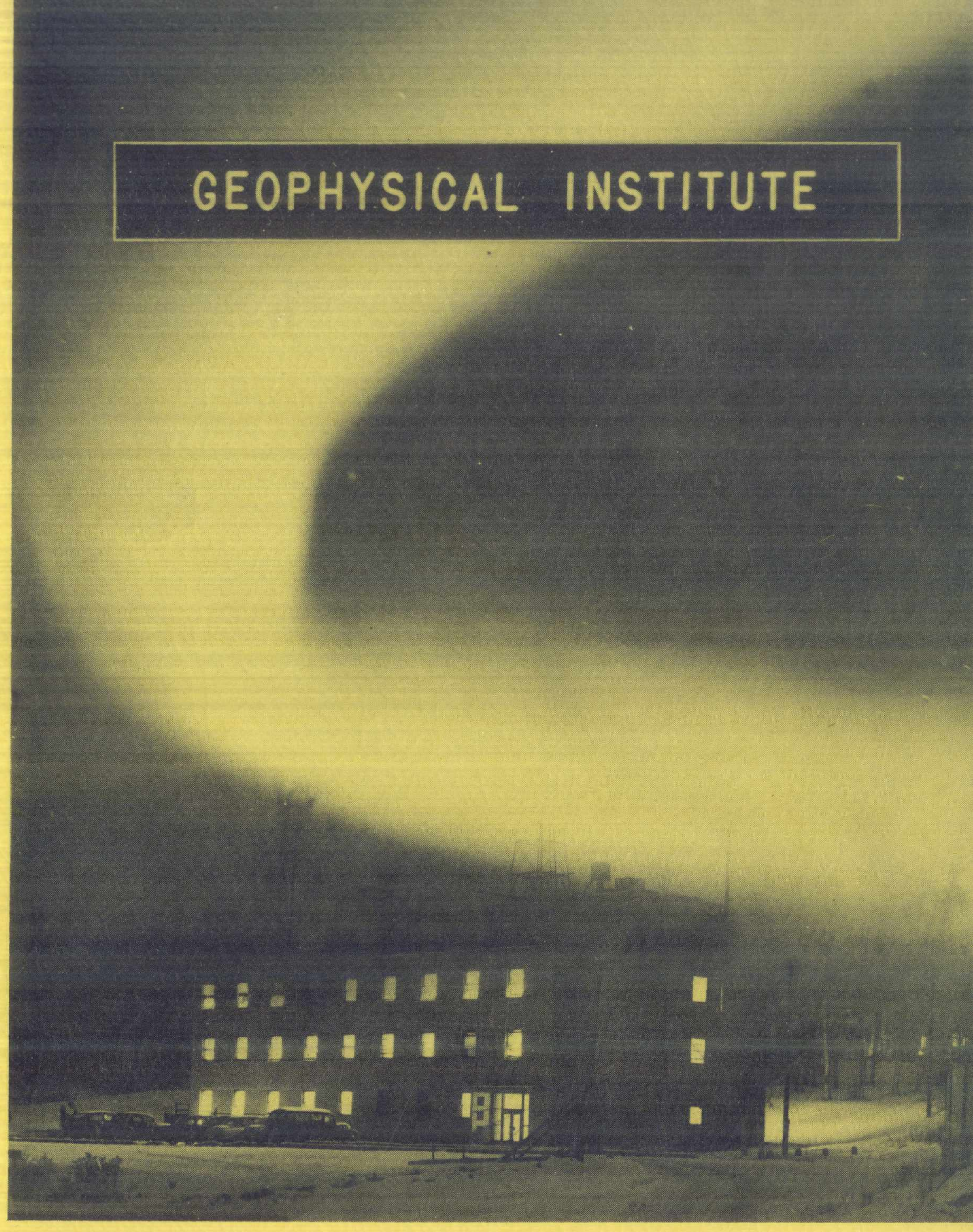

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RADIO PROPERTIES OF THE AURORAL IONOSPHERE

Supplementary Progress Report
August 1958

Air Force Contract No. AF 30(635)-2887
Project No. 5535 - Task 45774

Rome Air Development Center
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GEOPHYSICAL INSTITUTE

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RECENT ANALYSIS OF ANGULAR SCINTILLATION INFORMATION ON 223 MC.

