, Nakaminato-shi, Ibaragi-ken, Japan.

Telegrams : Dempa, Hiraiso, Ibaragi, Japan.

SUPERVISORY : M. ONOE.

Immediate charge : M. SHINNO.

III. — *America*

Regional Collections :

Belvoir (except Alaska).

Anchorage (for Alaska).

Interchange :

Belvoir : with Europe and from Japan.

Anchorage : to Japan.

Regional Distributions :

Belvoir (except Alaska).

Anchorage (for Alaska).

Boulder(mail).

Forecasting Centers :

Belvoir (at 0500, 1200, 1700, 2000, 2300 U.T. daily); (at 1600 on Monday and Thursday).

Anchorage (at 0200, 0900, 1800 U.T. daily); at 2300 U.T. on Tuesday and Friday).

Boulder (weekly — no fixed schedule yet).

Addresses :

(1) Belvoir :

Mail : N.A.R.W.S., National Bureau of Standards; Box 178, Ft. Belvoir, Va., U.S.A.

Telegrams : CRPL Warning Service, Bustandards, Ft. Belvoir, Va. (TWX — Engleside Va. 556).

Supervisory : A. H. SHAPLEY (Boulder).

Immediate Charge : R. C. MOORE.

(2) Anchorage :

Mail : N.P.R.W.S., National Bureau of Standards ; Box 1119, Anchorage, Alaska, U.S.A.

Telegrams : Bustandards ; Anchorage.

Supervisory : A. H. SHAPLEY (Boulder).

Immediate charge : M. E. NASON.

(3) Boulder :

Mail : C.R.P.L. National Bureau of Standards, Boulder, Colo., U.S.A.

Telegrams : via Belvoir or Anchorage.

Supervisory : A. H. SHAPLEY (C.R.P.L.) ; W. O. ROBERTS, High Altitude Obs.

Immediate charge : M. B. WOOD (C.R.P.L.) ; D. E. TROTTER (H.A.O.).

INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

Seventh General Assembly

The seventh General Assembly of I.C.S.U. met in Oslo in August 9-12 under the presidence of Professor B. Lindblad.

The meeting took place in the rooms of the Norvegian Academy of Science and Letters, and the Council is greatly indebted to the Academy for its generous hospitality.

The proceedings were opened by addresses from Professor S. Rosseland for the Academy, and Professor Lindblad, President of I.C.S.U., speaking to the representatives of 11 international scientific unions, and delegations from 18 countries.

The following are among the more important decisions taken by the Assembly :

1. The International Union of Physiological Sciences and the International Union of Biochemistry were admitted to I.C.S.U. as Specialised Unions.

The Assembly heard the fusion of one of the already existing Unions, the International Union of the History of Sciences, with the International Union of Logic, Methodology and Philosophy of Science ; and welcomed as a new Specialized Union the International Union of the History and Philosophy of Science.

2. The U.S.S.R., through the Academy of Sciences of Moscow, was welcomed unanimously as a new National Member.

3. A new scheme of annual dues for National Members was adopted, to come into force in 1956-57. The scheme envisages six categories of membership, with units of 20, 40, 80, 150, 300 and 600 U.S. dollars respectively : these units to be multiplied by the number of unions to which the National Member adheres, with the provisional so that the minimum subscription is $ 100. The National Members are free to choose their own category, but will be invited

to adhere under categories proposed by the Bureau of I.C.S.U. It is estimated provisionnaly that the introduction of this scheme will raise I.C.S.U. proper income from the present figure of around $ 40 000 to $ 45 000.

The Union will consider an increase in the present levy of 1 % of their annual income at the next meeting of the Executive Board of I.C.S.U.

4. The Assembly decided to instruct the Bureau to send to the Ninth General Conference of U.N.E.S.C.O., which will take place in New Delhi in 1956, an I.C.S.U. observer who is independent of any national delegation and who is thoroughly acquainted with I.C.S.U. activities and with U.N.E.S.C.O. General Conference procedure.

5. The Assembly decided to offer services of I.C.S.U. to the United Nations, through U.N.E.S.C.O., in a study of the biological and other effects of nuclear radiations as a basis for the scientific assessment of their implications with respect to living systems, and to this end, resolved to establish a special committee to delineate the problems to be explored and to coordinate and to integrate the information resulting from the studies undertaken.

6. The Assembly resolved to transmit a plea to the Secretary General of the United Nations, through U.N.E.S.C.O., that the rights of any nation carrying out foundamental research on the physical characteristics geology, and biology of the sea-bed and subsoil of the continental shelf, with the intention of open publication in the interest of all, should be safeguarded by an insertion to this effect in the Comments on the Draft Articles on the Continental Shelf, which will be presented by the International Law Commission for final ratification by the Ninth General Assembly of the United Nations in 1956.

The Assembly unanimously elected the following Officers for the period 1955-1958 :

President : Dr. L. V. Berker (U.S.A.).

Vice-Présidents : Father P. Lejay (France), Sir K. S. Krishnan (India).

Treasurer : Col. E. Herbays (Belgium).

Secretary General : Prof. A. V. Hill (U.K.).

Members : Prof. V. A. ENGELHARDT (U.S.S.R.), Prof. A. STOLL (Switzerland).

Retiring President : Prof. B. LINDBLAD (Sweden).

On the invitation of the National Academy Research Council of the United States, the Eight General Assembly I.C.S.U. will take place in Washington D. C. in 1958.

(Reprint from *I.C.S.U.Quarterly Bulletin*, nº 51, July-Sept. 1955.)

C.C.I.R

We have received the following papers relevant to C.C.I.R. Study Group nº VI activities (Ionospheric propagation).

— Identification of a precursor indicative of short-term variations of ionospheric propagation conditions. Contribution of the German Federal Republic to C.C.I.R. Study Programme nº 59.

— Japan. Report on basic prediction information for ionospheric propagation (Subject relevant to C.C.I.R. Study Program nº 60 (VI)).

— Japan. Report on the general time distribution of amplitude and its practical uses in observation of rapid fading (Subject relevant to C.C.I.R. Study Program nº 66 (VI)).

— U.S.A. Report on night field strengths, 540 to 1600 kc/s (Subject relevant to C.C.I.R. Study Program nº 63 (VI)).

— Study of fading Contribution of the Federal Republic of Germany to C.C.I.R. Study Program nº 66 (VI).

— Netherlands P.T.T. Service. Report on propagation of circularly polarized waves in the ionosphere (C.C.I.R. Resolution 14 (VI)).

— Netherlands P.T.T. Service. Report on pulse transmissions between Radio-Kootwijk and Casablanca (B.I.F.) (C.C.I.R. Study Programme nº 67 (VI)).

— Japan. Report on the lightning stroke counters (C.C.I.R. Study Programme nº 65 (VI)).

Work in 1953-1955 under auspices of the International Scientific Radio Union on non-linear effects in the ionosphere (C.C.I.R. Study Programme nº 61 (VI)).

