NRL Report 6829

Amplitude Scintillation at Randle Cliff Derived from ATS-1 Transmissions

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March 17, 1969

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CONTENTS

Abstract	ii
Problem Status	ii
Authorization	ii
INTRODUCTION	1
DATA ANALYSIS	1
DISCUSSION	1
CORRELATION WITH SPREAD F	2
CORRELATION WITH SPORADIC E	2
CORRELATION WITH MAGNETIC ACTIVITY	2
NIGHT VERSUS DAY DATA	3
CONCLUSIONS	4
FUTURE PLANS	4
REFERENCES	4

ABSTRACT

An amplitude scintillation analysis of vhf radiowave transmissions from the geostationary satellite ATS-1 has been conducted. It has been found that the amplitude scintillation activity is generally less intense during the day than during nocturnal hours. In fact, the present 1967 summertime data indicate that the full scintillation condition is 50% more likely to occur during nighttime than during the day over Randle Cliff. The data have been compared with the Fort Belvoir ionosonde data, and, as expected, point-to-point correlations are inconclusive. Nevertheless, the trend of the data compares more favorably with the diurnal pattern of sporadic E over midlatitudes than the spread F condition.

PROBLEM STATUS

This is an interim report on one phase of the problem; work on the problem is continuing.

AUTHORIZATION

NRL Problem R02-05
Project RF 001-02-41-4001

Manuscript submitted October 22, 1968.

AMPLITUDE SCINTILLATION AT RANDLE CLIFF DERIVED FROM ATS-1 TRANSMISSIONS

INTRODUCTION

During the Spring and Summer of 1967 (April 7 through August 15) 137.350-MHz transmissions from the synchronous satellite ATS-1 were received at Randle Cliff (38°39'37"N, 76°32'9"W). These data were analyzed for changes in Faraday rotation which have been associated with changes in the ionospheric electron content. This report is restricted, however, to the presentation of the shorter-period amplitude scintillation effects which are for the most part due to the motion of ionospheric inhomogeneities.

The principal motivation for studying the scintillation of vhf radio waves has long been to deduce the causal mechanism, i.e., the nature of irregularities which give rise to wavefront distortion. Generally one tries to associate certain geophysical effects with the appearance of scintillation. The two readily measurable parameters which describe the character of radiowave scintillation are the scintillation rate and some convenient scintillation amplitude index. The rate (for the synchronous satellite case) should be an increasing function of the speed with which the turbulent eddies or irregularities move, whereas the scintillation amplitude is by and large associated with the size of the irregularities as well as their fractional density variation. In this report the maximum fading depth (in decibels) is compared with sporadic E and spread F occurrence in addition to magnetic activity. Scintillation rates have not been measured as yet.

DATA ANALYSIS

Strip chart recordings of the ATS-1 transmissions were partitioned into equal segments having a time duration of 10 min, and within these intervals the maximum depth of scintillation (largest maximum minus the smallest minimum) was measured. These measurements were made with an accuracy of about ±1 dB and the diurnal patterns are represented by Figs. 1 through 93. To examine the possible effect of severe magnetic activity on the scintillation depth a particularly stormy period (May 25 through June 7) has been plotted and appears as Fig. 94a. Separate composite plots for periods of observation during April, May (exclusive of May 25 through May 31), June (exclusive of June 1 through June 7), July, and August are represented by Figs. 94b through 94f, respectively.

The occurrence of spread F and sporadic E as evidenced by the Fort Belvoir ionosonde has been noted, and the former is signified on the individual diurnal data plots (Figs. 1 through 93) by the letter F at the top of each graph. Plots of foEs (which are companion to Figs. 94a through 94f) are displayed as Figs. 95a through 95f.

DISCUSSION

Due to the density of the data points and a general tendency for the data points corresponding to periods of severe scintillation activity ($\geq$20 dB) to be distributed almost randomly with respect to solar zenith angle (time of day), it is difficult to extract much meaningful information from the composite charts. Nevertheless, if one's imagination is

used, one may discern from the magnetically active period composite (Fig. 94a) both a morning and a late afternoon paucity of data points corresponding to a scintillation depth in excess of 10 dB. During April (Fig. 94b), this effect shows up more clearly due to the fact that the population of "saturated" scintillation depth intervals is clearly diminished. During quiet days in May and June (Figs. 94c and 94d, respectively) and during July and August, a similar tendency is revealed although more subtle. On the basis of these results, one may conclude that two general regions of amplitude scintillation exist — one centered around midnight and the other centered around midday. The existence of two such regions has been detected by Aarons, et al. (1), and has also been noticed by Lawrence and Martin (2). It is generally accepted that scintillation is predominantly a nocturnal phenomenon, although a secondary midday maximum may exist. Aarons, et al. (1), imply that the midday maximum may be related to sporadic E, and an other than circumstantial relationship between scintillation and spread F (a nocturnal effect) is felt to exist according to most investigators.

CORRELATION WITH SPREAD F

A cursory inspection of the diurnal plots of scintillation depth on which are noted the spread F occurrences indicates that the correlation is not high on a point-by-point basis, even though it does indeed exhibit a maximum probability of occurrence during the midnight to 6 a.m. period. The fact that there is no point-to-point correlation is not surprising since the earth projection of the ionospheric point (referenced to a height of 400 km) is some 1700 km from the Fort Belvoir ionosonde for a Randle Cliff elevation angle of ~5 degrees. It is noteworthy that the scintillation activity during premidnight hours is reasonably high on the average but that spread F (via the Fort Belvoir ionosonde) is virtually absent before midnight. Consequently any strong relationship between spread F and the occurrence of amplitude scintillation appears to be lacking. Even if the amplitude scintillation which occurs between noon and 6 a.m. EST is caused by spread F irregularities, they are probably confined within patches which are less than several thousands of kilometers in horizontal extent.

CORRELATION WITH SPORADIC E

Plots of scintillation depth versus the sporadic E critical frequency parameter foEs have been made for each day of observation, and an inspection of these plots implies that there is no obvious correlation between the occurrences of sporadic E patches and the growth of scintillation on a point-to-point basis. Due both to their bulk and generally uninteresting character, these graphs are not included in this report. They will, however, be kept on file in case it is subsequently viewed that further analysis is warranted.

It is rather interesting that the composite plots of foEs (Figs. 95a through 95f) do, as a group, exhibit daytime and nighttime maxima in terms of the highest values recorded. In terms of minimum values of foEs, there is clearly a midday peak in the number of occurrences. Hence, the circumstantial correlation between large values of sporadic E critical frequency and amplitude scintillation is rather good. This is in agreement with some earlier results (3).

CORRELATION WITH MAGNETIC ACTIVITY

There appears to be little or no correlation between the depth of scintillation and the magnetic activity index A_{FR} derived from the Fredericksburg magnetograph. Figure 96 shows the maximum scintillation depth for both daytime (6 a.m. through 6 p.m. EST) and

nighttime (6 p.m. through 6 a.m. EST) periods for May plotted against the daily Fredericksburg index A_{FR}. This month exhibits the greatest excursion in magnetic activity, but there is obviously little or no relationship between the maximum daily scintillation depth and magnetic activity. The other months also showed no definite relationship. On the basis of an analysis of Transit 4A, 54-MHz transmissions, Aarons, et al. (1), have deduced a latitudinal pattern which suggests that for $K \geq 4$ (i.e., $A_{FR} \geq 27$) one would anticipate little enhancement in the scintillation depth over that value which is associated with $K \approx 0$ (i.e., $A_{FR} \approx 0$) for the Rangle Cliff latitude. Present results do not disagree with this anticipated result.

Although a scintillation rate analysis was not made, it appears that a relationship does exist between scintillation rate and magnetic activity. During periods of magnetic storms, the rates were observed to be somewhat higher. It would appear then that at the Randle Cliff latitude (38°39'37"N) additional irregularities may be produced, but their fractional density variation, which controls the scintillation depth, is not enhanced appreciably. It is possible that already existing irregularities are accelerated during magnetically active periods, giving rise to an increase in the scintillation rate without a corresponding increase in scintillation depth.

NIGHT VERSUS DAY DATA

Table 1 shows the amplitude distributions for the periods of observation in the months of April, May, June, July, and August, respectively, and Fig. 97 illustrates that nocturnal scintillation is generally more intense. We see that the full scintillation condition (≥20 dB) is about 50% more likely to occur during nighttime than daytime. Again the interpretation of this in terms of spread F irregularities is not too clear.

Table 1
Amplitude Distributions of Maximum Scintillation Depth

Month	Number of Amplitude Distributions for Several Maximum Scintillation Depths				
	≥ 0 dB* (Day/Night)	≥ 5 dB (Day/Night)	≥ 10 dB (Day/Night)	≥ 15 dB (Day/Night)	≥ 20 dB (Day/Night)
April	24/24	14/13	3/7	1/1	1/1
May	28/29	24/26	13/22	8/17	7/15
June	11/10	11/10	11/9	9/9	8/9
July	9/7	9/7	9/7	8/7	6/7
August	12/10	12/10	11/8	9/6	5/4

*The numbers in this column represent the total number of daytime and nocturnal periods for which the amplitude distribution was derived. The maximum number for both day and night should be 30, 31, 30, 31, 31, respectively, for April, May, June, July, and August. The numbers are less due to lack of sufficient data. Clearly the number in succeeding columns will be monotonically decreasing since restrictions are being placed on the amplitudes.

CONCLUSIONS

The important points to be extracted from these data are the following:

1. The depth of amplitude scintillation does not exhibit a high correlation with spread F, sporadic E, or magnetic activity on a point-to-point basis.

2. The diurnal pattern of scintillation depth does correspond (although not closely) with the diurnal pattern of sporadic E but does not correspond to the pattern of spread F (except possibly between midnight and dawn).

3. Nocturnal scintillation is more intense than the daytime variety.

These results should, of course, be qualified. For example, it must be emphasized that these data were obtained at an exceedingly low elevation (approximately 5 degrees). This suggests that tropospheric scintillation effects might have a tendency to mask out some of the ionospheric dependence. Also, due to the low elevation, it is felt that ground reflections may interfere with the direct path to some extent. However, since the beam was static, this could only be brought about by variable defocusing, which is produced by the turbulent medium. In addition, it is recognized that the ionospheric points corresponding to the E_s layer and the F2 maximum are located, respectively, at distances of approximately 500 and 1375 km to the west of the Fort Belvoir Ionosonde.

Hence, we didn't anticipate a good point-to-point correlation of the parameter foEs or spread F (as measured by the Fort Belvoir station) with the advent of scintillation activity, which presumably arises from a "turbulent" region farther west.

FUTURE PLANS

The nature of this type of experiment is such that a reliable estimate of the height of the scintillation producing irregularities may not be obtained. However, the experiment could be enhanced by the addition of a number of ionosondes strategically placed. A more direct approach for studying these turbulent regions of the ionosphere which will involve a radar-incoherent backscatter technique is currently being explored. From this technique it should be possible, in principle, to deduce not only the height of the ionospheric inhomogeneities but their densities as well.

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2. Lawrence, J.D., Jr., Martin, J.D., J. Geophys. Res. 69(No. 7):1293 (1964)

