

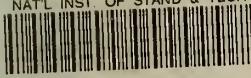
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Technical Note

No. 206-4

THE NORMAL PHASE VARIATIONS OF THE 18 kc/s SIGNALS FROM NBA OBSERVED AT COLLEGE, ALASKA

J. H. CRARY AND A. C. MURPHY

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ISSUED September 30, 1965

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Central Radio Propagation Laboratory
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The Normal Phase Variations of the 18 kc/s Signals
from NBA Observed at College, Alaska, U.S.A.

J. H. Crary and A. C. Murphy

Observations of the normal phase variations of the 18 kc/s signals radiated from the Canal Zone and received in College, Alaska, U.S.A., are given in the form of monthly averages and standard deviations at five minute intervals. The relations between the diurnal phase variations and the diurnal variation in the length of sunlit path are shown. The calculated mean diurnal change in effective height of reflection is 16 km. Values of the short term phase differences are also given.

Key Words: VLF, phase, normal, diurnal, Panama-Alaska.

1. Introduction

This is the fourth of a series of reports, each of which summarizes the normal (or undisturbed) behavior of the phase of signals from various VLF transmitters as observed at particular receiving sites. This report deals with the reception at College, Alaska (lat. N $64^{\circ} 51' 36''$, long. W $147^{\circ} 33' 48''$), of 18 kc/s transmissions of NBA in the Canal Zone (lat. N $09^{\circ} 03' 15''$, long. W $079^{\circ} 38' 53''$), a path length of 8054 km.

The earlier three reports in this series deal with the reception of NBA at Frankfurt, Germany [Brady et al., 1963], Maui, Hawaii [Brady et al., 1964a], and Boulder, Colorado [Brady et al., 1964b].

It is the purpose of these reports merely to present the reduced phase data, with a minimum of discussion. The data in these reports will be used in subsequent papers, each of which will deal with a specific aspect of the data on all the paths.

2. Data Analyses

All the phase data used in these reports have been taken, reduced, and presented in a uniform manner as described in the first of the series [Brady et al., 1963]. Thus tables 1-12 contain monthly phase averages (AVER) at 5 minute intervals, standard deviations (SDV), the number of observations (NO) used in obtaining these quantities, the quiet average (QAV), which is the average after values more than one standard deviation from AVER are discarded, and the number (NO) of values used in QAV. (A fuller description of these tables is given in the first note of this series).

3. Diurnal Phase Variations

The monthly mean diurnal phase changes and standard deviations for 1962, taken from tables 1-12, are plotted in figures 1 and 2. The average diurnal phase change for 1962 is 320 degrees. According to the mode theory of VLF propagation [Wait, 1962], a phase change of this magnitude corresponds to a change in the effective height of the ionosphere along the whole path of 16 km (assuming that the ionosphere is sharply bounded and that the mean of the daytime and nighttime heights is 80 km).

3.1 Seasonal Variation in Diurnal Phase Change

The mean diurnal phase change for each month is listed in table 13. Fourier analysis of these monthly means suggests that there may be small periodic variations having periods of 6 and 12 months. The apparent 6 months component has an amplitude of about 20° and a maximum in March. The apparent 12 month component has an amplitude of about 22° but a maximum in December. Because of the scatter in the monthly means, these periodic components are probably not significant. However, if they should prove to be significant, they represent peak-to-peak variations in the diurnal height change of about 1.0 km and 1.1 km, respectively.

3.2 Variation of Phase with Amount of Illuminated Path

The monthly average phase variation shown in figures 1 and 2 shows typical superficial dependence on the length of path which is in daylight [Crombie et al., 1958; Pierce, 1957]. A detailed examination of this relationship is given by plotting the diurnal phase changes at sunrise and sunset, together with variation in the length of illuminated path (at appropriate heights) at these times. This has been done in figures 3 and 4, which show the sunrise and sunset variations for March and June and for September and December, respectively, for 1962. The figures have been drawn so that the full diurnal phase variation fits the full "percent darkness" scale in each case.

The calculations of the length of illuminated path were made in the way described by Brady and Crombie [1964], and Crary [1965]. It is assumed in these calculations that the screening height of the earth's atmosphere is 30 km. Sunrise or sunset at the heights of 0 and 80 km are thus equivalent to solar zenith angles of 90° and 97° .

3.3 Sunrise

Figures 3 and 4 show that the smoothed sunrise phase change follows fairly closely the percentage of the path in darkness. In most cases the sunrise phase change started when the solar zenith angle was about 97° . More variability occurred in June, however, as shown in figure 3.

3.4 Sunset

Figures 3 and 4 also show that the dependence of the sunset phase change on the length of illuminated path is much weaker than at sunrise. In particular, the figures show quite clearly that during several hours before ground sunset at the eastern end of the path, a small phase retardation, typically ten percent of the total diurnal change, often occurs. This is most pronounced in March but also occurs to some extent in December. Then at ground sunset there is a further major phase retardation which generally follows fairly closely the variation in the percentage of path in darkness. When about 70% of the path has become dark the rate of change decreases considerably and in some cases it takes as long as four hours after ground sunset before normal nighttime phase value is attained.

4. Phase Stability

It was pointed out in the first paper of this series that both day-to-day phase stabilities and the phase variations over periods of time up to an hour or so were of interest. Typical values for the NBA-Frankfurt path were given in that paper.

The day-to-day deviations of phase observed over this path are given at 5 minute intervals for each month of 1962 in tables 1-12, and are also plotted in figures 1 and 2. During the hours when the path is completely daylit, the day-to-day standard deviations have an average value of about 10° without any seasonal trend being apparent. When the path is dark, the day-to-day standard deviations vary between about 20° and 45° , but tend to be higher in the winter. For this path, a change in phase of 1° corresponds to a calculated change in the effective height of the ionosphere of 0.051 km. Thus the observed phase differences noted above are equivalent to height changes of about 0.5 km during the day if it is assumed that the fluctuations are entirely due to the ionosphere. The nighttime values range between 1.0 and 2.3 km.

The method of obtaining the short term phase variations has been described in the first of this series [Brady et al., 1963]. Table 14 contains the rms phase difference calculated in this way for intervals of 10-90 minutes (T). The data are given for both daytime and nighttime conditions during February, April, June, August, October and December of 1962. As noted in the other papers of this series, the rms phase differences increase as the time interval T increases, particularly when T is small. There is a tendency for the magnitude of the fluctuations to be greater at night than during the day when T is small. The table suggests that this is true for all the tabulated intervals T only during the summer months. During the rest of the year a cross over from greater night values to greater day values tends to occur for values of T between 10 and 60 minutes. This behavior is different than that found in the previously reported observations in this series.