W. M. O.

Calendard of meetings of the world meteorological organization in 1955-1956

Data	Place	Name of Meeting
14-16 November 1955	Payerne-Switzerland	Working Group on International Comparison of Radiosondes.
16-25 February 1956	Ciudad Trujillo-Dominican Republic	International Hurricane Seminar.
March 1956	Dubrovnik-Yugoslavia	Regional Association VI (Europe), Second Session.
24 April 1956	Geneva-Switzerland	Executive Committee, Eighth Session.
April 1956 (tentative)	Geneva-Switzerland	WMO Working Group on the International Geophysical Year 1957-1958.
25-27 April 1956	Ciudad Trujillo-Dominican Republic	Eastern Caribbean Hurricane Committee, Fourth Session.
May-June 1956 (tentative)	Bermuda	Commission for Maritime Meteorology, Second Session.

Geneva, 20 October 1955.

INTERNATIONAL GEOPHYSICAL YEAR

National Committee Reports to the 3rd Meeting of C.S.A.G.I.(I.)

We only publish excerpts concerned with U.R.S.I. activities in the A.G.I. programme.

Australia

I. — *World Days*

Special attention will be paid to Geomagnetic, Auroral and Ionospheric Observations on World Days. Rocket flights (if possible) will be made on these Days. Arrangements for relaying announcements of Special World Days to Australian Observatories are under consideration.

IV. — *Auroral and Airglow Observations*

Radar echo observations with rotating antenna at 75 Mc/s are planned for Mawson, but the installation is uncertain. Subject to U.S.A. supplying equipment, 50 Mc/s fixed antenna observations will be made at Macquarie Island.

In collaboration with the French expedition, 73 Mc/s pulsed signals transmitted from Adelie Land will be recorded at Macquarie

Island. Spectrographic studies of aurora may be made at Mawson (uncertain).

All auroral observations will be collected and collated in Melbourne.

V. — *Ionosphere*

The ionospheric observatories at Watheroo, Hobart, Canberra, Brisbane, Townsville and Macquarie Island will be maintained, and an ionospheric recorder will be operated at Mawson. Plans for the observatory at Port Moresby are complete, but there is a delay in the programme, which may prevent this station being available at the beginning of the International Geophysical Year. Observations of ionospheric drifts by the meteor trail method will be made at Adelaide, Mawson and possibly at Port Moresby A proposal to record « whistlers » at Brisbane, as part of a joint programme with Japanese observers, is under consideration. Thomas noise recorders, operating at 5 frequencies between 500 kc/s and 15 Mc/s, will be operated at Pearce, W. A., and at two stations (not yet selected) in the tropics.

Belgium

(*Translation*)

I. — *World Days*

A patrol for reception of Alerts and warnings of World Days will be arranged.

It is expected to set up an organization to assure a rapid broadcast of information to Belgian participants to A.G.I. in Belgium and in the Belgian Congo.

V. — *Ionosphere*

Dourbes : N 50°06′ E 04°35′ — Vertical C3 Type — Bureau of Standards.
Léopoldville : S 04°22′ E 15°15′ — Vertical absorption.
Lwiro : S 02°16′ E 28°49′ — Vertical absorption.
Elisabethville : S 11°39′ E 27°28′, Vertical.
Bunia : S 01°30′ E 30°13′, Vertical.

VI. — *Solar Activity*

Lwiro : S 02°16′ E 28°49′.

Radio solar observations on 169 Mc/s, 6 m parabolic mirror.
Humain : N 50°12′ E 05°21′

(1) Radio solar observations :

(*a*) on 169 Mc/s, 6 m and 7.5 m parabolic mirrors ;

(*b*) on 900 Mc/s, two 3 m mirrors mounted as interferometer on 8 base line in E W direction, will operate for the A.G.I.

(2) Continuous observations on 27 kc/s.

(3) Recording of total cosmic radiation.

Bolivia

(*Translation*)

COMMITTEE

President : Prof. Dr. ISMAEL ESCOBAR V.
Secretary General : Cap. Eng. REYNALDO SALGUEIRO P.
Ionospheric Studies : Cap. JULIO MALDONATO.
Solar Radiation : Eng. RAFAEL VIDAURRE.
Latitudes and Longitudes : Cap. ARTURO ARAMBAR P.

Organizations represented in the A.G.I.National Committee

Bolivian Association for the Advancement of Science.
San Calixto Observatory.
Bolivian Radio Club.
Radio Serval (Interdepartmental Radio Service).

Working Programme

The following investigations can be undertaken in Bolivia during the I.G.Y.

V. — *Ionosphere*

1. The U.S.A. National Committee has considered the setting up of an ionospheric station at La Paz. The project seems feasible.

2. If the preceding project is put in operation, the National Committee considers that it will be able to co-operate to the ionospheric research programme drafted by C.S.A.G.I.

VIII. — *Latitudes and Longitudes*

4. Radio transmissions.

4.1. For longitude determination, use will be made of WWV and NSS signals.

4.2. The mean propagation time of time signals will be estimated before and during the I.G.Y.

Canada

PROGRAM

The various disciplines covered by the Canadian program are listed below with the location of the headquarters for the work and the individual or individuals taking a leading part in carrying it out.

I. — *World Days*

The Canadian observing stations will take part in world day measurements. Since many of the measurements are planned on a continuous basis, world days will make little difference to the measurements taken. No difficulty is expected in arranging a radio net for warning the observing stations but the details have not yet been worked out.

IV. — *Aurora and Airglow*

The Canadian Aurora Program will consist mainly of continuous observation of intensity, spectra and type at a group of stations extending through the Aurora belt in Northern Canada. In addition, Auroral radar will be operated at Ottawa, Baker Lake and Saskatoon. The general direction of the Auroral work will be carried out by B. W. Currie, Professor of Physics, University of Saskatchewan, Saskatoon, Saskatchewan. Cooperating with him, particularly in the radar net and in analyses of the results, is P. M. Millman, Division of Radio and Electrical Engineering, National Research Council, Ottawa, Canada.

The stations at which observations are to be carried out are as follows :

Auroral Radar : Ottawa, Baker Lake, Saskatoon.

All these stations will also have recording magnetometers. The headquarters station at Saskatoon will be carrying out addi-

tional work in spectroscopy of the upper atmosphere as a continuation of its normal program of Aurora research.

V. — *Ionosphere*

The Canadian Ionosphere Program will be carried out by the Radio Physics Laboratory of the Defense Research Board under the supervision of the Superintendent of the laboratory, J. C. W. Scott. The program includes the continued operation of the present standart vertical incidence ionosphere recorders which are at Ottawa, Resolute, Baker Lake, Churchill, and Winnipeg. In addition, recorders will be installed for the International Geophysical Year at Meanook, Victoria, Yellowknife and Norman Wells.

Equipment for measuring E-layer tides will be operated at Churchill and Ottawa.

Equipment for measuring absorption will be operated at Ottawa, Resolute, Baker Lake, Churchill and Winnipeg.

