Union Radio - Scientifique Internationale

INTERNATIONAL SCIENTIFIC RADIO UNION

U. R. S. I.

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INFORMATIONS

COMITÉ NATIONAL TCHECOSLOVAQUE

Nous avons le plaisir d'annoncer la constitution d'un Comité National Tchécoslovaque sous la Présidence du Professeur Dr. Josef STRANSKY, de l'Ecole Polytechnique de Prague.

We have the pleasure of announcing the constitution of a Czechoslovacian National Committee under the Chairmanship of Professor Dr. Josef STRANSKY, of the Polytechnical School of Pragen.

Commission Mixte de Radio - Météorologie

Joint Commission on Radio - Meteorology

Réunion de Stockholm du 22 & 23 juillet 1948

Stockholm Meeting 22 nd and 23 rd July 1948

EXECUTIVE MEETING.

Present : Prof. Chas. R. Burrows (President).
Dr. H. G. Booker.
Dr. J. F. Pawsey (representing Dr. E. G. Bowen).
M. E. Vassy (representing M. A. Perlat).
M. Lugeon and M. Lejay, although present in Stockholm, were unable to attend, the former due to illness, and the latter due to commitments at the C. C. I. R. Conference.

1. It was agreed that the Joint Commission should direct its attention, as opportunity arose, to the theoretical and experimental determination of those properties of the lower atmosphere which affect radio propagation, and that these should include :

(a) factors controlling temperature and humidity profiles,
(b) temporal and spacial variations of temperature and humidity of a random nature,
(c) radio climatology,
(d) reflection and scattering from particles and other inhomogeneities,
(e) gaseous absorption,
(f) instruments for measuring temperature, humidity, total water-vapour content, dropsize, drop density, etc.,
(g) storm detection by radar,
(h) storm detection by sferics,
(i) frontal passage by field-strength measurements.

2. It was agreed to bear in mind not only the need for fostering development of those aspects of meteorology required for radio science, but also ways in which radio technique can be

used as an aid in meteorology.

3. It was agreed that the President should investigate the possibility of adding the names of Prof. P. A. Sheppard and Mr. Wexler to the Joint Commission in place of Dr. A. H. R. Goldie and M. N. R. Hagen. It was also agreed that it would be desirable for M. W. E. Gorden to be added to the Joint Commission to act as a permanent secretary.

4. It was agreed that, so far as funds permit, the travelling expenses and daily subsistence allowance be paid to members of the Joint Commission who attend meetings. Further that, where members receive a partial grant to attend a meeting from some other source, the difference be paid, so far as funds permit, between the expenses and allowances described in the previous sentence and the grant received from another source.

5. It was agreed to ask U. R. S. I. to publish the proceedings of this meeting in its Bulletin and to supply reprints for circulation, the number of copies to be decided by the President having regard to the sum of $ 100 provided for this purpose by the International Council of Scientific Unions.

6. It was agreed to ask the International Council of Scientific Unions for a grant of $ 4.000 to support, at the discretion of the Joint Commission, the following four items of research :

(a) To produce a report summarizing all the information at present available on turbulence likely to be useful in radio meteorology.

(b) To analyse existing data on coastal anomalies in radio meteorology with a view to understanding particulary the phenomenon of the coastal front and the influence of sea breeze in radio meteorology.

(c) To investigate the possibility of measuring the temperature of clouds by measuring radiation from them at microwavelengths.

(d) To examine the possibility of measuring the temperature of the lower atmosphere by measuring radiation from the water vapour contained therein.

The need for research on subsidence was also mentioned.

7. It was agreed to hold the next meeting in about two years' time. The view was expressed that a meeting at the end of another Conference was undesirable.

TECHNICAL SESSION 1.

Present : Prof. Chas. R. Burrows (Chairman).
Dr. H. G. Booker.
Mr. F. T. Davies (representing Mr. A. Thomson).
Dr. J. F. Pawsey (representing Dr. E. G. Bowen).
M. E. Vassy (representing M. A. Perlat).

Among those also present were : W. B. Burgess, G. Millington, J. O. Nielsen, H. Norinder, J. Rybner, O. Rydbeck, R. L. Smith-Rose, Mme A. Vassy.

The following papers were presented :

Nr 1. — A THEORY ON RADAR REFLECTIONS FROM THE LOWER ATMOSPHERE.

by W. E. Gordon.

Associate Director, Electrical Research Laboratory
sponsored by the Office of Naval Research at the University
of Texas, Austin, Texas.

A theory is presented, supported by several sample sets of data, which indicates that the curious phenomenon dubbed « Angels » (Radar Reflections from the Lower Atmosphere) may be attributed to sharp changes in the dielectric constant. The required magnitude of the changes are computed from reflection theory and compared to sample meteorological data obtained from rapid response instruments. The near-discontinuities in the dielectric constant are produced by atmospheric turbulence. It is proposed that the observed radar reflections are the result of turbulent motion in the lower atmosphere.