5. Acknowledgment

The observations at College, Alaska, were obtained by Dr. H.F. Bates and Mr. Paul Albee of the Geophysical Institute of the University of Alaska. The work was supported under contract CST-7338 of the National Bureau of Standard from the Advanced Research Projects Agency, Washington, D. C., under order No. 183, which also supported the work at NBS.

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NBA (18 kc/s. BALBOA, PANAMA) TO COLLEGE, ALASKA
AVERAGE PHASE FOR JANUARY-MARCH AND OCTOBER-DECEMBER 1962

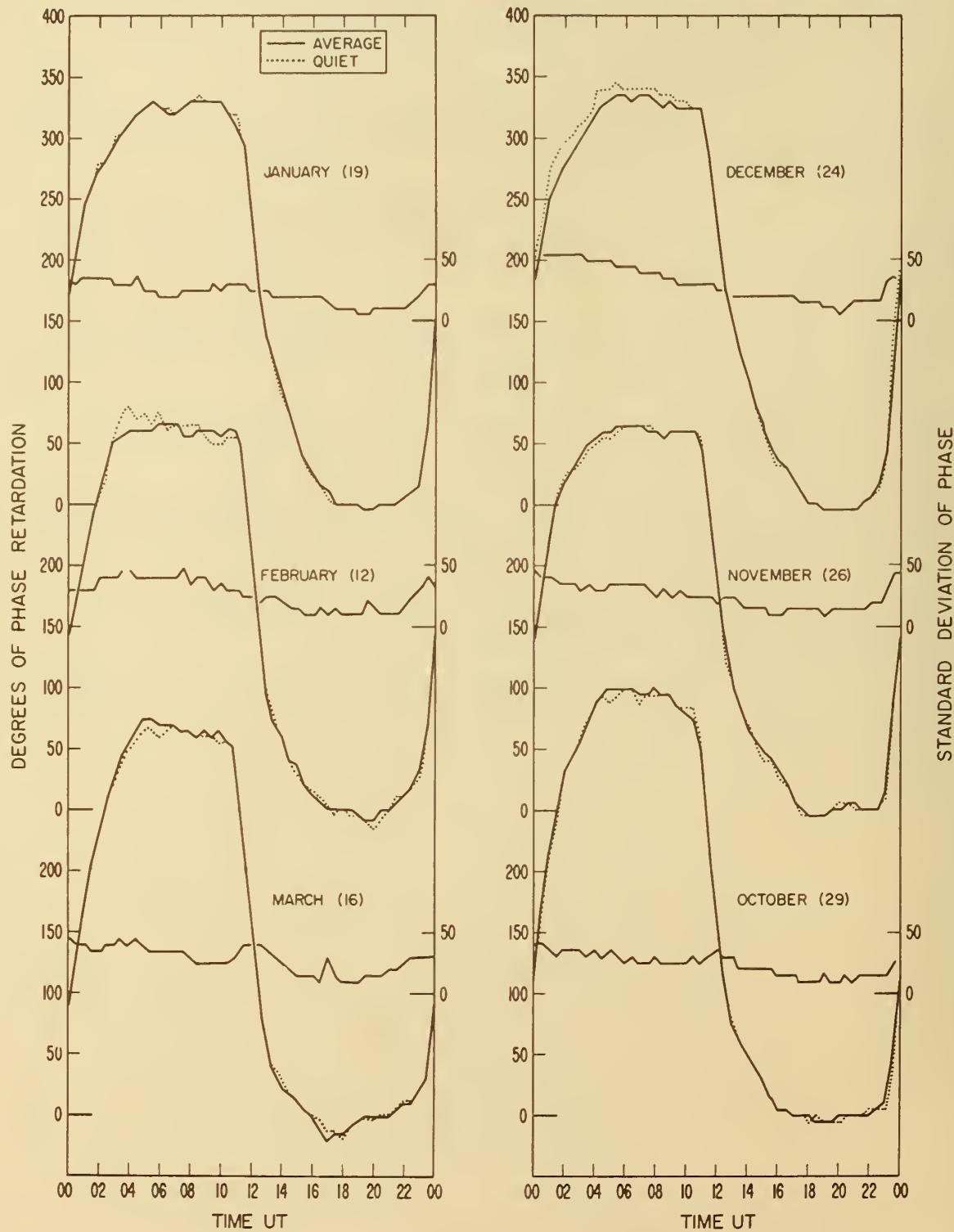


Figure 1. Mean phase variations and standard deviations in degrees for January-March and October-December 1962.