The following results supersede the corresponding information presented in Quarterly Progress Reports Nos. 1-5, 7, 8, Section II, pages 18-24, which relates angular scintillation to amplitude scintillation at 223 Mc. These results are based on 69 hours of data, selected for consistent, normal behavior within each hour examined. The previous results were based on only 22 hours of data, many of which did not exhibit the characteristic consistent amplitude scintillation magnitude within the hour which was typical of a particular index. Selection was necessary because of the limited amount of total information available and because consistency is especially important for the lower indices.

In treating the angular scintillation data, the effect of the small noise component always present in the recordings must be considered. The measured time of crossing the zero level will coincide with the actual time only if the noise happens to be zero at that instant. In order to take the noise into consideration, the antennas were replaced with 50 ohm termination resistances for a period of three minutes every hour, during which the pen recorder traced only the noise due to the equipment. The noise record for each hour was examined, and measurements of instantaneous noise amplitude were made at regular intervals. These values were then converted to equivalent angular scintillations which can be regarded as superimposed on the angular scintillations of the source itself.

To obtain the source scintillation (rms) for each hour, the noise scintillation (rms) was calculated and subtracted from the measured total angular scintillation (rms) by using the following relationship, which can be derived from elementary considerations:

$$(\Delta\theta_{rms})_{source} = \sqrt{(\Delta\theta_{rms})^2_{total} - (\Delta\theta_{rms})^2_{noise}} \tag{1}$$

This calculation was carried out for each hour examined. The mean and standard deviation of all the hourly values associated with the same index number were then computed and the results are plotted on a semi-log scale in Fig. 1.

Recalling that the amplitude index numbers (n) were chosen so that the mean amplitude scintillation ($\overline{\Delta A}$) for each index number was approximately twice that of the preceding lower index number, we can write:

$$(\overline{\Delta A})_n = 2\,(\overline{\Delta A})_{n-1} \tag{2}$$

or

$$(\overline{\Delta A})_n = 2^n\,(\overline{\Delta A})_o \tag{3}$$

and since

$$2^n = e^{n\ \ln 2} = e^{0.69n} \tag{4}$$

equation (3) becomes

$$(\overline{\Delta A})_n = (\overline{\Delta A})_o\ e^{0.69n} \tag{5}$$

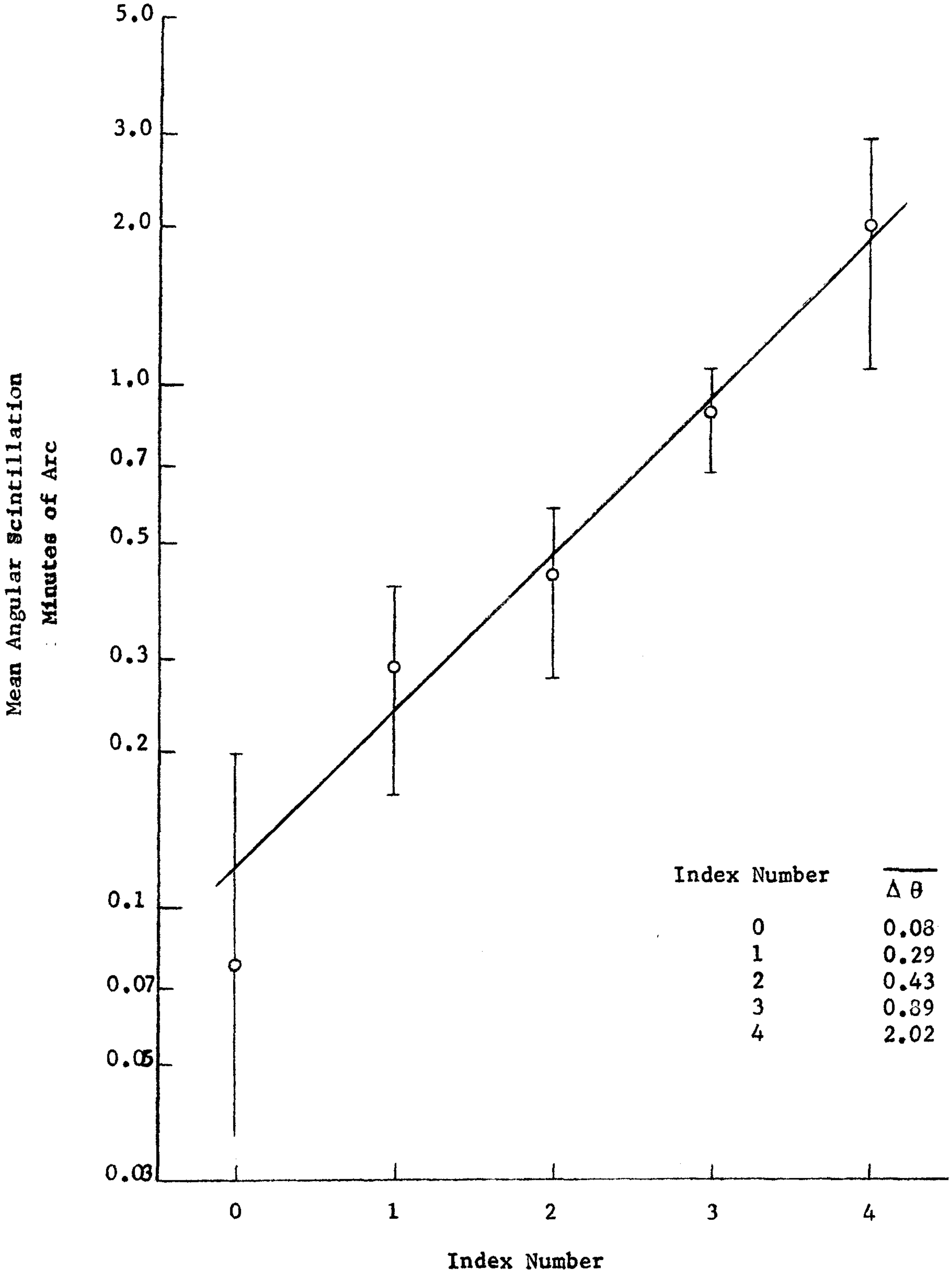

Fig. 1. Mean Angular Scintillation As A Function Of Index Number at 223 Mc

If, for small scintillations, the angular scintillation, $(\Delta\theta)$, is assumed to be proportional to the amplitude scintillation, we can write:

$$(\overline{\Delta\theta})_n = (\overline{\Delta\theta})_o \; e^{0.69n} \qquad (6)$$

where $(\Delta\theta)_o$ is the mean amplitude scintillation for index 0. A line with the slope given in equation (6) is drawn in Fig. 1 through the values plotted from the data; this line lies well within the standard deviation limits for each index.

In general, the large standard deviations are to be expected in view of the fact that each index contains a large range of scintillation amplitudes. The greatest amount of uncertainty is associated with the results for index zero because the signal-to-noise ratio was close to unity for this index.

In Fig. 2 is plotted, for each index, the probability of occurrence of angular scintillation greater than a certain value (plotted on the abscissa). These curves differ significantly from the corresponding set of the previous report not only in the manner of interpretation but also in the information contained.

It should be emphasized that the above results refer only to a frequency of 223 Mc. Similar work on 456 Mc is in progress although the available data are not yet as extensive as those for 223 Mc.