Oblique incidence receivers will be established at Alert, Churchill and Baker Lake with transmitters and receivers at Resolute and Winnipeg.

Close cooperation will be maintained among the Ionosphere, Auroral and Magnetic programs.

Scattering (back and forward) experiments will also be carried out at 35 and 50 Mc/s with a transmitter at Yellowknife and receivers at Baker Lake, Churchill, The Pas, Saskatoon and Meanook. Some information may be obtained from this on scattering from auroral displays and meteor trails.

In connection with the radio program, some work is also planned on audio atmospherics and whistlers.

V*a*. — *Meteors*

Meteor research in Canada includes the operation of two super-Schmit cameras on a 26-mile base near Meanook, and radar, photographic and visual observations at Ottawa. It is proposed during the International Geophysical Year to have both these stations in full operation with particular attention being given to periods of meteor showers, (Regular World Days). The super-Schmidt camera program at Meanook is being supervised by J. L. Locke, Dominion Observatory, Department of Mines and

Technical Surveys, Ottawa, and the radar, photographic and visual program at Ottawa is being supervised by P. M. Millman, Division of Radio and Electrical Engineering, National Research Council, Ottawa.

VI. — *Solar Activity and Solar Noise*

Solar noise measurements will be taken throughout the day continuously at a wave-length of 10 cm. This work will be carried out at Ottawa under the supervision of A. E. Covington, Division of Radio and Electrical Engineering, National Research Council, Ottawa. Solar noise measurements may also be taken in connection with the radio ionosphere program on frequencies of 50 and 500 Mc/sec. This will be carried out at Ottawa as part of the program of the Radio Propagation Laboratories of the Defence Research Board.

Chile

(*Translation*)

V. — *Ionosphere*

For the present time Chile has no instrumentation for ionospheric observation.

Nevertheless such investigation as a major importance, particularly taking into account the C.S.A.G.I. suggestion made at the Second Meeting to carry out observations at Conception.

For this purposes steps are being made to obtain one or two equipments, as Punte Arenas may be considered as the second site of great importance.

For what concerns the staff, the Universities of Chile and of Conception have engineers able after a short training, to instal monitors and carry out ionospheric observations.

Denmark

V. — *Ionosphere*

The Danish National Committee of U.R.S.I. is considering the following plans for ionospheric observations in Greenland during the International Geophysical Year :

1. *Ionospheric soundings at Godhavn.* — The regular ionospheric soundings being carried out at Godhavn in co-operation with

the National Bureau of Standards, U.S.A., will be continued with increased intensity during the International Geophysical Year. A new house for the station will be erected this year, and the equipment will be moved next summer. The new house will be situated at a distance from the settlement, where continuous runs can be made without disturbing the normal radio service.

A young electrical engineer is being specially trained for the purpose of doing scientific work during the International Geophysical Year, when two observers will be present at this station.

It is hoped that a photographic outfit can be acquired for the station to make regular records of the auroras.

2. *Ionospheric Absorption Measurements at Godhavn.* — In accordance with a proposal made by Professor Rydbeck, Sweden, it is contemplated to build equipment for continuous registration of the cosmic noise at a wavelength of 9 metres (frequency 33 Mc/s). As the cosmic noise is nearly equally distributed over all directions at this frequency, the field strength measured at vertical incidence will provide a fairly good picture of the amount of attenuation suffered by the noise during its passage through the ionosphere.

The equipment would be built and tested in Copenhagen.

3. *Atmospheric Noise at* 1-20 *Mc/s.* — Measurements of atmospheric noise have been carried out for some time in co-operation with the Radio Research Station of The Department of Scientific and Industrial Research, Slough, England.

Measurements carried out at Angmassgalik in S. E. Greenland have shown that apart from occasional electric storms the atmospheric noise at 1-20 Mc/s is extremely low. These measurements have now been stopped, since the equipment was lost by fire in December, 1954.

A new measuring station has been started at Narssaq in South Greenland from January, 1955. It may have to be moved to another site because the local man-made noise appears to be stronger than the atmospheric noise. In any case, however, noise measurements at 1-20 Mc/s will be made in South Greenland during the International Geophysical Year.

4. *Atmospheric Noise at* 15-150 *kc/s.* — During a recent visit to Slough it was decided to take up atmospheric noise measurements

at extremely low frequencies, 15-150 kc/s, at a suitable place in South Greenland with equipment acquired from the Department of Scientific and Industrial Research.

Finland

The Finnish observational program for the International Geophysical Year in the previous reports will be carried out.

For the moment, however, it is not certain that the ionospheric recorder planned for Sodankylä can be ready for use in time for the International Geophysical Year.

France

Antarctic Expedition to Terre Adelie

(Translation)

I. — *Generals*

The Antarctic Sub Committee of the French National Committee for the A.G.I. planned two stations in the Terre Adelie area of Antarctica :

Station Pointe Géologie : 66°40′ S — 140°01′ E
Station Plateau : in the South magnetic Pole area.

The Pointe Géologie Station can be associated for aurora studies to Resolute Bay, Canada, which is located on about the same geomagnetic latitude and on the same field strength line.

II. — *Scientific Programme*

	Pointe Géologie	Plateau	Raids
Aurora and airglow	×		
Geomagnetism	×	×	×
Glaciologie		×	×
Gravity	×		
Ionosphere	×		
Meteorology	×	×	×
	M. S. Noisel		
Seismology	×		×

N. B. — The detailed scientific programme will be circulated later on.

III. — *Equipment*

B. Scientific equipment.

Aurora and Airglow :

(*d*) 75 Mc/s radar with Yaggi rotating antenna, pulse reception at Pointe Geologie and Macquarie Island.

Ionosphere. — A panoramic sounder from the Laboratoire National de Radioélectricité, sweeping from 1.5 to 18 Mc/s in 6 or 60 seconds, with standard recording and a panoramic bay.

The aerial is constituted by three sliding parts fixed at various heights on two 21 m metal masts.

Great Britain

I. — *World Days*

1. Central Radio Propagation Laboratory (U.S. Bureau of Standards) will announce an Alert six days before an expected Special World Interval (S.W.I.).

2. C.P.R.L. will announce beginning of S.W.I. not less than 12 hours before the S.W.I. starts.

3. C.P.R.L. will notify termination of the S.W.I.

4. It is proposed that C.R.P.L. should make the above three announcements by cable to this country as it is not considered expedient or practicable that we should receive this information by Ursigram or by WWV transmissions.

5. For the distribution of the information to British participants in the programme of the International Geophysical Year, it is proposed to use the inland telegraph system for the United Kingdom and cable for the overseas stations.

6. The organizations to be informed include (*a*) universities (*b*) government departments and (*c*) private individuals.

7. Suggestion is also made to explore with the B.B.C. the practicability of relaying the alerts, warnings and other announcements at the end of one of the regular daily news bulletins.