NBA (18 kc/s, BALBOA, PANAMA) TO COLLEGE, ALASKA
 AVERAGE PHASE FOR APRIL-JUNE AND JULY-SEPTEMBER 1962

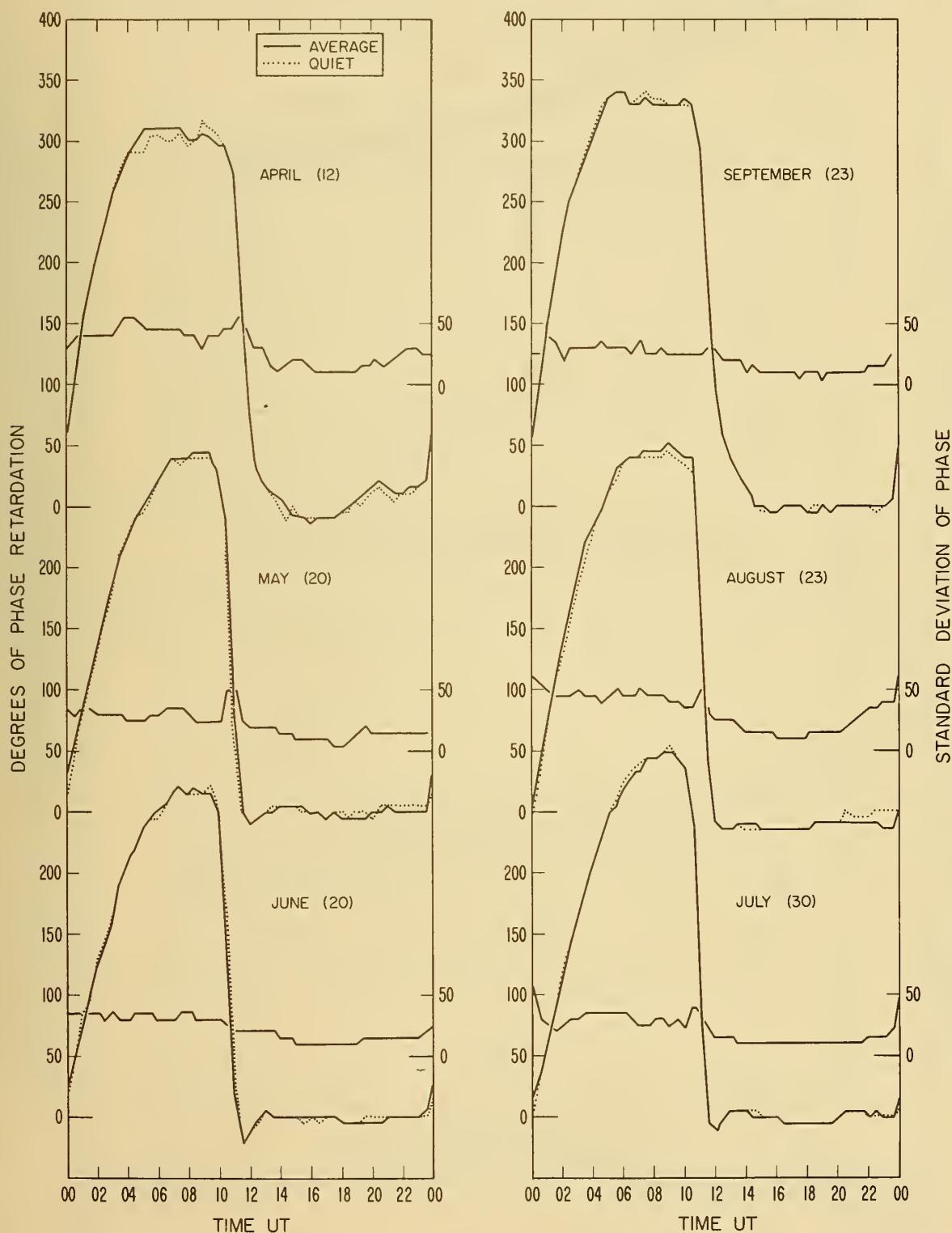


Figure 2. Mean phase variations and standard deviations in degrees for April-June and July-September 1962.

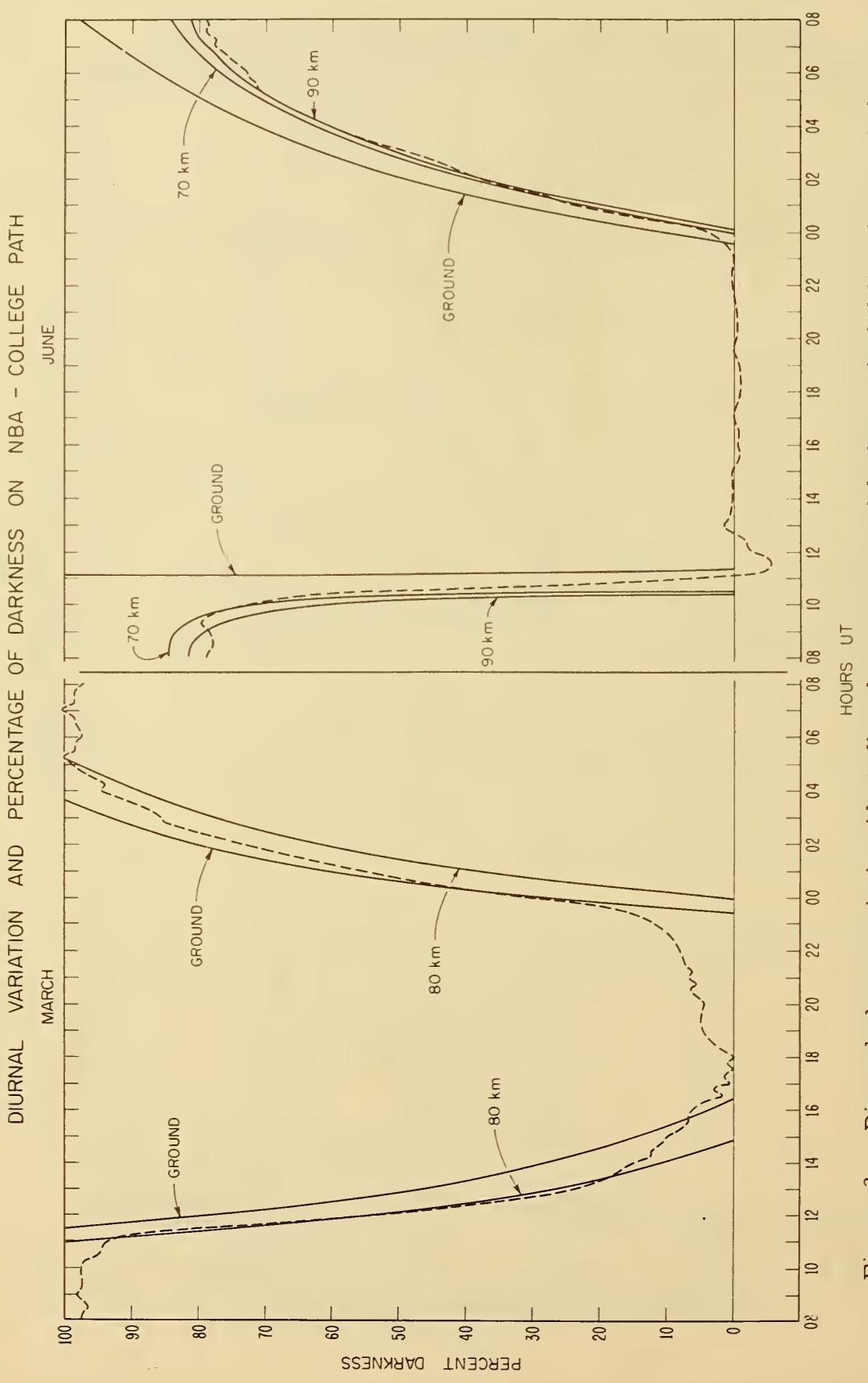


Figure 3. Diurnal phase variation (dotted) and percentage of darkness (solid lines) on path for March and June 1962. (Note: The ordinate also gives the percentage of the diurnal phase variation which has occurred.)