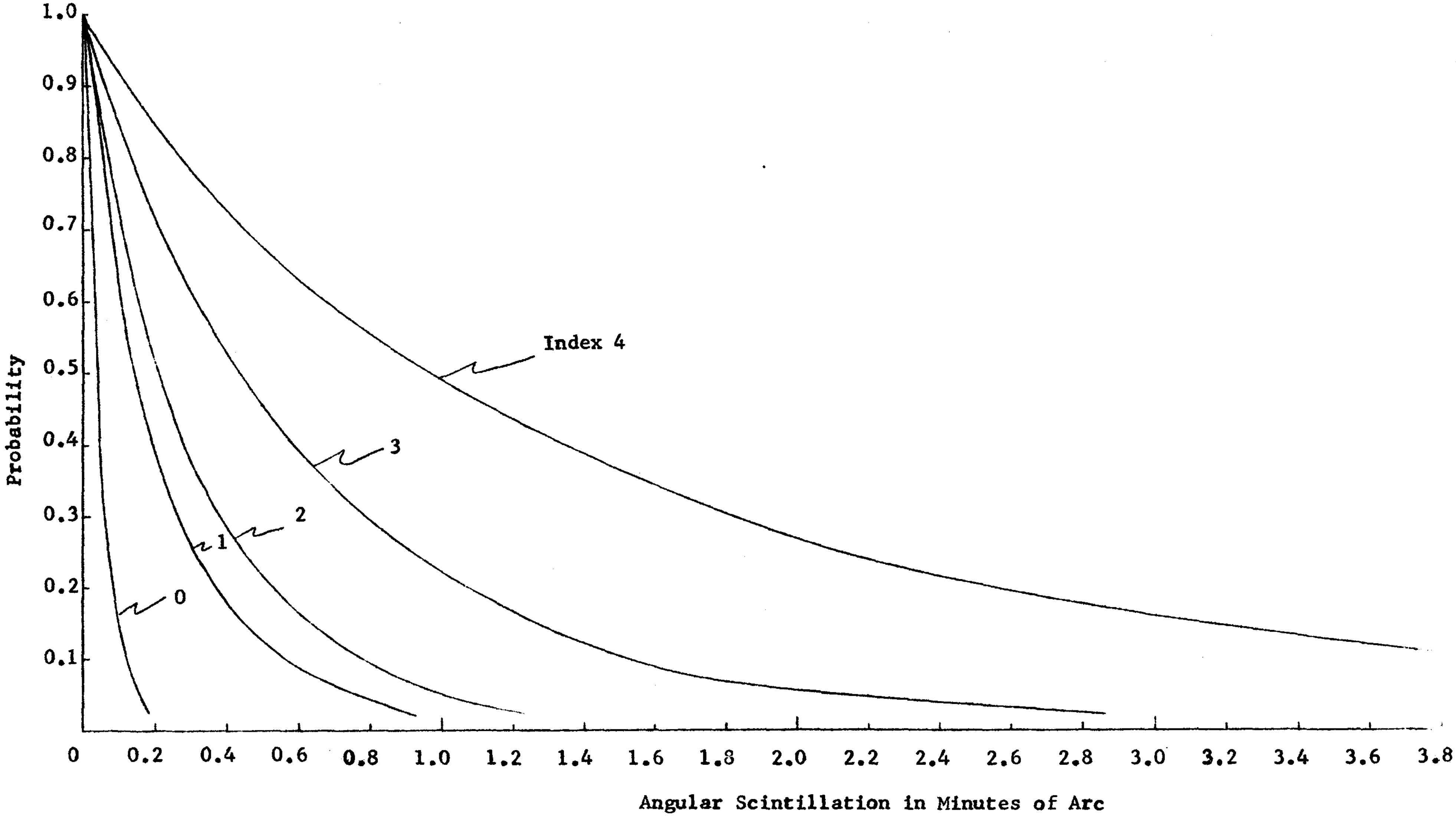

Fig. 2. Probability of Occurrence of Angular Scintillation at 223 Mc Greater than a Particular Value.