In discussion it was suggested that experiments involving simultaneous radio and meteorological observations should be conducted to ascertain conclusively the cause of the echoes.

Nr 2. — WEATHER RADAR RESEARCH AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

by Alan C. Bemis.

Meterology Department, M. I. T., Cambridge, Mass.
(Presented in abstract only.)

Radar is a completely new meteorological tool. Because of its extraordinary potentialities the U. S. Army Signal Corps suggested in 1946 that the Massachusetts Institute of Technology under-

take a research contract to explore the field. Objectives of the research are, first, to learn more about the basic phenomena involved; and second, to assist in the development of radar as a means of observing and studying the weather.

The project operates two radar systems at wave-lengths of 10 and 3 cm., and a large Air Force aircraft which is very thoroughly instrumented, including devices for measuring raindrop size and total liquid water content per unit volume of air. Measurements made by the aircraft are accurately coordinated in time and space with those made on the ground radar systems. Automatic cameras take rapid-sequence photographs of both « PPI » and « RHI » scopes. (The first type presents a plan view, the second a vertical section through the atmosphere.) From the radar photographs, the airborne instruments, visual observations, winds aloft data, and from other records, the structure of the atmosphere can be charted along sections of the aircraft's flight path. Some of the charts are reproduced as sample records. A few radar'scope photographs are also included showing particularly interesting features such as the cellular structure of precipitation echoes, effects of wind shear, and the « bright line » of radar return from the 0° C. isothermal surface. Plans call for several more years of research and study.

During the discussion a description was given of similar work in Canada including observations of the direction of the fall of rain. In Australia radar observations of the precipitation had been particularly helpful in connection with experiments on artificial production of rain.

Nr 3. — RADAR ECHOES FROM PRECIPITATION

by J. E. Hooper.

Telecommunications Research Establishment,
Great Malvern, England.

(Presented in abstract only.)

At wave-lengths of 10 cm. and below the echo power reflected by raindrops is appreciable. The magnitude of the phenomena has assumed considerable importance in the design of radar equipment both for the specific purpose of detecting precipitation to assist the meteorologist and the aviator, and for the detection of targets within a precipitation area.

Ryde has dealt fully with the theoretical aspect of the intensity of radar echoes from such meteorological phenomena as rain, snow, hail, etc., and has show that the echo intensity from a number of randomly distributed spherical particles of diameter small compared with the wavelenght is proportional to

$$\frac{N D^6 f(m) h}{\lambda^4}$$

where N is the number of particles per unit volume,
D is the diameter of the particles,
λ is the wave-length of the incident radiation,
m is a function of the dielectric constant and varies with λ
h is the pulse duration.

In the case of rain where D extends over a range of values the above expression must be averaged over the appropriate size distribution so that

$$\text{echo intensity} \quad \frac{N(D) D^6 f(m) h}{\lambda^4}$$

where $D|\lambda$ is small.

In order to check this theoretical relationship, experiments have been conducted at T. R. E. in which echo intensity from rain has been measured as a function of precipitation rate over the range 0-11 mm/hr. On the average the results agree to within about 2 db with the theoretical prediction made by Ryde assuming a certain and reasonable drop size distribution for each value of the precipitation rate and certain experimental values for the dielectric constant of water at the appropriate wave lengths. It is further shown that over the range of precipitation rates commonly experienced in temperate latitudes, the echo intensity is approximately proportional to the three halves power of the precipitation rate.

Measurements are being made on the dependence of echo intensity on wave-length and such results as are available indicate that theoretical predictions are of the right order. It should be pointed out that the increase in echo intensity from rain expected as a result of using shorter wave-lengths is offset below about 5 cms by the fact that attenuation of the radiation by the rain, the atmospheric gases and the water vapour increases considerably with frequency.

During the course of investigations on radar echoes from rain it has been observed that within the region of precipitation, the echo which derives from a layer a little below the freezing level is more intense than from either above or below it. It is thought that this increased echo is due to the fact that at this level the particles are largely water, with a higher dielectric constant than the ice particles above, and are more concentrated than the particles below due to the fact that they have not reached their terminal velocity. Measurements have been made of the echo intensities and of the terminal velocity of snow flakes, and the fact that the

ratio of the echo intensity from the layer to that from below is of the same order as the ratio of the terminal velocity of a water drop to that of the snow flake of equal mass supports this argument. It is observed, however, that in convective showers where the discontinuity between ice and water is less pronounced, the intense echo band is comparatively weaker.

Nr 4. — SCATTERING AND ATTENUATION OF MICROWAVE RADIATION THROUGH RAIN

by Fred. T. Haddock.

Naval Research Laboratory, Washington, D.C.