8. It is assumed that the Vahsel Bay expedition will be informed direct from C.R.P.L. or by other means.

IV. — *Aurora and Airglow*

3. The University Observatory, St Andrews. 56°20′ N 02°48′ W.

Observations : Spectrographic and interferometric observations of aurora and airglow. Radio echo observations of aurora.

Present equipment : 5″ spectrograph on loan from U.S.A. Fabry-Perot interferometer. Radio echo equipment to be purchased by Government Grant 1958.

4. At height of 900 ft on hill in Co. Antrim (in association with Queen's University Belfast) 55° N 06° W

Observations : Investigation of airglow emissions.

Present equipment : Infra-red photometer. Interferometer.

V. — *Ionosphere*

1. *British stations associated with D.S.I.R.* (directly or otherwise) :

(i) Inverness (D.S.I.R.) 57°28′ N 4°12′ W.

Observations : Vertical.
Present equipment : Automatic recorder.

(ii) Singapore (D.S.I.R.) 01°18′ N 103°50′ E.

Observations : Vertical.
Present equipment : Automatic recorder, Manual.

Observations : Absorption measurement, Atmospheric noise measurement.
Present equipment : Manual H. F.

Observations : Ionospheric winds.
Present equipment : Transmitter only.

(iii) Slough (D.S.I.R.) 51°30′ N 00°36′ W.

Observations : Vertical.
Present equipment : Automatic recorder.

Observations : Absorption measurement.
Present equipment : Manual.

Observations : Atmospheric noise wave form measurement.
Present equipment : Under development.

(iv) Port Stanley (D.S.I.R.) 51°42′ S 57°52′ W.
Falkland Islands.

Observations : Vertical.
Present equipment : Automatic recorder.

Observations : Absorption measurement.
Present equipment : Manual.

Observations : Atmospheric noise measurement.
Present equipment : Manual.

(v) Port Lockroy (F.I.D.S.) 64°49′ S 63°31′ W.
Graham Land.

Observations : Vertical.
Present equipment : Automatic recorder.
(Other ionospheric and atmospheric noise measurements might be desirable here if the Vahsel Bay expedition does not materialise.)

(vi) Ibadan (D.S.I.R. and Univers. of Nigeria) 07°24′ N 3°54′ E.

Observations : Vertical.
Present equipment : Automatic recorder.

Observations : Absorption measurement.
Present equipment : Manual.

Observations : Atmospheric noise measurement.
Present equipment : none.

2. *Swansea* :

University of Wales 51°38′ N 4°00′ W.

Observations : Vertical.
Present equipment : Automatic recorder.

Observations : Absorption measurement.
Present equipment : Automatic recorder.

Observations : Ionospheric winds in F2 region *p'f*.
Ionospheric winds in F2 region *p'l*.
Present equipment : 3 recorders at Slough, Swansea and Bangor
3 *p'l* equipment.

Observations : Ionospheric winds in E region by Mitra fading method.

Present equipment : None.

3. *Cavendish Laboratory* :

Cambridge University 52°13′ N 00°06′ E.

Observations : 1. A detailed study of sudden ionospheric disturbances.

2. Recording and timing of « whistlers ».

3. --8 *See* notes below.

Present equipment : Equipment for items (1), (2), (4) and (7) exists in whole or in part.

Notes on above : Observations at the Cavendish Laboratory.

1. A detailed study of sudden ionosphere disturbances (S.I.Ds) and their relation to solar events.

(*a*) The continuous measurement of the relative intensity of galactic radiation on a frequency near 17 Mc/s.

(*b*) Measurement of the relative strength of pulses reflected from the ionosphere at vertical incidence on three frequencies, such as 2, 4 and 6 Mc/s.

(*c*) Recording of phase and amplitude of the wave reflected nearly vertically from the very low frequency sender G.B.R.

(*d*) Recording of phase and amplitude of the wave reflected nearly vertically from two of the senders of the English Decca System.

(*e*) Recording of the intensities of waves received at more oblique incidence from Decca and broadcasting senders.

(*f*) Recording of the integrated intensity of atmospherics on a frequency of 22 Mc/s.

2. Recording and timing of « whistlers » five minutes in every hour and analysis of their dispersions.

3. Accurate recording of the equivalent height of reflection of waves of frequency about 2 Mc/s from the E layer and determination of tidal movements.

4. Measurement of drifts by the method of close-spaced receivers ; in the E and lower F layers by the use of reflected pulses, and

in the upper F layer by the use of radio star scintillations. If desired the Laboratory would prepare a document outlining a standard procedure for the analysis of records made by the method of close spaced receivers. They would also be prepared to collect, correlate, and issue the results from other stations measuring drifts, provided the observers at those stations performed the first reductions from the records.

5. If the D.S.I.R. does not undertake to analyse the $h'(f)$ curves from six selected stations to give $N(h)$ curves, as suggested, then the Laboratory would like to perform this analysis.

6. Observations of the scintillations of radio stars over the 24 hours on 38 Mc/s for the purpose of estimating the depth of the scintillations. These observations will be related to, but different from those for the measurement of drift (item 4).

7. Recording the wave-forms of atmospherics simultaneously with other workers.

8. Continuous observation of the sun on 38 and 81.5 Mc/s.

4. *Edinburgh* :

Edinburgh University 55°55′ N 03°11′ W.

Observations : Ionospheric absorption measurement using galactic noise source.

Present equipment : ?

Observations : Ionospheric interpretation unit.

5. *Jodrell Bank Cheshire* :

University of Manchester 53°14′ N 02°18′ W.

Observations : Routine meteor observations by radio echo technique.

Present equipment : Special radio echo equipment for continuous delineation of meteor radiants.

Observations : Routine auroral and meteor observations by radio echo technique plus auroral photography.

Present equipment : Special radio echo equipment for recording total meteor activity together with radio echo recording of aurorae with continuous automatic photography.

Observations : E region winds using meteor technique.
Present equipment : Special radio equipment for wind measurement in the 70 to 120 km region using the Doppler method on ionised meteor trails.

Observations : Upper atmosphere pressures, temperatures and scale heights 50 to 120 km region.
Present equipment : Special radio echo equipment for measurement of heights of meteor trails working in conjunction with Schmidt camera.

Observations : (1) Scintillation of radio stars, global effects in F region, influence of aurorae, etc.
(2) F region winds using scintillation of radio stars.
Present equipment : (1) Continuously following aerial, equatorially mounted with recording equipment.
(2) 3 station special receiving equipment.

XI. — *Rockets*

Aberporth or elsewhere depending on arrangements yet to be made 52°06′ N 04°34′ W.
Observations : Study of Physical Properties of the Atmosphere up to 60 km and possibly 90 km.

XV. — *Publications and Publicity*

The publication of results will take place principally in the journals of learned societies or existing regular publications of Government Departments.

Vahsel Bay Stations — Antarctic Expedition

IV. — *Aurora*

Auroral observations, visual and photographic and radio echo.

V. — *Ionospheric measurements*

(i) Vertical incidence ionospheric characteristics.
(ii) Absorption measurements.
(iii) Atmospheric noise measurements.
(iv) Ionospheric drift.