3. Goodman, J.M., J. Atmospheric Terrest. Phys. 29:607 (1967)

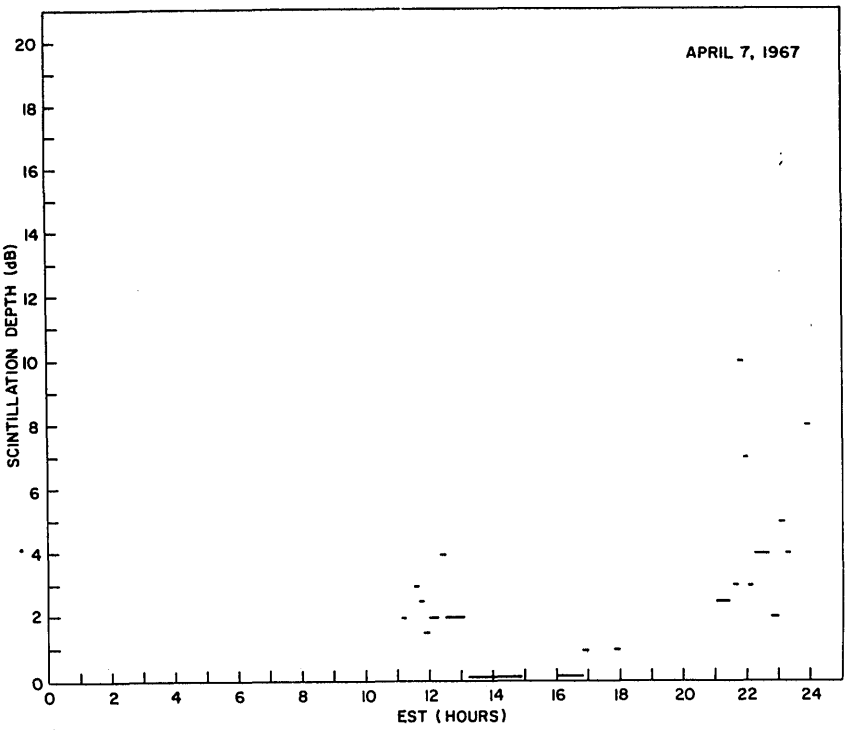


Fig. 1 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

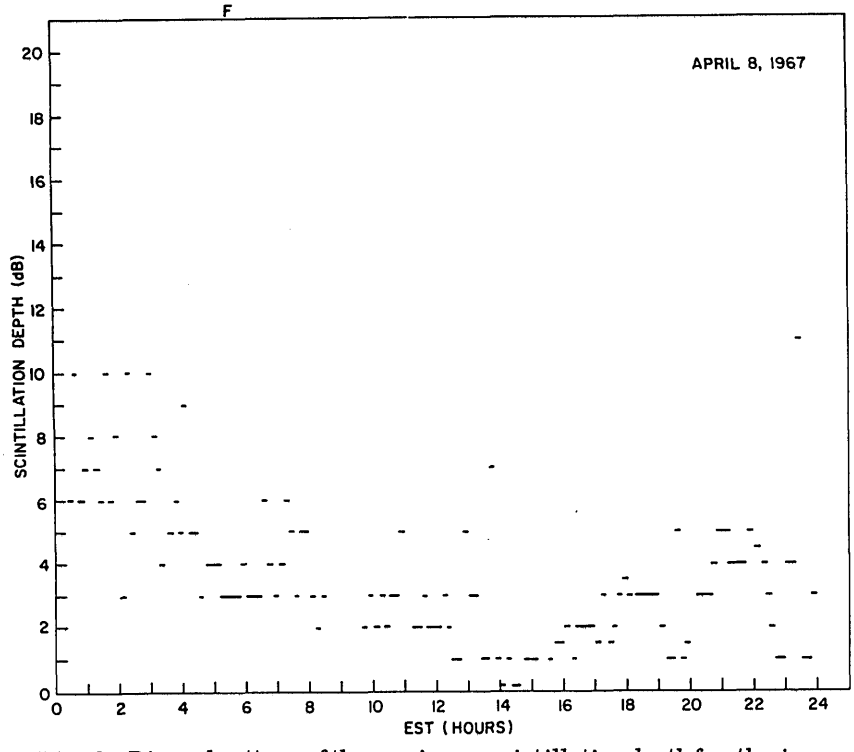


Fig. 2 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

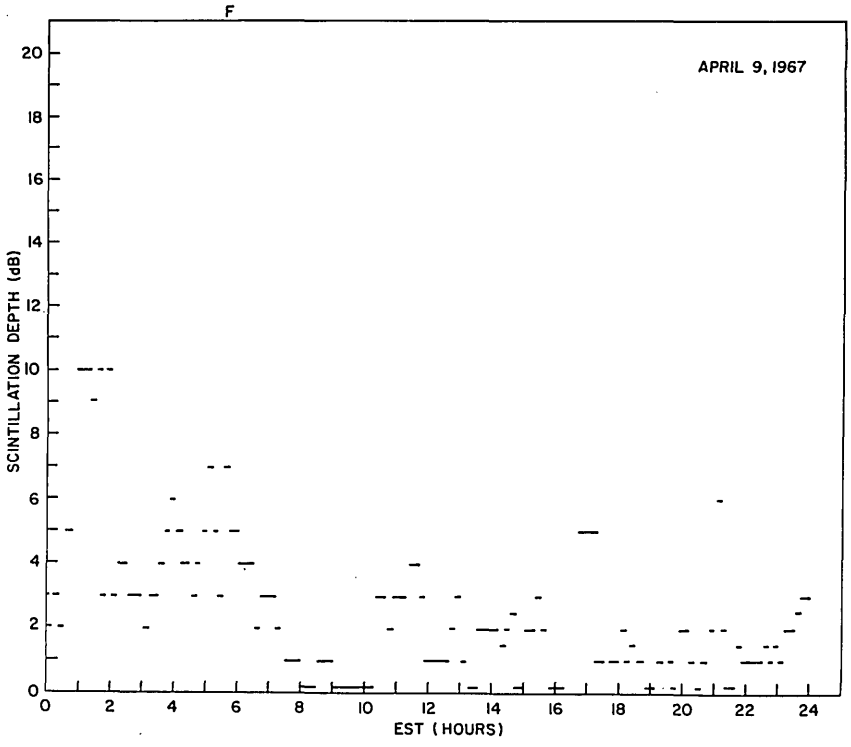


Fig. 3 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

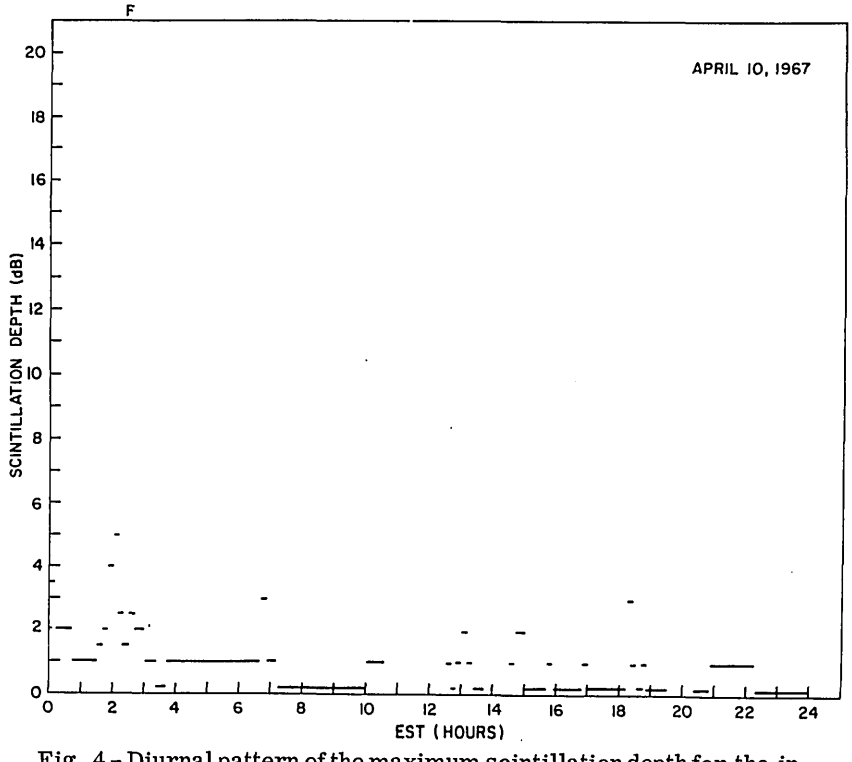


Fig. 4 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

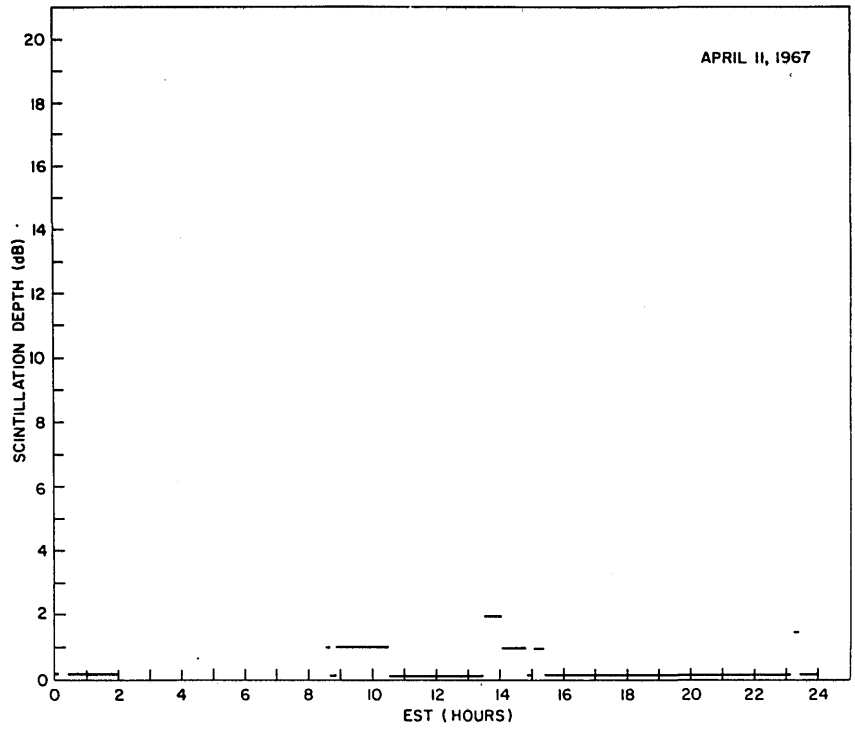


Fig. 5 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

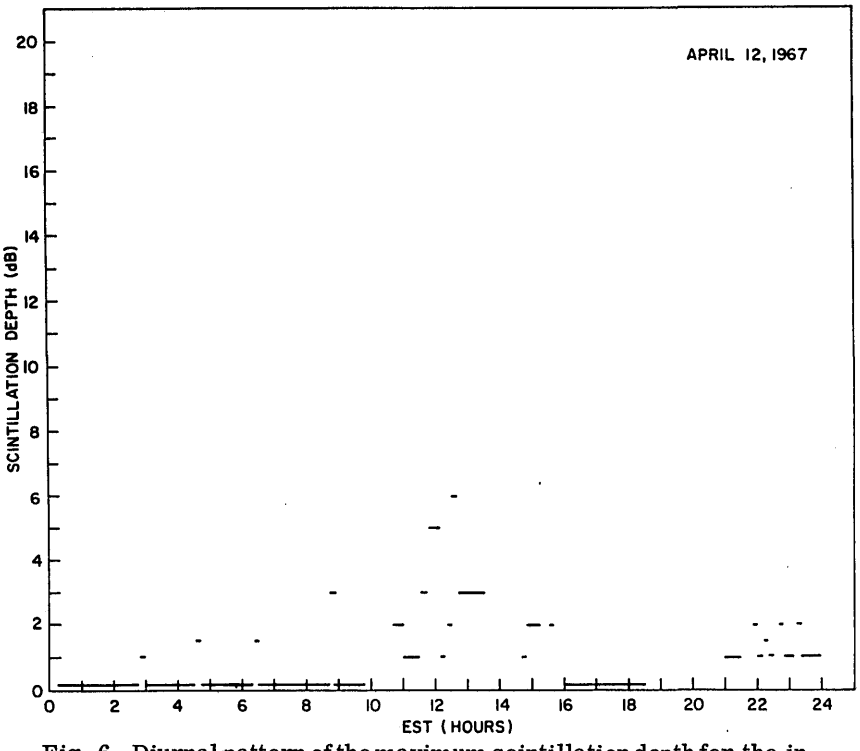


Fig. 6 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

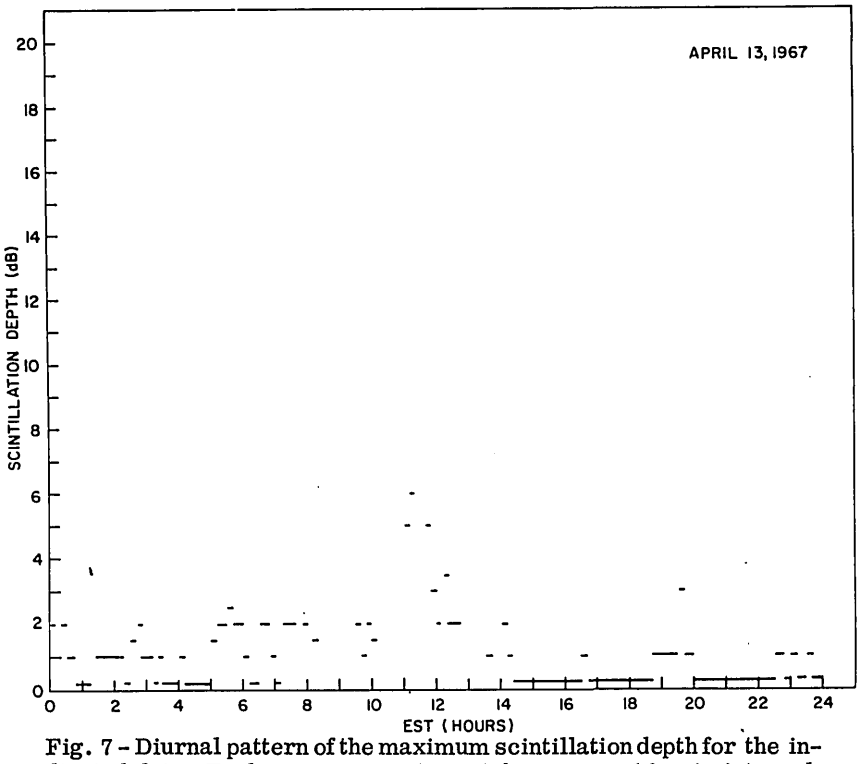


Fig. 7 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

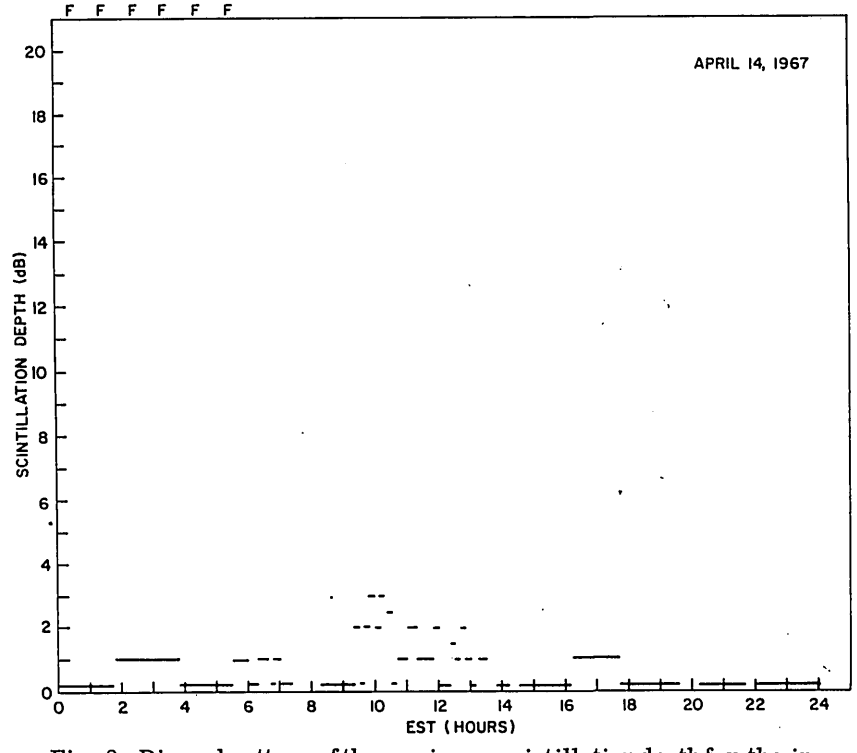


Fig. 8 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

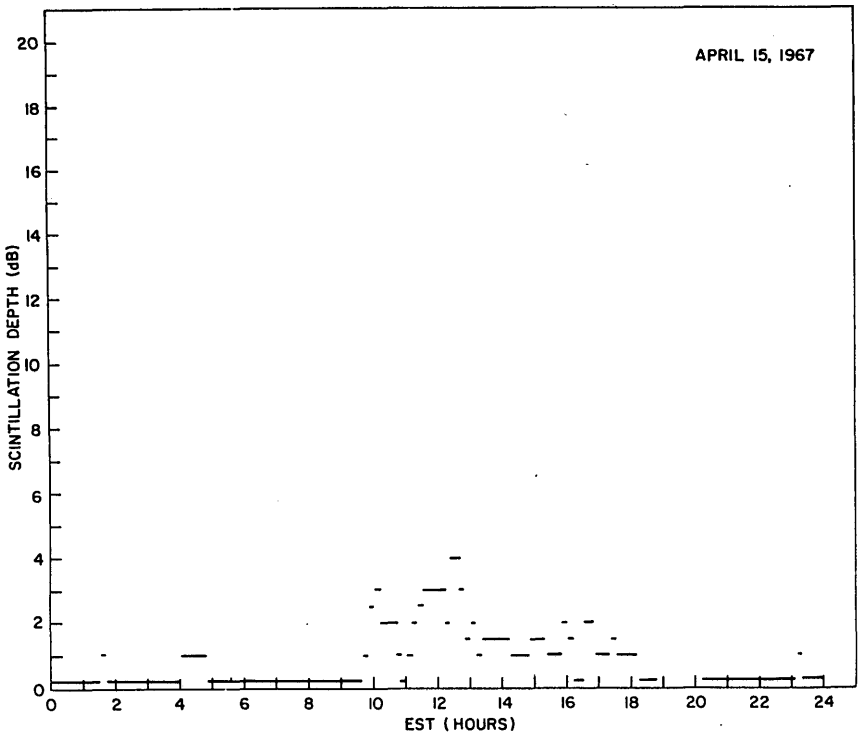


Fig. 9 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

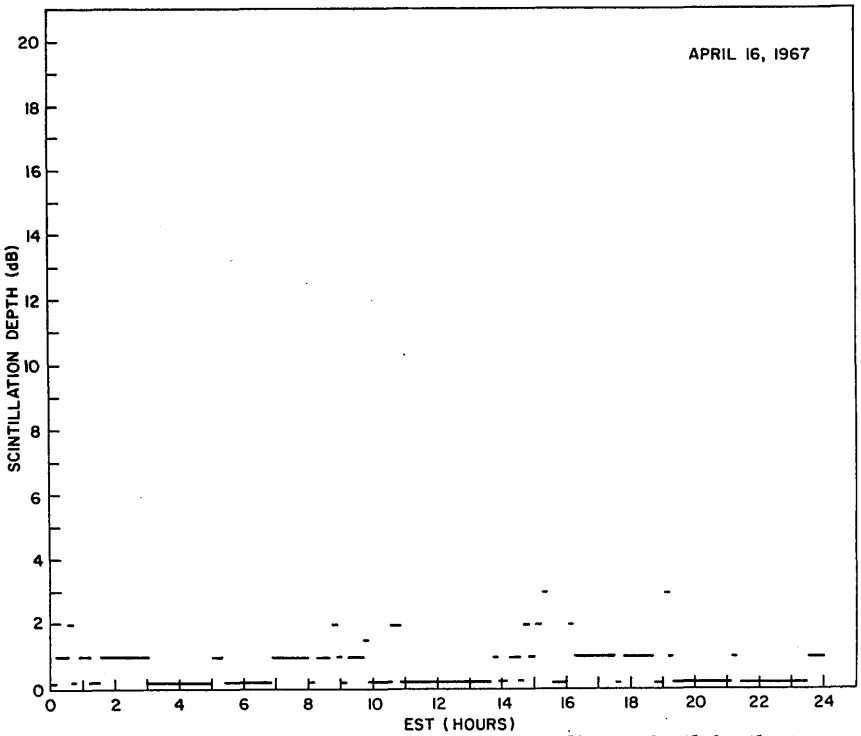


Fig. 10 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

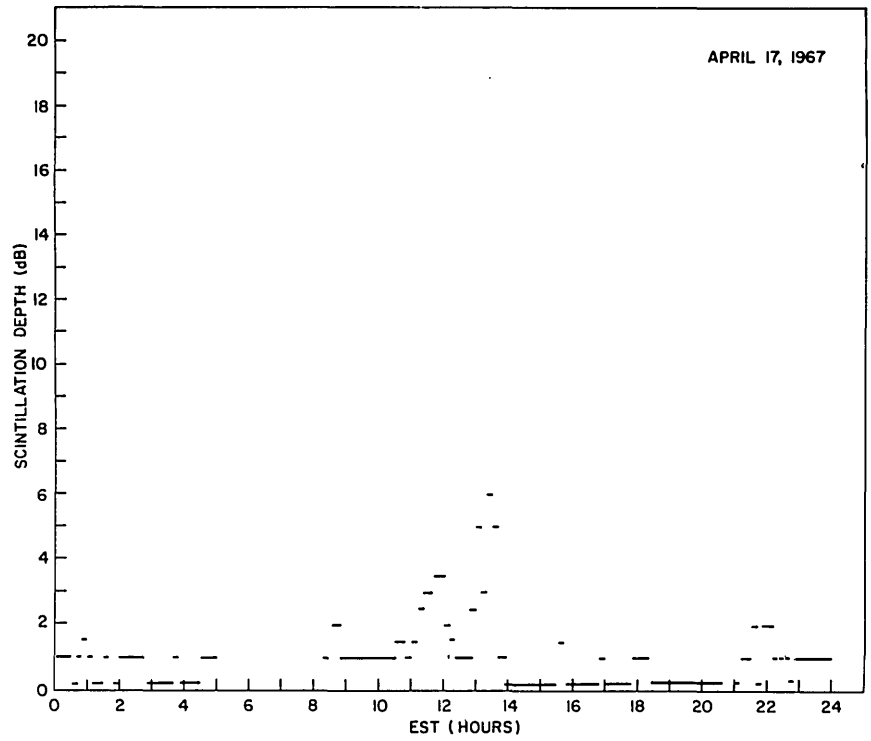


Fig. 11 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

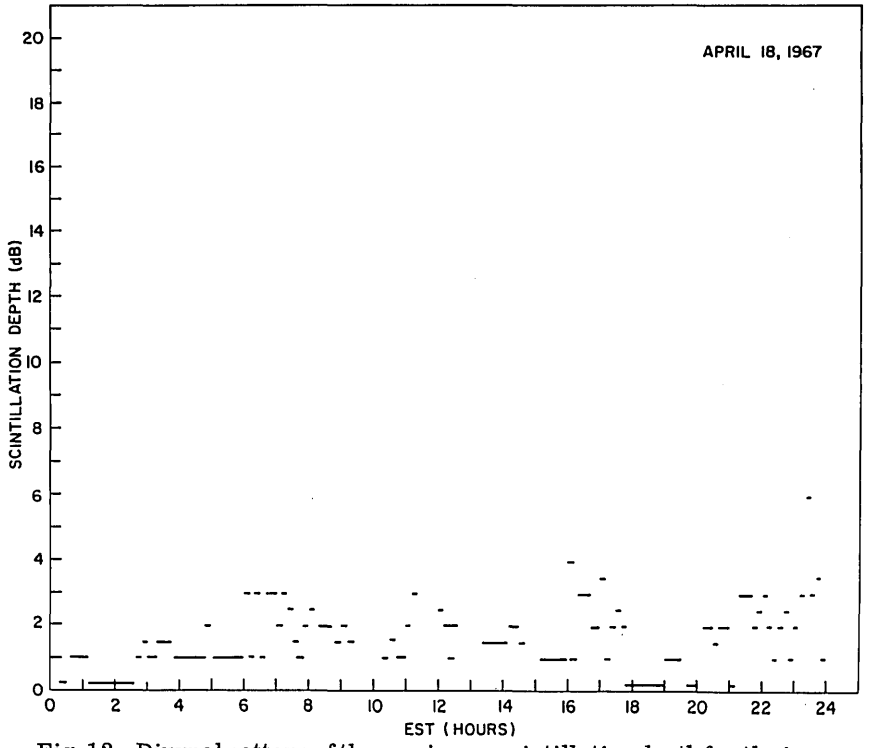


Fig. 12 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

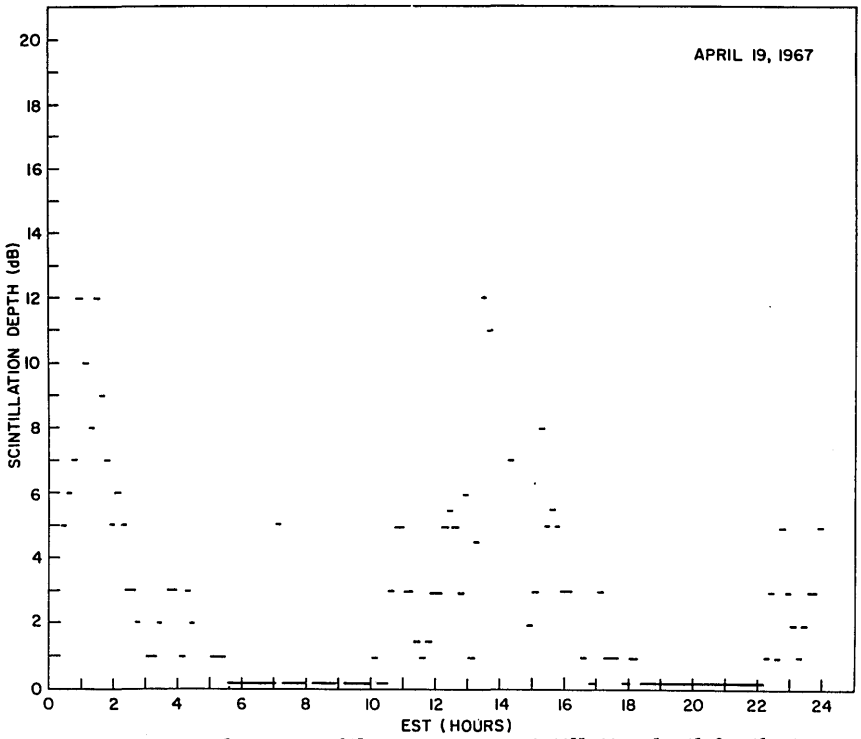


Fig. 13 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

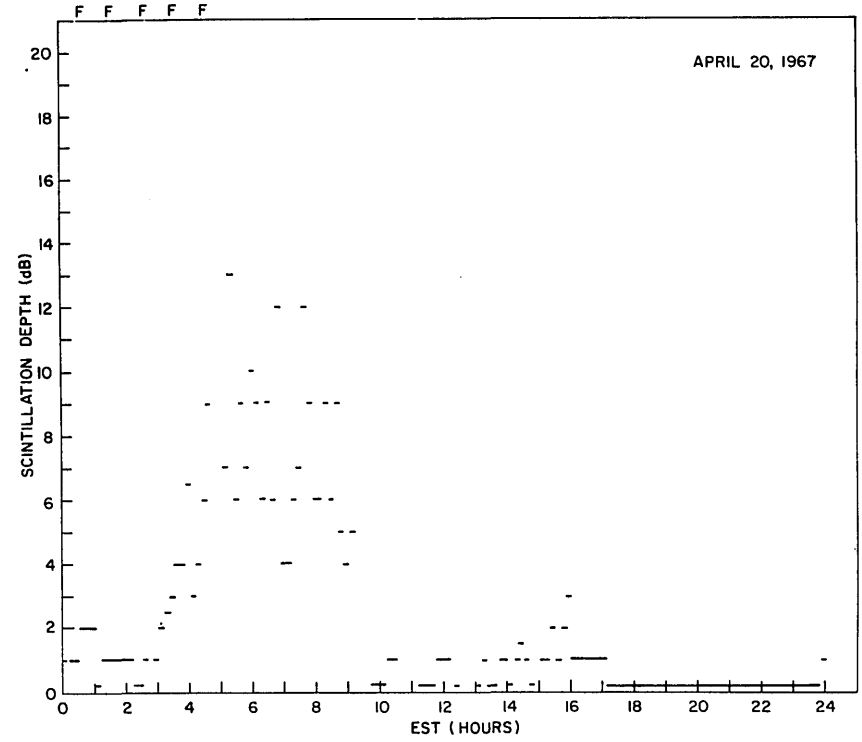


Fig. 14 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

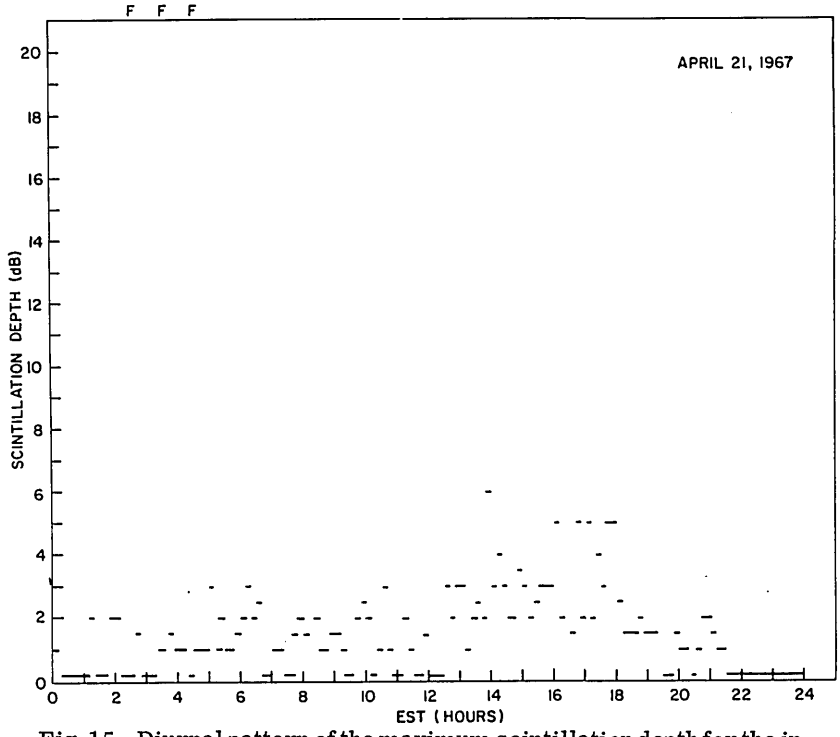


Fig. 15 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

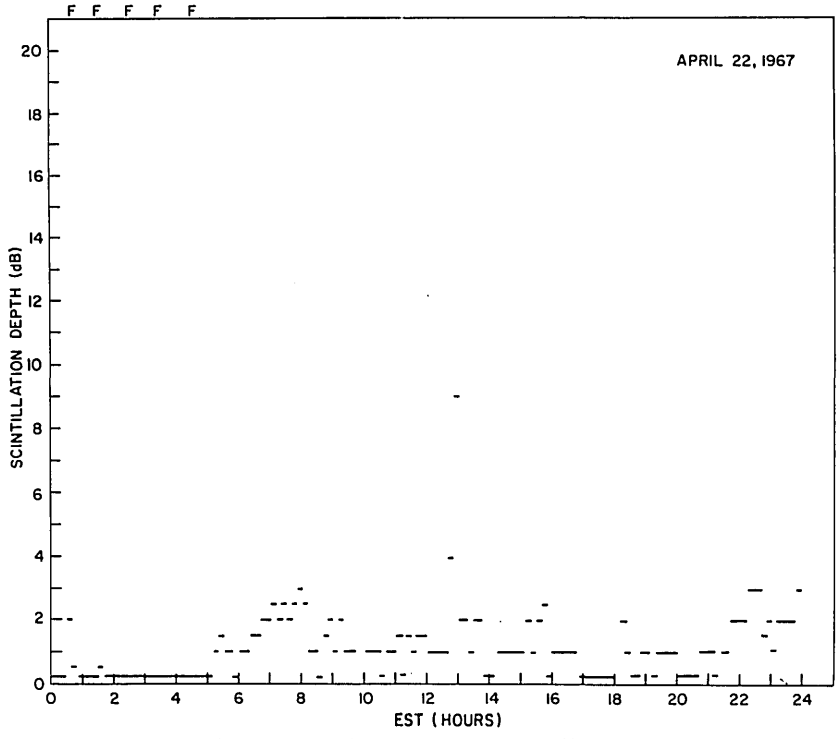


Fig. 16 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

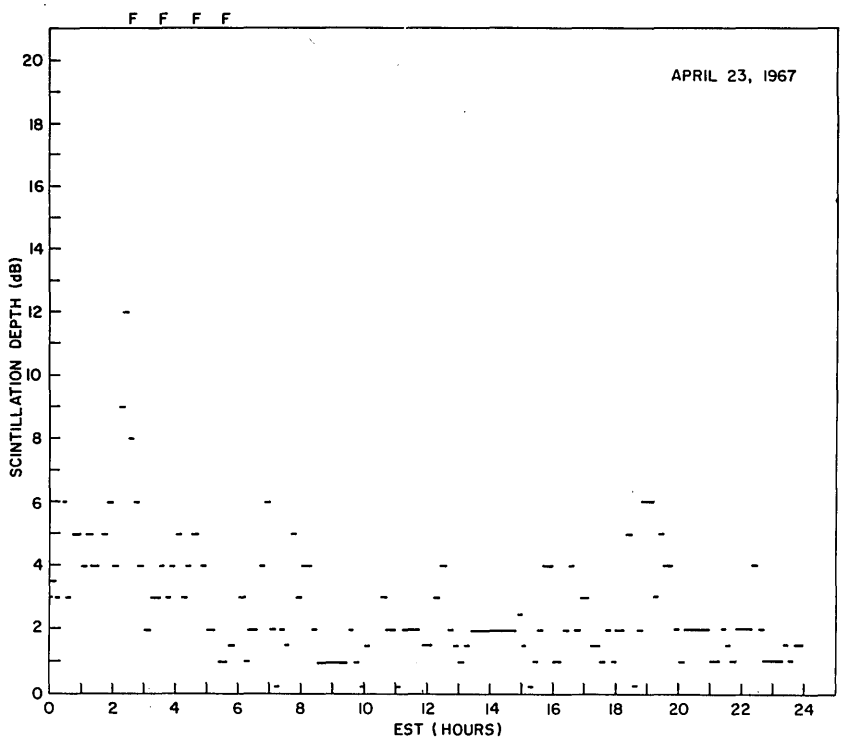


Fig. 17 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

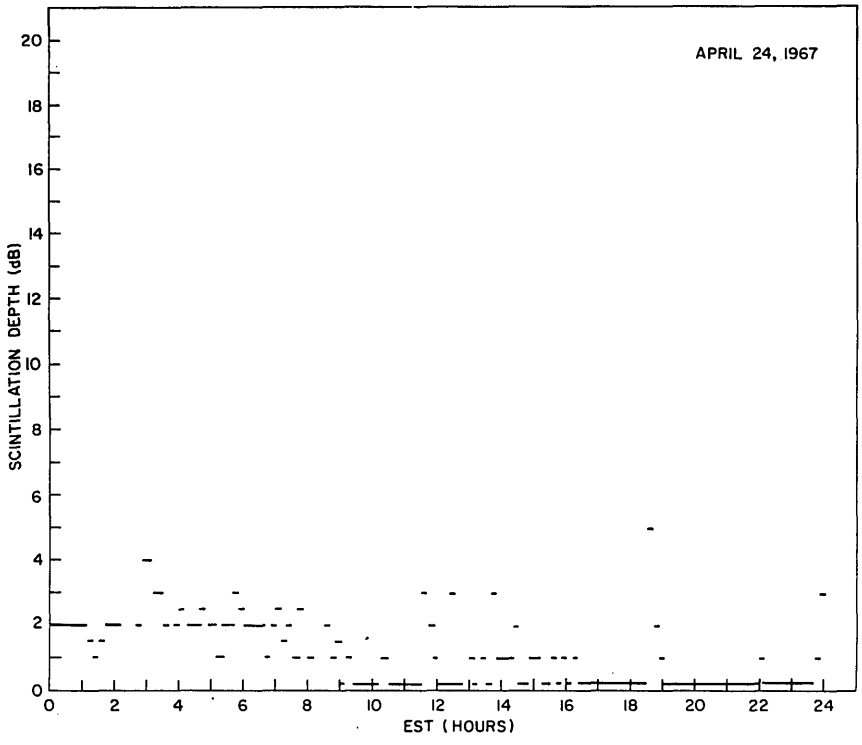


Fig. 18 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

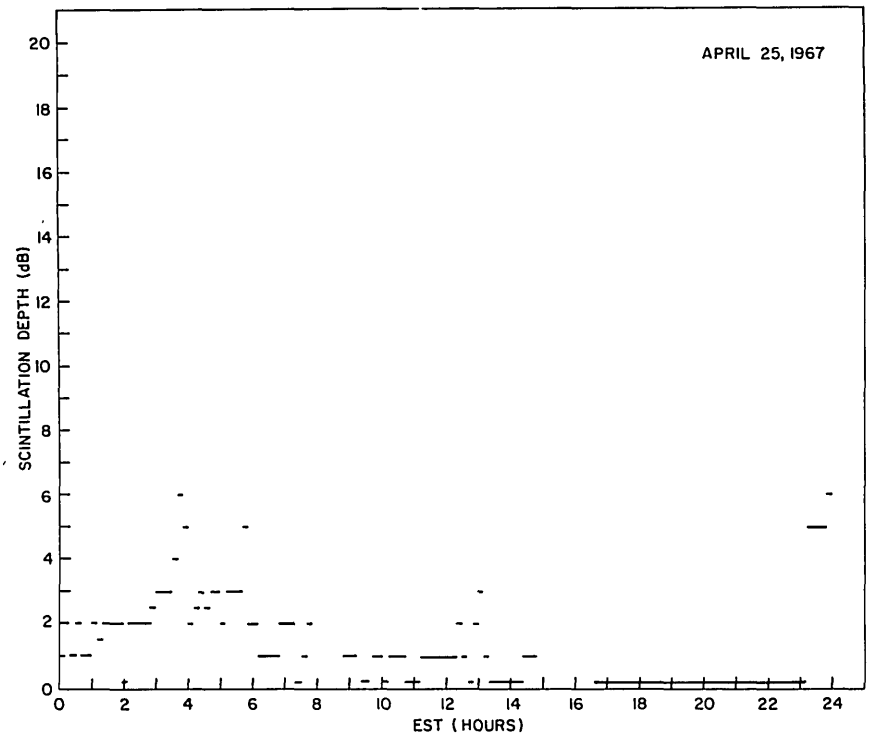


Fig. 19 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

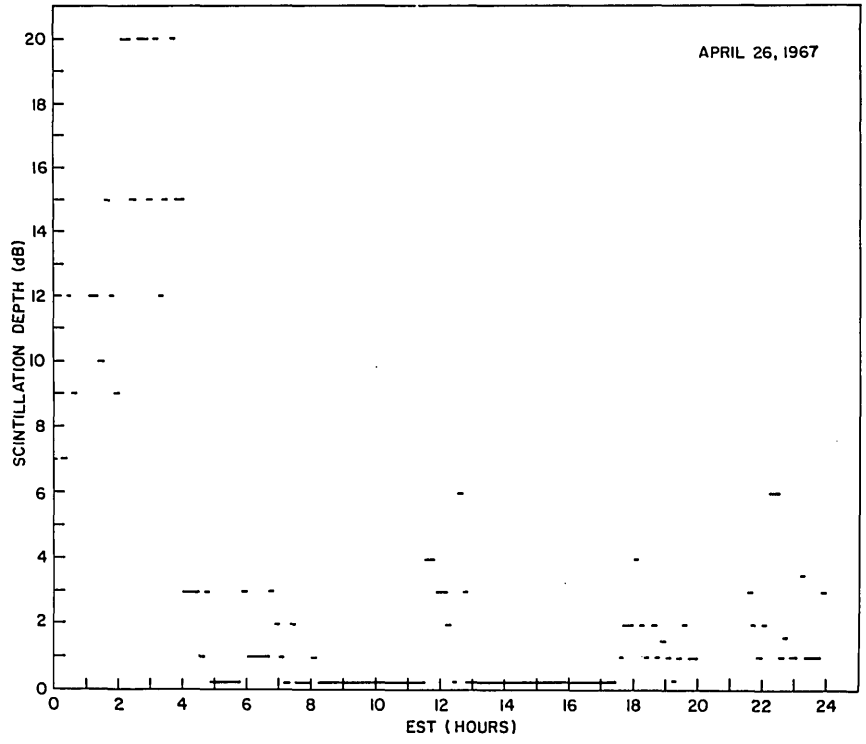


Fig. 20 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of hoirzontal lines implies that data were not obtained.