In order to facilitate the choise of frequency bands in the millimetre wave-length region, particulary for random applications, it is essentiel to know the effect of rain, fog, etc., on performance. For this reason, calculations were made on the attenuation due to absorption and scattering by rain-drops and the radar cross-section of rain-drops. These calculations were made at 3, 5, 9, 17 and 30 millimetres for a range of dropsizes sufficient for nearly all rainfalls. Interpolations have been made in order to obtain the curves for 12.5 millimetres.

Nr 5. — THE WORLD DISTRIBUTION OF RADIO NOISE

by H. A. Thomas.

National Physical Laboratory, Teddington, England.

Measurement of radio noise has been in progress since 1922 at a number of locations and over periods ranging from a few days to several years. Examination of all the available data shows that they are very limited in scope ; there has been no correlation between measurements at different places and the significance of bandwidth has not been appreciated.

An attempt to obtain reliable noise data simultaneously at a number of locations by use of standardized measuring equipment was first made in 1945. Observations from fourteen stations have been in progress for nearly three years, measurements being made at each station every hour on frequencies of 2.5, 5.0, 10.0, 15.0 and 20.0 Mc/s. Since 50 % of all values lie within 5 decibels and 90 % within 10 decibels of the median value, the median noise has a very real significance.

Some indication that the noise source was local was found. Lack of satisfactory knowledge of the mechanism of noise production makes noise prediction hazardous.

In discussion some concern was expressed at the suggestion that there might be a nature source of terrestrial noise other than that due to lightning flashes. If such a suggestion is to be made it should be supported by quite convincing evidence. The view was expressed that the difference between noise at Calcutta and Colombo could probably be largely explained in terms of the movement and activity of the intertropical front.

Nr 6. — ATMOSPHERICS

by T. W. Wormell and E. T. Pierce.

Solar Physics Observatory, Cambridge, England.

Some recent studies at Cambridge of the structure of the disturbances, due to lightning discharges, of the vertical electric field at the earth's surface will be described and discussed. The investigation falls into two main parts.

The first consists primarily of the study of the effects of discharges at sufficiently small distances for the electrostatic effect to be prominent (within 100 km, say) and is carried out by obtaining a continuous record of the variation with time of the electric field. Cathode-ray equipment is, of course, used, but with auxiliary apparatus of sufficiently long time-constant (6 sec.) for the slow part of the field-change to be recorded without serious distortion. The time scale of the photographic record is about 15 cm. to a second. On such a record the typical change of field produced by a lightning discharge appears as a rather slow and smooth variation of electric field with a duration which frequently lasts for an appreciable part of a second and which may exceed one second. This slow variation is often, particularly if the field-change is of positive sign, interrupted by one or more very much more rapid jumps in the value of the field, these sudden changes appearing instantaneous on a time scale such as is here being considered. The fraction of the total change of field which occurs slowly may have any value from a few per cent up to 100 %. The presence of such rapid proportion in the field-change would appear to be characteristic of flashes to earth; the « jumps » consist, indeed, of Appleton and Chapman's « b-portion » of the field-change and are associated with the return stroke of a discharge to earth. The converse of this statement is not necessarily true, however. For some purposes these records are supplemented by further records obtained with a capillary electrometer and suitable amplifier. With this system it is possible very simply to accumulate data on the total magnitude and signs of field-changes up to distances of about 200 km.; the system has also the great advantage, for the present purpose, that it records only the electrostatic effect of the discharge even when radiation field greatly exceeds it in magnitude.

The second investigation concerns the detailed waveform of the disturbance due to the radiation fields from considerably more distant discharges, usually many hundreds of kilometres distant. A simple and successful method for the economical recording of such waveforms has been developed which utilizes an electrical beam trigger actuated by the initial portion of the atmospheric itself. With a typical adjustment of the instrumental constant, 1 cm. on the record represents 1 millisec and the total duration of one photograph is about 20 millisec. « Atmospherics » from distant sources recorded by such an apparatus fall into two main types, as is well known, the first consisting of a series of rapid and rather irregular fluctuations with a frequency of the order of 10-20 kc/s. The principal feature of the second type, which has, usually, a considerably bigger amplitude than the first, for sources at comparable distances, is a rather regular damped train of oscillations (the train being very much longer at night than for daylight observations) with the period increasing along the train. The first type is usually associated with the stepped leader process of a lightning discharge; the source of the second can with confidence be ascribed to the rapid return stroke of a flash to earth. The main features of this type of disturbance can be explained in terms of a simple primary pulse which is modified during propagation as a result of the superposition of numerous reflections from ionosphere and ground, so that the disturbance arriving at a distant point has the appearance of a damped train of oscillations (Laby and others, Schonland and others). A preliminary series of midwinter observations suggests reflections from a height of 70-80 km., with a reflection coefficient of the order of 0.7 at night and 0.35 by day.

Nr 7. — MICROWAVE ATMOSPHERIC ABSORPTION AND COSMIC NOISE

by M. Schulkin.

Naval Research Laboratory, Washington, D.C.

