April 9. Warning notices were issued within a few hours of the storms' commencements.

New methods and forms for disturbance forecasts are being systematically tested. These include general forecasts of SID, forecasts of conditions on specific radio circuits, general 24-hour forecasts (as contrasted with disturbance warning notices), and forecasts based on various individual solar-geomagnetic conditions.

14.1/9. Cosmic Noise Directivity

The 32-foot mirror on an altiazimuth mounting was originally designed to turn down to an altitude of 12°. In view of the fact that important parts of the sky are near the southern horizon, it was decided to make alterations in the turntable so that the mirror could point to 0° altitude. This work is now in progress. The electronic equipment for this machine is under consideration. Due to the fact that the high-frequency spectrum is well filled with stations, the frequency at which a galactic survey can be made has not yet been determined.

14.1/10. Rehabilitation of Wurzburg Equipment

All of the available giant Wurzburg machinery has been assembled and is in operating order. The excess material (20 tons) has been scraped and removed as junk. Aside from certain minor operating difficulties, which are gradually being ironed out, this project is complete.

14.1/11. UHF Radiometer for Solar Noise

Collection of data has continued at 480 Mc. A second machine at 160 Mc was put into operation, and a substantial quantity of data was secured. The initial results at these two frequencies were described by Grote Reber at the American Astronomical Society during its summer meeting at Ottawa, Canada, on June 22, in which talk the special observations of May 10 (see Project 14.1/5) were also described. Some interference is being encountered between the fourth harmonic of the 40-Mc meteor set and the 160-Mc solar radiometer. Consequently, some consideration is being given to moving the frequency of the solar radiometer slightly in the hope of eliminating this situation.

The third radiometer was completed and put into operation at 53 Mc. Interference on this machine caused by the second harmonic of the 27-Mc meteor transmitter made it impossible to operate both of these equipments simultaneously. A try was made at 62 Mc, but interference was encountered from the television transmitter in Baltimore on channel number 2. Since a frequency band of at least a few megacycles is desirable for the operation of solar radiometers, the exact frequency at which this machine will ultimately be used will depend upon the results of a survey now being made.

Computations on echo-delay data, furnished by Section 14.5, indicated that, for reasonable assumptions of the height of the reflecting layer, approximately 30 to 55 hops were necessary to explain the observed delays. Corresponding values of the angle of ionospheric incidence lay between about 80.4° and 76°, while corresponding values of angle of arrival lay between about 3.6° and 10.6°, the former value being in good agreement with that usually taken as the lower limiting practical value for high-frequency radio transmission.

A number of graphs showing diurnal, seasonal, and frequency variations of attenuation coefficient over various transmission paths, together with nomograms for solving low-frequency transmission problems, and graphs showing diurnal, seasonal, and frequency variations of radio noise, were prepared for the Provisional Frequency Board at Geneva.

Values theoretically proportional to low-frequency radio noise received from the surrounding hemispherical area, if it may be assumed that the monthly mean intensity of emitted noise is proportional to the probability of occurrence of thunderstorms, were computed for all months, at two hours of the day, and for three frequencies, for Washington, D.C. These values are for comparison with observed values of radio noise at these times and frequencies, obtained by Austin. Similar computations were in process for comparison with noise data observed at London by the Bell Telephone Laboratories.

14.1/7. Special Arctic Phenomena

Work on this project has, so far, been confined to study of literature and planning for operations. A bibliography on radio propagation in Arctic regions was prepared, a copy of which was sent to the Office of Chief Signal Officer.

14.1/8. Disturbance Forecast and Warning Service

This service, consisting of (1) semiweekly radio disturbance forecasts, published weekly in CRPL-J reports, (2) semihourly disturbance warning notices broadcast on WWV, and (3) compilation of reports of solar and geomagnetic activity was continued.

There were three important geomagnetic disturbances and several minor ones during April, May, and June, 1949. The most severe, May 12-13, which disrupted communications generally, was associated with an active solar region near the sun's meridian. The forecast 6 days before proved correct, and a warning notice was broadcast several hours before communication circuits were affected. The disturbance of June 4-6, associated with a less clearly active solar region, was missed in the regular forecast, while a disturbed period beginning April 7-8 had been expected

Miscellaneous Activities

Procedure for processing ionospheric data by punch-card methods has advanced significantly. This will afford a means of analysis and tabulation of observational data by machine methods with considerable reduction in the use of personnel.

The Illinois Institute of Technology conferred upon Grote Reber its annual award for distinguished scientific achievement at the Alumni meeting held May 20.