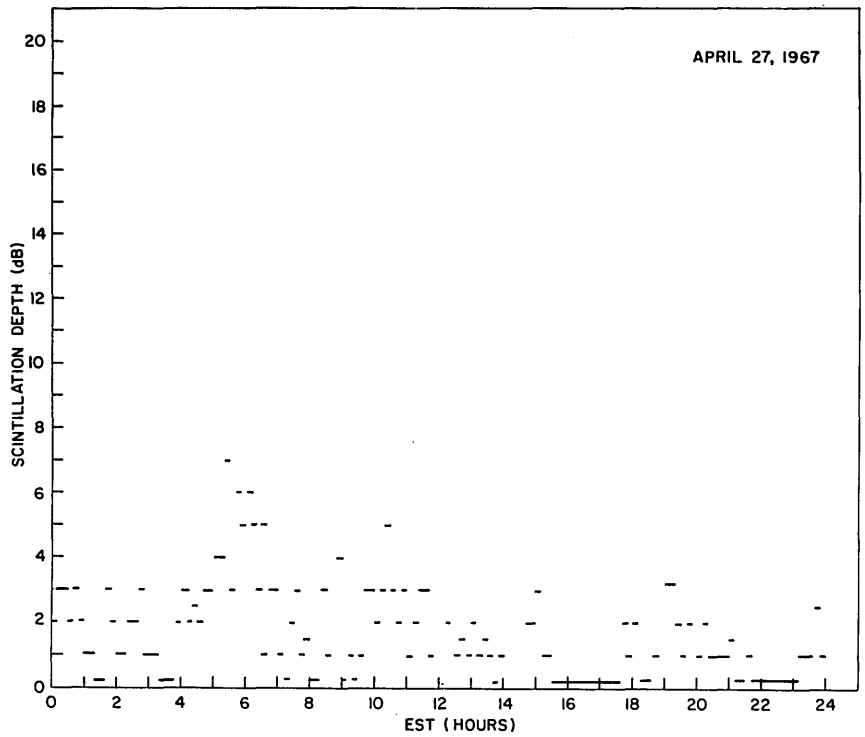


Fig. 21 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

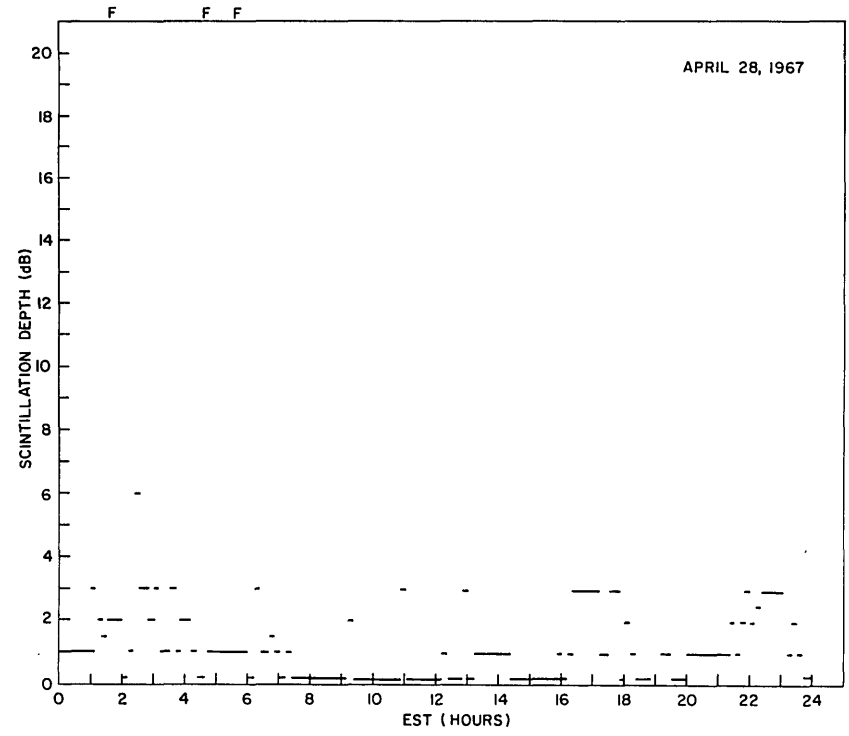


Fig. 22 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

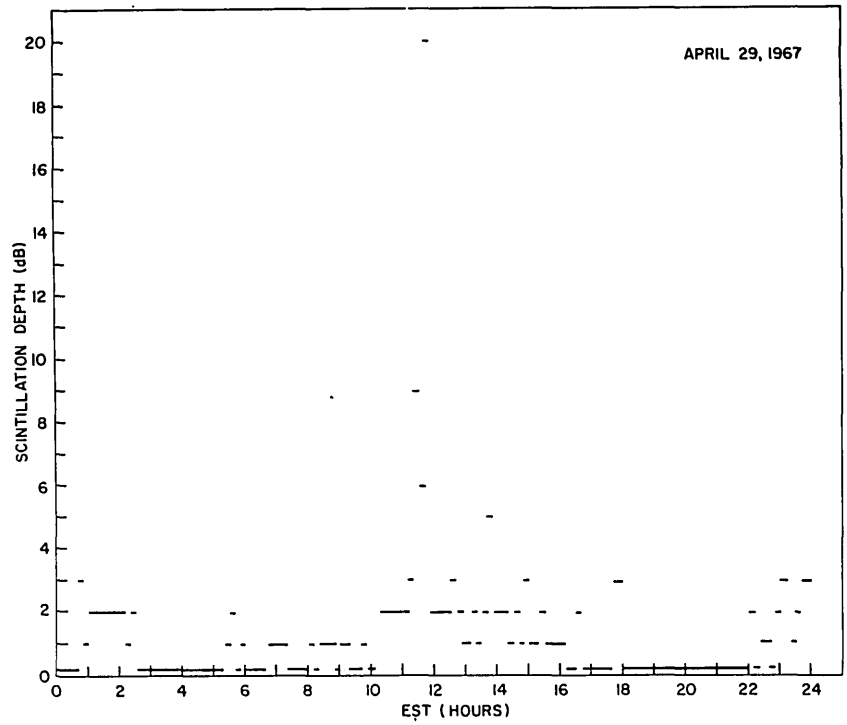


Fig. 23 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

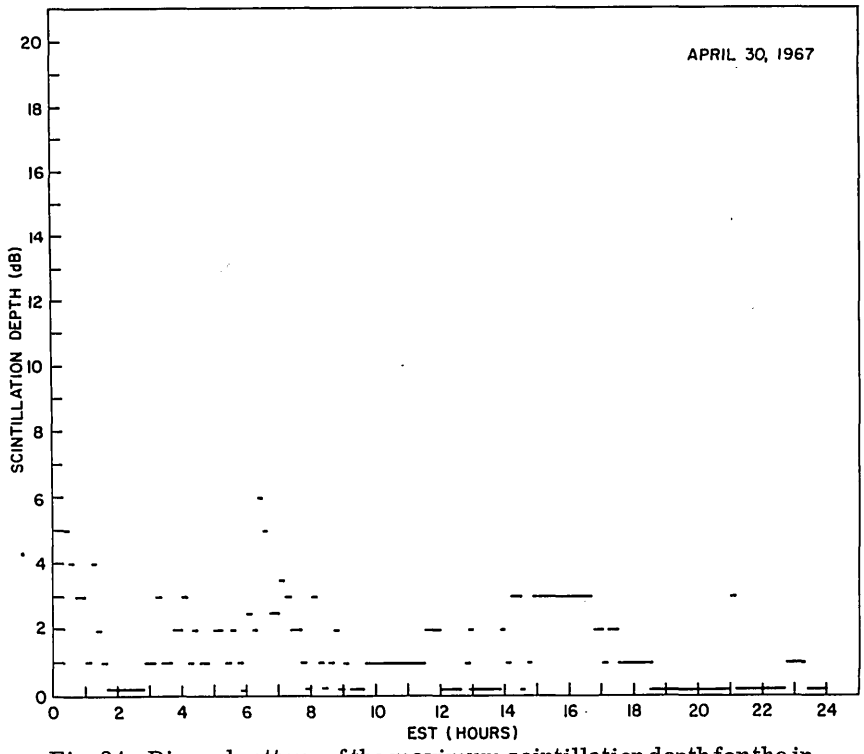


Fig. 24 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

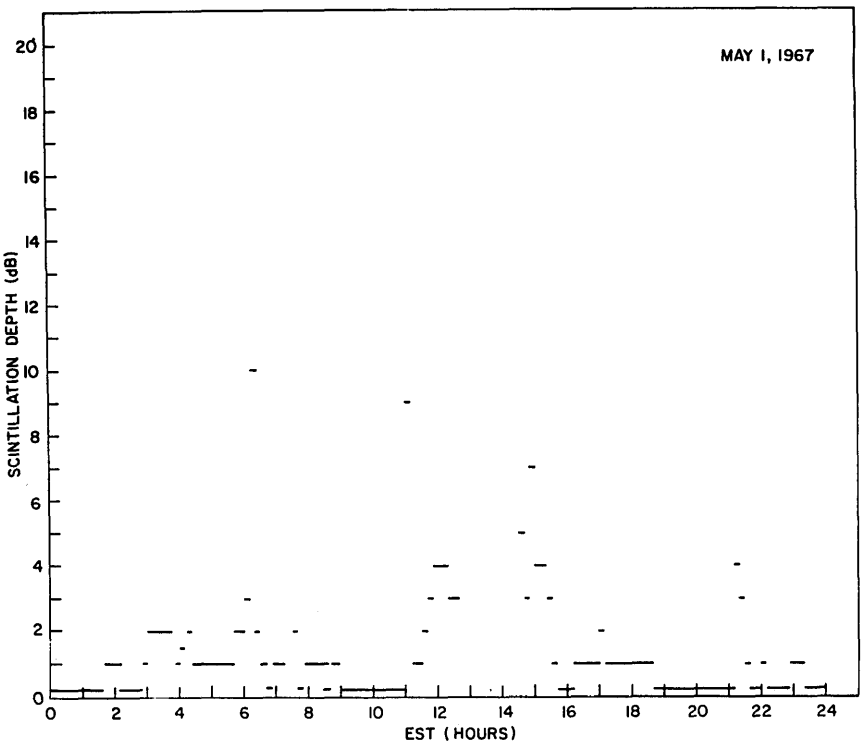


Fig. 25 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

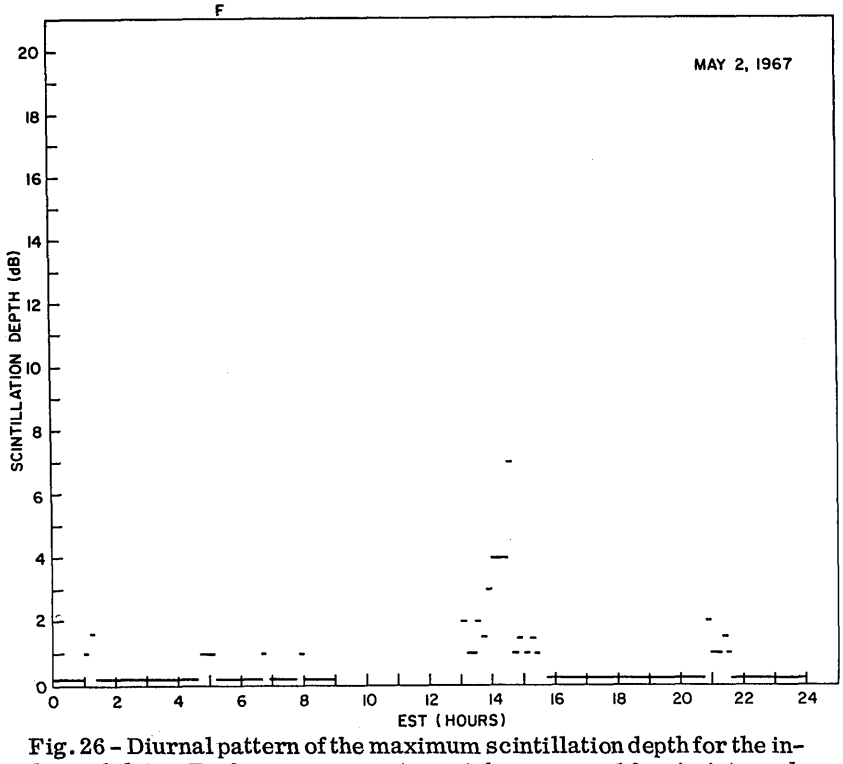


Fig. 26 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

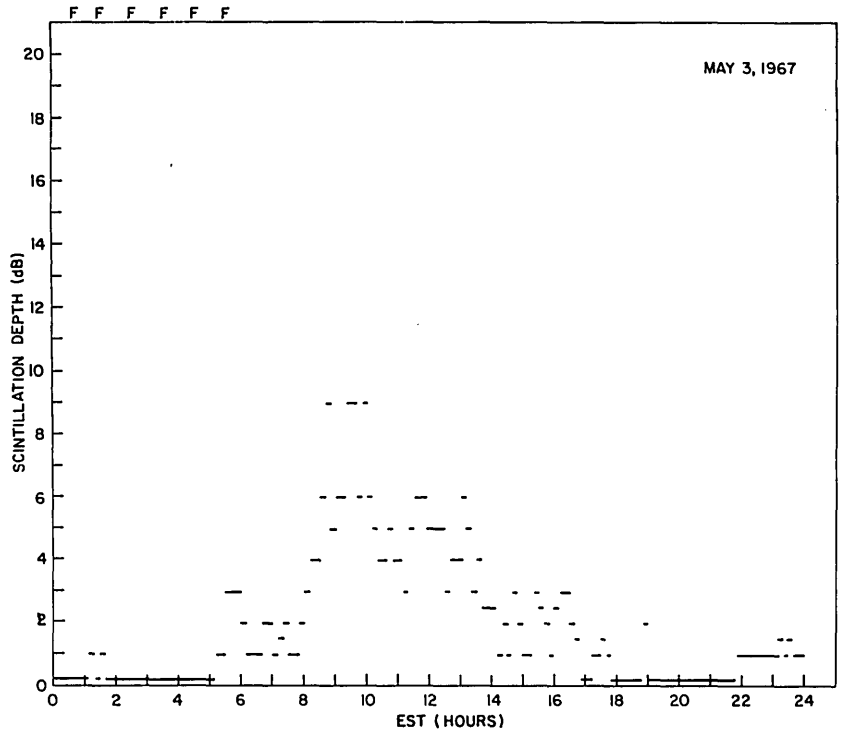


Fig. 27 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

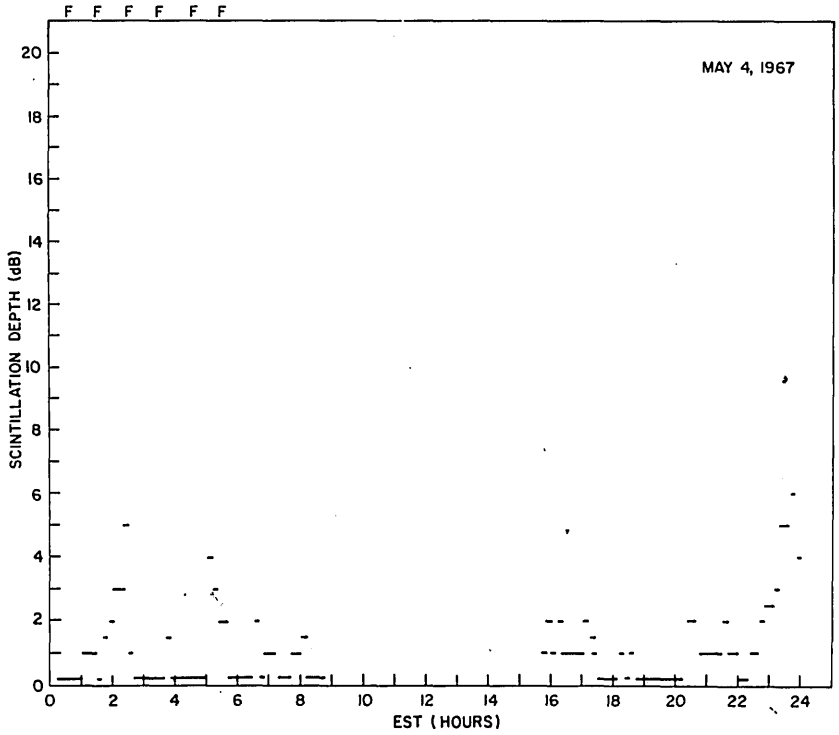


Fig. 28 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

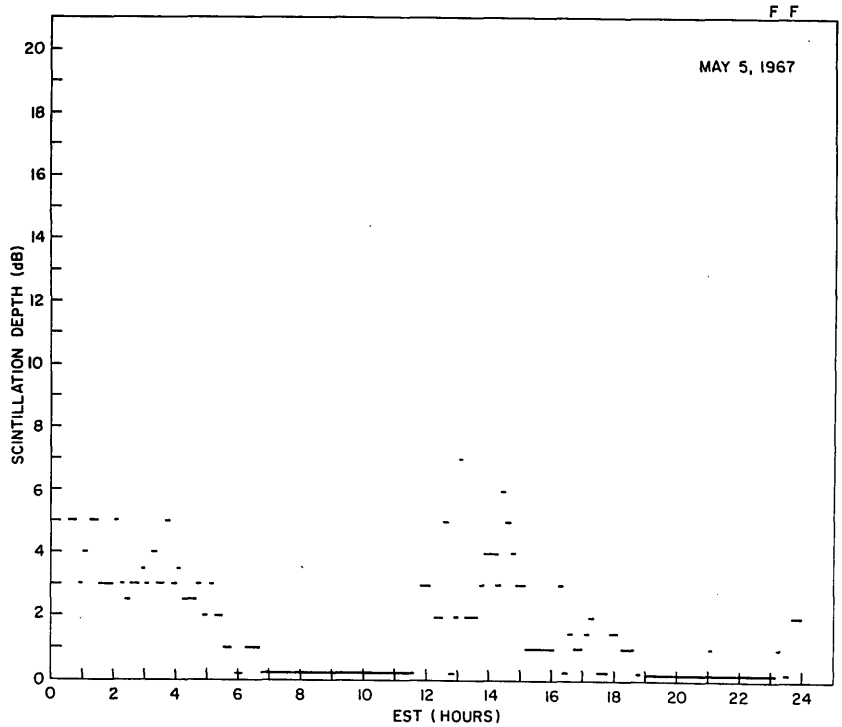


Fig. 29 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

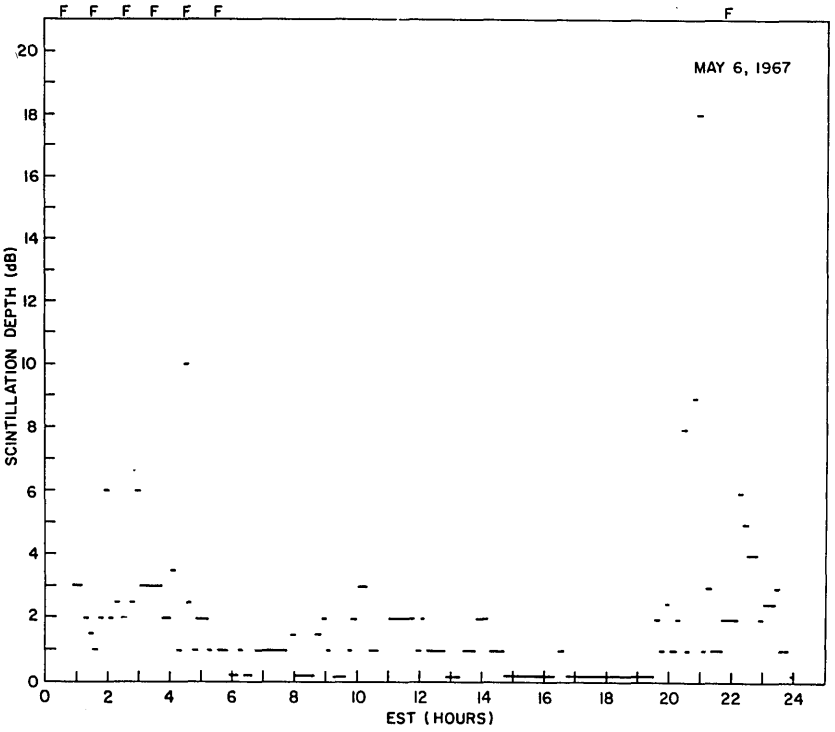


Fig. 30 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

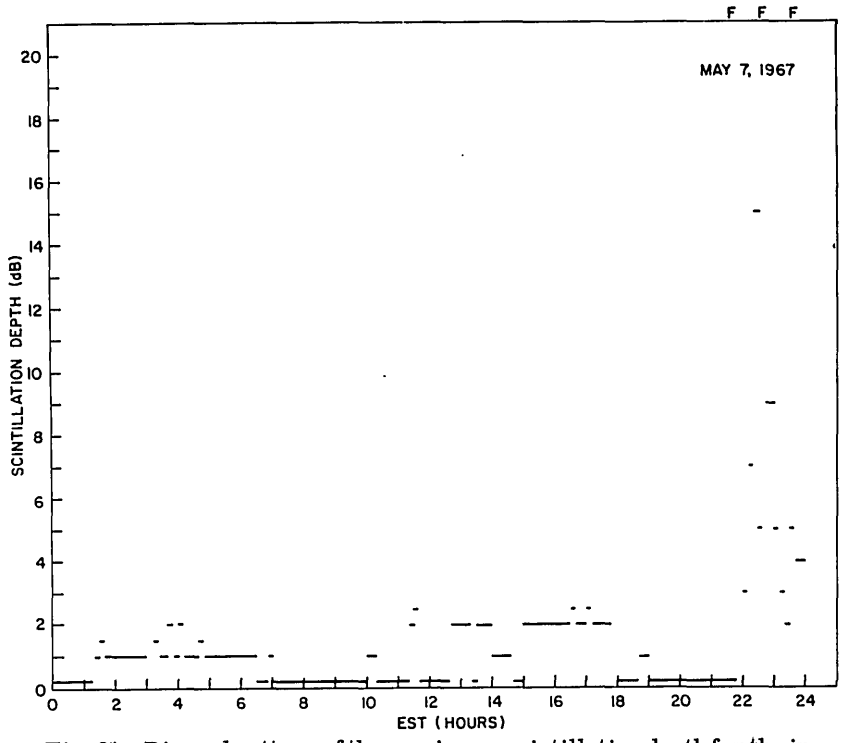


Fig. 31 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

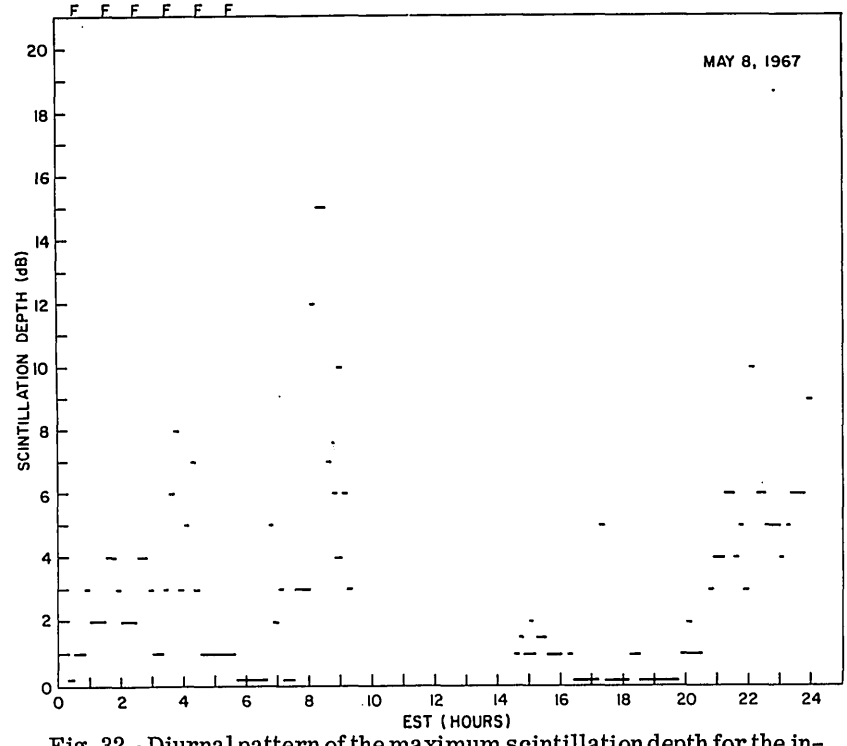


Fig. 32 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

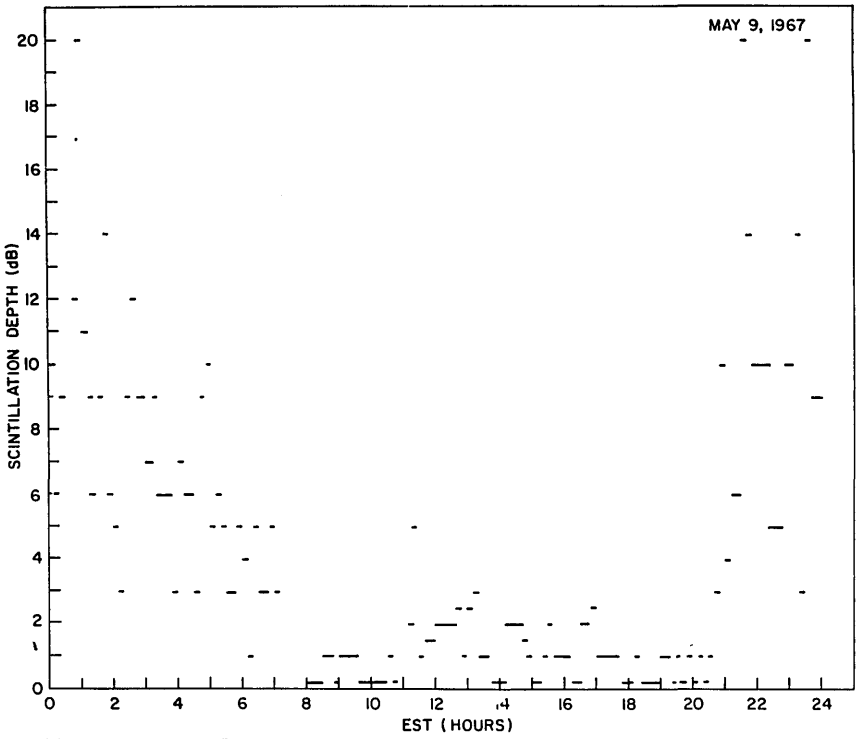


Fig. 33 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

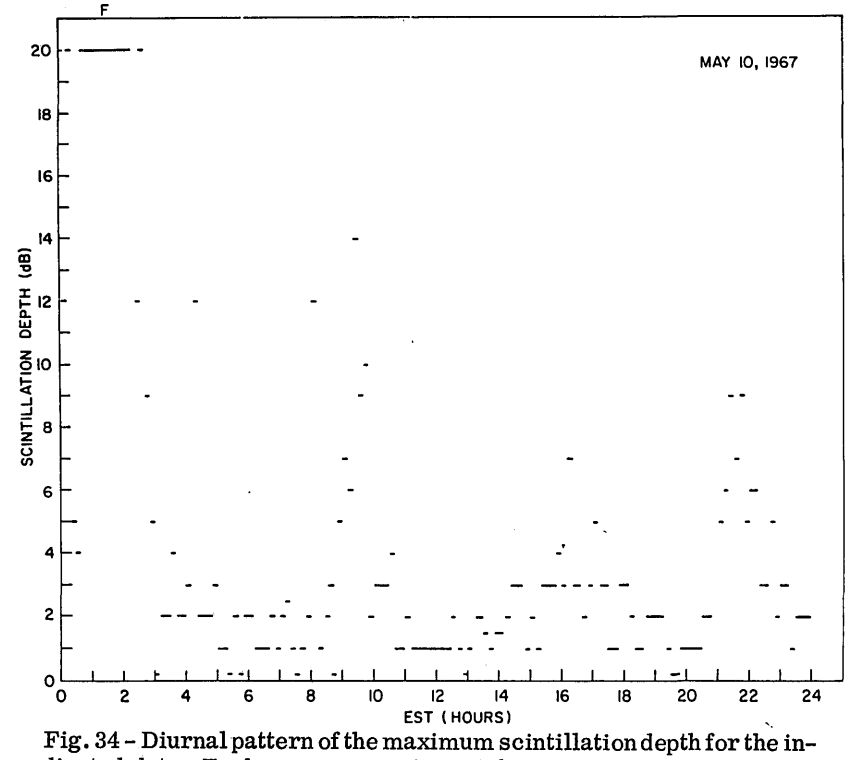


Fig. 34 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

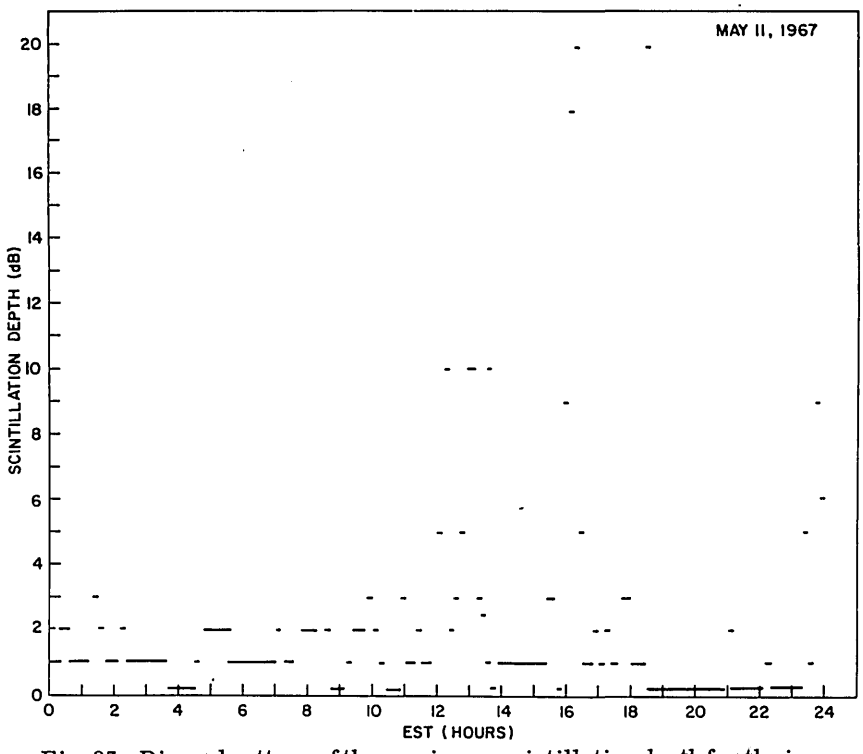


Fig. 35 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