A detailed examination has been made of Dicke's microwave radiometer data at wavelengths of 1.00 cm., 1.25 cm. and 1.50 cm. in the light of later microwave absorption studies of water vapour and oxygen. The limitations of Dicke's analysis are discussed. It is shown that exact conclusions can only follow from independently determined oxygen absorption, water vapour absorption and cosmic noise data. Accepting the published water vapour absorption data, limits are placed on the possible magnitudes of cosmic noise and oxygen absorption at these frequencies.

N° 8. — APPAREIL POUR LA MESURE DE L'EPAISSEUR D'EAU CONDENSABLE : QUELQUES RESULTATS

par A. et E. Vassy.

Faculté des Sciences, Paris.

Description of an instrument for the determination of precipitable water; it uses a photoelectric cell and allows of very quick and simple measurement by the ratio of intensities for two wavelengths : 9.360 A and 8.700 A.

The results now available show a strong diurnal variation of precipitable water and permit the study of the meteorological situation when Halm's formula is not valid.

The possibility of measuring temperature by a similar method was raised in discussion.

TECHNICAL SESSION II.

Present : Prof. Chas. R. Burrows (President).
Dr. G. Booker.
Mr. N. R. Hagen.
M. R. Lejay.
Dr. J. Lugeon.
M. E. Vassy (representing M. A. Perlat).
Among those also present were : W. B. Burgess, R. Bureau, W. Gerber, B. Josephson, G. Millington, J. Rybner, R. L. Smith-Rose, M^me^ A. Vassy.

The following papers were presented :

N^r^ 9. — THE CANTERBURY PROJECT A RADIO METEOROLOGICAL INVESTIGATION IN THE SOUTH ISLAND OF NEW ZEALAND

by R. S. Unwin and B. Milnes.

Department of Scientific Research, Wellington, C1, New Zealand.

A long term investigation into the phenomenon of superrefraction at radar frequencies under advection conditions has recently been completed in the South Island of New Zealand. The investigation, a collaborative effort between D. S. I. R., United Kingdoms, and D. S. I. R., New Zealand, termed the Canter-

bury Project, ran from the early Spring of 1946 to December 1947, and was aimed at providing sufficient meteorological and radio propagation data to solve current problems in radio meteorology, notably the correlation of field strength distribution in and above the duct with the properties of the duct itself, and the checking of the diffusion and other theories on the modifications of an air mass passing offshore.

The problems involved and the experimental technique adopted in the project are described, and selected data are discussed. No theoretical or statistical treatment of results is attempted in this paper, but it is considered that sufficient data have been amassed to go far in helping to solve the problems involved.

Nr 10. — INFORMATION FOR JOINT COMMISSION ON RADIO-METEOROLOGY

by F. G. Bowen.

Council for Scientific and Industrial Research.

Division of Radiophysics, Australia.

I. — SUMMARY OF AUSTRALIAN RADIO METEOROLOGICAL RESEARCH PROGRAMME.

Much of the experimental work on radio meteorology in Australia is carried out by the Radiophysics Laboratory of the Council for Scientific and Indusrial Research. The present programme is as follows :

1. Reflection and Superrefraction in the Lower Atmosphere.

There is evidence that abnormal propagation on metre en decimetre waves in the lower atmosphere is brought about reflection as well as refraction processes. A survey has been conducted of the incidence of these effects around the whole of Australia and large parts of New Guinea. The survey has brought out a number of interesting phenomena two of which are being made the subject of more detailed investigation.

(a) **N. S. W. « Coastal Front ».**

Abnormal propagation occurs around the coast of New South Wales during weather conditions which, for want of a better name, have been called the « Coastal Front ». Quantitative measurements of the radio and meteorological factors involved have show that the mechanism is one of reflection rather than refraction.

(b) **The Inland Radiation Inversion.**

A series of observations has been carried out 400 miles inland in New South Wales on winter nights when radiation inversion takes place. The measurements are prompted by radio considerations but the problem is essentially a meteorological one and is attacked from this point of view. The analysis of results is nearing completion. One immediate result which is most surprising is that if the ground slopes by as little as one foot in a mile there is enough horizontal movement of the air to upset the simple conditions which were anticipated.

Associated with experimental work are theoretical studies of wave propagation in the lower atmosphere.

2. **Variation of Velocity of Radio Waves in the Atmosphere.**

The effect of varying atmosphere conditions on the velocity of radio waves is important in the application of radar to geographic and geodetic survey. The problem is being studied and measurements of the change in temperature pressure and water vapour content of the air over long paths have been made. It is clear from this study that satisfactory corrections for the variations can be made.

3. **Artificial Stimulation of Rainfall.**

This is primarily a meteorological investigation of the processes at work when clouds are stimulated to rain by various seeding materials. Radio and radar play an important part as observational tools in determining the presence or otherwise of drops and particles before seeding and in observing the growth after seeding.