Greece

(*Translation*)

V. — *Ionosphere*

A station (radio-sounder) under the control of the Ionospheric Institute of the Athens Observatory will be established and will be operated before the end of 1955.
Coordinates : Lat. N. 37°58'20" ; Long. E 23°43'.
Region : NB.

Spain

(*Translation*)

V. — *Ionosphere*

Tortosa, Ebro observatory. The vertical incidence ionospheric sounding station is operating since April 1955.

VI. — *Solar Activity*

The Ebro Observatory at Tortosa is achieving the equipment te collaborate to the programme of continuous optical and radio solar observations.

United States of America

Preface

This report presents the current plans for United States participation in the International Geophysical Year, 1957-58, as requested by the Secretary General of the Special Committee for the International Geophysical Year (C.S.A.G.I.) for the C.S.A.G.I. Brussels Meeting, September 8-14, 1955. The report has been prepared by the U. S. National Committee for the I.G.Y., its Technical Panels in the various I.G.Y. disciplines, and its Secretariat. While the plans here presented are much more specific than in the Committee's 1954 report for the C.S.A.G.I. Rome Meeting, many details necessarily have yet to be developed.

References to other nations in this document, to stations, sites, and territories of other nations, occur as a matter of convenience for purposes of discussion of this report. For example, there are a number of references to places and activities involving several

North and South American and European countries. Many of these countries have long conducted cooperative programs in geophysics with workers and institutions of the United States : these cooperative programs are expected to continue during the I.G.Y. and it is hoped that additional new work will be undertaken jointly.

Joseph KAPLAN,
Chairman.

Washington, D. C.
August, 1955.

I. — *World Days*

Members of the U.S.N.C. Technical Panel on World Days and Communications are : A. H. SHAPLEY (*Chairman*), John W. EVANS, A. B. MEINEL, Millett G. MORGAN, Homer E. NEWELL, Jr.

During the I.G.Y. there will be four types of specially designated world days or series of days on which special observing programs may be scheduled. They are :

1. *Regular World Days* (*R.W.D.*). — Three or four days per month, selected long in advance. The draft calendar appears in the report of the C.S.A.G.I. Rome meeting, subject to presumably only minor modifications by C.S.A.G.I. in the fall of 1955 (see *U.R.S.I., Inf. Bull.*, **90**). Two consecutive days are designated at new moon, and the remainder near quartier phase and prominent meteor showers.

2. *Alerts*. — When there is an unusually active solar region on the sun's disk, a world-wide « alert » will be broadcast. The alert will remain posted until the activity subsides or until the region passes to the invisible solar hemisphere. The alert serves notice that the probability of solar flares occurring is heightened. It also warns that there is a strong possibility that a geomagnetic disturbance will take place in the days following, and that a « Special World Interval » will be invoked.

3. *Special World Interval* (*S.W.I.*). -- This will be called on 24-hour notice when there is a strong possibility that a significant geomagnetic disturbance will commence within the 24 hours following the start of the interval. The interval will be terminated when the disturbance has subsided, or in about 25 hours in cases

the forecast disturbance does not materialize. The National Bureau of Standards radio forecasting center at Ft. Belvoir, Virginia, is the World Warning Agency, and acts with the advice of similar centers in other countries.

4. *World Meteorological Intervals* (*W.M.I.*). — These are series of ten consecutive days each quarter. W.M.I. include the solstice or equinox day and also three R.W.D.

In general, there will be heightened observational activity on Regular World Days and during Special World Intervals in all programs in Ionospheric Physics and Geomagnetism.

There are tentative plans for an expedition to the South Pacific for observations of the October 12, 1958 total solar eclipse. Thus far, only solar observations are contemplated.

STATIONS AND PROGRAMS

Project Code :		*Agency Code* :	
DC	World Day Communication	AFCRC	Air Force Cambridge Research Center
DD	Data Distribution	CRPL-NBS	Central Radio Propagation Laboratory
EE	Eclipse Expedition	HAO	High Altitude Observatory
WWA	World Warning Agency	NRL	Naval Research Laboratory

Stations	Nominal Location		I.G.Y. Program	Operating Agency
	Latitude	Longitude		
Anchorage, Alaska .	61°10′ N	149°55′ W	DC	CRPL-NBS
Boulder, Colorado ..	40°02′ N	105°18′ W	DD	CRPL-NBS, HAO
Danger Island, Cook Islands	11° S	166° W	EE	AFCRC, NRL
Ft. Belvoir, Virginia .	38°44′ N	77°08′ W	WWA, DC	CRPL-NBS

The communication network for distributing notices of Alerts and Special World Intervals will be centered at the National Bureau of Standards at Fort Belvoir, Virginia and Anchorage, Alaska. Plans to broadcast this information on standard frequency stations are as yet incomplete. It is expected that the primary method of distributing this information as well as the short time

summaries for more detailed broadcasts will be finalised at the forthcoming C.S.A.G.I. meeting. The present arrangements for international short-time summary data interchange for radio propagation forecasting are expected to continue. This includes a two-way interchange daily with Europe and with Japan.

There will be available weekly preliminary reports giving information in somewhat more detail concerning ground observations of Solar Activity, Geomagnetism and in any other fields for which a need may be expressed. This report will be an extension of the present weekly report on Solar Activity issued jointly by High Altitude Observatory and National Bureau of Standards.

IV. — *Aurora and Airglow*

Members of the U.S.N.C. Technical Panel on Aurora and Airglow are : Joseph KAPLAN (*Chairman*), Sydney CHAPMAN (*Ex-officio*), C. T. ELVEY, C. W. GARTLEIN, A. B. MEINEL, D. H. MENZEL, N. J. OLIVER, A. M. PETERSON, F. E. ROACH, E. TOUSSEY, E. H. VESTINE. Consultants to the Panel are : D. K. BERKEY, G. Gordon LITTLE.

The aurora and airglow are both optical phenomena of the upper atmosphere, however, it is generally believed that different mechanisms of excitation are involved. The aurora is generally thought to be excited through bombardment of the atmosphere by ionized particles emanating from the sun, whereas the airglow is thought to result from chemical reactions in the upper atmosphere. The following investigations have been designed to assist in determining the modes of excitation and further differentiating the two phenomena. Since both phenomena are essentially world-wide, the aurora occurring only on rare occasions, the most promising attack on the problem appears to be studies of the distributions of the phenomena over the globe at specific times, and their changes with time. These distributions, or synoptic maps, will then be studied with respect to solar phenomena and other geophysical phenomena occurring simultaneously.

A. — AURORAL STUDIES

The auroras are the visible paths created as the bombarding particles travel through the atmosphere. The particles, thought to be mostly protons, not only excite the atoms and molecules

to radiate but ionize many of them, thus producing trails of electrons. Furthermore, when the protons are slowed sufficiently, they may recombine with an electron of the ionosphere and thus radiate the characteristic hydrogen spectrum.