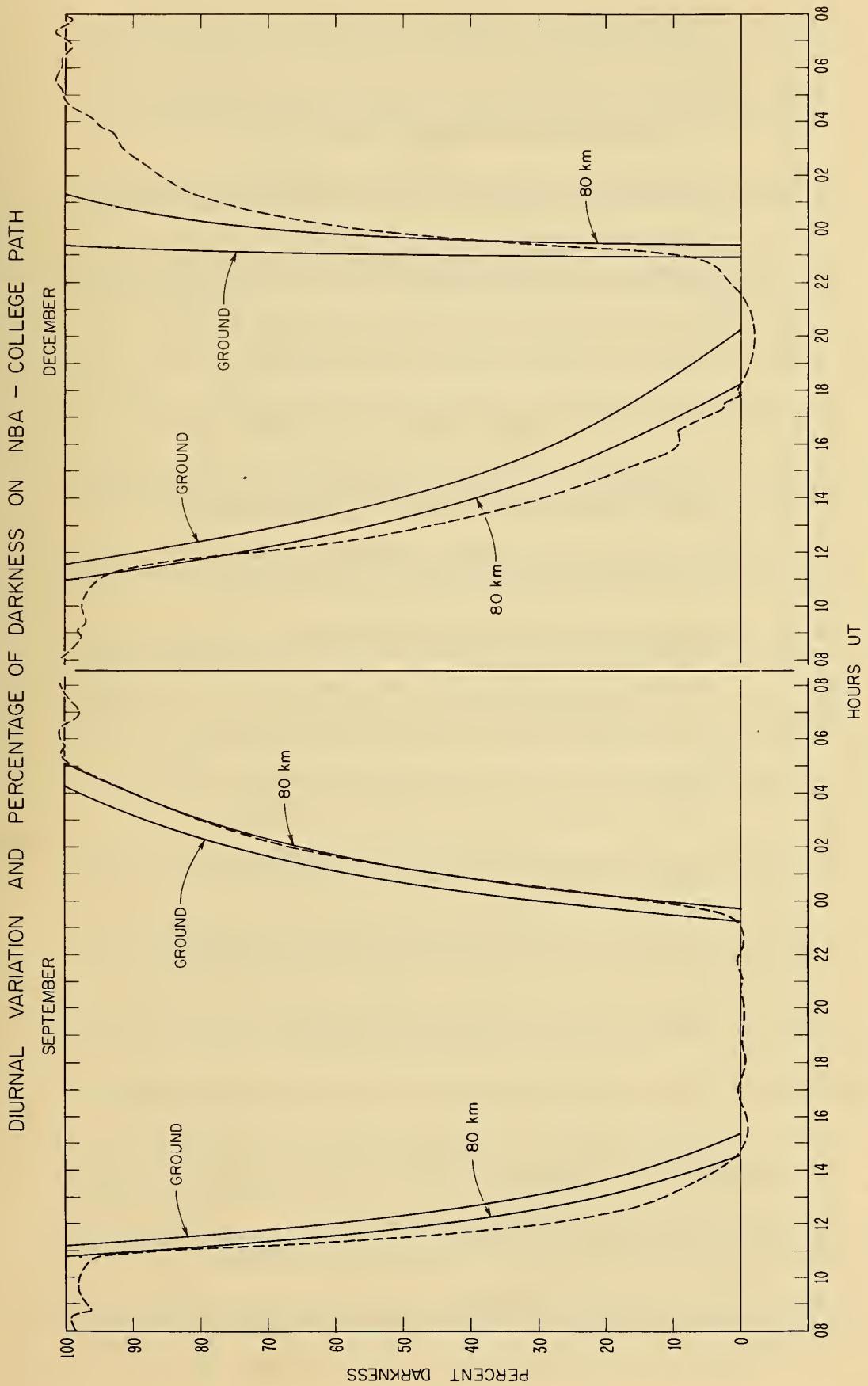


Figure 4. Diurnal phase variation (dotted) and percentage of darkness (solid lines) on path for September and December 1962. (Note: The ordinate also gives the percentage of the diurnal phase variation which has occurred.)

Table 1

Table 2

MONTHLY AVERAGE ON PATH	DAY NO	UT	AVER SDV	2 FOR MONTH 2 1962											
				MIN					MAX						
00	362.	28.	358.	317.	325.	329.	325.	325.	325.	325.	325.	325.	325.	325.	325.
01	291.	30.	322.	317.	329.	325.	325.	325.	325.	325.	325.	325.	325.	325.	325.
02	260.	28.	235.	235.	235.	235.	235.	235.	235.	235.	235.	235.	235.	235.	235.
03	203.	41.	203.	202.	202.	202.	202.	202.	202.	202.	202.	202.	202.	202.	202.
04	195.	43.	195.	195.	195.	195.	195.	195.	195.	195.	195.	195.	195.	195.	195.
05	190.	43.	189.	189.	189.	189.	189.	189.	189.	189.	189.	189.	189.	189.	189.
06	189.	42.	189.	189.	189.	189.	189.	189.	189.	189.	189.	189.	189.	189.	189.
07	188.	41.	188.	188.	188.	188.	188.	188.	188.	188.	188.	188.	188.	188.	188.
08	186.	40.	186.	186.	186.	186.	186.	186.	186.	186.	186.	186.	186.	186.	186.
09	189.	41.	178.	178.	178.	178.	178.	178.	178.	178.	178.	178.	178.	178.	178.
10	190.	42.	187.	187.	187.	187.	187.	187.	187.	187.	187.	187.	187.	187.	187.
11	192.	43.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.
12	192.	299.	25.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.
13	404.	27.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.
14	429.	24.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.
15	460.	18.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.
16	467.	15.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.
17	494.	11.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.
18	502.	10.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.
19	504.	9.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.
20	505.	10.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.
21	501.	8.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.
22	493.	9.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.	192.
23	468.	29.	12.	474.	450.	443.	443.	443.	443.	443.	443.	443.	443.	443.	443.