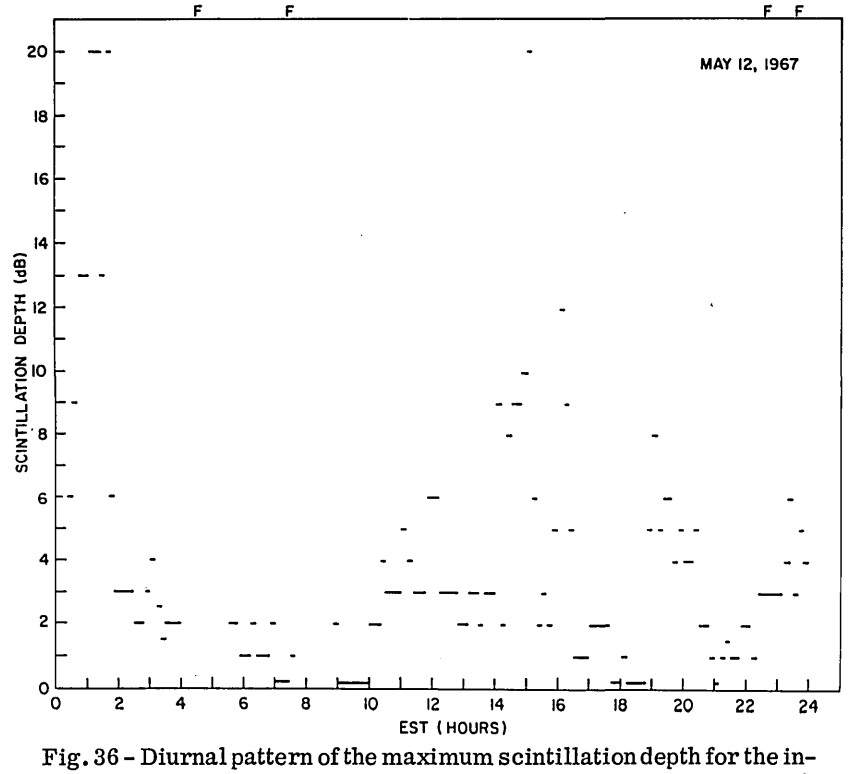


Fig. 36 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

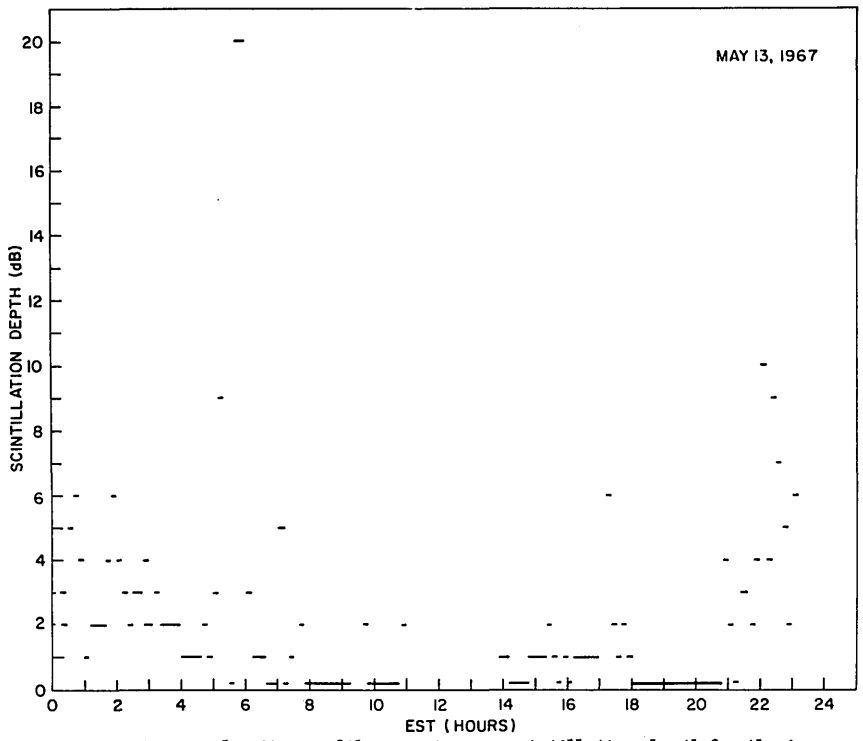


Fig. 37 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

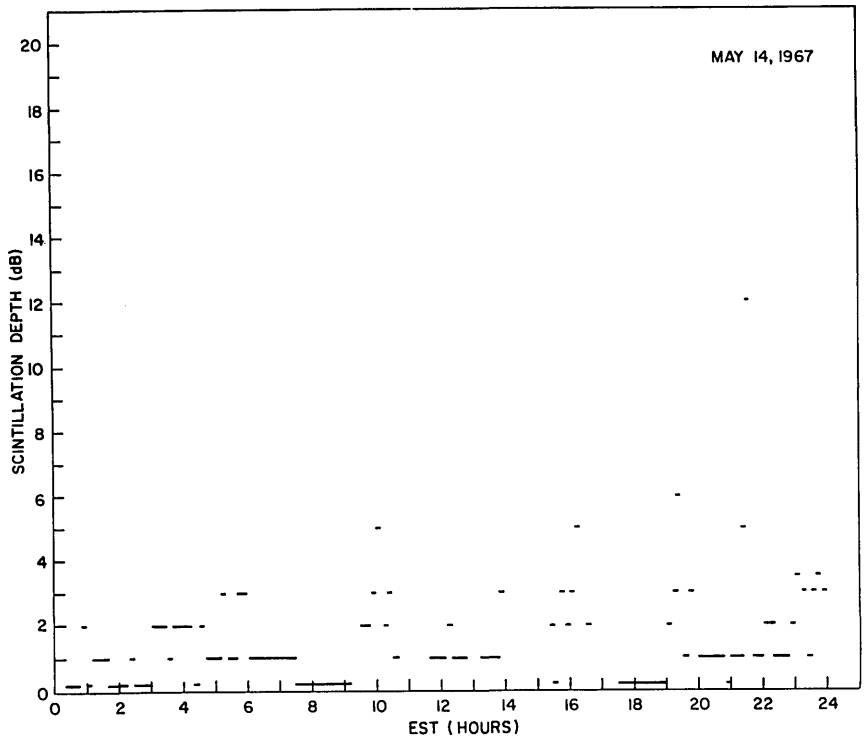


Fig. 38 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

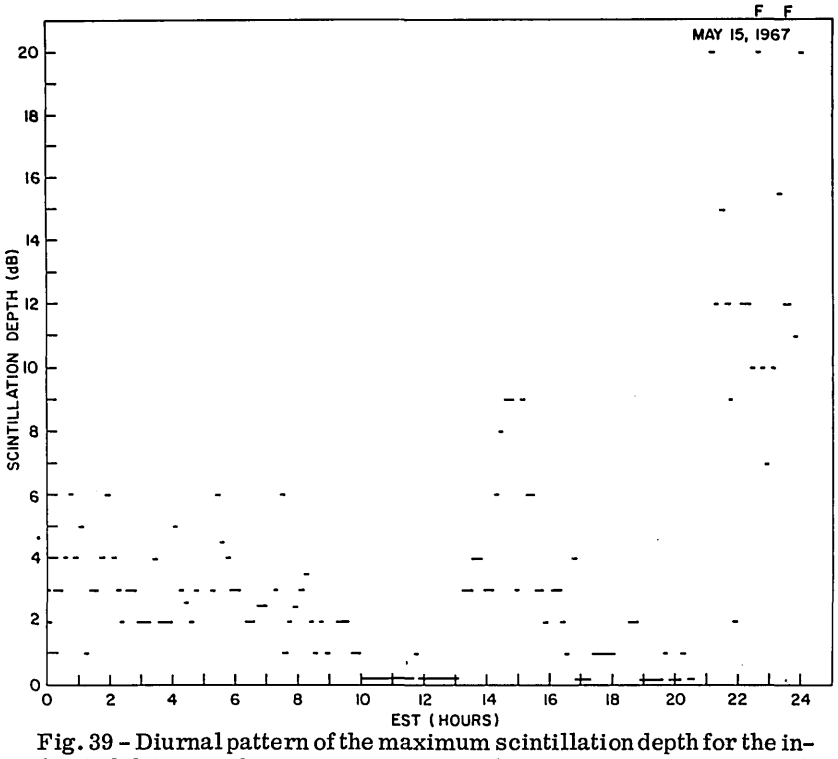


Fig. 39 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

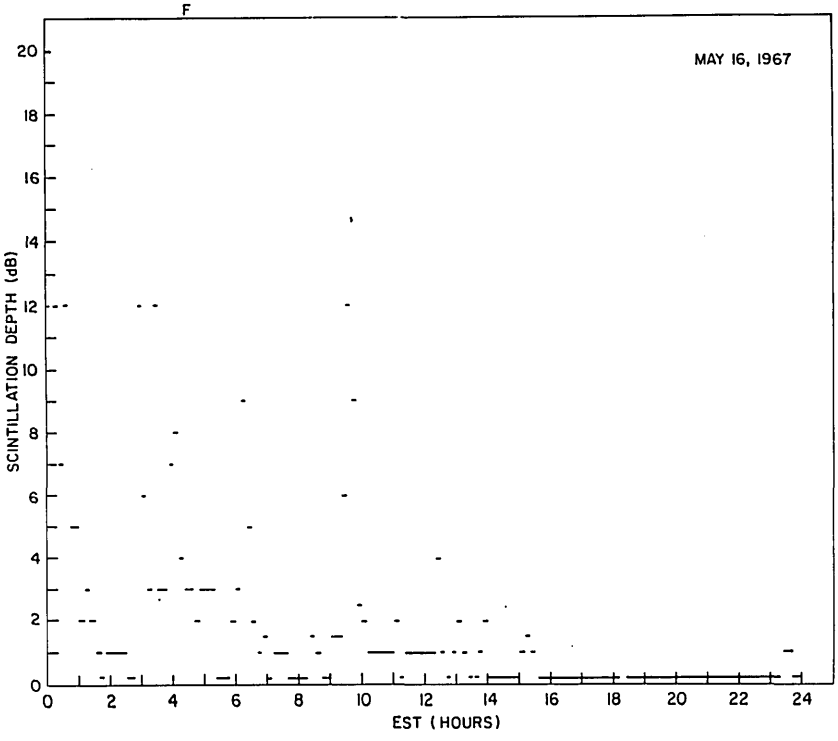


Fig. 40 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

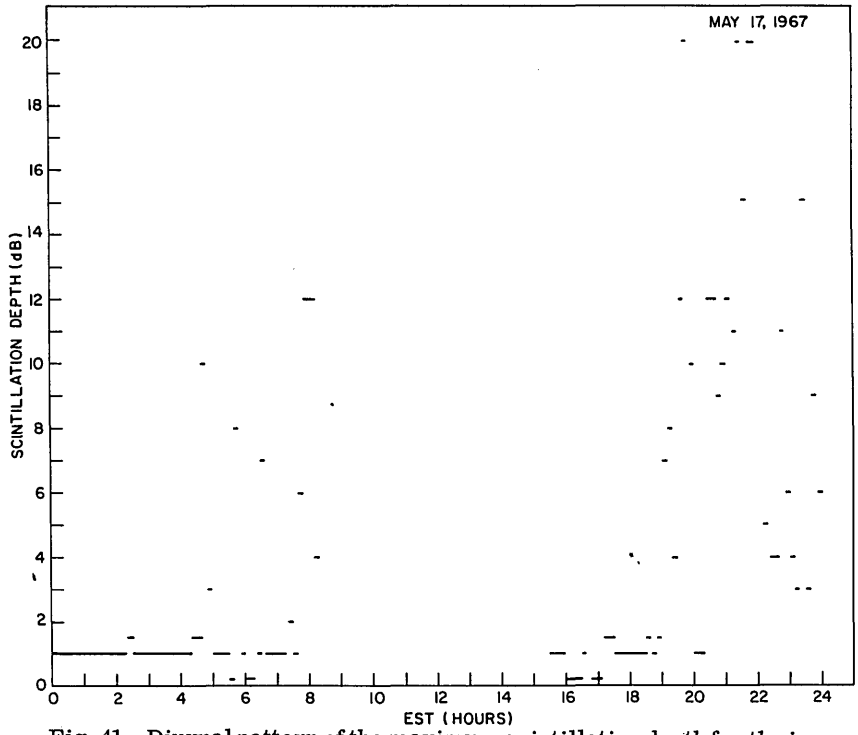


Fig. 41 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

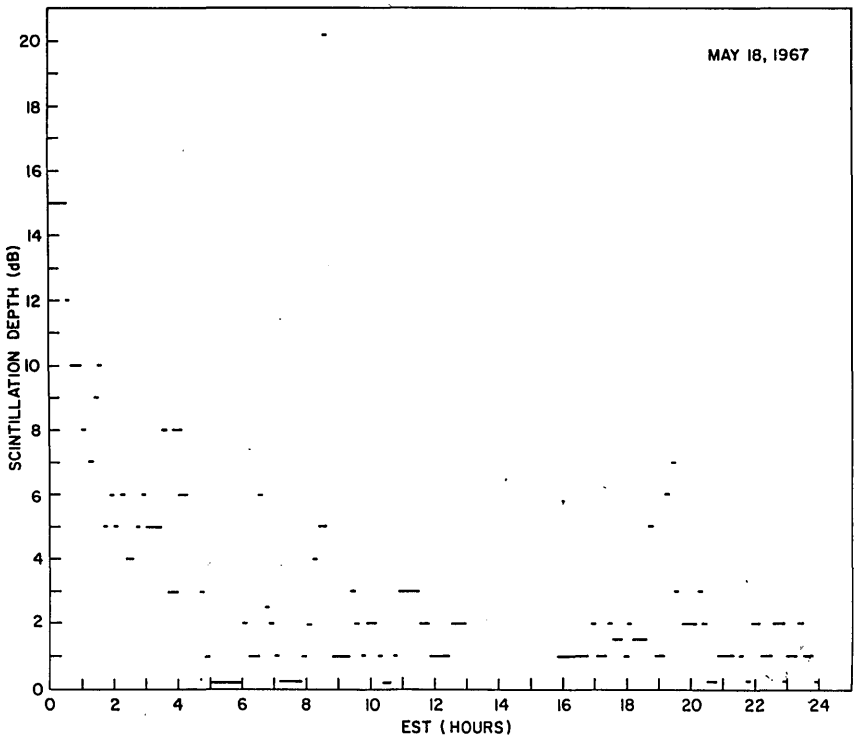


Fig. 42 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

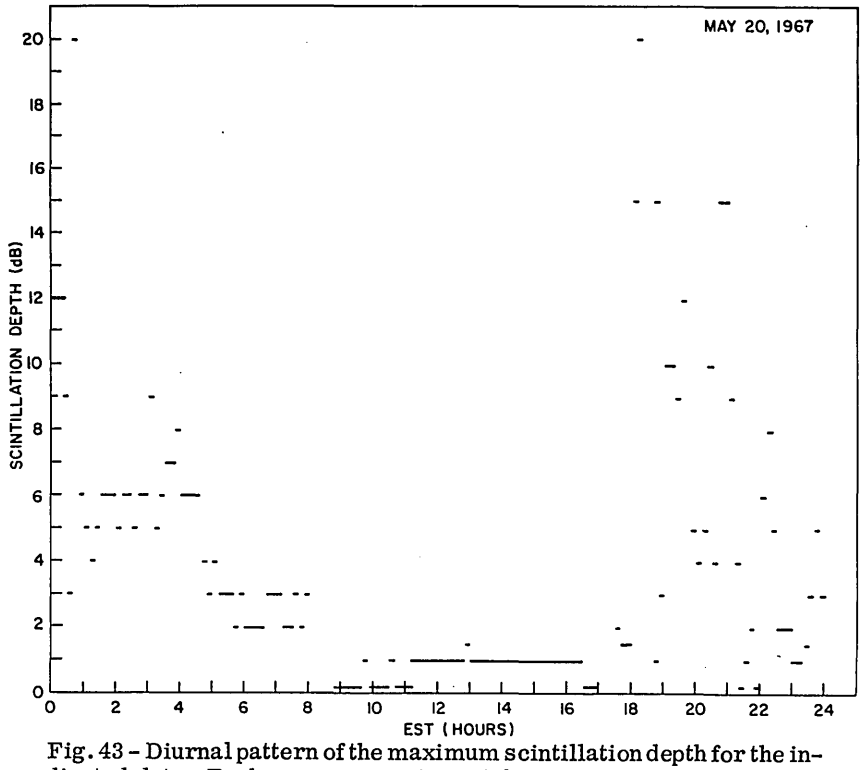


Fig. 43 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

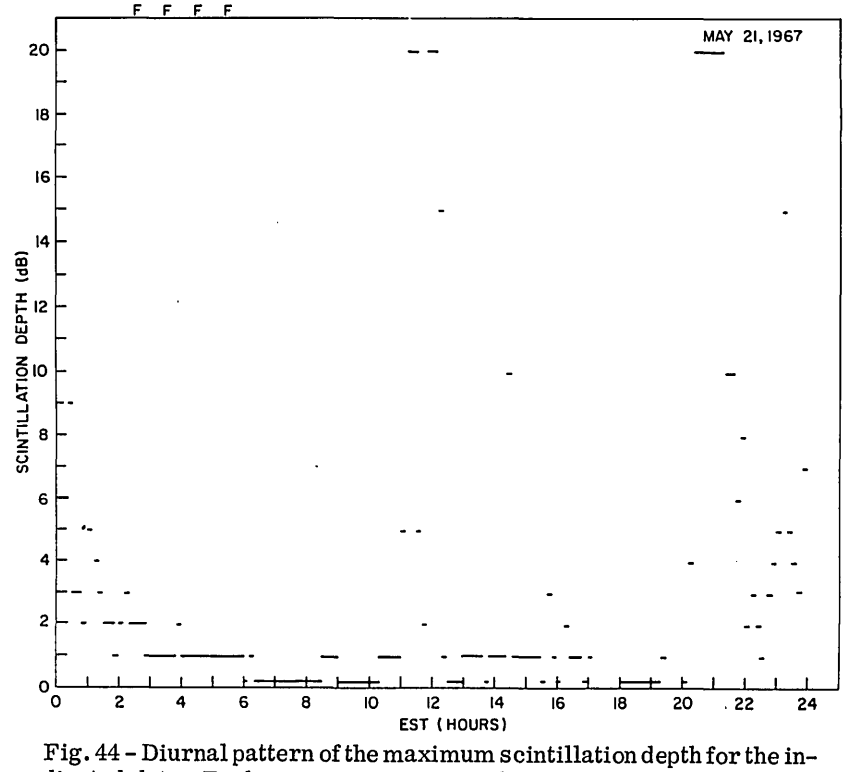


Fig. 44 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

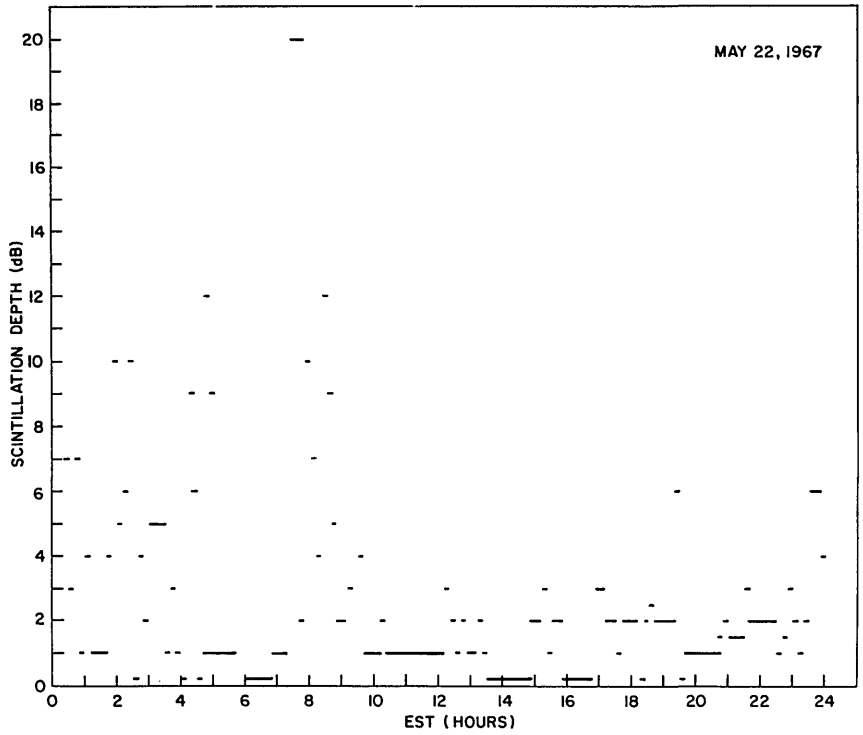


Fig. 45 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

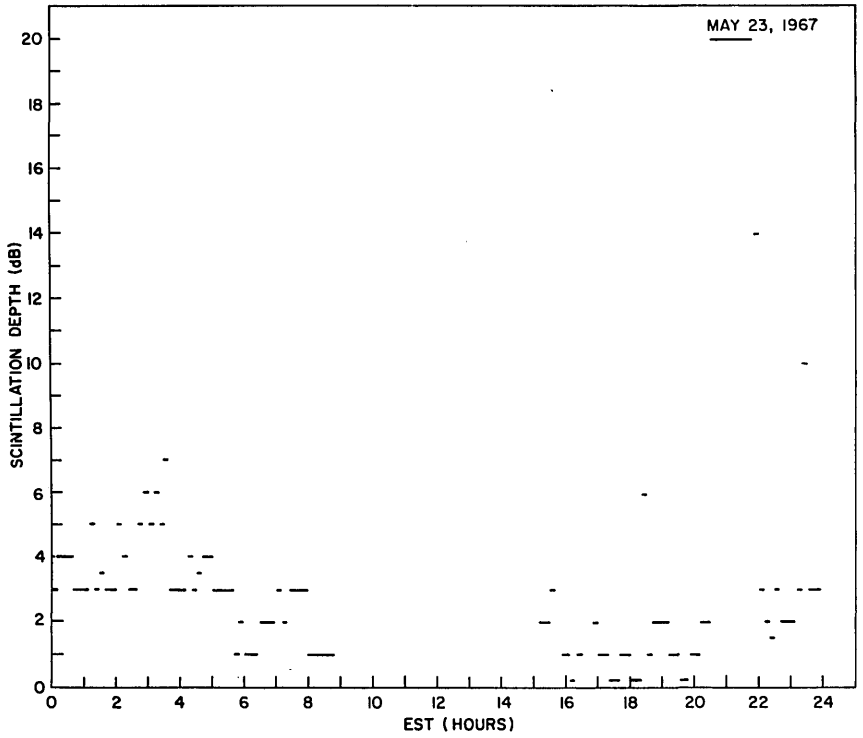


Fig. 46 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

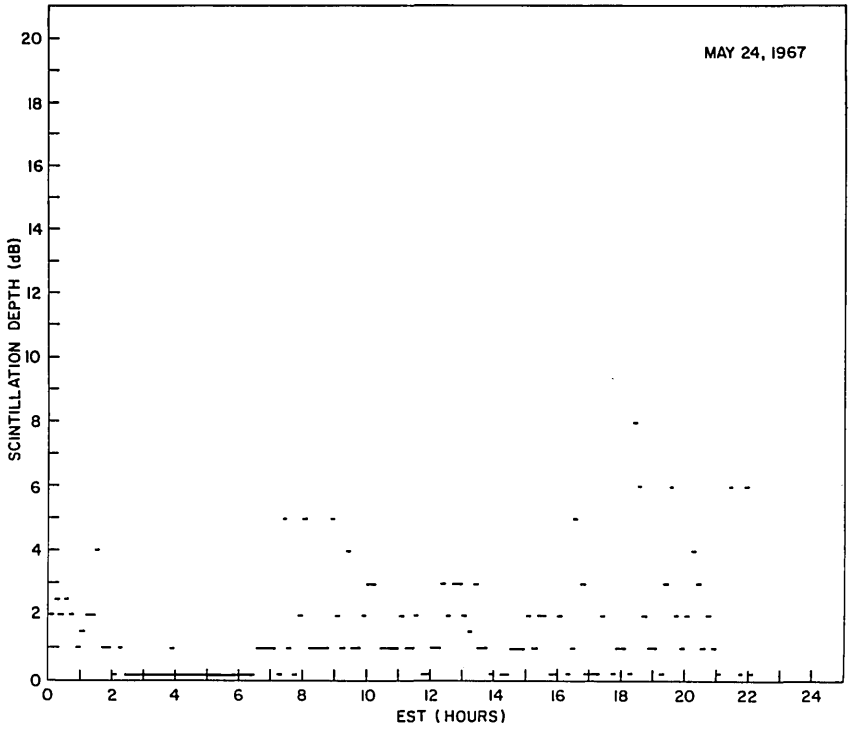


Fig. 47 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

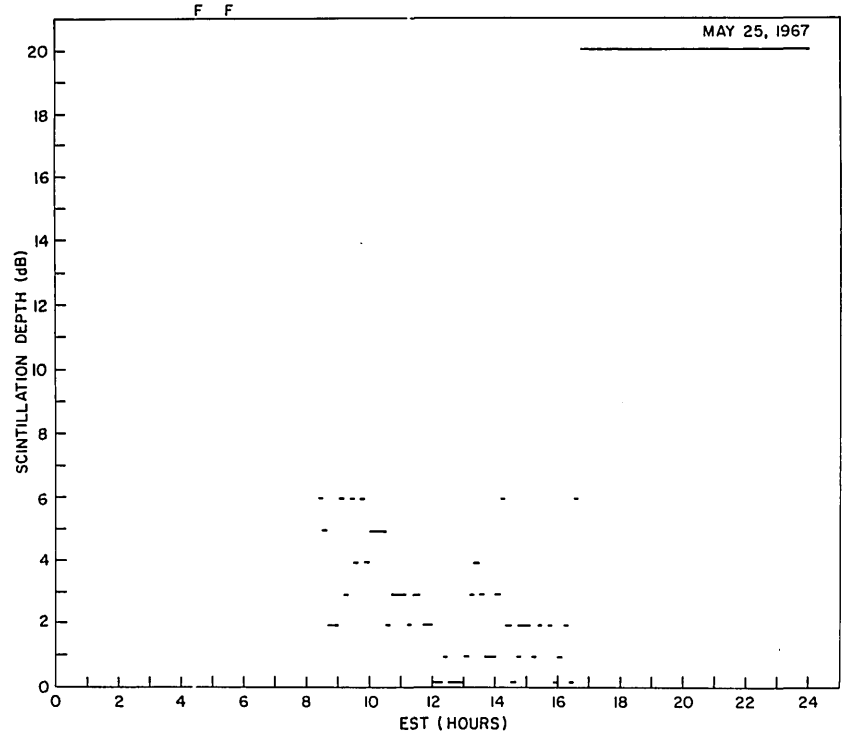


Fig. 48 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

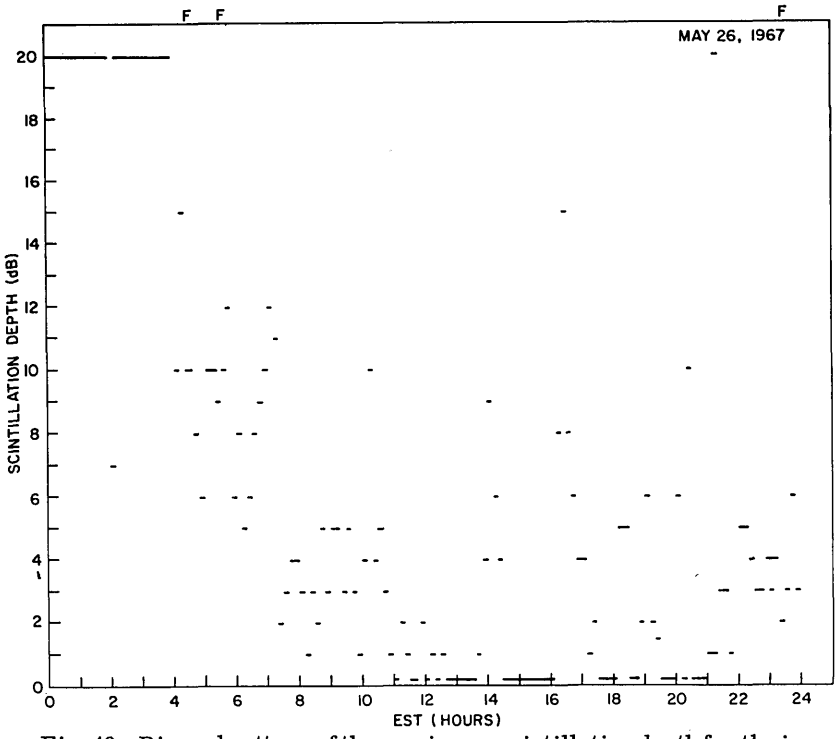


Fig. 49 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

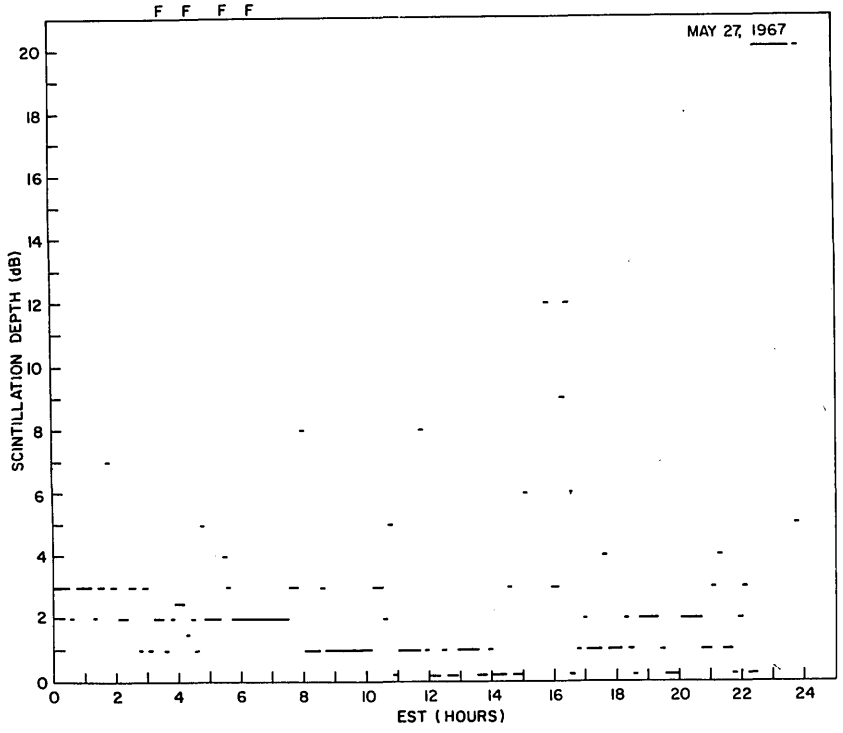


Fig. 50 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