There are three very important types of data concerning auroras which need be observed on a synoptic basis, namely, the locations of auroras by optical methods, the locations of the incidence of hydrogen, and the location of the ionized regions associated with the visible auroras using radar techniques.

The I.G.Y. program for observations of the aurora may be classified in three main divisions : 1. Geographical Incidence of Auroras, 2. Spectroscopic Observations of Auroras, and 3. Special Techniques for Auroral Investigations.

1. Geographical Incidence of Auroras. — The primary consideration in the design of the observing programs of auroras has been to construct synoptic maps showing the distribution of auroras ; however, the data are valuable, also, for statistical studies. In Alaska and the northern portions of the U. S. where auroras are frequent, the photographic technique will be used primarily ; in the southern latitudes of the U. S., the collection of auroral observations will be mainly by visual methods. In all cases the data derived from observations of auroras will be forwarded to regional centers, one at College, Alaska, the other at Ithaca, N. Y., for processing and dissemination.

(*c*) *Radar Observations of Auroras.* — The Radar observations of auroras have many advantages over the visual and photographic records since clouds and daylight do not affect them. However, it must be kept in mind that the echoes from auroras are not necessarily coincident with the optical auroras since the radio signal is returned from the electrons associated with the aurora. Current research in Alaska using pulsed radio techniques has demonstrated that echoes from auroral ionization may be readily distinguished from those due to ground backscatter and reflections from sporadic E.

Since the cost, both for equipment and skilled personnel to obtain radar observations of auroras is great, observations are planned along only two chains of stations. One chain of stations will be situated across the auroral zone in Alaska, a second chain

of stations (to monitor the longitudinal distribution of auroras) is planned in the Northern United States at approximately 56° north geomagnetic latitude. This chain of stations will connect with those planned for England and Sweden to give a range in longitude from the Aleutian Islands in Alaska through the United States to Sweden. U. S. radar stations will operate at approximately 50 Mc/s.

In order to determine whether auroras appear simultaneously at opposite ends of a geomagnetic field line, radar equipment will be installed at Nome, Alaska — these studies to be correlated with studies made by Australian scientists using similar equipment at Macquarie Island.

3. Special Techniques for Auroral Investigations. — The principal technique for investigations of aurora other than those mentioned above is the application of radio astronomy.

(*a*) *Scintillation of Radio Stars Through Auroral Disturbances.* — The scintillations of radio stars have been shown to vary rapidly in the auroral zone. Marked changes in the scintillations occur within minutes, and it seems highly possible that this may result from the transit of an aurora or auroral sporadic E cloud across the line of sight.

(*b*) *Absorption of Extra-Terrestrial Radio Waves in the Auroral Zone.* — A method of measuring the absorption of radio waves passing through the ionosphere has been developed at the Geophysical Institute, College, Alaska. Advantage is taken of the general background of radio noise associated with the galaxy and a continuous recording is made of its intensity. Absorptions at frequencies of 30 Mc/s and 65 Mc/s appear to correlate well with the polar radio black-out.

(*c*) *Radio Noise Associated with Auroras.* — The question of radio noise emitted by auroras is far from being settled. Marked increases of the noise level on high frequency radio circuits have been observed during periods of auroral displays. However, up to the present, it has been impossible to determine whether the increased noise level originated with the auroras or merely resulted from the auroras producing a good reflecting and scattering medium which propagated noise and other radio interference from large distances.

STATIONS AND PROGRAMS

Project Code :

AR Auroral Radar
DR Data Reduction
RA Radio Astronomy

Agency Code :

AFCRC Air Force Cambridge Research Center
CIW Carnegie Institution of Washington
CRPL Central Radio Propagation Laboratory
CU Cornell University
GI Geophysical Institute, U. of Alaska
SU Stanford University

Stations	Nominal Location		IGY Program	Operating Agency
	Latitude	Longitude		
United States :				
Alamogordo, N. M. .	35°54′ N	105°58′ W	Rockets	AFCRC
Bellingham, Wash. .	48°45′ N	122°29′ W	AR	SU
Boulder, Col.	40°02′ N	105°18′ W	DR	CRPL
Cambridge, Mass. ..	42°25′ N	71°10′ W	DR	AFCRC
Fritz Peak, Col.	39°52′ N	105°31′ W	AR	CRPL
Ithaca, N. Y.	42°27′ N	76°31′ W	AR, DR, RA	CU
Stanford, Calif.	37°26′ N	122°10′ W	AR	SU
Washington, D. C. ..	38°55′ N	77°04′ W	RA	CIW
Alaska :				
Anchorage	61°10′ N	149°55′ W	AR	GI
Barter Island	70°08′ N	143°40′ W	AR	GI
Cold Bay	55°12′ N	162°43′ W	AR	GI
College	64°51′ N	147°50′ W	AR, DR, RA	GI
Naknek	58°44′ N	157°02′ W	AR	GI
Nome	64°30′ N	165°26′ W	AR	GI
Pt. Barrow	71°20′ N	156°46′ W	AR	GI
Greenland :				
Thule, Greenland ...	76°33′ N	68°50′ W	RA	AFCRC

V. — *Ionosphere*

Members of the U.S.N.C. Technical Panel on Ionosphere are : Millett G. Morgan (*Chairman*), H. W. Wells (*Secretary*), H. G. Booker, Frederic Dickson, R. A. Helliwell, Wolfgang Pfister, A. H. Shapley, Ralph J. Slutz, A. H. Waynick. Consultants to the Panel are : H. W. Curtis, A. M. Peterson, R. C. Peavey (*Recording Secretary*).

In ionospheric physics, five programs of synoptic observations will be carried out : (*a*) sweep-frequency pulse-echoes at vertical incidence, (*b*) fixed-frequency pulse backscatter at oblique incidence with azimuthal sweep, (*c*) naturally occurring audio-frequency radio waves, (*d*) integrated terrestrial radio noise on fixed frequencies, and (*e*) absorption. Absorption will be measured at high latitudes by monitoring extra-terrestrial noise, and it is hoped to make pulse-echo measurements of absorption at one or more fixed frequencies with the sweep-frequency vertical-incidence recorders. One station using equipment specifically intended to measure absorption at vertical incidence by the pulse-echo method will also be in operation. The observation of fixed-frequency pulse backscatter at oblique-incidence with azimuthal sweep will provide some information on drifts.

In addition to the synoptic program, it is planned to observe : (*a*) oblique-incidence D- and E-region forwardscatter at vhf in an equatorial region, and possible confirmation of the existence of F-region forwardscatter at vhf over long equatorial paths, (*b*) sweep-frequency pulse backscatter at oblique incidence at 55° N geomagnetic latitude looking towards the geomagnetic pole, and (*c*) Es reflection coefficients at oblique incidence.