II. — SUGGESTED LIST OF PROBLEMS FOR CONSIDERATION BY THE COMMISSION.

1. **Reflection and Superrefraction in the Lower Atmosphere.**

Magnitude and frequency of occurrence in different parts of the world.

Detailed investigation of mechanism.

Thoeretical studies of the wave propagation and meteorological factors involved .

2. **Velocity of Propagation of Radio Waves in the Lower Atmosphere.**

Theoretical and practital studies of velocity of propagation of radio waves over long atmospheric paths.

Studies of meteorologidal factors involved.

Determination of methods of correction for variations in velocity.

3. **Reflection of Radio Waves from Drops and Particles in Cloud.**

Practical studies of the intensity of reflection from drops and particles of different types and sizes.

Comparison of theory and experiment.

Application to studies of cloud and rain formation.

4. **Instrumental Development.**

Development of meteorological instruments for measurements of :

Temperature ;
Pressure ;
Humidity ;
Total Water Vapour Content ;
Drop Size ;
Drop Density ;
Ion Density, etc.

Development of instruments to measure the above in a form suitable for telemetering.

Development and application of radio and radar techniques for cloud and weather studies.

Nr 11. — A SURVEY OF SUPERREFRACTION IN THE COASTAL REGIONS OF AUSTRALIA

by F. J. Kerr.

Radio Physics Laboratory, Sydney, Australia.

A survey has been made of the incidence of radio superrefraction round the coast of Australia and nearby islands. It is based on the systematic reporting of the strengths of echoes from ground objects at distances of from 50 to 200 miles, observed by Royal Australian Air Force 200 Mc/s. radar stations. These observations taken hourly over periods of up to eighteen months, have been analysed in terms of geographical position, season of the year, time of day and synoptic weather situation. Longer range superrefraction involving ranges of 300 to 500 miles is also found off north-west Australia. The main points arising from the analysis are :

(1) Superrefraction is common on all Australian coasts except the north-east and is particularly strong and regular in north-west Autralia.

(2) The seasonal incidence shows a maximum in mid-winter in the north and mid-summer in the south. The transition between winter and summer maximum along the west coast is accomplished by a splitting into two maxima in spring and autumn ; along the east coast a single weak maximum is progressively delayed.

(3) Superrefraction over the coastal areas is associated with one general synoptic condition, the off-shore movement of a relatively warm and dry air mass.

(4) Superrefraction on overland echoes is due almost exclusively to night time radiation inversions. The longer range echoes, 300-500 miles, are more sporadic in occurence, but show a tendency to occur simultaneously over large areas during occasional days throughout the year, except in December and January.

Nr 12. — SOME PROBLEMS IN RADIO METEOROLOGY

by H. G. Booker.

Christ's College, Cambridge.

Refraction of radio waves of wave-length less than about ten metres in the troposphere is a phenomenon usually associated with quite steep inversions of temperature and lapses of humidity within the first few thousand feet of the atmosphere and often within the first hundred feet. A radio ray may be bent downwards with a curvature exceeding the curvature of the earth either by an inversion of temperature exceeding about 6°F/100 feet, or by a lapse of humidity exceeding about $\frac{1}{2}$ gm/kg/100 feet, or by a combination of the two. To cause marked unorthodox radio propagation these steep gradients need to be maintained through a layer of atmosphere whose thickness varies from say 50 feet to 500 feet depending on the radio wave-length under consideration. Generally speaking, the lower in the atmosphere the gradients occur the more striking is the phenomenon of radio refraction, and steep gradients at heights above about 5.000 feet are not usually of great interest.

The obvious meteorological phenomena likely to cause radio refraction are nocturnal radiation-inversions over land, advection-inversions caused by warm dry air over land moving out over sea, and low subsidence-inversions. High subsidence-inversions are not usually a direct cause of radio refraction; their presence may however indicate weather-conditions favourable to development of radiation or advection-inversions.

The meteorological problem is to specify the profiles of temperature and humidity associated with these phenomena at least with sufficient accuracy to state whether the above mentioned gradients are exceeded, and if so between what intervals of

height. Moreover it is necessary to be able to do this not merely in a special experiment but also from the ordinary data available in synoptic meteorology. It is suggested that the way to do this is to formulate a satisfactory theory of how the profiles of temperature and humidity arise, and then to check the theory carefully by experiment. The upshot should be a means of specifying the profiles in terms of parameters measuring the stability of the air, the wind-speed, and so on, and these should be ascertainable from ordinary meteorological data.

The application of the conjugate power-law theory of eddy-diffusion to the problem is described, as well as a comparison which had been made with observed profiles of temperature and humidity. The comparison, although satisfactory in some respects, seems to indicate that the profile-index involved in the theory shows more signs of depending on the degree to which the diffusion-process has developed than on the stability of the air. It is suggested that what is required is a theory in which the coefficient of eddy-diffusion increases linearly from zero at ground-level to a maximum at no great height, and then decreased again, and a way in which this might be achieved is outlined.