D. K. Bailey and R. C. Kirby continued to serve as technical advisors to the American Delegation to the Provisional Frequency Board in Geneva.

Mr. T. N. Gautier served as technical advisor to the American Delegation to the Fourth Inter-American Regional Conference of the International Telecommunications Union, meeting in Washington.

A. G. McNish and A. H. Shapley participated in the Conference on Ionosphere Research held at State College, Pa., June 26-29.

A. G. McNish served on the panels on Basic Research, Terrestrial Magnetism and Electricity, and Land Navigation of the Research and Development Board, and on the Arctic Ionospheric Advisory Committee.

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Routine measurements were made as frequently as possible on the signals from marine beacon "K" (290 kc) at Cape Henry, Virginia, and from CFH (115 kc) at Halifax, N.S. These measurements showed sunset effects which need further investigation.

14.5/11. Cosmic Radio Noise

Operation of cosmic noise recorders on the frequencies of 25, 50, 75 and 110 Mc was maintained during the quarter. Reduction of the raw data on the recorder charts to curves of noise intensity vs time was kept current. The radiation resistors of an experimental 110-Mc dipole antenna was measured to determine whether or not the radiation resistance had changed during the winter and spring months because of changes in the electrical characteristics of the ground. Within the accuracy of measurement the radiation resistance was the same value as measured in November 1948.

A screen one wavelength on a side was placed under the experimental 110-Mc antenna system which consists of a half-wave dipole, one-quarter wavelength above ground. Measurements of the radiation resistance of this arrangement were being made at the end of the quarter. It was proposed to make simultaneous comparisons of received cosmic noise intensity using this experimental antenna and the standard recording antenna.

A fifth recording system for 35 Mc was completed and preliminary tests of its performance were being made. A technique for stabilizing the gain of the preamplifier-converter by stabilizing the dc plate currents of the electron tubes used in this unit gave indications of improved performance.

14.5/13. Effects of Meteors on Radio Wave Propagation

A range-time cathode-ray tube presentation with a moving-film recording camera was set up for simultaneously obtaining meteor counts on several frequencies. This instrument was operated to obtain data on 2 channels, 27 and 40 Mc, on a 12-hour-per-day basis during the last month of the quarter, in conjunction with transmitting and receiving equipment associated with this project.

Work was being done to replace the 27-Mc transmitter unit with a similar unit having higher power and also to complete a new transmitting and receiving system for 54 Mc.

A camera-recorder unit to measure relative intensities of meteor reflections on any two frequencies was completed but not completely tested.

14.5/15. Standard Direction-Finder Measurements

The report "Standard Direction Finder Measurements, Provisional Draft," dated March 12, 1945, was reproduced as "Standard Direction Finder Measurements, Second Provisional Draft", dated March 30, 1949.

The results of the measurements indicated that the receiver with back bias was considerably superior to the other receivers from the standpoint of pulse reception through cw jamming. At some levels an improvement as great as 20 db was realized.

Further progress was made in the design of receivers having stable gain characteristics. A technique for stabilizing the gain of the rf stages was developed by the use of current feedback and by operating the tubes at reduced transconductance. It was found that the inherent stability is much improved at low transconductance because of the lower slope of the cathode current vs transconductance curve of the tube. The technique of operating the tubes at reduced transconductance was also applied to the if. feedback couples and resulted in a substantial increase in gain stability with variable supply voltages and changes in tube characteristics. A narrow-band (6-kc) feedback amplifier mentioned in the previous quarterly report was constructed and its performance was found to be satisfactory.

Techniques were developed for hermetically sealing the iron-core i.f. transformers. The stability of the converter stage was substantially improved by including the converter as the first stage of a feedback couple.

Work was in progress in assembling an experimental model of the complete receiver.

14.5/10. Differential Phase Variation at LF

A thorough check of the system was made to determine the nature and magnitude of errors in the measured phase caused by:

(a) Deviation of beat frequency between received signals and the local oscillator.

(b) Amplitude of the beat frequency wave.

(c) Detuning effects in the receiver.

(d) Settings of the af and rf gain controls.

(e) Percentage modulation of local oscillator for most accurate measurements of the reference phase.

An improved technique for operating the system was developed as a result of these tests. Also an indication was obtained that the present accuracy of the phase measurements is within approximately plus or minus 1.5 degrees.

The audio-frequency manual phase shifter was recalibrated using standard audio frequencies at station WWV.