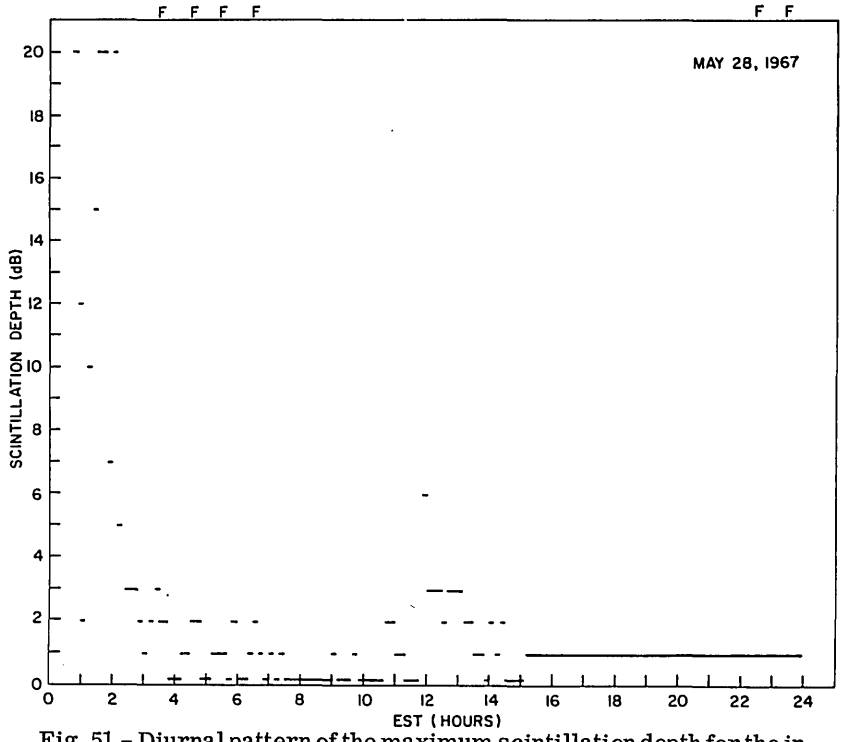


Fig. 51 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

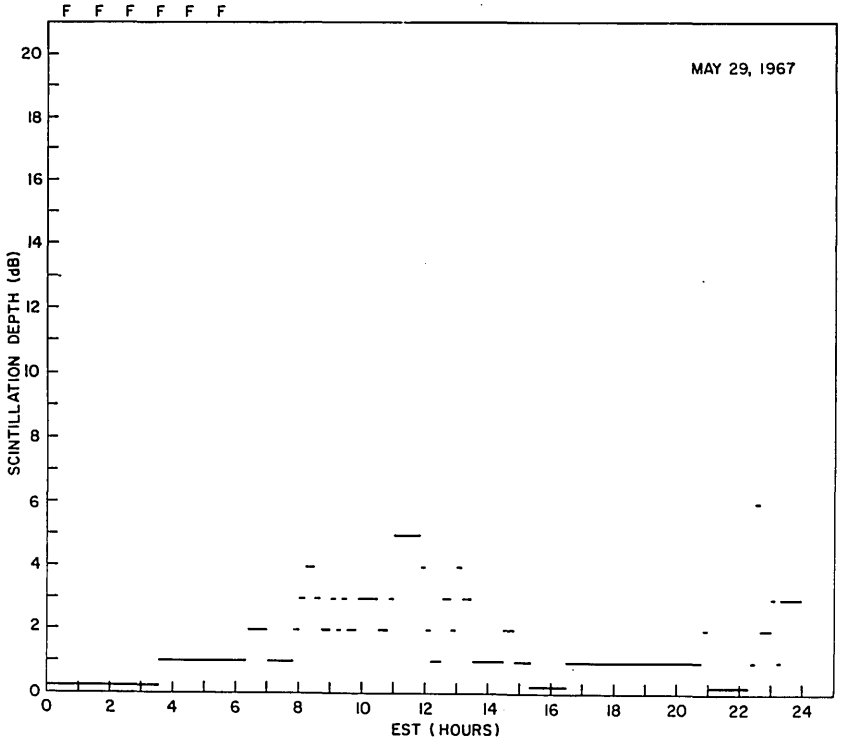


Fig. 52 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

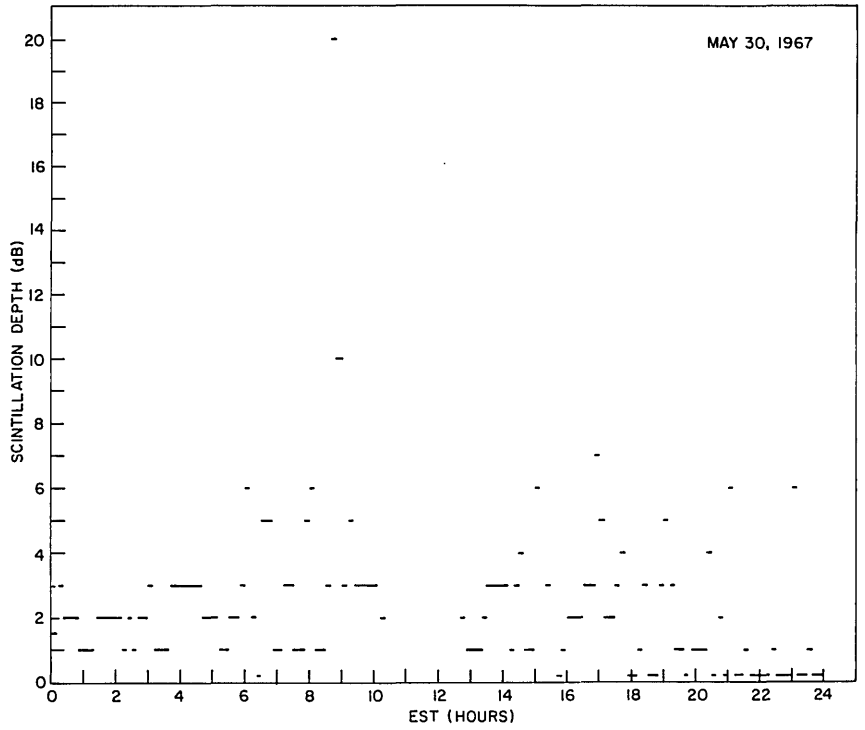


Fig. 53 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

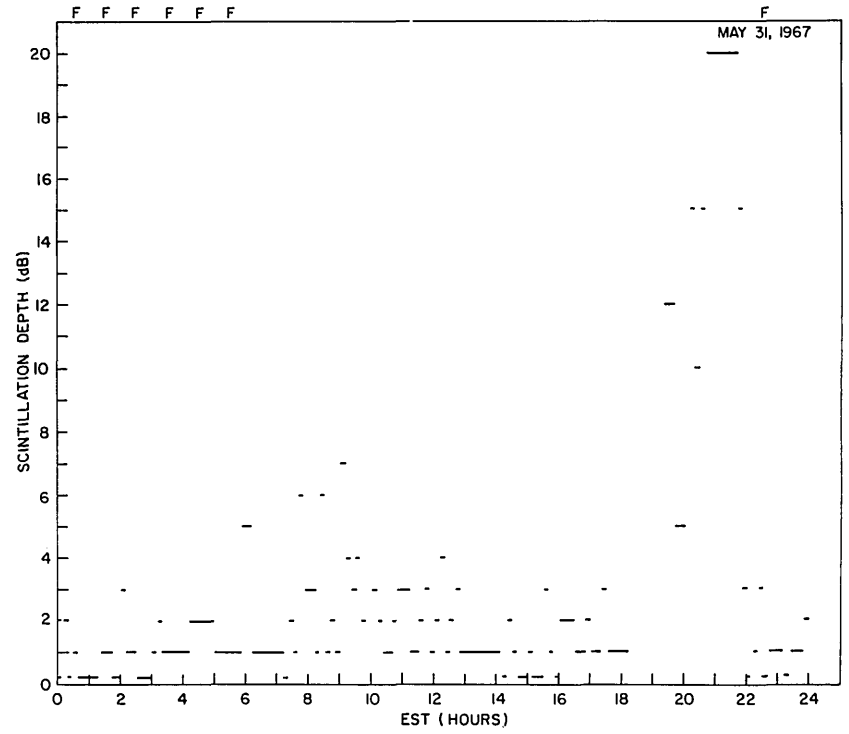


Fig. 54 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

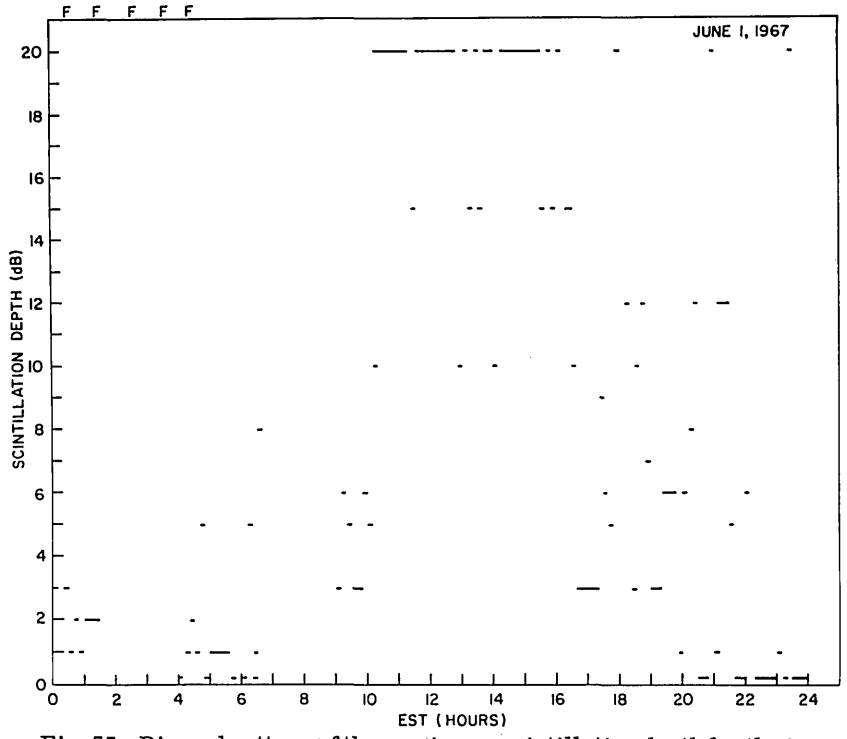


Fig. 55 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

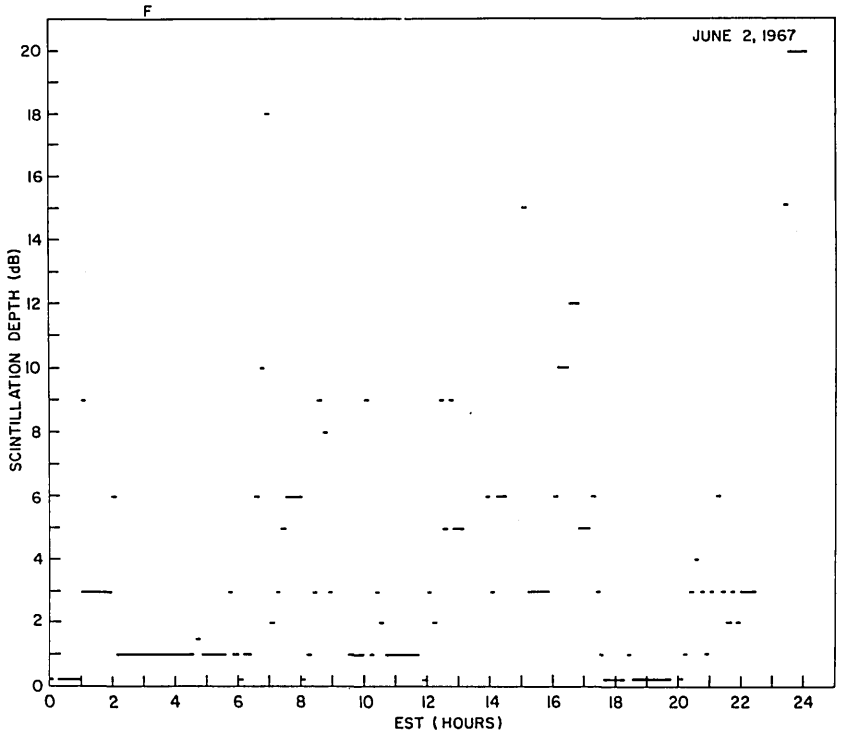


Fig. 56 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

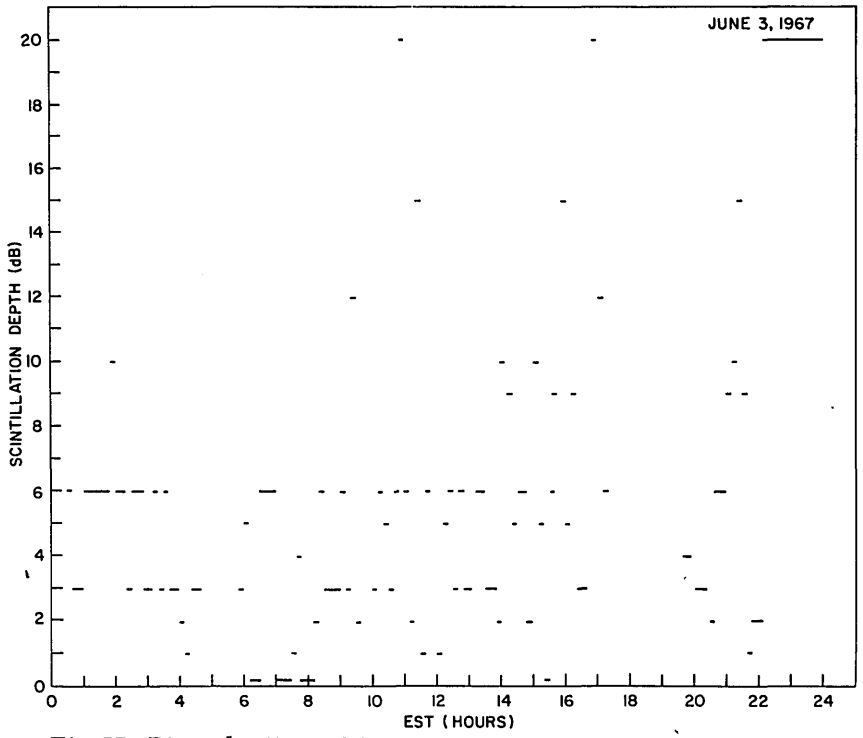


Fig. 57 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

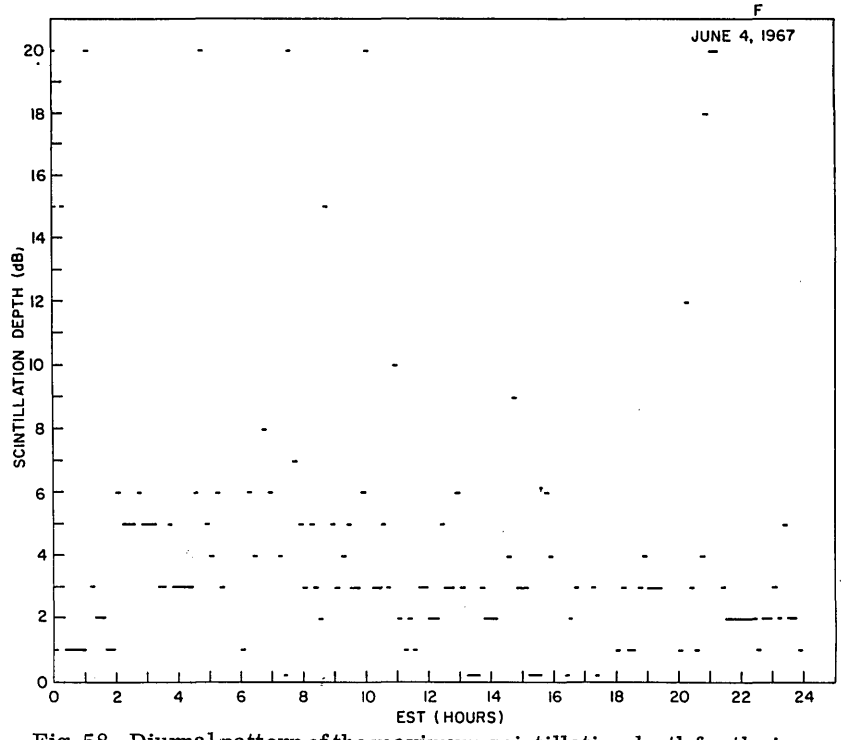


Fig. 58 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

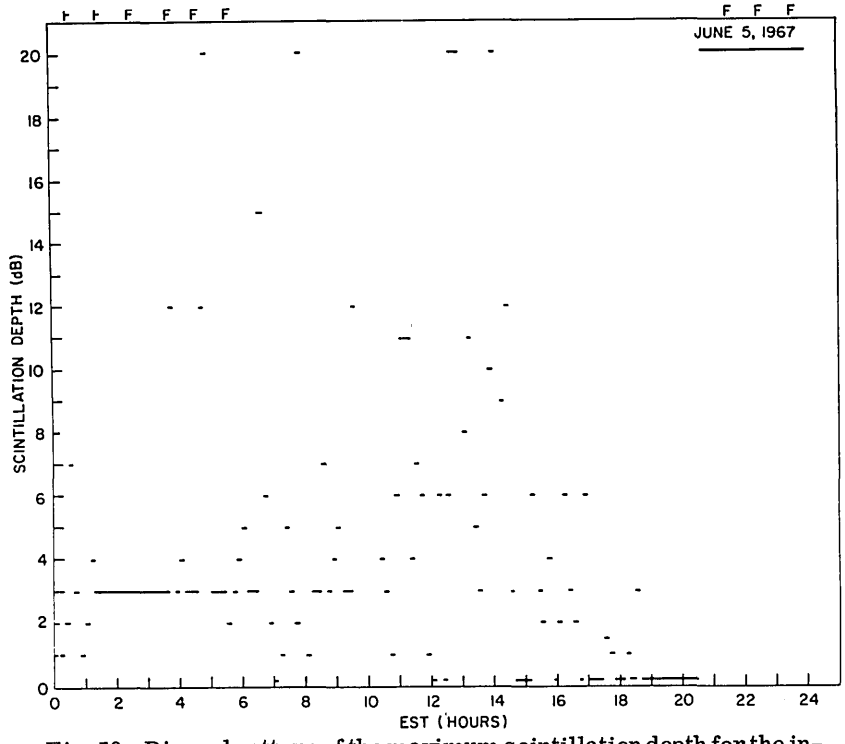


Fig. 59 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

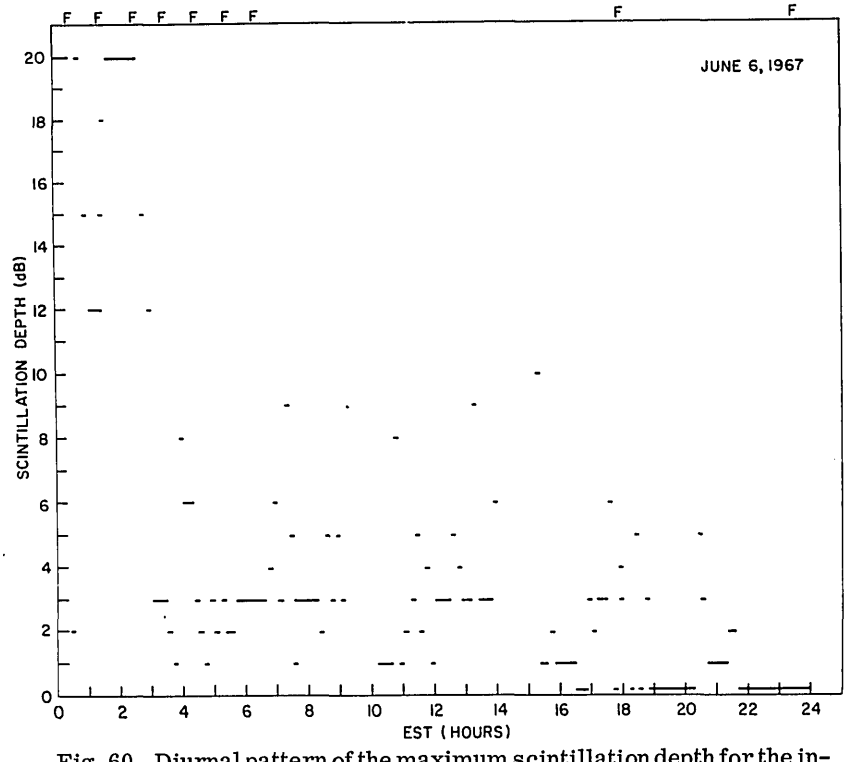


Fig. 60 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

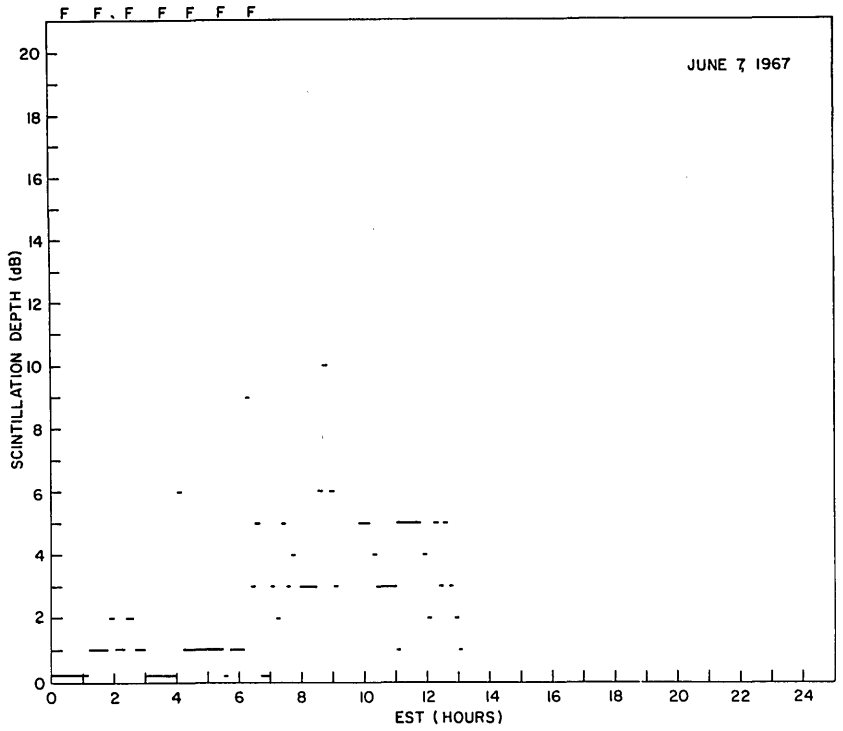


Fig. 61 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

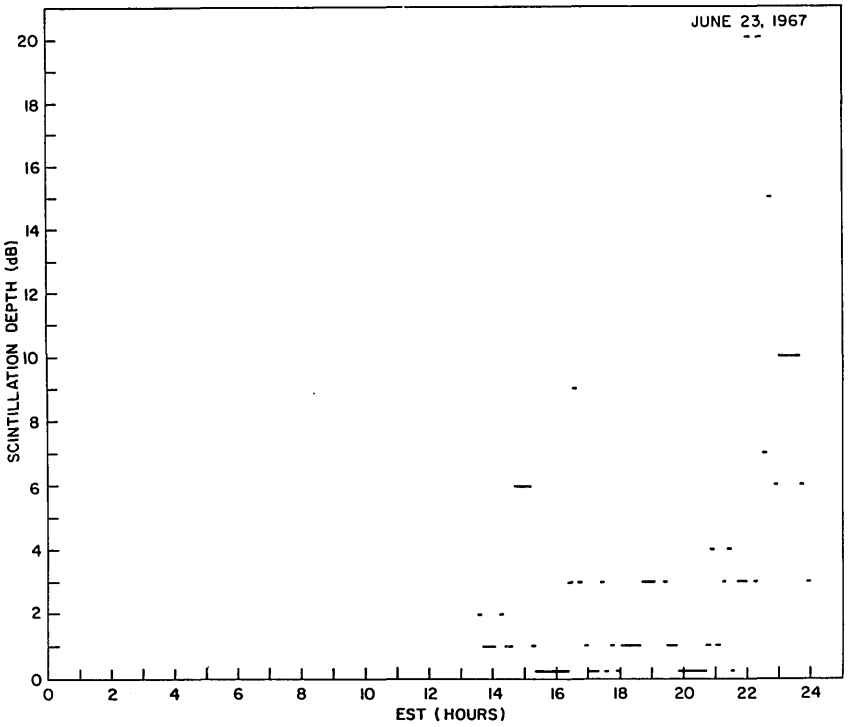


Fig. 62 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

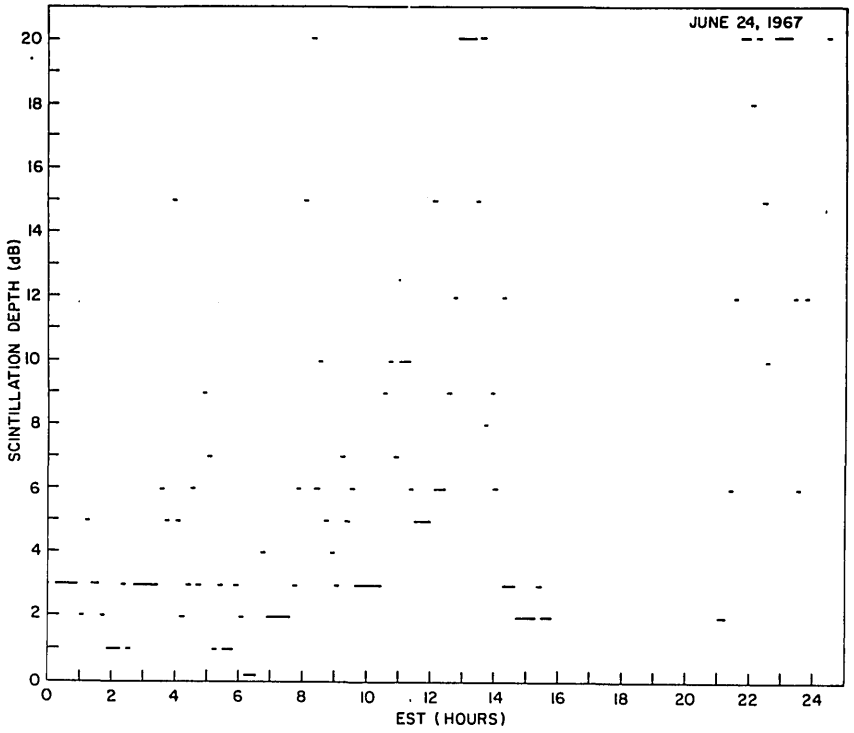


Fig. 63 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

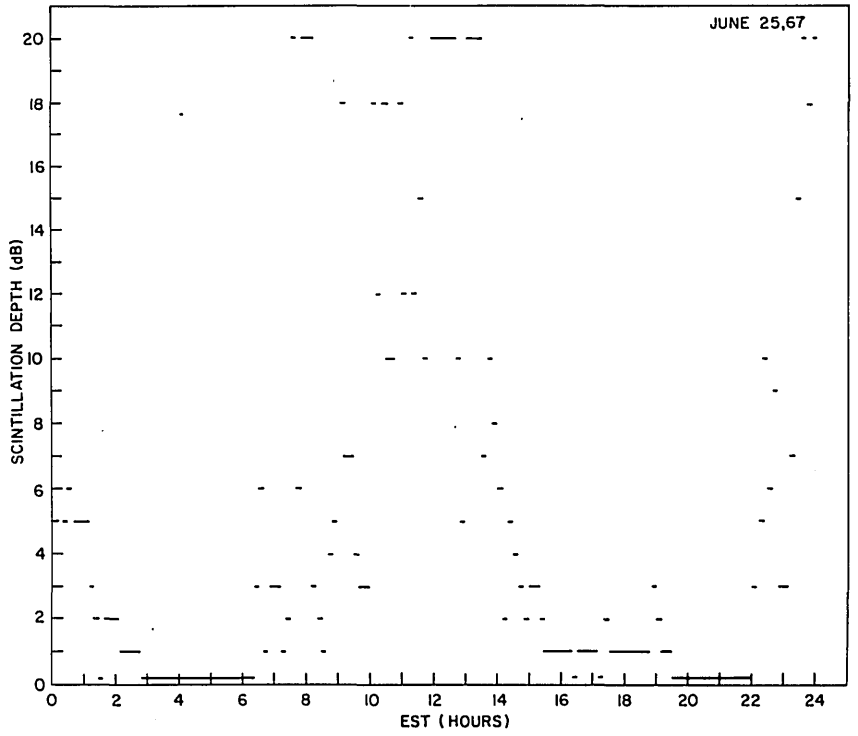


Fig. 64 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

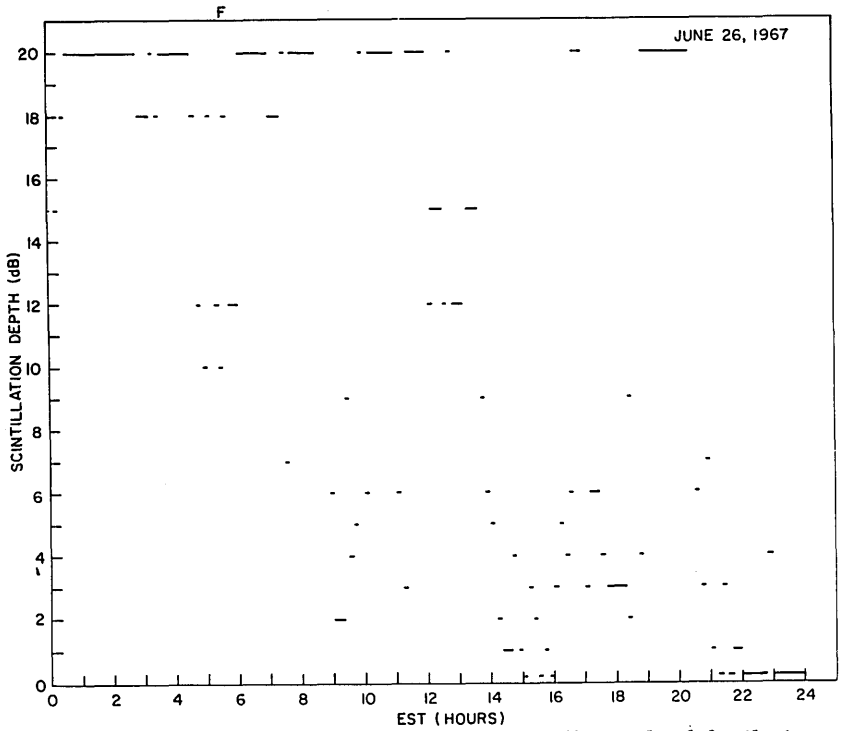


Fig. 65 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