Nr 13. — SUMMARY OF TROPOSPHERIC EXPERIMENTS CARRIED OUT IN FRANCE

by M. Bertaux.

Laboratoire National de Radioélectricité.

Measurements have been started on propagation between Corsica and the French coast of radio waves of wave-lengths 3 metres, 20 centimetres ant 10 centimetres. Field-strength has been measured precisely only on the 3 metres wave-length and the range involved exceeds the range of the optical horizon. Meteorological measurements of the distribution of temperature and humidity are being made with the aid of an aircraft. It was found during April 1948 that periods of superrefraction occurred in association with a temperature inversion at a height of the order of a few hundred metres. The skip phenomenon, well know in connection with the ionosphere, has been observed.

In discussion Dr. Smith-Rose stated that it had been found in England that relative freedom from fading could frequently be achieved by using a range a little greater than that corresponding to optical intervisibility, although the mean level of field-strength was then lower than if an optical link is used.

Mr. Lugeon described a situation in which communication with a radio-sonde balloon was maintained on a wave-length of 3 metres in spite of an intervening mountain, the mechanism being, it would appear, reflection from a temperature-version at a heigth a little above the top of the mountain.

Mr. Millington draw attention to two types of fading that are experienced in tropospheric propagation. In one type fading is simultaneous on two different wave-lengths such as 3 and 10 centimetres and is presumably due to variations in the degree to which the refracting layer is developed. But when fading is due to interference between a ground wave and a wave reflected from an elevated temperature inversion, fading would have a marked dependence on wave-length.

Nr 14. — COMPARISON OF TROPOSPHERIC RECEPTION AT 44.1 Mc/s. WITH 92.1 Mc/s. OVER THE 167-MILE PATH, ALPINE, NEW JERSEY, TO NEEDHAM, MASSACHUSETTS

by G. W. Pickard and H. T. Stetson.

Cosmic Terrestrial Research Laboratory, Massachusetts Institute of Technology.

As only surface readings of the meteorological element at Boston and at other points on the Alpine-Needham path are available, the only definite correlations that can be given are with these surface elements, or the surface index of refraction derived therefrom. Using three years data for index of refraction and field-strength the correlation between field index of refraction was found highest for Boston index of refraction, lower for the mean of the path as a whole, and lowest for Hartford, Connecticut, which is at nearly the mid-point of the path. For this reason Boston surface index of refraction was chosen.

There are three possible modes of tropospheric transmission ; first, a general bending downward of the wave-front in the first few kilometres above the surface depending upon the mean refractive lapse rate ; second, reflection from inversion or from interfaces of air masses of different refractive index, and third, duct transmission.

Lacking three dimensional meteorological knowledge of the troposphere over the Alpine-Needham path, we can rule out duct transmission for W2XMN purely because a 7-metre wave requires a duct width of over 7 kilometres. And, as is evident from the high correlation between the lower curves of figure 1, the modes of transmission must be the same for 92.1 Mc/s. as for 44.1 Mc/s. The generally good correlation between the Alpine fields and surface index of refraction indicates that the principal control is the general lapse rate in the first few kilometres, for this is, statistically, at least proportional to surface index of refraction. High Alpine fields at times when the surface index of refraction was low, as for example on September 1 and 9 can only be accounted for by reflection from relatively low inversion layers or interfaces.

In discussion the value of 7 kilometres for the critical duct width at 7 metres was questioned : a much smaller value seemed appropriate.

N° 15. — REFRACTIVE INDEX PROFILES DEDUCED FROM RADIO OBSERVATIONS

by J. W. Green.

U. S. Navy Electronics Laboratory.

Using a theory presented by Mac Farlane (1) measurements of non optical field strengths on several frequencies under standard and non-standard meteorological conditions have been used for determining the index of refraction profiles. These theoretical profiles are compared with measured index of refraction profiles.

(1) G. G. Mac Farlane, « A method for deducing the refractive-index profile of a stratified atmosphere from radio observations », Meteorological Factors in Radio-Wave Propagation. Report of a conference held on 8 April 1946 at the Royal Institution, London, by the Physical Society and Royal Meteorological Society, published by the Physical Society, London.

N° 16. — AVERAGE RADIO RAY REFRACTION IN THE LOWER ATMOSPHERE

by M. Schulkin.

Naval Research Laboratory, Washington, D.C.

It has been found that the actual air refraction in the lower atmosphere below 18 km. deviates considerably from that which has been assumed when we use an effective radius of the earth equal to 4/3 of its actual value as an allowance for this refraction. Thus, altough the 4/3 earth's radius assumption provides a reasonably good approximation in the average case, these deviations from the true refraction have been show to be fairly large both as a function of altitude and of geographical location. The practical importance of these deviations in terms of field intensity calculations have not yet been evaluated, but they may turn out to require another type of refraction approximation which allows for the observed variations with respect to height and geographical location.

