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Radio Astronomy. - To more completely understand the nature of cosmic noise a program in radio astronomy was instituted in the closing month of the previous fiscal year. The various projects may be divided into two classifications, namely, those dealing with radio waves generated in the sun, and those dealing with radio waves generated in the milky way.

The first solar radiometer with a mirror 25 feet in diameter was installed on an equatorial mounting, so that it might readily track the sun; it is in daily operation measuring the intensity of solar radiation at a frequency of 480 Mc/s. Outbursts of radio energy from the sun were observed on a number of occasions. The second of these machines was erected and will operate at 160 Mc/s. A third radiometer is planned for use at a still lower frequency.

The milky way experiments will use a mirror approximately 32 feet in diameter which has previously been used to conduct surveys of the galaxy at 160 Mc/s and 480 Mc/s. This mirror is being reinstalled upon a turntable to give it an alti-azimuth mounting for use in surveying the milky way at other frequencies.

These celestial radio waves manifest themselves as frying and hissing noises and are apparently of a natural origin. They impose limitations on the range and minimum usable signal levels of services using the very high frequency range including frequency-modulation broadcasting, television, and the communications and radio navigation services.

Radio Propagation in the FM and Television Bands. - With the advent of frequency modulation and television broadcasting, it has become increasingly important that the modes of propagation of such signals be studied with the object of providing a quantitative and objective basis for the allocation of frequencies to these services. The high-powered emissions of regularly operated FM broadcast stations provided an excellent source of signals to be studied at long distances and recordings of field intensities of FM broadcast stations operating in the vicinity of 100 Mc at distances as large as 150 miles were measured at the Bureau. It has been found that the condition of the atmosphere as regards its refracting, reflecting and wave-guiding properties becomes very important in determining the strength of signals received, particularly at the greater distances. The variations in the elevation of the terrain and location and size of buildings in the propagation path are also important. These very high frequency signals received at the longer distances fade at times in the same manner as the lower frequency signals transmitted by way of the ionosphere. Studies of the characteristics of this type of VHF fading have led to the conclusion that the received signal is actually a combination of signals arriving over a number of different propagation paths. At other times the received field intensities are extremely strong and steady as might be expected if the signals were guided around the surface of the earth by the waveguide action of an atmospheric duct. Results of these studies have proven useful in determining the limits of the service range and the range at which interference will be caused to other stations operating in this portion of the spectrum; this type of information is vital for the allocation of these frequencies on a sound engineering basis.

High-Power Pulse Transmitter. - A high-power pulsing transmitter was built for use in experimental studies of radio transmission by the Bureau itself and by other agencies performing special experiments requiring a source of special high-power emissions. Radar-like pulses with a peak power of about 250 kw are emitted on a high frequency (about 13660 kc) which affords long-distance sky-wave propagation via the ionosphere. The energy is beaméd westward by means of a directive antenna at the Sterling, Va. laboratory.

These emissions were picked up periodically at U. S. Navy Electronics Laboratory at San Diego, Calif., in the form of groups of pulses which indicated the modes by which radio waves are propagated across the continent at different times and seasons. Relative travel times and intensities of the modes were made visible in a cathode-ray oscilloscope. At Alamogordo, New Mexico, A Boston University group working for the U.S. Air Force used the Sterling emissions for a comparison of radio reception in the V-2 rocket with reception on the ground.

At the Bureau a study of energy returned along the beam, known as "back-scatter", was made. Back-scatter is energy returned to the site of the transmitter by a phenomenon similar to diffuse reflection. In any given case the returned energy is received as a mass of rapidly varying spikes indicating that the back-scatter originates in a large area composed of many scatter sources for which the path lengths are continuously changing relative to each other, producing an effect analogous to the twinkle of stars.

An attempt was made to determine to what extent the ground and to what extent the E-layer of the ionosphere is the source of back-scatter. Evidence of scatter from both regions has been present but at the distance to Alamogordo ground scatter seems most prominent, as determined by use of a transponder (corresponding to an "i.f.f." used in radar).

Construction of a new, more stable transmitter is under way and it is planned to make more exhaustive studies of the phenomena already noted.

Differential Phase Variation at Low Frequency. - In this project an experimental radio-phase-measuring system similar to a radio-navigation system was set up in the field for the purpose of determining the errors in low-frequency radio-navigation systems caused by propagation phenomena as distinguished from instrumental errors. Two mobile receiving units were set up at the ends of a base line about three miles long with a control station in a truck near the middle. Radio-frequency waves from distant transmitters received at each end are converted to audio frequency, their relative phases being preserved. These audio-frequency tones are transmitted via FM to the central control truck