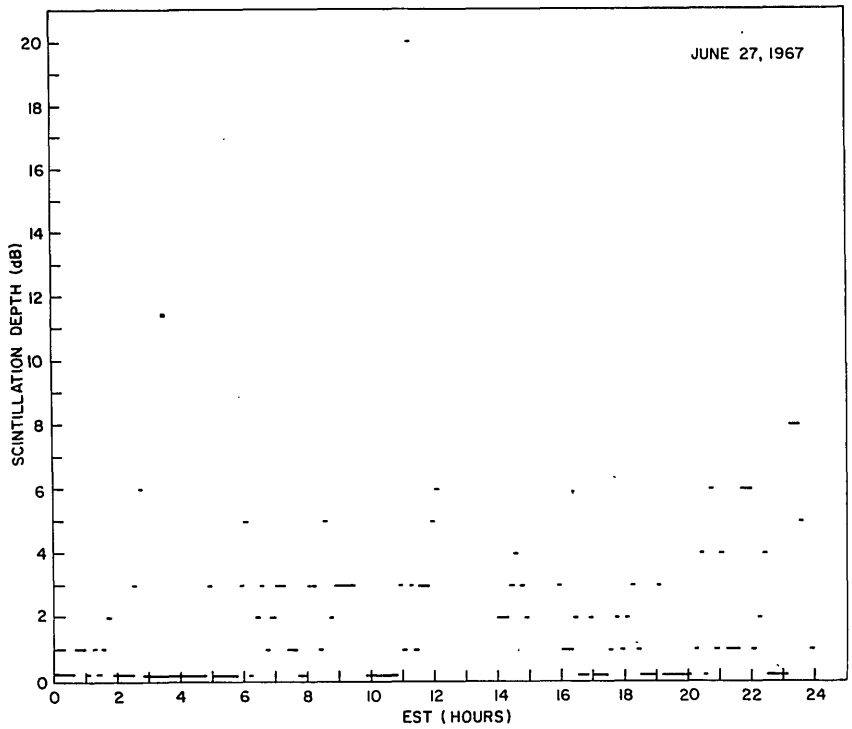


Fig. 66 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

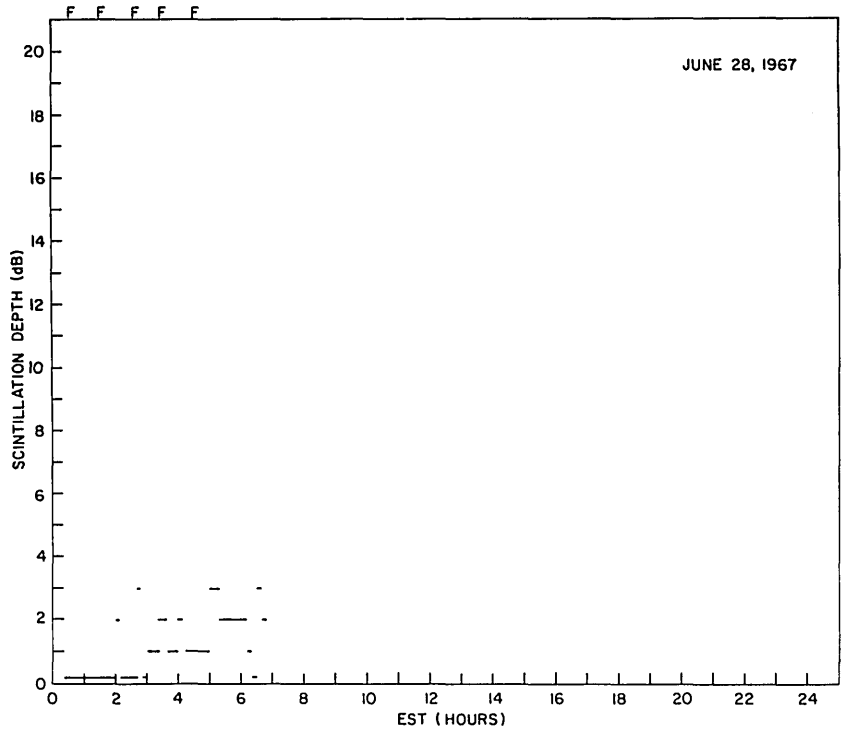


Fig. 67 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

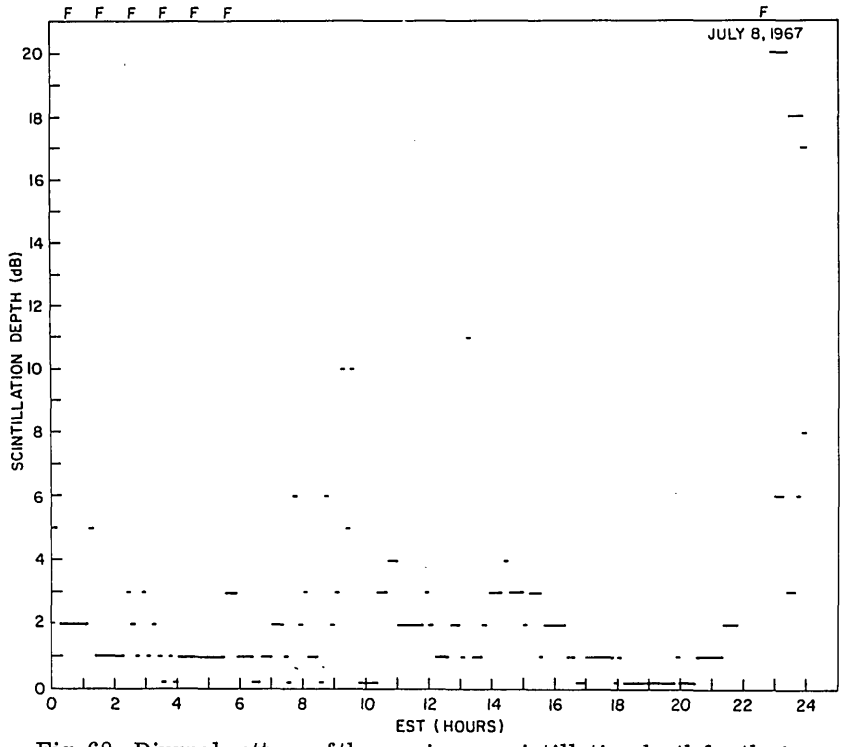


Fig. 68 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

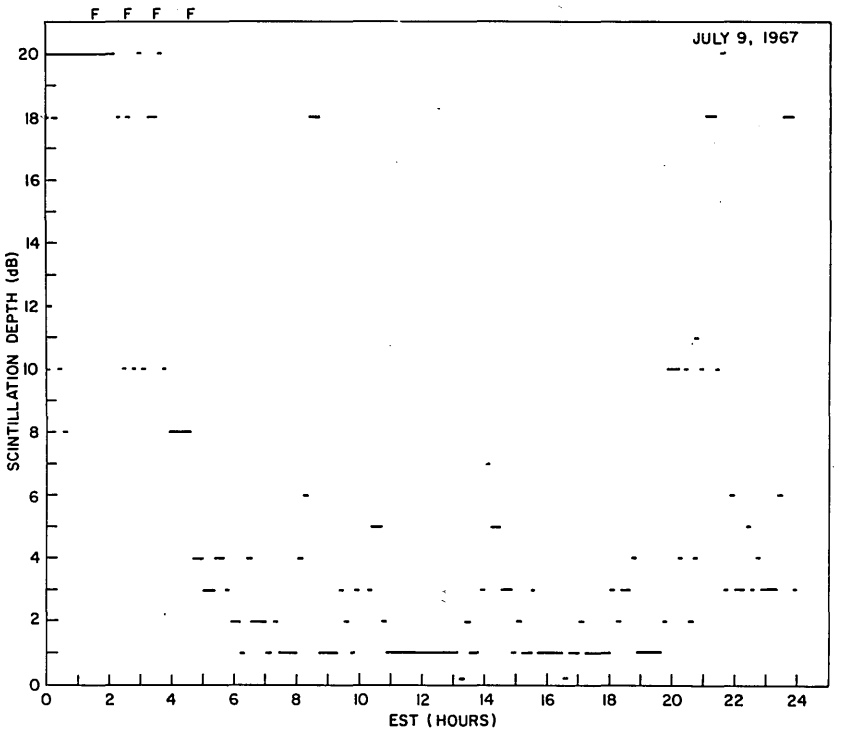


Fig. 69 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

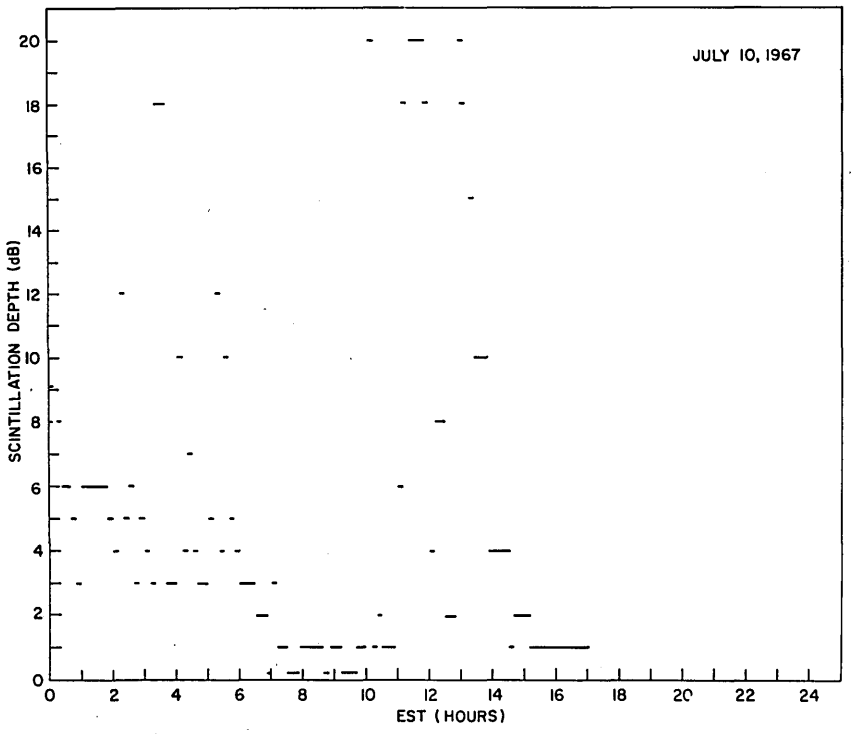


Fig. 70 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

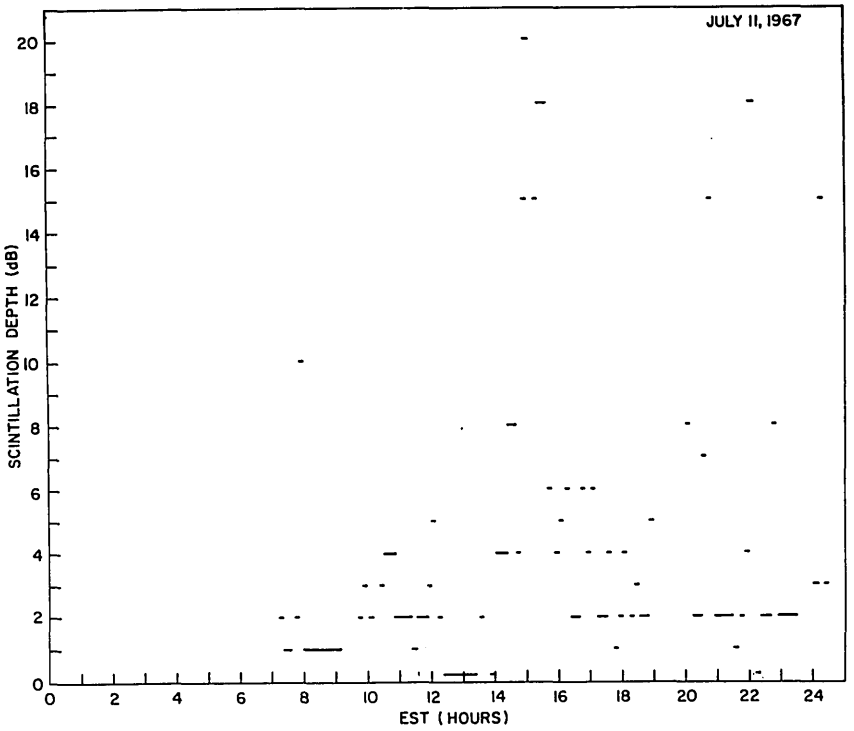


Fig. 71 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

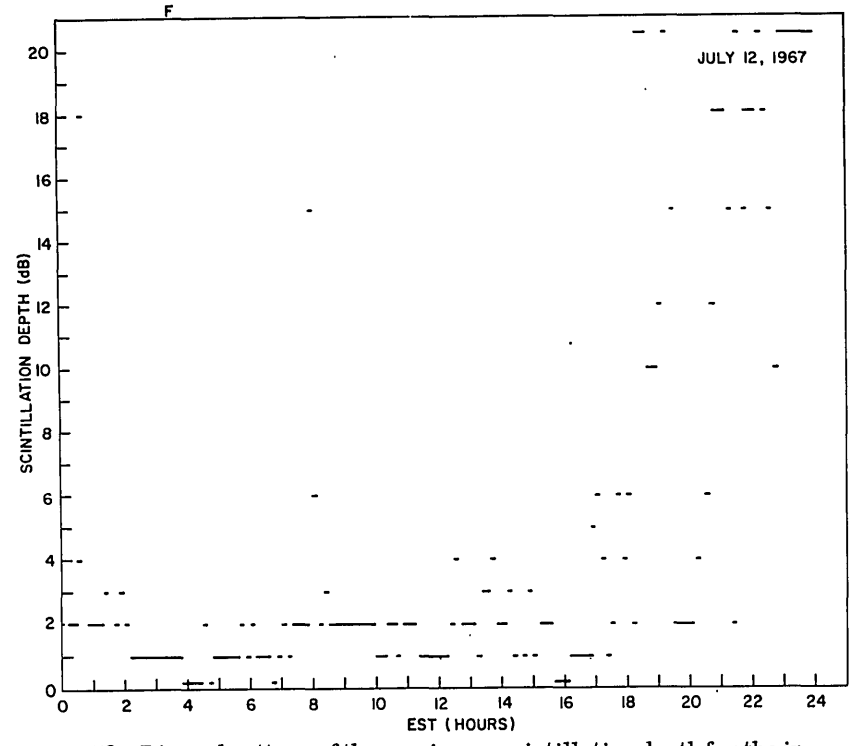


Fig. 72 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

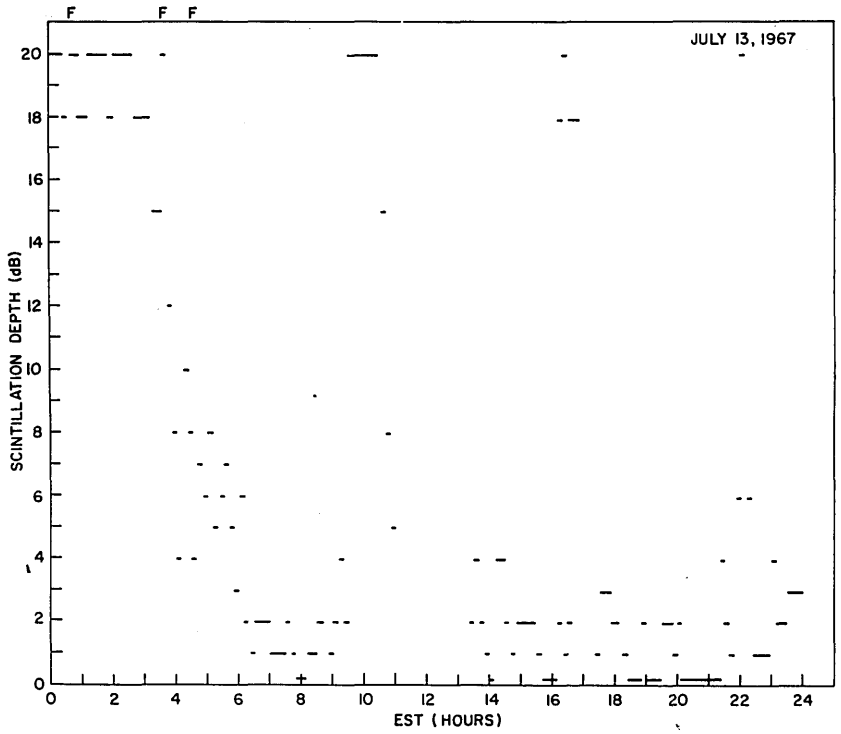


Fig. 73 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

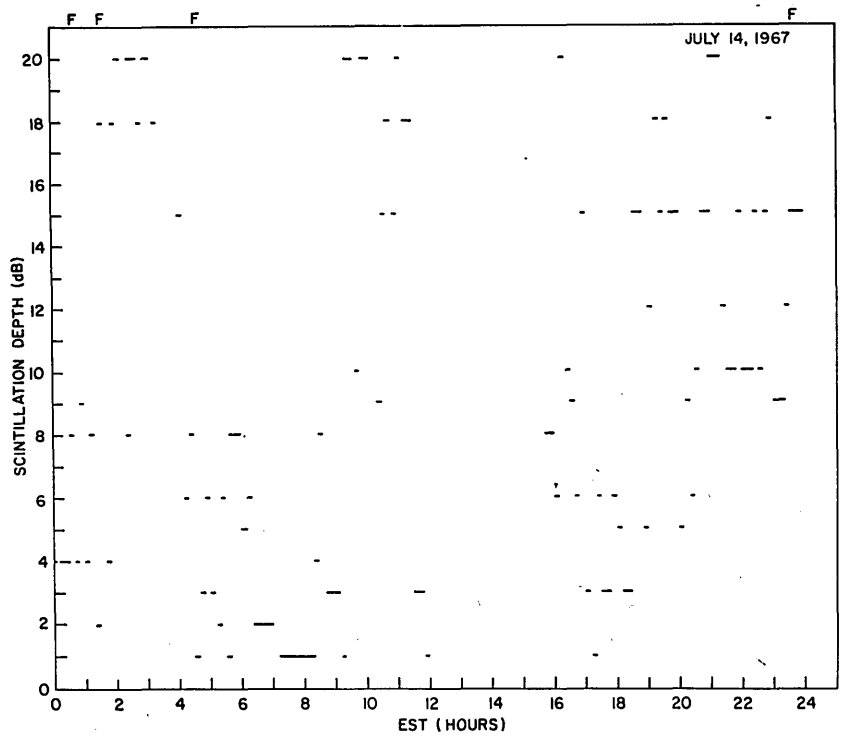


Fig. 74 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

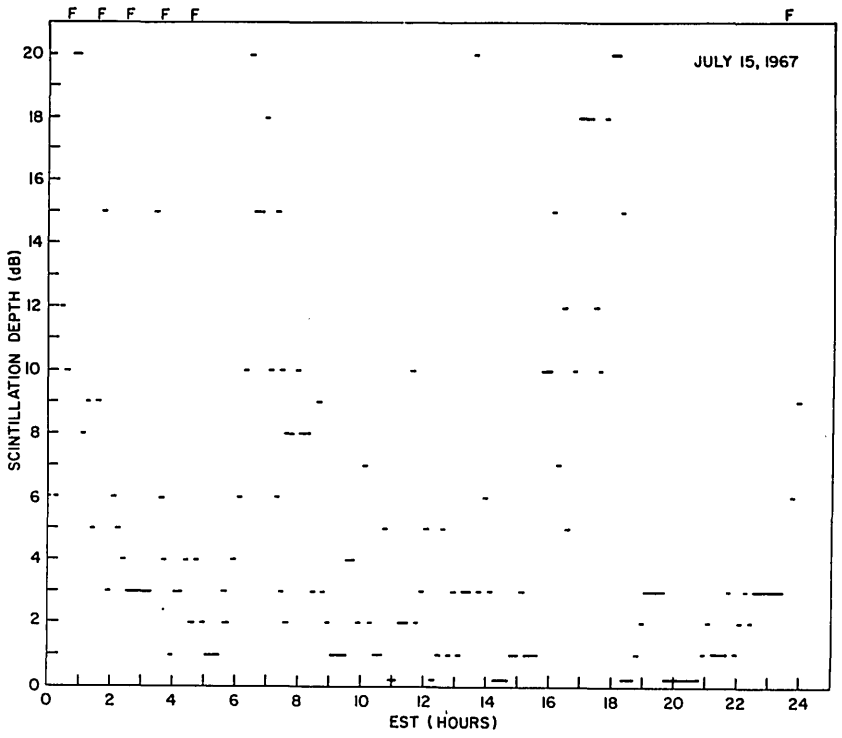


Fig. 75 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

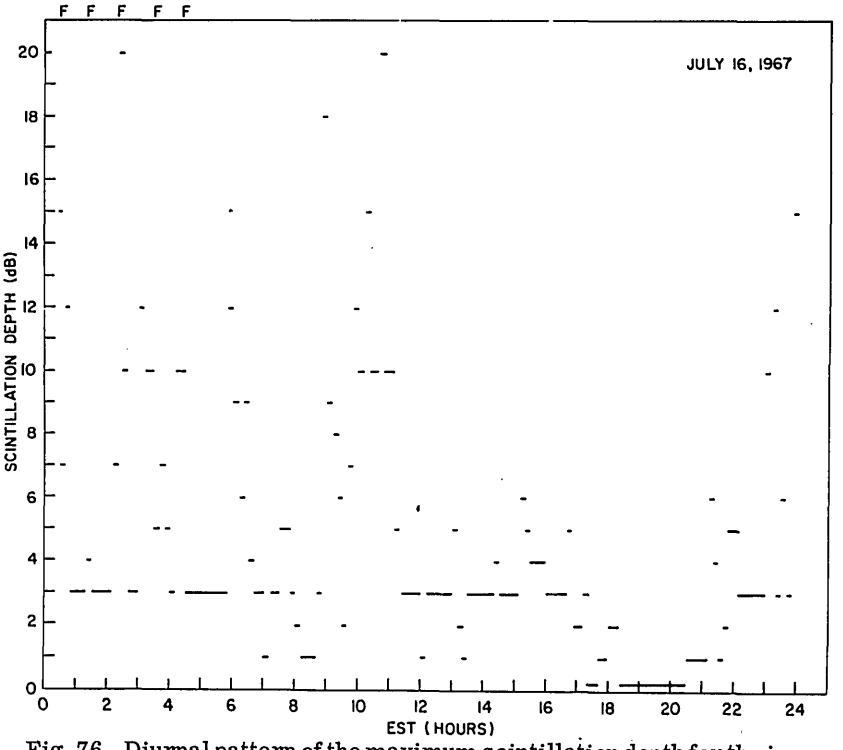


Fig. 76 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

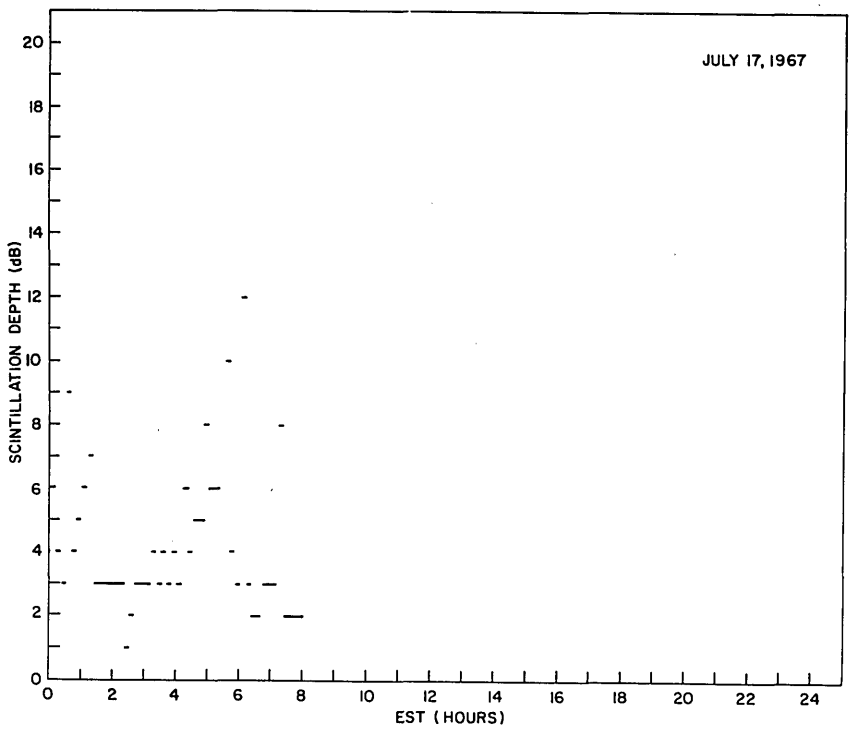


Fig. 77 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

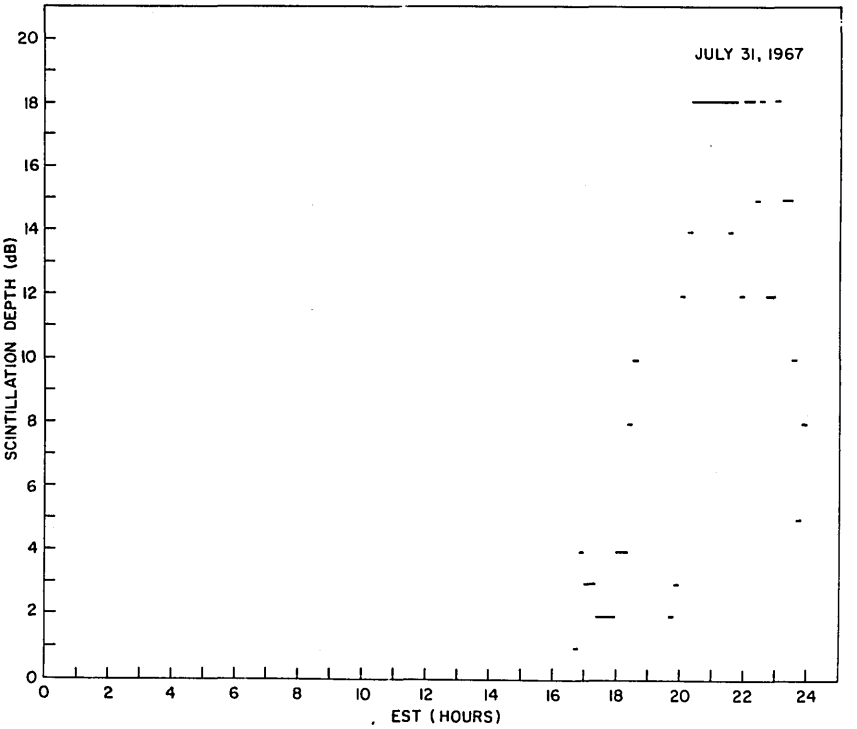


Fig. 78 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

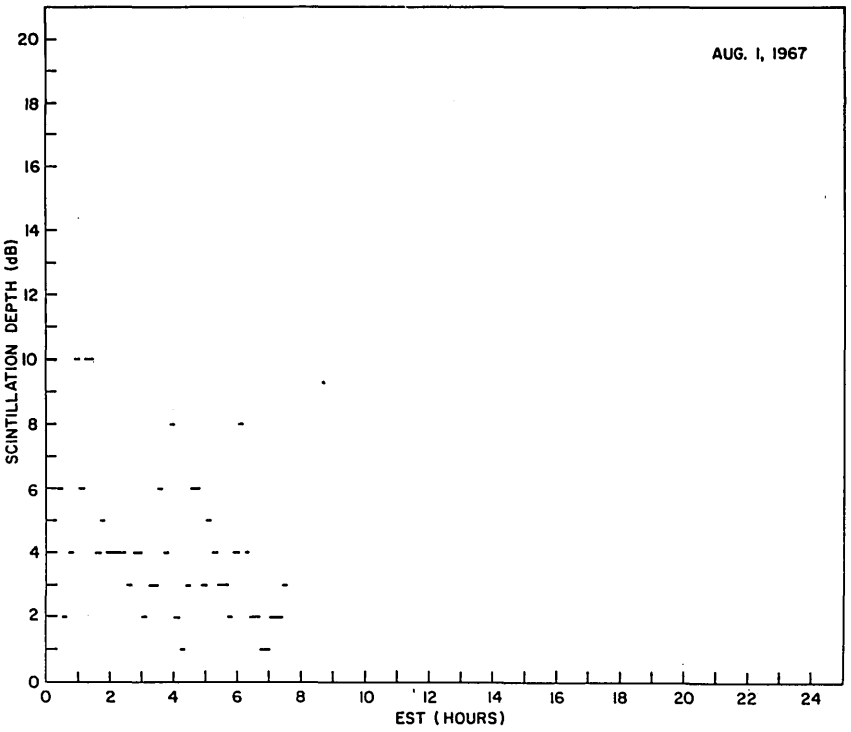


Fig. 79 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

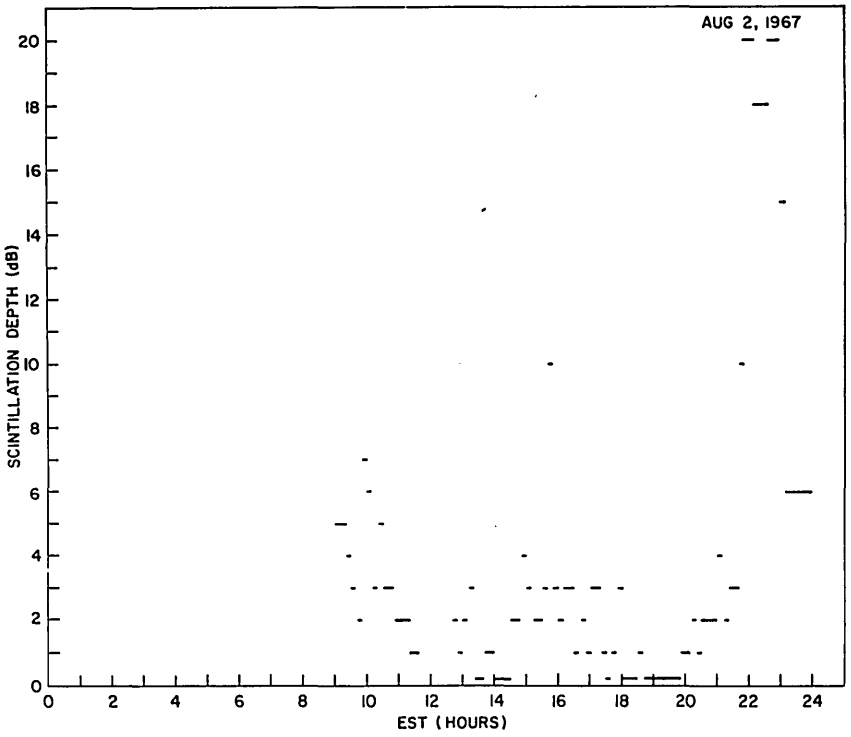


Fig. 80 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