Commission Mixte de l'Ionosphère
Mixed Commission on the Ionosphere

REUNION DE BRUXELLES du 28 au 30 juillet 1948
BRUSSELS MEETING - 28th to 30th July 1948

The First Meeting of the above Commission was held at Brussels on July 28th - 30th, 1948. The following were present :

Sir Edward Appleton (Chairman) ;
Professor S. Chapman ;
Professor L. Vegard ;
Dr. R. v. d. R. Woolley ;
Dr. C. R. Burrows (Representing Dr. J. H. Dellinger) ;
Dr. M. A. Tuve (Representing Dr. L. V. Berkner) ;
Professor F. J. M. Stratton (General Secretary, I. C. S. U.) ;
Lieutenant-Colonel E. Herbays (Secretary, U. R. S. I.) ;
Dr. W. J. G. Beynon (Secretary, Mixed Commission).
Prof. Manneback (Louvain University, Treasurer U.R. S.I) ;
Lieutenant-Colonel Dorsiment (Vice-President, U. R. S. I.) ;
Dr. M. Nicolet (Institut Royal Météorologique de Belgique) ;
M. Bourgeois (Directeur de l'Observatoire Royal de Belgique).

Six sessions of the Commission were held. The subdivision of the field of work and the introductory speakers are given below.

1. Knowledge of the ionosphere by radio sounding methods.
   (Sir Edward Appleton.)

2. Knowledge of the ionosphere from studies of aurorae.
   (Professor L. Vegard.)

3. Atomic processes in the ionosphere.
   (Dr. M. Nicolet.)

4. (a) Solar knowledge relevant to the ionosphere ;
   (b) Correlation of ionospheric with astrophysical phenomena.
   (Dr. R. v. d. Woolley.)
   (Professor F. J. M. Stratton.)

5. Knowledge of the ionosphere from studies of geomagnetism.
   (Professor S. Chapman.)

6. General discussion on the work of the Commission.

Arising from the discussion at these meetings the Commission formulated the following resolutions for consideration by the appropriate Scientific Unions. (U. R. S. I., U. G. G. I., or I. A. U.)

U. R. S. I. 1. That special attention should be paid in ionospheric eclipse measurements to a search for a possible correlation between region F_2 and solar coronal emission.

U. R. S. I. 2. That, in order to facilitate comparison with meteor and other data, efforts should be made to compare sporadic E ionisation in the northern and southern hemispheres on the same basis of assessment.

U. R. S. I. 3. That, in order to complete a close network of ionospheric stations along a line of longitude and ambracing both the geographical and the geomagnetic equators, the Australian authorities should be encouraged to establish further normal incidence ionosphere sounding stations, for example, at Port Morsby and at Rabaoul.

U. R. S. I. 4. That all ionospheric stations should be encouraged to examine their data for solar and lunar tides (magnitudes and phases) for the various ionospheric layers.

I. A. U. 5. That astronomers be encouraged to measure the light-intensity/time relationship during solar flares with a view to correlating this with ionospheric and magnetic effects.

I. A. U. 6. That calcium flocculi figures be again published in the Quarterly Bulletin of Solar Data or at least made available to bona-fide ionospheric users.

U. R. S. I. 7. The Commission endorses the decision reached at the 1948 Stockholm meeting of U. R. S. I., to make a special study of individual ionospheric storms of all types.

U. G. G. I. 8. That, in view of the importance of atmospheric oscillations in the ionosphere, all types of geophysical data (e. g. meteorological, magnetic and cosmic ray) should be examined for solar and lunar daily tidal periodicities.

U. R. S. I. and U. G. G. I. 9. That a reasonably speedy publication of hourly values of the measurements made at magnetic ionospheric observatories is considered an essential part of the activities of such observatories and continues to be of great importance for the progress of ionospheric research.

U. G. G. I. 10. That the continued publication of international daily and 3-hourly magnetic character figures is of great value to ionospheric research (both C and K figures).

U. R. S. I. 11. That U. R. S. I., should be asked to consider the development of a scheme for assigning world ionospheric indices (daily or for shorter periods or both) for the various ionospheric layers.

I. A. U. 12. That, in view of the possible influence of extra-terrestrial material as a source of abnormal ionospheric ionisation the International Astronomical Union should be asked to promote the more accurate measurement of the seasonal and other intensity variations of zodiacal light.

U. G. G. I. 13. That, to promote a proper understanding of the atomic processes in the ionosphere, it is necessary to obtain auroral and night-sky spectra with better definition and greater dispersion than hitherto.

I. G. G. U. and U. R. S. I. 14. That, in view of the remarkable geomagnetic control of F_2 layer density and the know adnormal variation of the daily magnetic force in regions where the geomagnetic and geographical equators are widely separated, efforts should be made to achieve operation, for one or two years, of a chain of ionospheric and magnetic stations accross these equators near the longitude of Huancayo or in East Africa and, if possible, another chain near a place at which these equators coincide.