1. Synoptic Observations :

(*a*) *Sweep-Frequency Pulse-Echoes at Vertical Incidence.* — Frequency-sweeps will be made after normal fashion from 1-25 Mc/s with high-power pulse equipment (approximately 10 kW). Virtual-height *vs.* frequency records will be made on 35 mm film every 15 minutes and scaled daily. Continuous recording is planned for World Days and other special intervals. In order to complete a pole-to-pole chain of stations along the Americas, and to study the classical properties of the ionosphere at very high latitudes,

it is planned to establish and operate several new stations during the I.G.Y.

(*b*) *Fixed-Frequency Pulse Backscatter.* — Pulse equipment using relatively long, medium power pulses (2 milliseconds, 2 kW) will be operated simultaneously on three fixed frequencies (approximately 12, 18, and 27 Mc/s) at oblique incidence with azimuthal sweep. Rotating, directional antennas with echoes presented in polar plots will be employed.

By selecting a network of stations whose ranges overlap, very effective synoptic studies can be made of E*s*, aurorally reflected signals, meteor ionization trails, and the regular layers. On the highest frequency, it is planned to use short pulses (2 microseconds) as well as the long pulses.

(*c*) *Naturally Occurring Audio Frequency Radio Waves.* — Sensitive listening apparatus will be employed in the audio range to record « whistlers » and « swishes », known to correlate with electric discharges in the atmosphere, and the « dawn chorus », known to correlate with geomagnetic disturbance and aurora and to effect the propagation of whistlers and swishes. From magnetic tape records, the dependence of the dispersion and of the frequency of occurrence of whistlers and swishes will be determined. On the basis of the theory of T. L. Eckersley and L. R. O. Storey, these data will be used to compute the density and distribution of ionized matter far beyond the reaches of the known ionosphere. There is no theory of the dawn chorus, and data on this phenomenon will be compared with geomagnetic and auroral observations in order to seek a better understanding of it.

Station siting has been carried out with a view to establishing the latitude and longitude dependence of the phenomena in the Northern Hemisphere, and to seeking a verification of Storey's Theory that whistlers are propagated along the earth's magnetic flux lines between the hemispheres.

(*d*) *Integrated Terrestrial Radio Noise on Fixed Frequencies.* — Equipment measuring the absolute value of the average noise power, and the logarithm of the mean field intensity on eight frequencies (50.0, 113.45, 246.5, 545 kc/s, and 2.4975, 4.9975, 9.9975, 19.993 Mc/s) at a band width of 300 c/s will be used in the synoptic study of these parameters. The recording range of the

equipment is 100 db with a short-time dynamic range of 40 db. Measurements will be made simultaneoulsy on two frequencies and integrated over a seven minute interval, after which the equipment will switch to the next pair of frequencies for an equal interval. Measurement at a bandwith of 50 c/s is also under consideration.

The program has been integrated with existing noise measuring stations and spherics *df* stations. Additional noise *df* data can be obtained from the stations observing fixed-frequency pulse backscatter at oblique incidence with azimuthal sweep by operating that equipment with the transmitters turned off. A simple 12 Mc/s noise *df* set using a rotating, directional antenna is under consideration for installation at the noise-measuring stations themselves.

(*e*) *Absorption.* — The observation of extra-terrestrial noise provides the most satisfactory means of measuring the high ionospheric absorption which occurs at high latitudes. Using frequencies between 20 and 30 Mc/s, one can obtain a satisfactory compromise between available noise signal, sensitivity to absorption, and interference from terrestrial signals. A four-station network in the Alaska-Yukon area is planned with one station at a middle latitude for comparison and for measurement of solar flare effect for correlation with the rocket program.

The well-known vertical-incidence pulse echo method of measuring absorption on 2 Mc/s will be employed at one permanent station. The possibility of making measurements at each of the vertical-incidence sweep-frequency stations is also being studied.

2. Other Observations :

(*a*) *Oblique-Incidence Forward Scatter.* — Oblique-incidence D- and E-region forwardscatter measurements are planned for an equatorial region, and possible confirmation is sought for the existence of F-region forwardscatter at vhf over long equatorial paths. Continuous recordings will be made over a one-way path of very high power transmissions at about 50 Mc/s in an equatorial region for comparison with results at hand from middle and high latitudes. Information will be sought on diurnal and

seasonal behavior and on special events and effects. It is tentatively planned to locate the path along the coast of Peru, with Huancayo near the midpoint of the path.

Using the transmitter provided for this experiment, and another at Houston, Texas, it is also planned to organize observers at suitable locations to detect F-region forwardscatter which has been suggested by previous reports from amateurs and by the correlation of those reports with spread-F records obtained at Huancayo.

(*b*) *Sweep-Frequency Pulse Backscatter at Oblique Incidence.* — Sweep-frequency pulse backscatter measurements will be made at oblique incidence at 55° N geomagnetic latitude looking toward the geomagnetic pole. This experiment will be coordinated with similar observations of the same transmissions made at 65° geomagnetic latitude, 1200 km north of the transmitter along the direction of transmission. The correlation of the backscattered signals with the specular signals will provide useful information about the regular behavior of the ionosphere in the auroral zone.

(*c*) *Es Reflection Coefficients at Oblique Incidence.* — Using techniques described by Kono et alii (« Study of long distance propagation of vhf waves by Es ionization, « *Jour. Radio Res. Lab.*, Tokyo, vol. 1, p. 1, March 1954), it is proposed to operate cw transmitters on approximately 37, 55.5, and 74 Mc/s, feeding highly directional antennas with about 1 kW. The signals will be monitored at distances of 1000 to 2000 km with receivers having a pass-band of less than 100 c/s and a sensitivity of the order of 0.1 microvolts-meter. A recorder would register levels from 10 db above free-space level to 60 db below.

A list of ionospheric stations is appended to the report, these stations will be included in the list to be published by U.R.S.I.

VI. — *Solar Activity*

Members of the U.S.N.C. Technical Panel on Solar Activity are : A. H. Shapley (*Chairman*), Horace Babcock, John W. Evans, Leo Goldberg, John P. Hagen, S. B. Nicholson, W. O. Roberts.

The chief objective of the solar activity work during the I.G.Y. is to achieve detailed and comprehensive records by systematic

observation of the sun through improved coordination of the observing programs of the existing solar observatories of the world. These will also be detailed studies by the most modern techniques of phenomena which are most likely to have direct terrestrial effects. The manifestations of solar activity of particular concern during I.G.Y. are sunspots, flares, plages, emissions from the corona, solar magnetic fields, and radio wave emissions at various frequencies.

3. Indirect Flare Detectors. — It is planned to have at least three indirect flare detection installations at McMath-Hulburt Observatory, High Altitude Observatory, and Upper Air Observatory. It has not been finally determined whether these will involve measurement of enhancement of low frequency atmospherics or the absorption of the galactic noise background. It is to be noted that the I.G.Y. programs in Ionospheric Physics and in Aurora and Airglow also provide for similar instrumentation. All these observations will supplement the present high frequency field intensity observations in the rapid detection of ionospheric effects of solar flares.