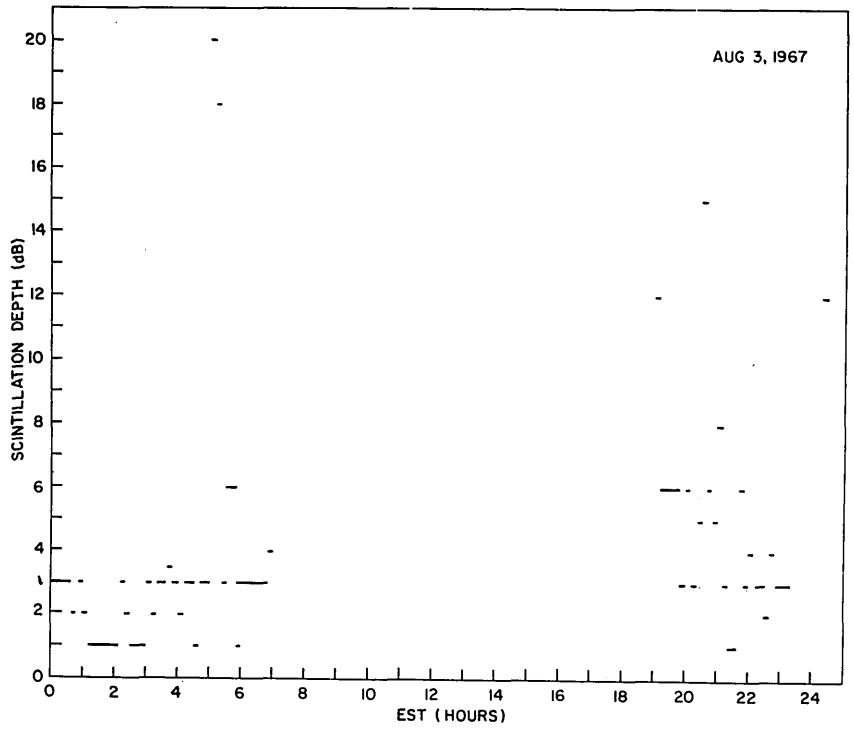


Fig. 81 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

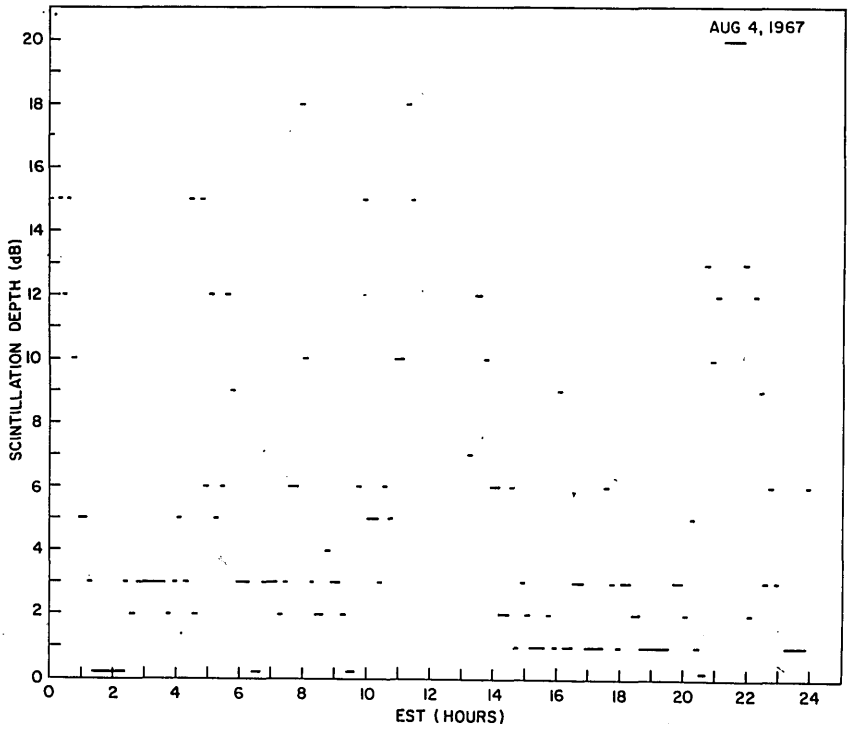


Fig. 82 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

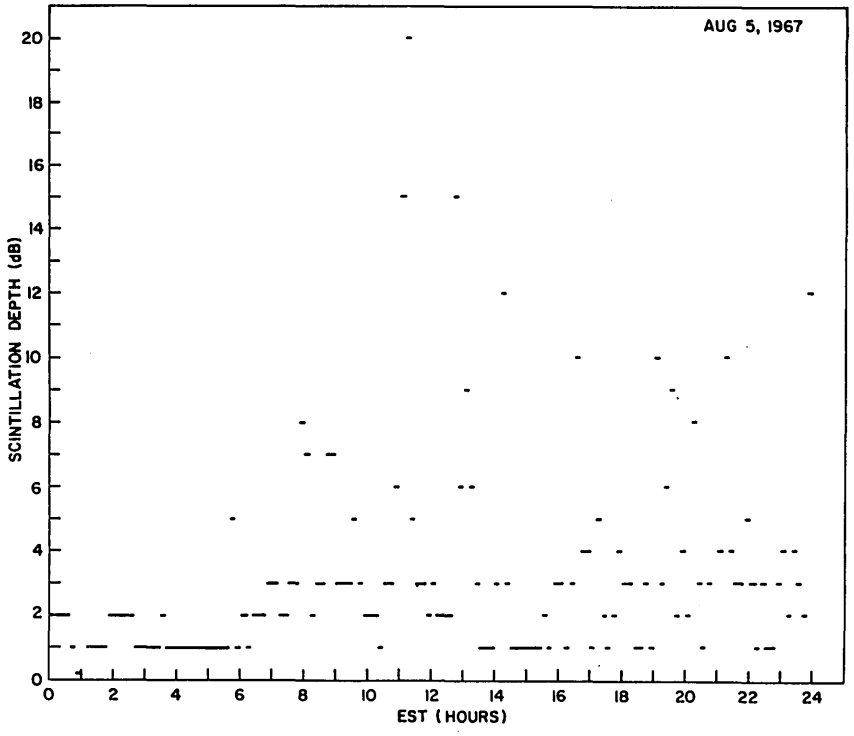


Fig. 83 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

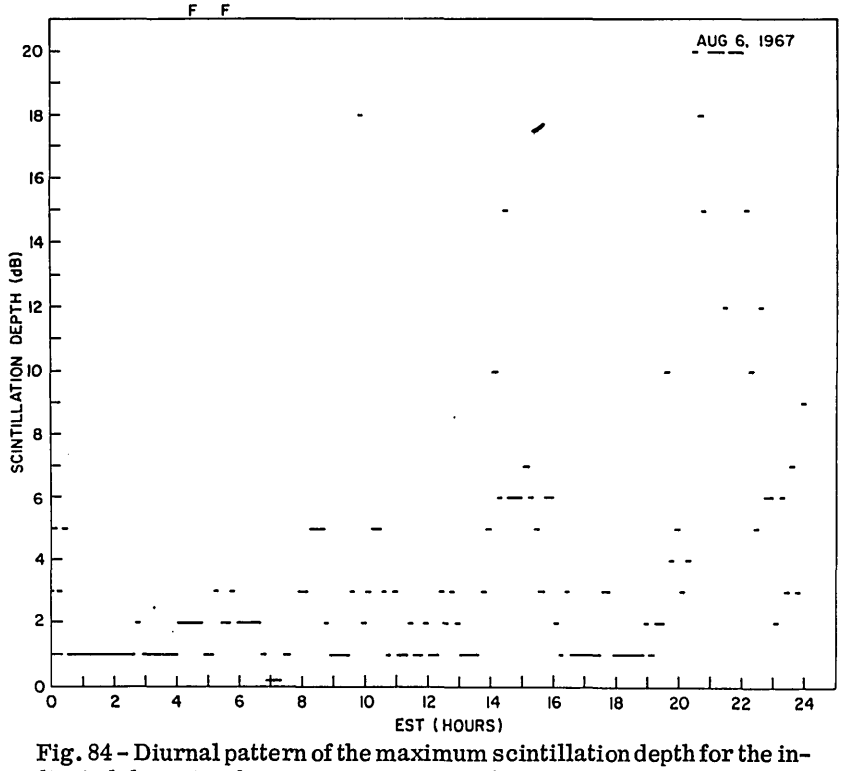


Fig. 84 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

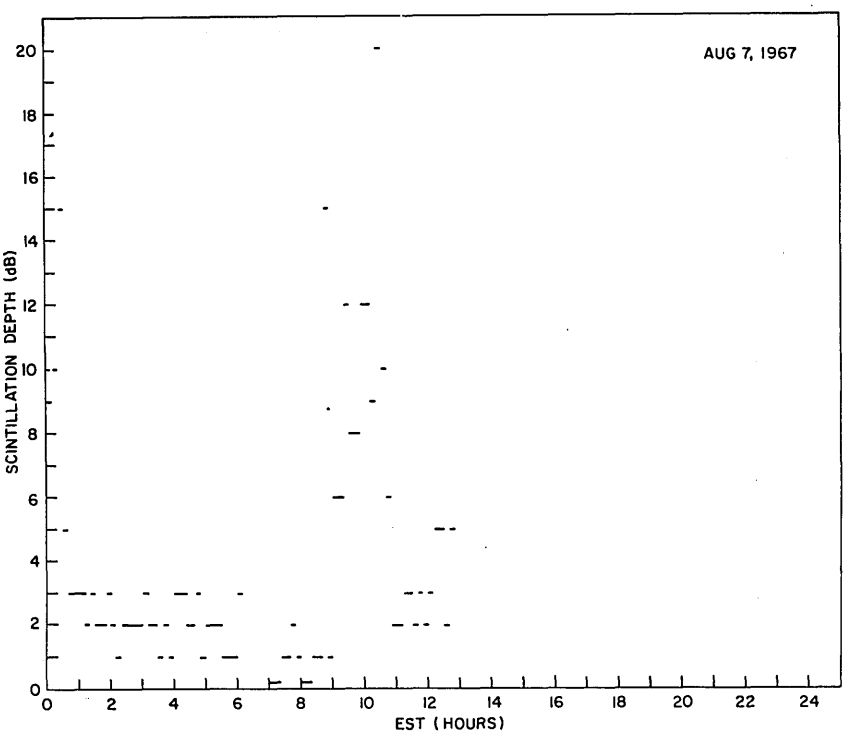


Fig. 85 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

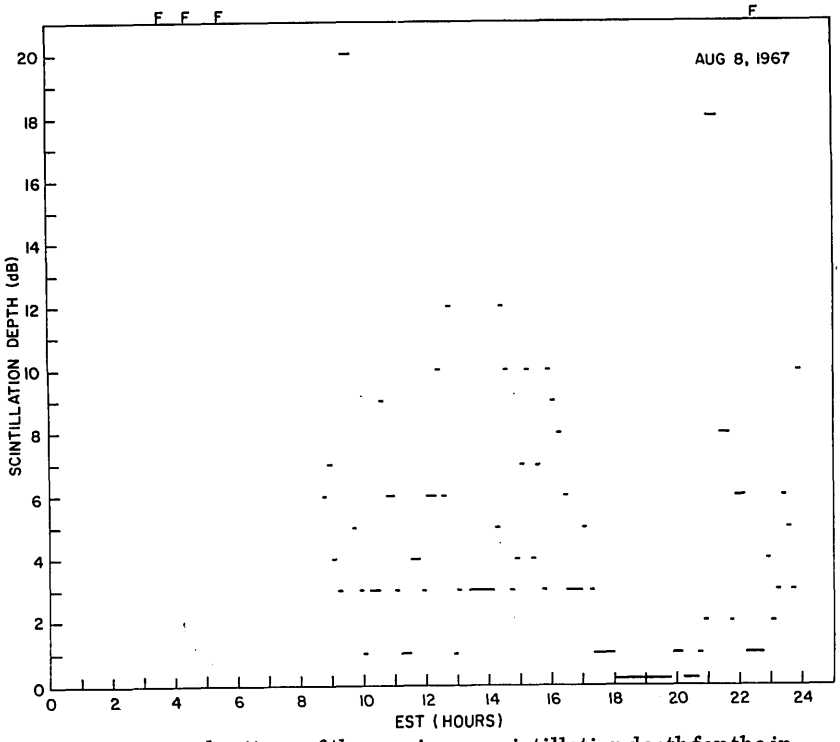


Fig. 86 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

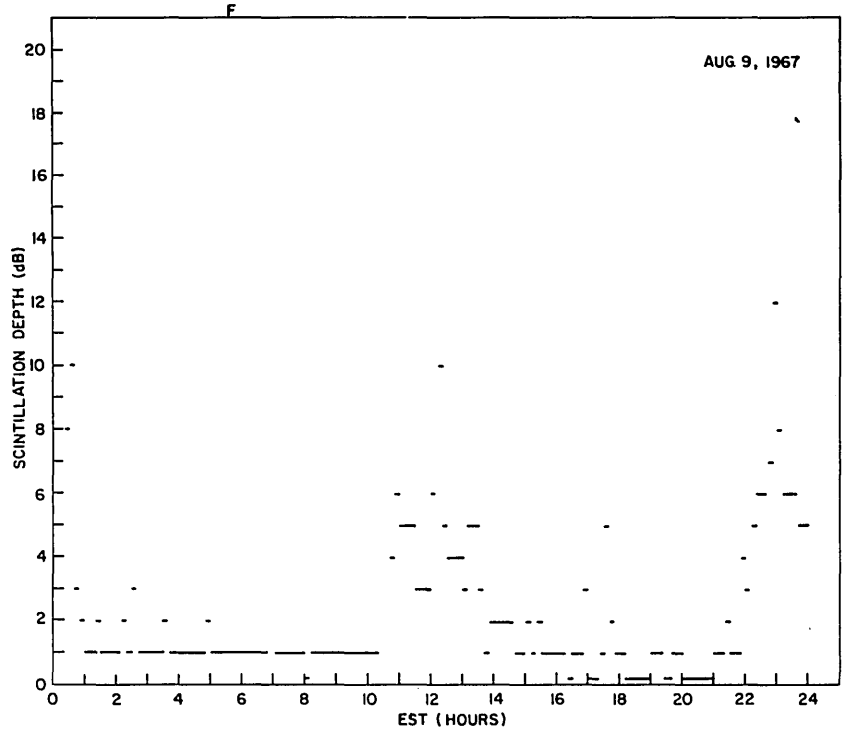


Fig. 87 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

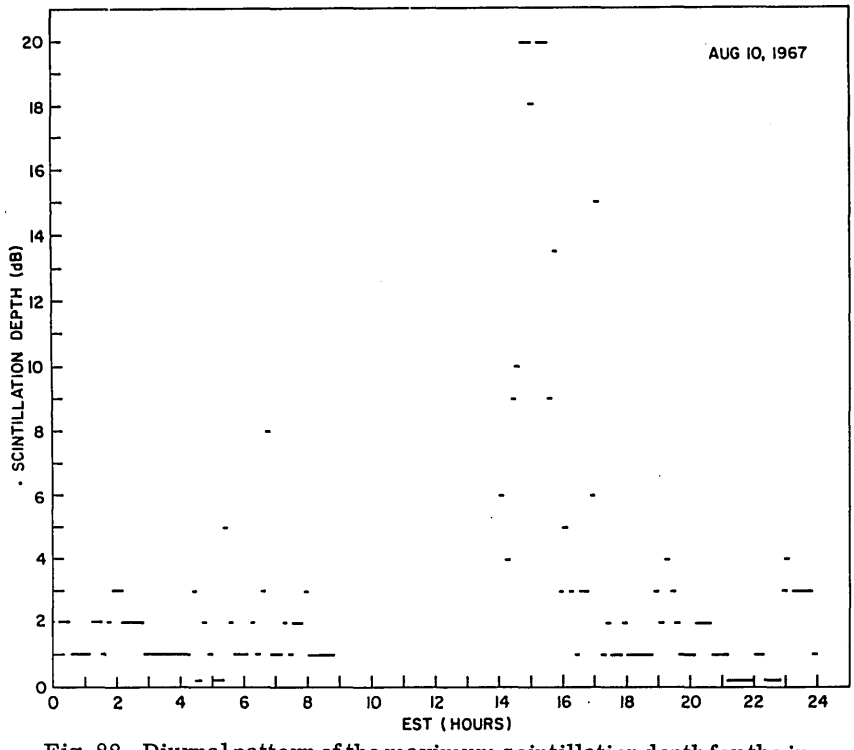


Fig. 88 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

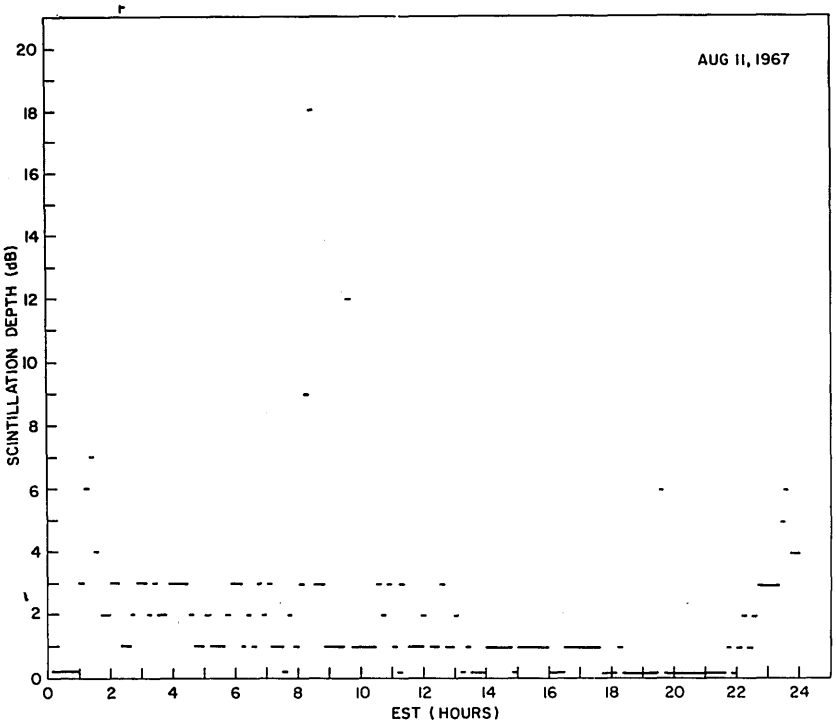


Fig. 89 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

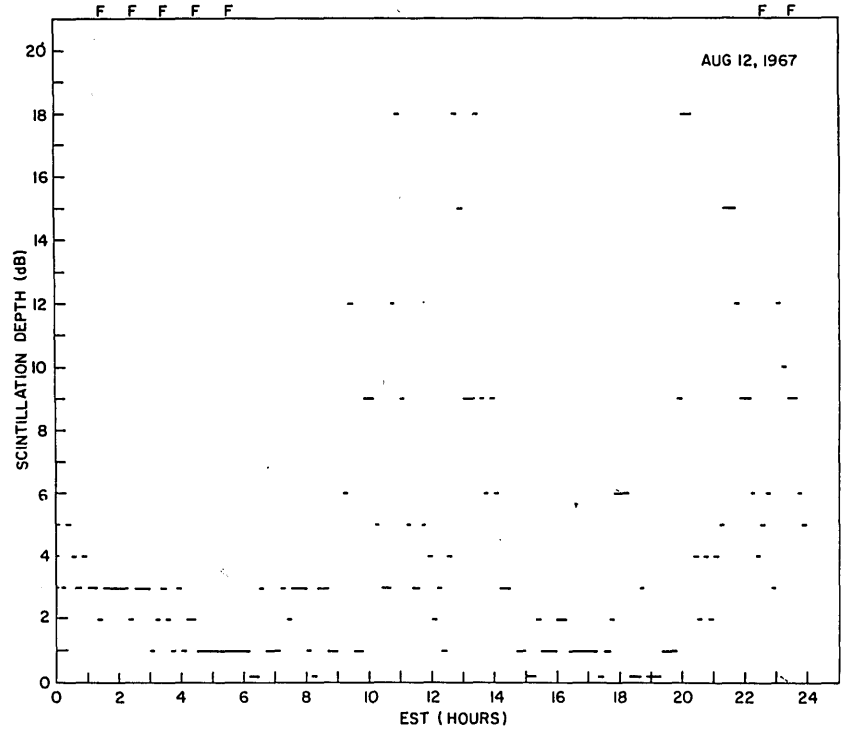


Fig. 90 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

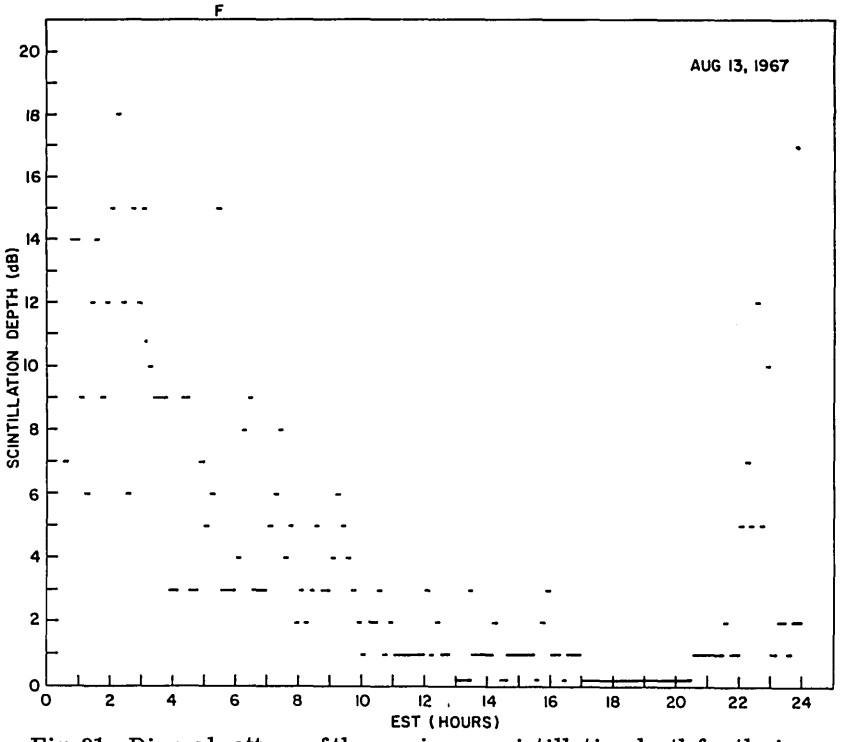


Fig. 91 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

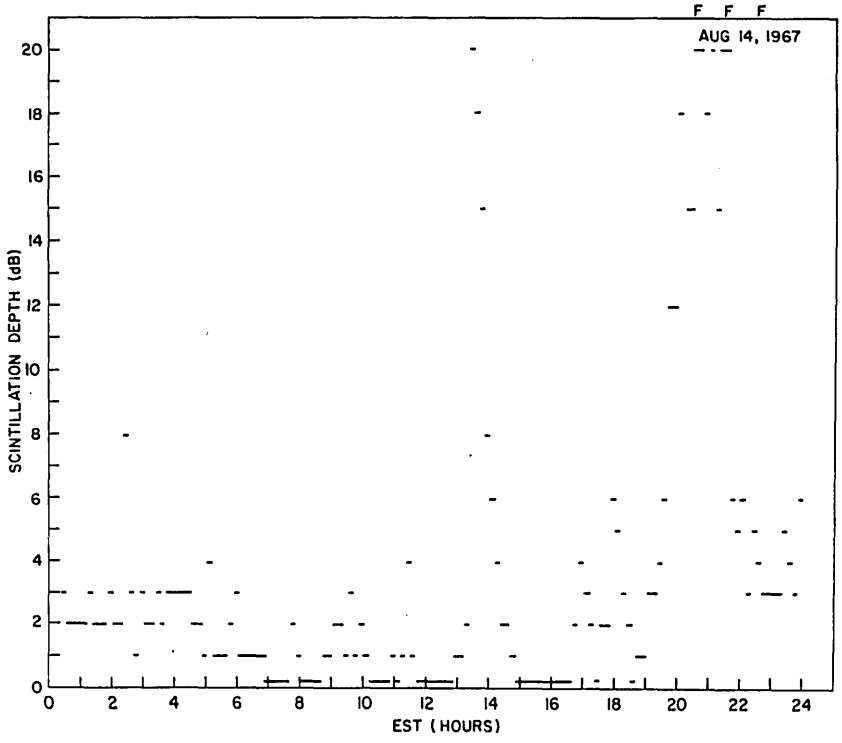


Fig. 92 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

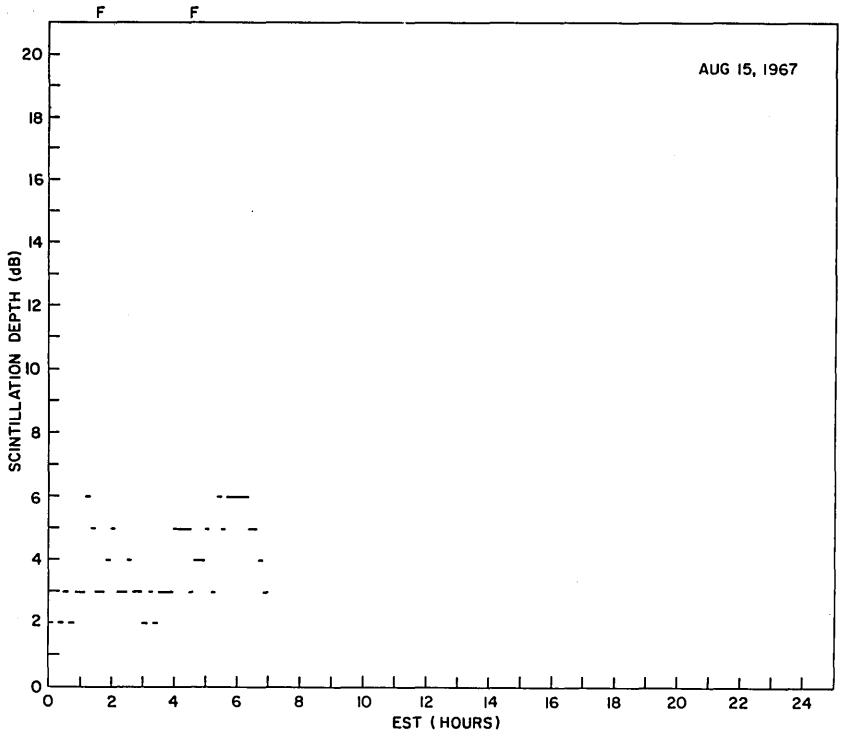
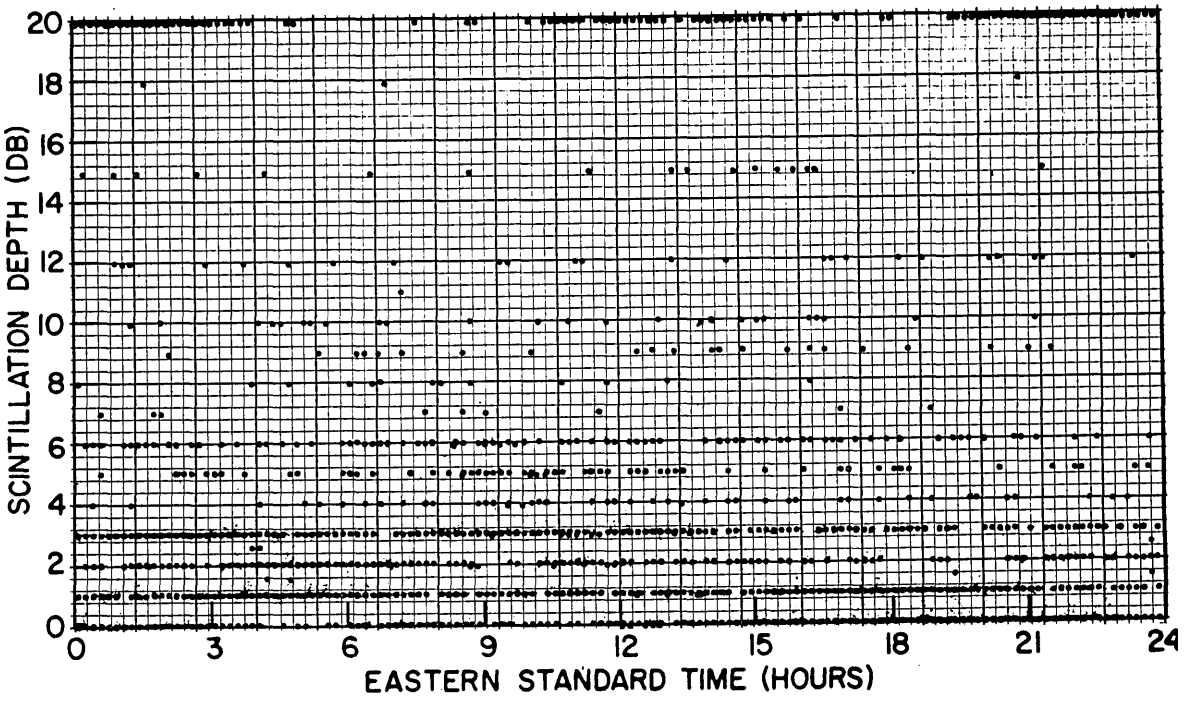
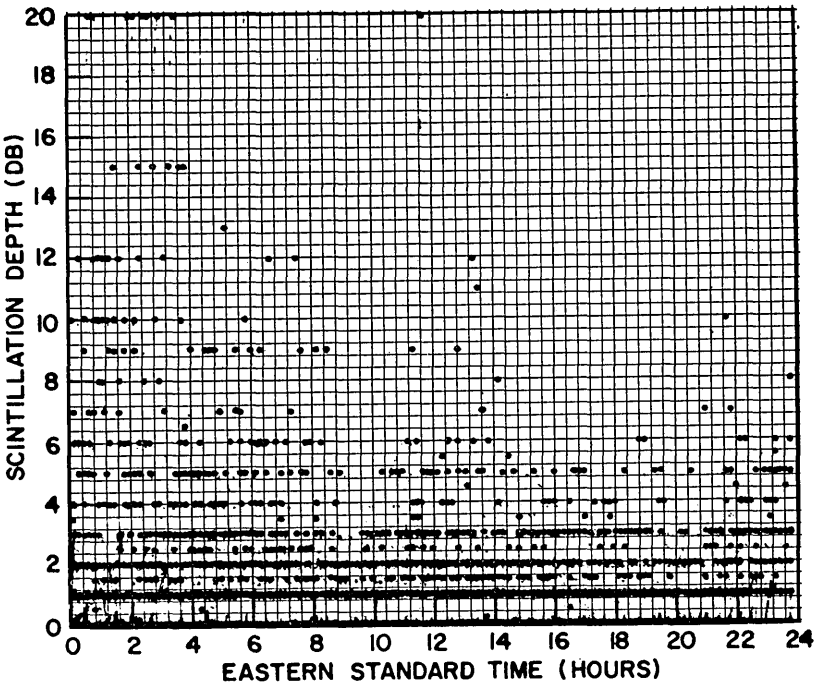


Fig. 93 - Diurnal pattern of the maximum scintillation depth for the indicated date. Each measurement was taken over a 10-min interval. The absence of horizontal lines implies that data were not obtained.