U. R. S. I. and I. A. U. 15. That, in view of the possibility that solar corpuscular streams are a source of ionospheric and other geophysical phenomena, attention is drawn to the need for the detection of such streams by the absorption of light or of radio waves.

U. R. S. I. 16. That special attention should be paid to the study of the D-Layer of the ionosphere by continuous vertical incidence high power measurements of the reflection of long waves or by studies of the absorption of shoter waves.

Documents - Travaux

PAPERS - WORKS

Les documents suivants ont été reçus au Secrétariat Général pendant le mois de juillet 1948.

Les Membres de l'Union, désireux d'obtenir l'un ou l'autre de ces documents, sont priés de s'adresser au Secrétariat Général.

The General Secretary's Office has received during July 1948 the following documents.

Members of the Union, wishing to receive some of those documents are requested to apply to the General Secretary's Office.

BELGIQUE — BELGIUM

Nr B/193. — **Centre de Contrôle des Radiocommunications des Services Mobiles (C. C. R. M.).**
Rapport mensuel Aé/6/48. — Juin 1948.

Nr B/194. — **Centre de Contrôle des Radiocommunications des Services Mobiles (C. C. R. M.).**
Rapport mensuel M/6/48. — Juin 1948.

Nr B/195. — **Institut Royal Météorologique de Belgique. Service du Rayonnement.** Prévisions Ionosphériques. — Septembre 1948.

ETATS-UNIS D'AMERIQUE — UNITED STATES OF AMERICA

Nr B/196. — **Central Radio Propagation Laboratory. National Bureau of Standards. F. 46.** — June 1948. — Ionospheric Data.

FRANCE

Nr B/197. — **Annales de Radioélectricité.** — Tome III. — Juillet 1948. — No 13.

Extrait du sommaire :

P. 169. — O. Dœhler : Sur les propriétés des tubes à champ magnétique constant. IIe partie. Les oscillations de résonance dans le tube à champ magnétique constant.

P. 184. — O. Dœhler et W. Kleen : Sur l'influence de la charge d'espace dans le tube à propagation d'onde.

P. 189. — M. Denis et R. Liot : Contribution à l'étude des procédés et appareils de mesure dans le domaine des ondes centimétriques.

P. 221. — P. Rivière : La liaison radiotéléphonique multiplex Continent-Corse.

P. 240. — J. Polonsky : Perfectionnements aux amplificateurs munis d'une voie à contre-réaction.

GRANDE-BRETAGNE — GREAT BRITAIN

Department of Scientific and Industrial Research. Radio Research Board.

Issued by Radio Division. National Physical Laboratory.

Bulletin C. — Monthly Bulletin of Radio Atmospheric Noise.

Nr B/198. — Measurements for July, 1947.

Nr B/199. — Measurements for August, 1947.

Nr B/200. — Measurements for September, 1947.

Nr B/201. — Measurements for October, 1947.

Nr B/202. — Measurements for November, 1947.

Bulletin B. — Monthly Bulletin of Ionospheric Characteristics.

Nr B/203. — Falkland Islands and Port Lockroy for March, 1948. Slough and Fraserburgh for April, 1948.

Nr B/204. — Falkland Islands and Port Lockroy for April, 1948. Slough and Fraserburgh for May, 1948.

Nr B/205. — **The Marconi Review.** — Vol. XI. — Nr 2. — April-June, 1948.

Abstract of Contents :

P. 54. — Fourier Transforms in Aerial Theory.

ITALIE. — ITALY

Nr B/206. — Le Consiglio Nazionale delle Ricerche a publié le Compte Rendu du Congrès tenu pour le Cinquantenaire des découvertes de Marconi.
The Consiglio Nazionale delle Ricerche has published the Proceedings of the Congress held for the fiftieth Anniversary of the Marconi's discoveries.
« Atti del Congresso Internazionale per il Cinquantenario della scoperta Marconiana della Radio. »
Editeur - Editor : Dott. Giovanni Bardi, Salita de Crescenzi, 16, Roma.

Bolletino di Documentazione Elettrotecnica.

Nr B/207. — Anno Secondo. — Gennaio-Dicembre 1944.

Nr B/208. — Anno Terzo. — Gennaio-Dicembre 1945.

Nr B/209. — **Geofisica Pura e Applicata.** — Vol. XII. — Fasc. 1-2. — 1948.

Extrait du sommaire :

P. 91. — Registratori ionosferici automatici.
P. 92. — Perturbazioni radio di origine cosmica e solare.
P. 94. — Giorni internazionale per l'osservazione dei fenomeni radio-atmosferici.
P. 95. — La conclusione dei lavori del Secondo Anno Polare Internazionale 1932-33.

Nr B/210. — **Geofisica Pura e Applicata.** — Vol. XII. — Fasc. 3-4. — 1948.

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