Table 3

MONTHLY AVERAGE ON PATH		2 2 FOR MONTH 3 1962		5 MIN		10 MIN		15 MIN		20 MIN		MIN	
UT	AVER	SOV NO	QAV NO	+ 4.3	1.5	400.	111	- 397.	112	- 389.	112	- 387.	112
00	415.	43.	115	- 38.1	1.5	362.	111	- 351.	112	- 350.	112	- 379.	112
01	364.	41.	115	- 368.	1.1	327.	112	- 311.	112	- 305.	112	- 344.	112
02	2296.	33.	115	- 330.	1.5	297.	113	- 282.	112	- 279.	112	- 308.	112
03	245.	39.	115	- 259.	1.6	268.	112	- 254.	1.2	- 252.	1.3	- 249.	1.2
04	224.	39.	115	- 239.	1.1	238.	1.5	- 235.	1.1	- 232.	1.0	- 234.	1.0
05	183.	42.	116	- 227.	1.5	227.	1.2	- 222.	1.2	- 219.	1.2	- 207.	1.2
06	177.	40.	116	- 210.	1.3	210.	1.3	- 209.	1.3	- 204.	1.2	- 197.	1.2
07	184.	42.	116	- 206.	1.3	206.	1.3	- 199.	1.2	- 198.	1.3	- 189.	1.3
08	187.	29.	116	- 184.	1.2	184.	1.6	- 184.	1.6	- 183.	1.6	- 176.	1.2
09	192.	23.	116	- 190.	1.2	188.	1.1	- 184.	1.2	- 182.	1.2	- 177.	1.2
10	194.	24.	116	- 189.	1.2	189.	1.1	- 184.	1.2	- 182.	1.2	- 176.	1.2
11	194.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2
12	194.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2
13	194.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2
14	196.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2
15	196.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2
16	196.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2
17	196.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2
18	196.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2
19	196.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2
20	196.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2
21	196.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2
22	196.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2
23	196.	24.	116	- 184.	1.2	184.	1.0	- 184.	1.2	- 182.	1.2	- 176.	1.2

Table 4

Table 5

MONTHLY AVERAGE ON PATH	2 2 FOR MONTH 5 1962												
	UT	AVER	SDV	NO	QAV	MIN	520.13	520.13	5 MIN	10 MIN	15 MIN	20 MIN	
00	529.	33.	20	515.	13	533.	32.	20	520.	13	538.	32.	20
01	568.	31.	20	548.	12	563.	32.	20	553.	11	568.	32.	20
02	614.	36.	20	578.	14	597.	34.	20	582.	14	577.	33.	20
03	626.	31.	20	605.	14	622.	35.	20	609.	14	607.	31.	20
04	667.	30.	20	638.	13	664.	26.	19	638.	12	629.	31.	20
05	667.	31.	20	661.	14	671.	30.	20	670.	13	659.	31.	20
06	688.	30.	20	683.	14	693.	30.	20	694.	13	679.	31.	20
07	712.	28.	20	709.	14	726.	26.	20	723.	14	732.	25.	20
08	725.	26.	20	724.	14	728.	25.	20	743.	13	735.	26.	20
09	739.	25.	20	748.	15	742.	28.	20	751.	15	746.	25.	20
10	748.	27.	20	758.	14	752.	32.	20	761.	15	758.	31.	20
11	759.	31.	20	770.	14	762.	32.	20	762.	15	761.	31.	20
12	769.	31.	19	773.	14	774.	31.	19	769.	13	767.	31.	19
13	782.	31.	20	784.	14	786.	33.	20	780.	13	782.	33.	20
14	789.	33.	20	790.	15	792.	34.	20	793.	14	792.	34.	20
15	792.	33.	20	788.	15	794.	30.	20	788.	15	792.	30.	20
16	795.	29.	20	789.	14	796.	30.	20	791.	14	795.	30.	20
17	794.	25.	20	788.	13	797.	25.	19	795.	13	796.	25.	19
18	794.	26.	19	794.	14	797.	27.	20	790.	13	795.	26.	19
19	794.	25.	19	782.	13	793.	25.	19	792.	13	788.	25.	19
20	789.	34.	20	788.	15	794.	32.	20	788.	15	792.	32.	20
21	792.	32.	20	788.	14	794.	30.	20	788.	15	792.	30.	20
22	795.	27.	20	788.	13	796.	30.	20	791.	14	795.	30.	20
23	794.	25.	20	788.	13	797.	25.	19	790.	13	795.	25.	19
24	794.	26.	19	773.	14	784.	33.	20	780.	13	786.	33.	20
25	794.	25.	19	782.	13	793.	25.	19	789.	13	795.	25.	19
26	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
27	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
28	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
29	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
30	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
31	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
32	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
33	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
34	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
35	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
36	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
37	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
38	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
39	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
40	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
41	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
42	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
43	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
44	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
45	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
46	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
47	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
48	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
49	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
50	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
51	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
52	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
53	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
54	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
55	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
56	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
57	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
58	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
59	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
60	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
61	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
62	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
63	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
64	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
65	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
66	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
67	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
68	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
69	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
70	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
71	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
72	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
73	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
74	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
75	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
76	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
77	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
78	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
79	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
80	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
81	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
82	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
83	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
84	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
85	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
86	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
87	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
88	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
89	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
90	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
91	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
92	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
93	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
94	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
95	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
96	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
97	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
98	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
99	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
100	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
101	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
102	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
103	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
104	794.	25.	19	782.	13	793.	25.	19	788.	13	795.	25.	19
105	794.	25.	19	782.	13</								

Table 6

MONTHLY AVERAGE ON PATH	2 2 FOR MONTH 6 1962											
	UT	AVER	SDV	NO	QAV	NO	MIN	5 MIN	10 MIN	15 MIN	20 MIN	25 MIN
00	525.	37.	20	513.16	527.	1.6	530.	515.16	518.16	538.13	532.13	538.15
01	554.	34.	19	584.15	585.	1.6	537.	515.14	519.14	529.13	527.13	529.15
02	598.	33.	20	598.13	603.	1.6	534.	519.13	520.13	525.12	523.12	525.15
03	642.	36.	21	631.13	645.	1.6	535.	520.12	522.12	527.12	525.12	527.15
04	663.	32.	21	647.16	671.	1.6	535.	520.12	522.12	527.12	525.12	527.15
05	688.	33.	20	667.17	691.	1.6	535.	520.12	522.12	527.12	525.12	527.15
06	706.	31.	20	690.15	707.	1.6	535.	520.12	522.12	527.12	525.12	527.15
07	722.	33.	20	724.	734.	1.6	535.	520.12	522.12	527.12	525.12	527.15
08	734.	33.	20	734.	743.	1.6	535.	520.12	522.12	527.12	525.12	527.15
09	743.	34.	20	743.	751.	1.6	535.	520.12	522.12	527.12	525.12	527.15
10	750.	31.	20	750.	757.	1.6	535.	520.12	522.12	527.12	525.12	527.15
11	757.	32.	20	757.	764.	1.6	535.	520.12	522.12	527.12	525.12	527.15
12	767.	32.	20	767.	769.	1.6	535.	520.12	522.12	527.12	525.12	527.15
13	768.	08.	19	768.	768.	1.6	535.	520.12	522.12	527.12	525.12	527.15
14	769.	08.	19	769.	769.	1.6	535.	520.12	522.12	527.12	525.12	527.15
15	770.	09.	19	770.	770.	1.6	535.	520.12	522.12	527.12	525.12	527.15
16	770.	09.	19	770.	770.	1.6	535.	520.12	522.12	527.12	525.12	527.15
17	770.	09.	19	770.	770.	1.6	535.	520.12	522.12	527.12	525.12	527.15
18	770.	09.	19	770.	770.	1.6	535.	520.12	522.12	527.12	525.12	527.15
19	770.	09.	19	770.	770.	1.6	535.	520.12	522.12	527.12	525.12	527.15
20	770.	09.	19	770.	770.	1.6	535.	520.12	522.12	527.12	525.12	527.15
21	770.	09.	19	770.	770.	1.6	535.	520.12	522.12	527.12	525.12	527.15
22	770.	09.	19	770.	770.	1.6	535.	520.12	522.12	527.12	525.12	527.15
23	770.	09.	19	770.	770.	1.6	535.	520.12	522.12	527.12	525.12	527.15