4. Radio Noise Patrol. — It is expected that patrol observations at or near 200 Mc/s will be continued at Cornell University and at the NBS (Boulder). An effort will be made to have a third 200 Mc/s patrol station in Hawaii. A patrol at 10 cm, 3 cm, and 8 mm wave-length will be carried out by the Naval Research Laboratory. It is expected that dynamic high frequency spectral observations of radio noise bursts will be undertaken at Upper Air Observatory or University of Michigan or both. Burst spectra in the microwave range are planned to be observed by Naval Research Laboratory. Other special radio astronomical studies of the sun are planned by some of the above institutions. Preliminary and also final reports of the patrol observations will be available soon after observations; reductions of the special observations will be on a somewhat slower schedule.

Observations of the October 1958 eclipse of the sun both in the visual and radio regions of the spectrum are currently being planned.

STATIONS AND PROGRAMS

Project Code :

RFS Radio Frequency Spectra
RNP Radio Noise Patrol

Agency Code :

CRPL Central Radio Propagation Laboratory
CU Cornell University
HCO Harvard College Observatory
NRL Naval Research Laboratory
UARO Upper Air Research Observatory
U of Mich University of Michigan
USNO United States Naval Observatory

Stations	Nominal Location		IGY Program	Operating Agency
	Latitude	Longitude		
United States :				
Ann Arbor, Mich. (approx.)	42°17′ N	83°44′ W	RFS	U of Mich
Boulder, Col.	40°02′ N	105°18′ W	RNP	CRPL
Ithaca, N. Y.	42°27′ N	76°31′ W	RNP	CU
Sacramento Peak (Sunspot, N. M.) ...	32°43′ N	105°45′ W	RFS	UARO and HCO
Washington, D. C. ..	38°55′ N	77°04′ W	RFS, RNP	USNO, NRL
.....	.....	.....	.....	.....
Pacific Area :				
Maui, T. H. (approx.)	20°50′ N	156°30′ W	RNP	undecided

XI. -- *Rockets*

Members of the U.S.N.C. Technical Panel on Rocketry are : F. L. WHIPPLE (*Chairman*), H. E. NEWELL, Jr. (*Executive Vice-Chairman*), W. BERNING, W. G. DOW, N. C. GERSON, B. HAURWITZ, Joseph KAPLAN, W. J. O'SULLIVAN, S. F. SINGER, W. STROUD, J. A. VAN ALLEN, P. H. WYCKOFF. Consultants to the Panel are : N. C. SPENCER, L. M. JONES, F. B. MCDONALD, R. M. SLAVIN, J. W. TOWNSEND, G. F. SCHILLING (*Secretary*).

Although the field of research designated by the word « rocket » encompasses certain special aspects of a number of fields of atmospheric physics, it is not a scientific field in itself. It is made up of new, and usually more direct techniques of approach to many of the long-standing problems of geophysics. In view of the specialized facilities, techniques, and operational problems which are involved, the United States National Committee has established the rocket program as a separate category for the I.G.Y.

The scientific basis for the proposed rocket I.G.Y. program is to be found in the need for basic data which ground based experiments are unable to provide. Lacking these data, most existing theories on the cause and formation of the aurora, or the changes and fluctuations of the earth's magnetic field are very incomplete. Even in the case of the ionosphere there is yet no completely satisfactory theory.

The place of the simple Chapman layer in a complete theory of the ionosphere is still an open question, as are relative importances of recombination, diffusion, and the earth's magnetic field. There is, in fact, still sonciderable question as to the proper interpretation to put on ground based measures of ionospheric quantities.

In the field of solar terrestrial relationships the rocket alone can supply many of the needed answers. The character of the solar radiation at the bottom of the atmosphere is already considerably affected by the absorption of the high energy photons in the exosphere, the ionosphere, and the ozone layer. Ground based measurements, for example, cannot indicate which solar radiations are responsible for producing the different ionospheric layers. The speculation as to the solar flare radiations causing a sudden ionospheric disturbance fills many volumes ; the answer may be furnished during one rocket flight.

The relations between the aurora, ionospheric currents, high altitude winds, and observed fluctuations in the earth's magnetic field are still to be clarified.

The examples listed briefly above indicate but a few of the many and complex problems in the high atmosphere awaiting solution. A fundamental purpose of the rocket I.G.Y. program

is to shed further light upon such questions as these. To this end experiments will be performed in the following disciplines :

5. Ionospheric and Geomagnetic Measurements. — The variation of charge density with altitude in the ionosphere will be determined in the auroral zone by a variety of techniques. An effort will be made to distinguish between electrons and ions. Measurements will be made of the earth's magnetic field at various latitudes to provide information on the position and magnitude of electrical currents flowing in the lower ionosphere, and on auroral particle streams.

6. Satellite Measurements. — Rockets make possible direct measurements of quantities which are either not observable or are only indirectly observable from the ground. They can also be used for measuring the altitude dependence of geophysical parameters. But they have a marked disadvantage in that they spend only a short time at any one altitude during their flight, and that their total flight time in itself is relatively short. Thus, particularly in the case of the large rockets used for extreme altitude studies, they are not easily adapted to synoptic type or long term studies. This is an unfortunate shortcoming, since fluctuations in such solar effects as ultraviolet and X-ray radiations, cosmic ray intensities, current rings encircling the earth, and particle streams impinging upon the high atmosphere are among the most important and interesting of problems connected with the physics of the upper atmosphere and with solar-terrestrial relationships.

An earth circling satellite vehicle would, however, make it possible to make long term observations on quantities such as those listed above. Such a satellite could also be used as a means for refining geodetic data. The basic techniques for the launching and instrumentation of an artificial earth satellite are now available, and it is planned to launch a number of such vehicles as part of the U. S. I.G.Y. rocket program.

The satellite vehicle will orbit above the earth at altitudes between 200 miles at perigee, and perhaps 800 miles at apogee. In encircling the earth it will be observable by many countries and from many of the I.G.Y. stations being established for the overall I.G.Y. program. In order to realize the greatest possible

benefit from this undertaking, complete information about the orbiting vehicle and its instrumentation will be made availble to the nations participating in the I.G.Y. program so that those countries can take part in the observation and use of it.

It is planned to use the I.G.Y. satellites for the following types of experiments. The total number of experiments actually to be carried out will, however, depend on the total payload capacity of the vehicles launched.

(*a*) Determination of outer atmosphere densities by observation of the air drag effect upon the satellite's orbit.

(*b*) Obtaining of more accurate measures of the earth's equatorial radius and oblateness, of intercontinental distances, and of other geodetic data than are presently available.

(*c*) Long term observations of solar ultraviolet radiation.

(*d*) Studies of intensities and fluctuations in intensity of the cosmic and other particle radiations impinging upon the outer atmosphere.

(*e*) Determination of the density of hydrogen atoms and ions in interplanetary space.

(*f*) Observations of the Stormer current ring.

(*g*) If possible, determination of the distribution of mass in the earth's crust along the orbitral track.

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