

Air Force Contract No. AF 19(604)-1089

Quarterly Report No. 2

For Period July 11 to September 10, 1954

This report briefly describes the progress made at the Geophysical Institute of the University of Alaska during the past three months, in the study of arctic radio wave propagation under the Air Force Contract No. AF 19(604)-1089.

Task No. 1 Study of ionospheric back-scatter from 5 to 25 Mc/s.

No progress owing to lack of equipment.

Task No. 2 Study of auroral reflections at 100 Mc/s and higher frequencies.

(a) At 100 Mc/s. The SCR-270-DA radar set has been modified as suggested in the previous report, with a resultant very considerable increase in overall sensitivity (for example, fixed echoes are now received at all azimuths up to ranges of at least 150 Km). During the next quarter it is planned to make measurements of the effective reflection coefficient of certain of these fixed features (e. g. Mt. McKinley 250 Kms S. W. of College).

Previous to the advent of the August Perseid meteor shower, the radar antenna was converted to give the narrow horizontal beam width needed for the determination of meteor radiants. During the shower, observations were made in order to determine the effect of the aurora upon the meteor echo rate. Whilst the observations appear to show an enhanced meteor rate during aurora, the results were not conclusive, and further tests are planned for the Orionid and Taurid showers of October and November.

radar echoes, an observing tower has been erected at the radar site. Large windows on all sides permit photography of the visible forms. Visual observations have been made on many nights and good photographs of the aurora have been obtained on six nights. The analysis of the correlation between the visual and the radar data is not complete, but it is already clear that though there have been times when the correlation was excellent, there have also been occasions when there was no apparent relation between the visible forms and the radar echoes.

(b) Above 100 Mc/s. A study of antennas for 900 Mc/s work was made and two suitable designs erected and their polar diagrams measured. The rhombic antenna procured for this frequency did not prove satisfactory.

The narrower beam of the antenna has made possible a considerable increase in the detail of the P. P. I. pictures of auroral echoes. One common type of echo, seen most often during the early and late hours of a display, is a long straight line running approximately in an East-West direction. This type of echo suggests that the reflection arises from an auroral "arc".

One very interesting point is that there has never been a night (since the equipment has been operated at its increased sensitivity) when auroral echoes have not been obtained. Observations have been made on many so-called "quiet" nights as well as disturbed nights since late July. This would suggest that aurora has been present every night.

With a view to checking the correlation between visible aurora and the

A pre-amplifier for use at V. H. F. was designed and built but failed to operate satisfactorily above 700 Mc/s. Preliminary tests are now being made using an APR-4 receiver (without R. F. amplifier) and a pulsed 900 Mc/s signal.

Task No. 3 Propagation studies on existing 7000 Mc/s link.

No pen recordings have been taken on this link during this quarter.

It is planned to renew observations during the winter months.

Task No. 4 The prediction of auroral and ionospheric storms.

The collection of data on auroral and ionospheric storms is continuing.

and includes visual and radar observations of aurora, radio absorption measurements, magnetic and earth current data, and analysis of the occurrence of polar blackouts on the GJ ionospheric sounding equipment at College.

Task No. 5 Study of Whistlers

The amplifier plus associated circuitry and loop antenna described in the previous report have been placed in the woods several hundred yards from the Campus proper, at a point which previous tests have shown to possess a suitably low interference level. A pair of field wires connects the amplifier with listening apparatus in the Institute building. These wires are also used to supply D. C. power to heat the battery-operated amplifier as a protection against the low temperatures. The apparatus is in operation,

and spot checks for "Whistler" Activity have been made at various hours of the day and night. A total of about 5 hours of listening time has been logged, as yet no whistlers have been heard. Further checks are planned, particularly during magnetic storms and auroral activity.

Other Work

1. Investigation of Existing Communication Systems.

Records of the transmission loss on one of the existing AN/TRC links are being taken on a routine basis. The comparison of the records with B curves prepared from radio-sound data taken at one terminal is continuing.

2. Investigation of Unusual Propagation Paths.

Following preliminary observations made during July, an electrically-rotatable direction-finding antenna for Channel 11 television was erected at Lake Minchumina at the end of August. This antenna consists of two bays of five-element Yagi antennas stacked four high. A reversing relay in the feedline of one side of the array allows the two halves of the antenna to be operated in anti-phase, so that the operator can achieve maximum accuracy by orienting the antenna for a minimum signal. The direction measurement can be reproduced with an accuracy of about one degree. A relative signal-strength meter has been provided on the existing TV receiver.

In addition to the above direction-finding equipment, an APR-4 receiver with a fixed antenna and pen recorder is used to monitor continuously the strength of the 200 Mc/s picture signal.

The TV signal is generally present, seldom deviating more than 50 percent in amplitude or ± 1 degree in bearing. However, varying troposphere conditions appear to influence the signal strength. Two unusual effects have been noticed. Firstly, the signal occasionally undergoes a slow decrease to a small fraction of its normal strength and returns to normal within about an hour or so. This is accompanied by a large shift in the bearing as observed with the direction-finding antenna. Secondly, there is a slow change throughout the six-hour broadcast period each day which shows correlation with the Anchorage tides. This can be explained by the interference between the direct ray and the ray reflected from the water surface of Knik Arm.

3. Conference on "Quality Control" as applied to Radar Performance.

Members of the Geophysical Institute staff have continued to work in close cooperation with local Air Force personnel and have been available for discussion and advice as requested. Two members attended by invitation, an unclassified conference with the above title held at the Elmendorf base at Anchorage on September 21, when Dr. Little spoke on Tropospheric Propagation as applied to communication and radar quality control, and Mr. Leonard described some of the auroral radar observations at the Geophysical Institute. Mention was also made of the parts played by diffraction effects, solar radio noise, and auroral radio noise emissions and echoes as factors affecting radar performance.