Table 7

MONTHLY AVERAGE ON PATH	2 2 FOR MONTH 7 1962	UT	AVER SDV NO	DAY NO	+ 5 MIN					MIN				
					5.1	5.12	5.25	5.15	5.11	2.1	5.19	5.24	2.0	5.28
00	517.	595.	31	501.	28	516.	541.	515.	511.	2.1	523.	524.	2.0	528.
01	534.	29.	31	535.	22	569.	571.	548.	576.	2.2	564.	563.	2.0	568.
02	568.	24.	31	560.	22	590.	592.	573.	576.	2.2	586.	585.	2.4	586.
03	590.	22.	30	622.	21	627.	648.	606.	606.	2.2	620.	616.	2.3	620.
04	622.	25.	31	648.	20	649.	670.	636.	636.	2.0	647.	646.	1.9	664.
05	644.	26.	31	666.	20	666.	677.	630.	630.	2.0	664.	663.	2.1	664.
06	666.	32.	31	670.	19	670.	697.	634.	634.	2.0	688.	687.	2.2	688.
07	692.	36.	31	690.	22	693.	700.	637.	637.	2.0	706.	709.	1.8	710.
08	711.	36.	31	713.	18	716.	720.	634.	634.	2.0	725.	728.	2.0	730.
09	731.	32.	31	734.	19	734.	739.	633.	633.	2.0	742.	745.	1.9	745.
10	748.	34.	31	749.	19	750.	754.	634.	634.	2.0	756.	757.	2.0	757.
11	756.	36.	31	756.	20	756.	756.	633.	633.	2.0	766.	768.	2.1	771.
12	769.	33.	30	774.	21	771.	771.	634.	634.	2.0	778.	780.	2.0	783.
13	782.	26.	30	787.	21	783.	787.	631.	631.	2.0	790.	792.	2.0	793.
14	793.	27.	30	796.	21	794.	797.	630.	630.	2.0	797.	797.	2.2	798.
15	796.	29.	30	794.	23	798.	797.	629.	629.	2.0	798.	798.	2.2	799.
16	802.	30.	30	804.	24	804.	804.	629.	629.	2.0	804.	805.	2.2	805.
17	804.	32.	30	804.	24	804.	804.	629.	629.	2.0	804.	805.	2.2	805.
18	809.	32.	30	809.	24	809.	809.	629.	629.	2.0	809.	810.	2.2	810.
19	809.	34.	30	809.	24	809.	809.	629.	629.	2.0	809.	810.	2.2	810.
20	810.	34.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
21	810.	35.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
22	810.	36.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
23	810.	37.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
24	810.	38.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
25	810.	39.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
26	810.	40.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
27	810.	41.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
28	810.	42.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
29	810.	43.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
30	810.	44.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
31	810.	45.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
32	810.	46.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
33	810.	47.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
34	810.	48.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
35	810.	49.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
36	810.	50.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
37	810.	51.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
38	810.	52.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
39	810.	53.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
40	810.	54.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
41	810.	55.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
42	810.	56.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
43	810.	57.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
44	810.	58.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
45	810.	59.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
46	810.	60.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
47	810.	61.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
48	810.	62.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
49	810.	63.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
50	810.	64.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
51	810.	65.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
52	810.	66.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
53	810.	67.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
54	810.	68.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
55	810.	69.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
56	810.	70.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
57	810.	71.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
58	810.	72.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
59	810.	73.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
60	810.	74.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
61	810.	75.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
62	810.	76.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
63	810.	77.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
64	810.	78.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
65	810.	79.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
66	810.	80.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
67	810.	81.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
68	810.	82.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
69	810.	83.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
70	810.	84.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
71	810.	85.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
72	810.	86.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
73	810.	87.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
74	810.	88.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
75	810.	89.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
76	810.	90.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
77	810.	91.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
78	810.	92.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
79	810.	93.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
80	810.	94.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
81	810.	95.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
82	810.	96.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
83	810.	97.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
84	810.	98.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
85	810.	99.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
86	810.	00.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
87	810.	01.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
88	810.	02.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
89	810.	03.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
90	810.	04.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
91	810.	05.	30	810.	24	810.	810.	629.	629.	2.0	810.	811.	2.2	811.
92	810.	06.	30	810.	24	810.	810.	629.	629.	2.0	810			