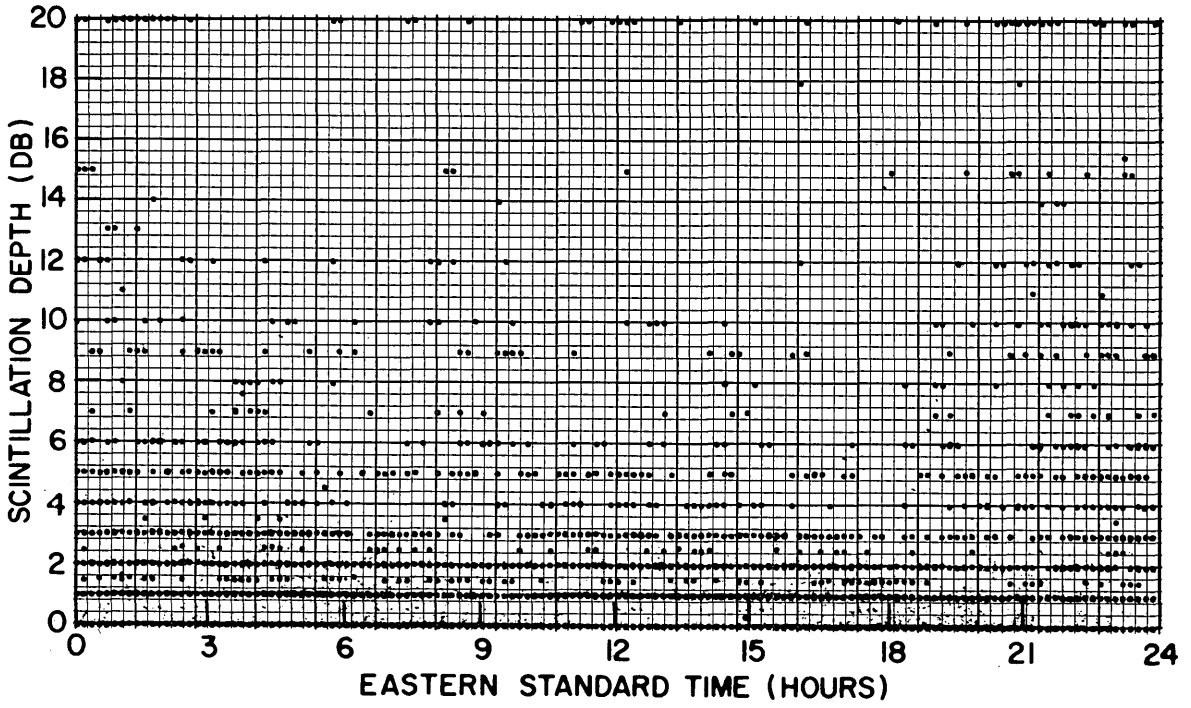


(a) May 25 through June 7, 1967

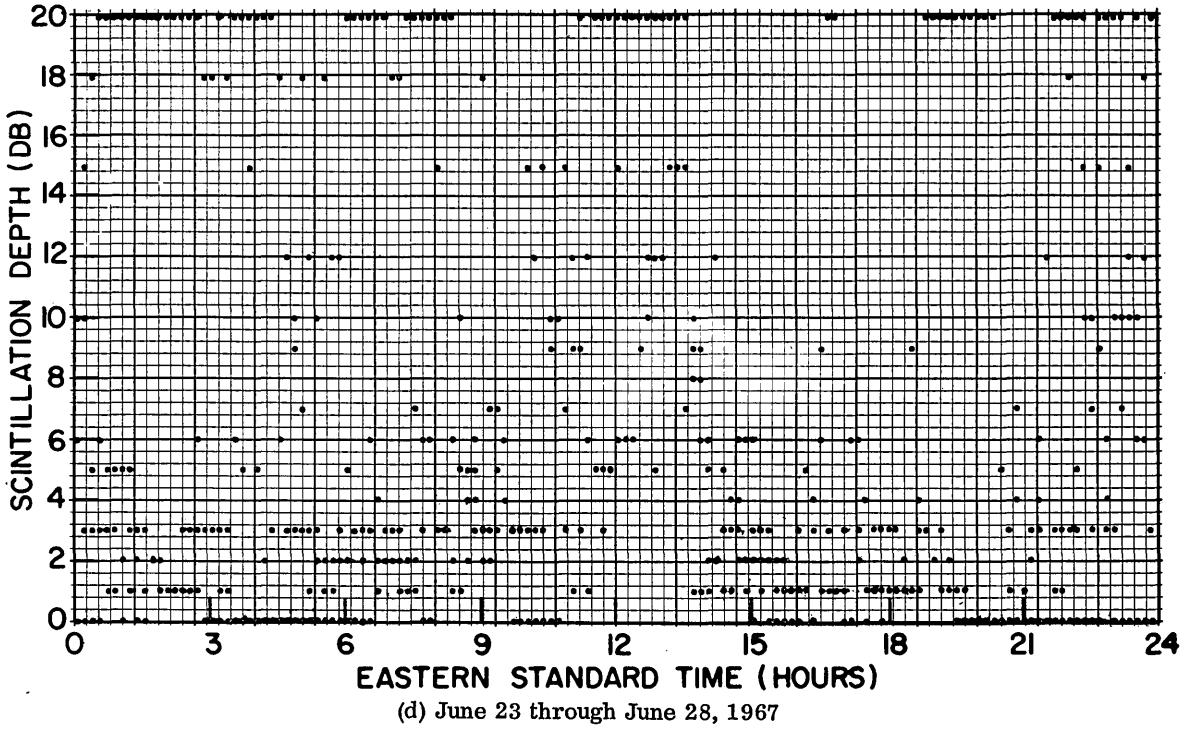


(b) April 7 through April 30, 1967

Fig. 94 - Composite of maximum scintillation depth versus time of day

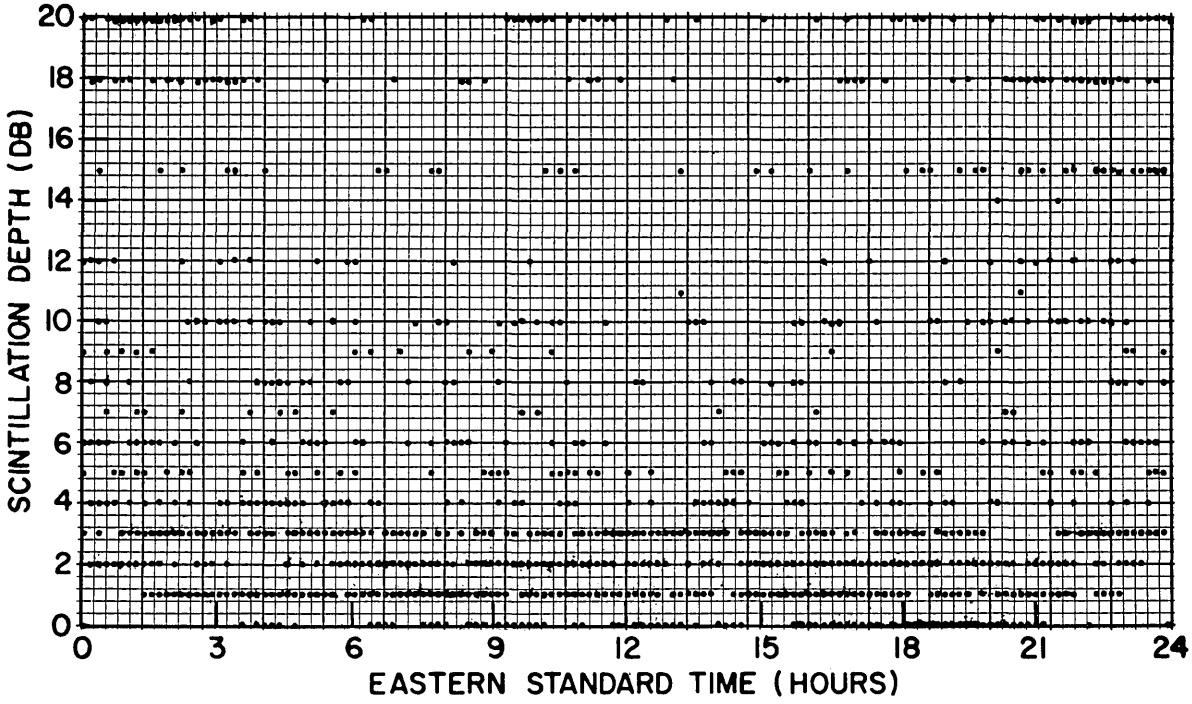


(c) May 1 through May 18 and May 20 through May 24, 1967

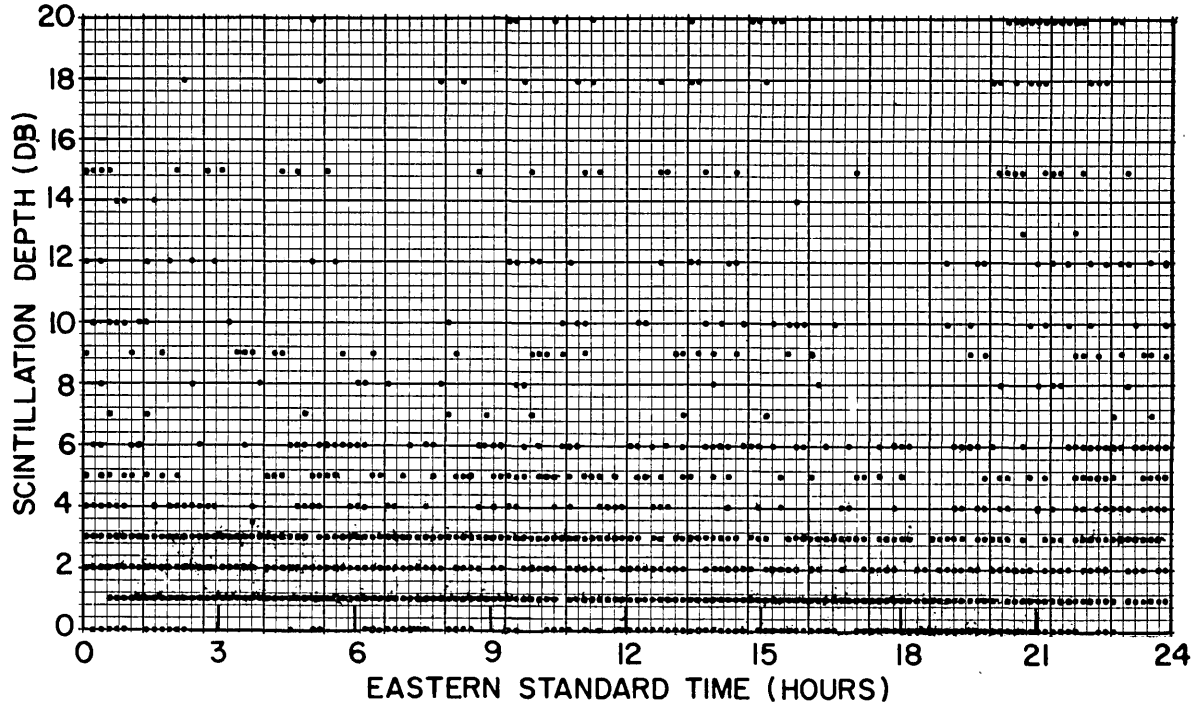


(d) June 23 through June 28, 1967

Fig. 94 (Continued) – Composite of maximum scintillation depth versus time of day

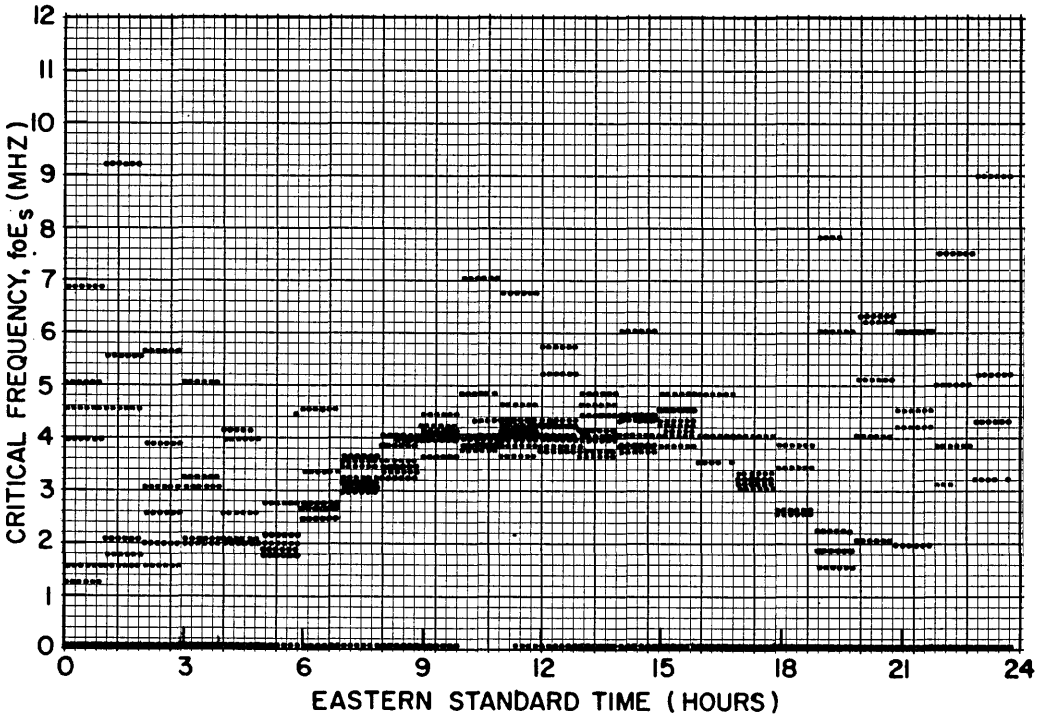


(e) July 8 through July 17 and July 31, 1967

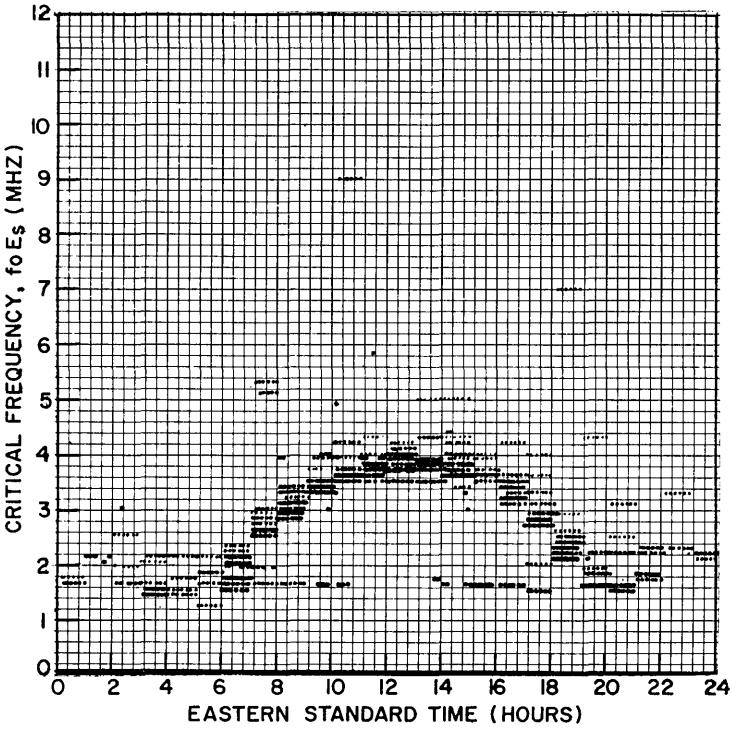


(f) August 1 through August 15, 1967

Fig. 94 (Continued) - Composite of maximum scintillation depth versus time of day

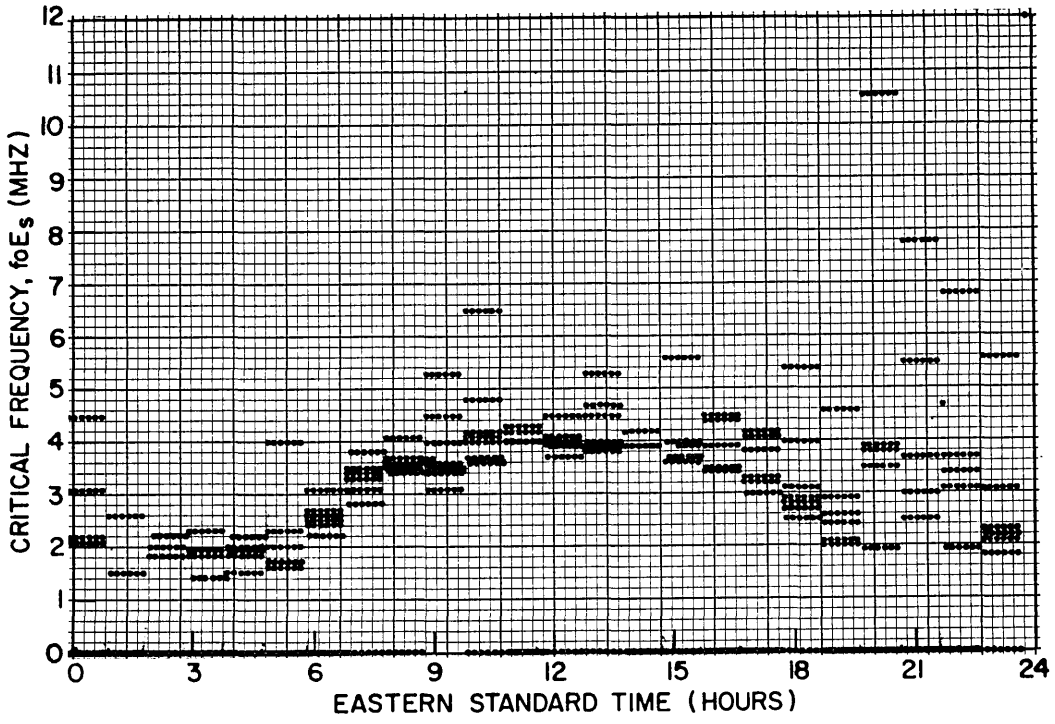


(a) May 25 through June 7, 1967

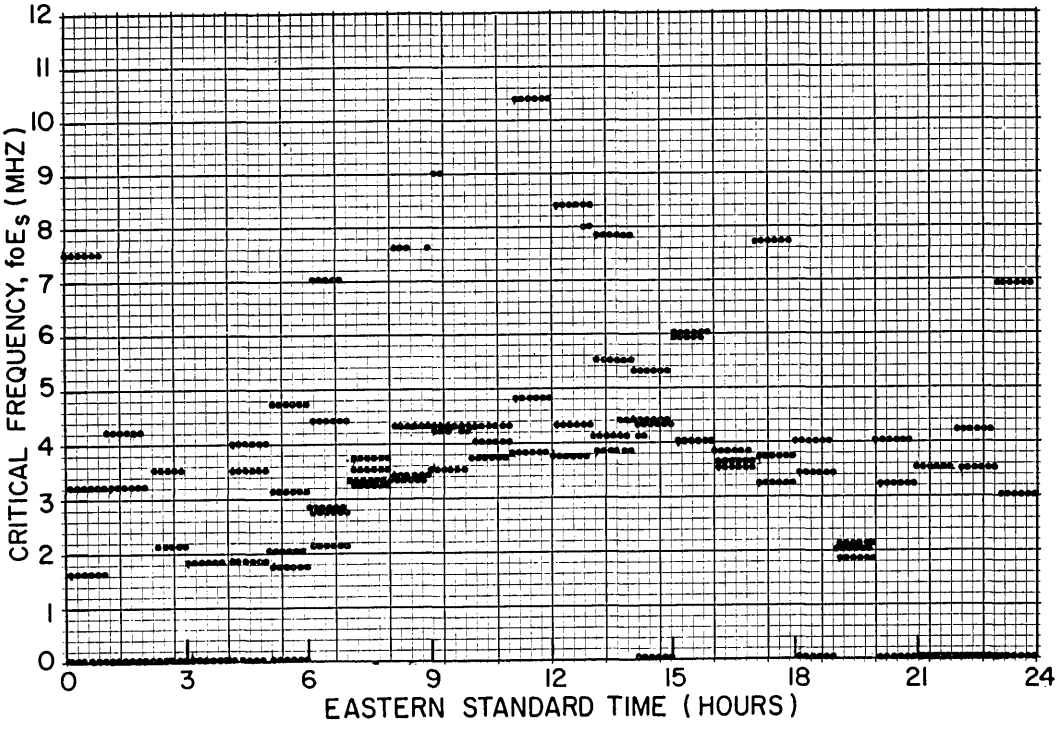


(b) April 7 through April 30, 1967

Fig. 95 - Sporadic E activity data. Data were obtained from the Fort Belvoir ionsonde.

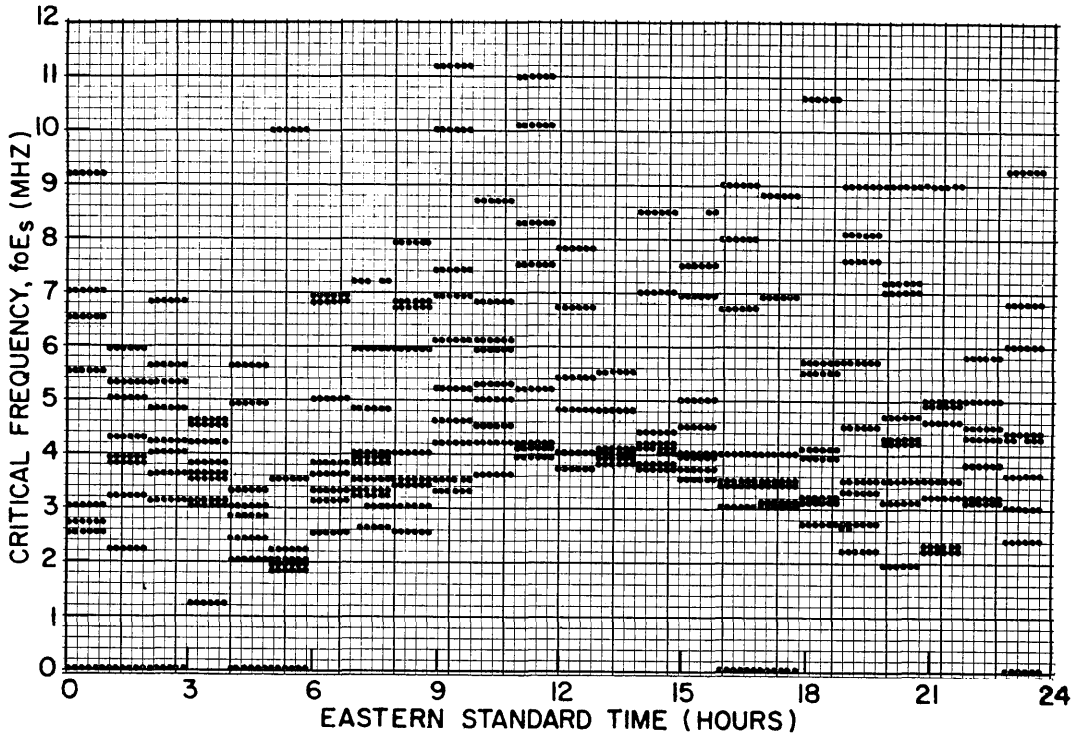


(c) May 1 through May 18 and May 20 through May 24, 1967

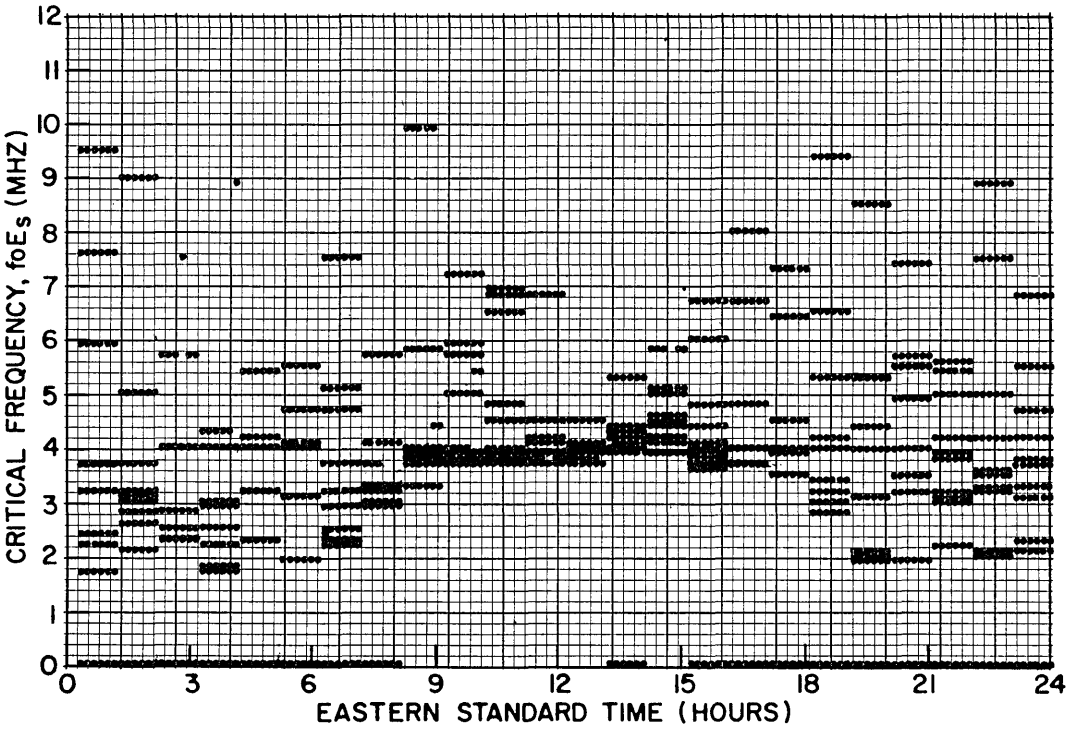


(d) June 23 through June 28, 1967

Fig. 95 (Continued) - Sporadic E activity data. Data were obtained from the Fort Belvoir ionsonde.



(e) July 8 through July 17 and July 31, 1967



(f) August 1 through August 15, 1967

Fig. 95 (Continued) - Sporadic E activity data. Data were obtained from the Fort Belvoir ionsonde.

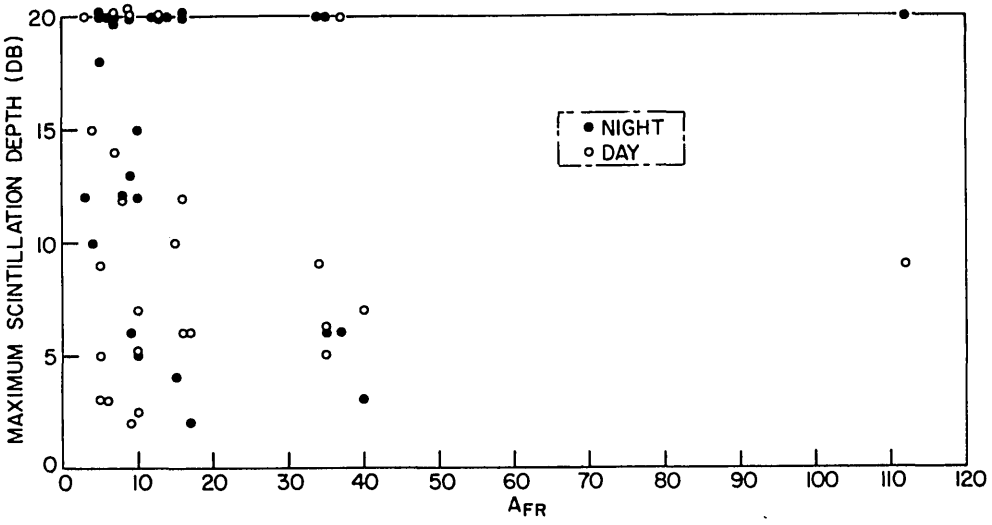


Fig. 96 - The largest values of nocturnal and daytime (maximum) scintillation depth corresponding to significant periods of observation in May, 1967, versus the geomagnetic index A_{FR}. Twenty-six daytime and 28 nocturnal periods are included.

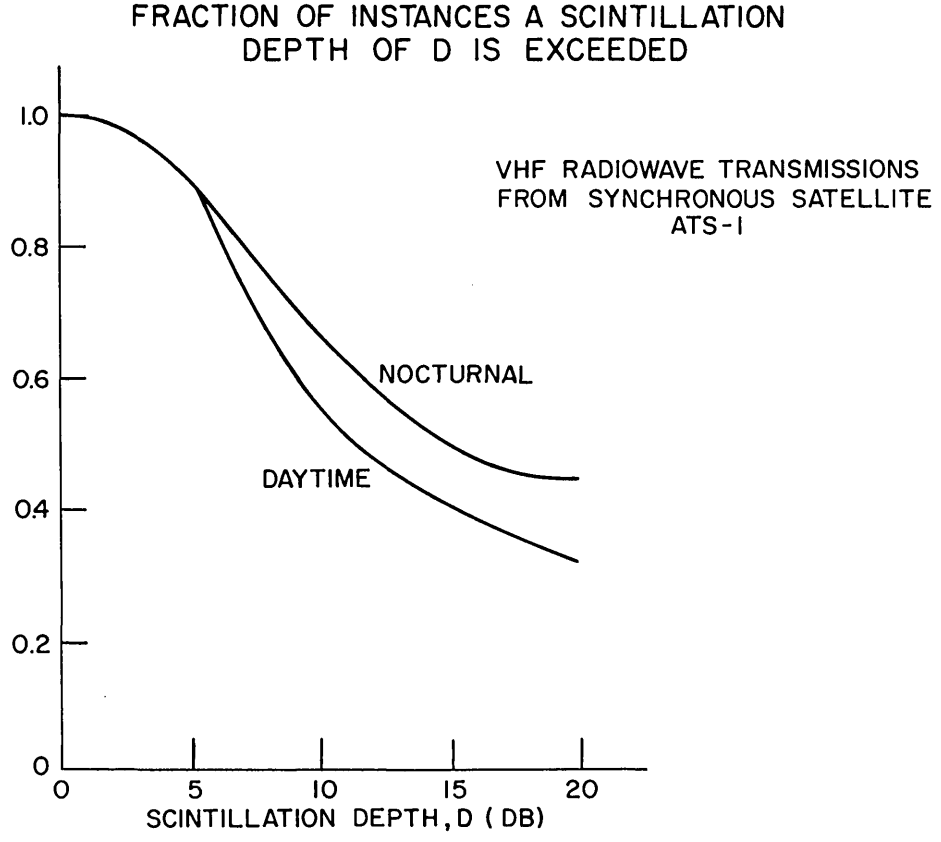


Fig. 97 - Fraction of instances for which a specified maximum scintillation depth of D has been exceeded. This maximum scintillation depth corresponding to a 50% probability of occurrence is approximately 10dB during the day and 14dB at night.

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
Naval Research Laboratory Washington, D.C. 20390	Unclassified
	2b. GROUP

3. REPORT TITLE

AMPLITUDE SCINTILLATION AT RANDLE CLIFF DERIVED FROM ATS-1 TRANSMISSIONS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Interim report on one phase of the problem; work is continuing.

5. AUTHOR(S) (First name, middle initial, last name)

John M. Goodman and John E. Blundy

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
March 17, 1969	62	3

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
NRL Problem R02-05	NRL Report 6829
b. PROJECT NO. RF 001-02-41-4001	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Department of the Navy (Office of Naval Research), Washington, D.C. 20360

13. ABSTRACT

An amplitude scintillation analysis of vhf radiowave transmissions from the geostationary satellite ATS-1 has been conducted. It has been found that the amplitude scintillation activity is generally less intense during the day than during nocturnal hours. In fact, the present 1967 summertime data indicate that the full scintillation condition is 50% more likely to occur during nighttime than during the day over Randle Cliff. The data have been compared with the Fort Belvoir ionosonde data, and, as expected, point-to-point correlations are inconclusive. Nevertheless, the trend of the data compares more favorably with the diurnal pattern of sporadic E over midlatitudes than the spread F condition.

DD FORM 1 NOV 65 1473 (PAGE 1)

S/N 0101-807-6801

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Irregularities						
Sporadic E						
Spread F						
Magnetic activity						