Table 8

Table 9

MONTHLY AVERAGE ON PATH		2 2 FOR MONTH 9 1962	NO	DAV NO	MIN 5	MIN 10	MIN 15	MIN 20	MIN 25	MIN 30	MIN 35	MIN 40	MIN 45	MIN 50	MIN 55	MIN 60	MIN 65	MIN 70	MIN 75	MIN 80	MIN 85	MIN 90	MIN 95		
UT	AVER	23.0	548.	14	569.	12	567.	13	576.	14	582.	15	586.	16	592.	17	596.	17	600.	17	604.	17	610.	17	
00	00	23.1	549.	14	560.	12	556.	13	565.	14	572.	15	578.	16	584.	17	590.	17	596.	17	602.	17	608.	17	
.01	01	23.8	652.	19	660.	17	669.	19	670.	18	679.	20	686.	21	693.	22	700.	23	709.	23	716.	23	723.	23	
.02	02	34.2	692.	18	698.	18	704.	18	710.	19	716.	19	723.	20	729.	21	735.	22	742.	22	749.	22	756.	20	
.03	03	74.9	727.	20	720.	23	725.	21	730.	22	735.	22	741.	23	748.	24	754.	24	760.	24	767.	19	774.	19	
.04	04	78.7	749.	21	749.	22	753.	21	759.	22	765.	22	771.	23	777.	23	783.	23	789.	23	795.	22	801.	17	
.05	05	80.4	822.	22	820.	23	825.	22	830.	23	835.	23	840.	23	845.	23	850.	23	855.	23	860.	23	865.	17	
.06	06	83.9	836.	23	838.	23	843.	23	848.	23	853.	23	858.	23	863.	23	868.	23	873.	23	878.	23	883.	16	
.07	07	83.2	839.	22	832.	22	836.	22	840.	22	844.	22	848.	22	852.	22	856.	22	860.	22	864.	22	868.	16	
.08	08	83.6	832.	23	837.	23	842.	23	847.	23	852.	23	857.	23	862.	23	867.	23	872.	23	877.	23	882.	16	
.09	09	83.0	830.	23	834.	23	838.	23	842.	23	846.	23	850.	23	854.	23	858.	23	862.	23	866.	23	870.	16	
.10	10	83.4	834.	23	837.	23	841.	23	845.	23	849.	23	853.	23	857.	23	861.	23	865.	23	869.	23	873.	16	
.11	11	82.9	829.	23	832.	23	836.	23	840.	23	844.	23	848.	23	852.	23	856.	23	860.	23	864.	23	868.	16	
.12	12	68.7	683.	23	72.0	23	76.2	23	80.8.	23	85.4.	23	90.0.	23	94.6.	23	99.2.	23	103.8.	23	108.4.	23	113.0.	23	
.13	13	54.2	542.	23	58.6.	23	63.0.	23	67.4.	23	71.8.	23	76.2.	23	80.6.	23	85.0.	23	89.4.	23	93.8.	23	98.2.	23	
.14	14	52.3	52.3	56.7.	23	61.1.	23	65.5.	23	69.9.	23	74.3.	23	78.7.	23	83.1.	23	87.5.	23	91.9.	23	96.3.	23	100.7.	23
.15	15	49.8.	49.8.	53.0.	23	57.4.	23	61.6.	23	65.8.	23	70.0.	23	74.2.	23	78.4.	23	82.6.	23	86.8.	23	91.0.	23	95.2.	23
.16	16	49.6.	49.6.	56.0.	23	59.8.	23	64.0.	23	68.2.	23	72.4.	23	76.6.	23	80.8.	23	85.0.	23	89.2.	23	93.4.	23	97.6.	23
.17	17	49.9.	49.9.	54.2.	19	58.1.	19	62.0.	19	65.9.	19	69.8.	19	73.7.	19	77.6.	19	81.5.	19	85.4.	19	89.3.	19	93.2.	19
.18	18	49.7.	49.7.	50.4.	19	54.7.	19	58.6.	19	62.5.	19	66.4.	19	70.3.	19	74.2.	19	78.1.	19	82.0.	19	85.9.	19	89.8.	19
.19	19	49.9.	49.9.	50.7.	18	54.9.	18	58.8.	18	62.7.	18	66.6.	18	70.5.	18	74.4.	18	78.3.	18	82.2.	18	86.1.	18	89.0.	18
.20	20	49.8.	49.8.	50.0.	18	54.8.	18	58.7.	18	62.6.	18	66.5.	18	70.4.	18	74.3.	18	78.2.	18	82.1.	18	86.0.	18	89.9.	18
.21	21	50.2.	50.2.	50.3.	19	54.9.	19	58.8.	19	62.7.	19	66.6.	19	70.5.	19	74.4.	19	78.3.	19	82.2.	19	86.1.	19	89.0.	19
.22	22	50.1.	50.1.	50.2.	19	54.8.	19	58.7.	19	62.6.	19	66.5.	19	70.4.	19	74.3.	19	78.2.	19	82.1.	19	86.0.	19	89.9.	19
.23	23	50.3.	50.3.	50.4.	17	54.7.	17	58.6.	17	62.5.	17	66.4.	17	70.3.	17	74.2.	17	78.1.	17	82.0.	17	85.9.	17	89.8.	17

Table 10

MONTHLY AVERAGE ON PATH		2 2 FOR MONTH 10 1962		5 MIN		10 MIN		15 MIN		20 MIN		25 MIN											
UT	AVER	SDV	NO	QAV	NO	UT	AVER	SDV	NO	QAV	NO	UT	AVER	SDV	NO	QAV	NO	UT	AVER	SDV	NO	QAV	NO
00	610.	39.	29	615.	21	669.	17	673.	17	670.	17	671.	17	672.	17	673.	17	674.	17	675.	17	676.	17
01	711.	36.	29	714.	17	714.	17	714.	18	714.	18	714.	18	714.	18	714.	18	714.	18	714.	18	714.	18
02	778.	32.	28	781.	21	790.	21	792.	21	796.	22	796.	22	796.	22	796.	22	796.	22	796.	22	796.	22
03	807.	34.	29	820.	19	823.	19	823.	19	823.	19	823.	19	823.	19	823.	19	823.	19	823.	19	823.	19
04	837.	32.	29	838.	18	840.	18	840.	18	840.	18	840.	18	840.	18	840.	18	840.	18	840.	18	840.	18
05	848.	34.	29	845.	18	845.	18	845.	18	845.	18	845.	18	845.	18	845.	18	845.	18	845.	18	845.	18
06	849.	34.	29	843.	19	843.	19	843.	19	843.	19	843.	19	843.	19	843.	19	843.	19	843.	19	843.	19
07	850.	28.	28	844.	21	844.	21	844.	21	844.	21	844.	21	844.	21	844.	21	844.	21	844.	21	844.	21
08	845.	23.	29	845.	22	845.	22	845.	22	845.	22	845.	22	845.	22	845.	22	845.	22	845.	22	845.	22
09	848.	23.	29	844.	17	844.	17	844.	17	844.	17	844.	17	844.	17	844.	17	844.	17	844.	17	844.	17
10	836.	27.	28	836.	21	836.	21	836.	21	836.	21	836.	21	836.	21	836.	21	836.	21	836.	21	836.	21
11	820.	32.	28	820.	28	820.	28	820.	28	820.	28	820.	28	820.	28	820.	28	820.	28	820.	28	820.	28
12	724.	36.	29	726.	22	726.	22	726.	22	726.	22	726.	22	726.	22	726.	22	726.	22	726.	22	726.	22
13	697.	31.	29	691.	29	690.	29	690.	29	690.	29	690.	29	690.	29	690.	29	690.	29	690.	29	690.	29
14	561.	19.	26	561.	26	562.	26	562.	26	562.	26	562.	26	562.	26	562.	26	562.	26	562.	26	562.	26
15	548.	19.	26	538.	26	538.	26	538.	26	538.	26	538.	26	538.	26	538.	26	538.	26	538.	26	538.	26
16	506.	20.	22	502.	24	502.	24	502.	24	502.	24	502.	24	502.	24	502.	24	502.	24	502.	24	502.	24
17	503.	15.	24	503.	24	503.	24	503.	24	503.	24	503.	24	503.	24	503.	24	503.	24	503.	24	503.	24
18	499.	11.	24	499.	14	499.	14	499.	14	499.	14	499.	14	499.	14	499.	14	499.	14	499.	14	499.	14
19	497.	11.	24	497.	14	497.	14	497.	14	497.	14	497.	14	497.	14	497.	14	497.	14	497.	14	497.	14
20	498.	10.	25	498.	12	498.	12	498.	12	498.	12	498.	12	498.	12	498.	12	498.	12	498.	12	498.	12
21	502.	13.	25	502.	19	502.	19	502.	19	502.	19	502.	19	502.	19	502.	19	502.	19	502.	19	502.	19
22	505.	15.	26	505.	26	505.	26	505.	26	505.	26	505.	26	505.	26	505.	26	505.	26	505.	26	505.	26
23	509.	17.	27	542.	27	542.	27	542.	27	542.	27	542.	27	542.	27	542.	27	542.	27	542.	27	542.	27

Table 11

MONTHLY AVERAGE ON PATH		2 2 FOR MONTH 11 1962	
MONTH	AVER	QAV NO	SDV
JAN	63.9.	643.0	25
FEB	68.6.	693.0	27
MAR	72.4.	720.0	17
APR	75.3.	775.0	25
MAY	76.4.	776.0	25
JUN	77.1.	779.0	25
JULY	77.3.	781.0	21
SEPT	78.0.	788.0	21
OCT	79.0.	797.0	21
NOV	80.0.	803.0	21
DEC	80.4.	811.0	19
JAN	81.1.	812.0	19
FEB	81.2.	813.0	19
MAR	81.2.	814.0	19
APR	81.4.	815.0	19
MAY	81.5.	815.0	19
JUN	81.5.	815.0	19
JULY	81.6.	816.0	19
SEPT	81.6.	816.0	19
OCT	81.7.	817.0	19
NOV	81.7.	817.0	19
DEC	81.7.	817.0	19
JAN	81.8.	818.0	19
FEB	81.8.	818.0	19
MAR	81.8.	818.0	19
APR	81.9.	819.0	19
MAY	81.9.	819.0	19
JUN	81.9.	819.0	19
JULY	81.9.	819.0	19
SEPT	81.9.	819.0	19
OCT	81.9.	819.0	19
NOV	81.9.	819.0	19
DEC	81.9.	819.0	19
JAN	82.0.	820.0	19
FEB	82.0.	820.0	19
MAR	82.0.	820.0	19
APR	82.1.	821.0	19
MAY	82.1.	821.0	19
JUN	82.1.	821.0	19
JULY	82.1.	821.0	19
SEPT	82.1.	821.0	19
OCT	82.1.	821.0	19
NOV	82.1.	821.0	19
DEC	82.1.	821.0	19
JAN	82.2.	822.0	19
FEB	82.2.	822.0	19
MAR	82.2.	822.0	19
APR	82.3.	823.0	19
MAY	82.3.	823.0	19
JUN	82.3.	823.0	19
JULY	82.3.	823.0	19
SEPT	82.3.	823.0	19
OCT	82.3.	823.0	19
NOV	82.3.	823.0	19
DEC	82.3.	823.0	19
JAN	82.4.	824.0	19
FEB	82.4.	824.0	19
MAR	82.4.	824.0	19
APR	82.5.	825.0	19
MAY	82.5.	825.0	19
JUN	82.5.	825.0	19
JULY	82.5.	825.0	19
SEPT	82.5.	825.0	19
OCT	82.5.	825.0	19
NOV	82.5.	825.0	19
DEC	82.5.	825.0	19
JAN	82.6.	826.0	19
FEB	82.6.	826.0	19
MAR	82.6.	826.0	19
APR	82.7.	827.0	19
MAY	82.7.	827.0	19
JUN	82.7.	827.0	19
JULY	82.7.	827.0	19
SEPT	82.7.	827.0	19
OCT	82.7.	827.0	19
NOV	82.7.	827.0	19
DEC	82.7.	827.0	19
JAN	82.8.	828.0	19
FEB	82.8.	828.0	19
MAR	82.8.	828.0	19
APR	82.9.	829.0	19
MAY	82.9.	829.0	19
JUN	82.9.	829.0	19
JULY	82.9.	829.0	19
SEPT	82.9.	829.0	19
OCT	82.9.	829.0	19
NOV	82.9.	829.0	19
DEC	82.9.	829.0	19
JAN	83.0.	830.0	19
FEB	83.0.	830.0	19
MAR	83.0.	830.0	19
APR	83.1.	831.0	19
MAY	83.1.	831.0	19
JUN	83.1.	831.0	19
JULY	83.1.	831.0	19
SEPT	83.1.	831.0	19
OCT	83.1.	831.0	19
NOV	83.1.	831.0	19
DEC	83.1.	831.0	19
JAN	83.2.	832.0	19
FEB	83.2.	832.0	19
MAR	83.2.	832.0	19
APR	83.3.	833.0	19
MAY	83.3.	833.0	19
JUN	83.3.	833.0	19
JULY	83.3.	833.0	19
SEPT	83.3.	833.0	19
OCT	83.3.	833.0	19
NOV	83.3.	833.0	19
DEC	83.3.	833.0	19
JAN	83.4.	834.0	19
FEB	83.4.	834.0	19
MAR	83.4.	834.0	19
APR	83.5.	835.0	19
MAY	83.5.	835.0	19
JUN	83.5.	835.0	19
JULY	83.5.	835.0	19
SEPT	83.5.	835.0	19
OCT	83.5.	835.0	19
NOV	83.5.	835.0	19
DEC	83.5.	835.0	19
JAN	83.6.	836.0	19
FEB	83.6.	836.0	19
MAR	83.6.	836.0	19
APR	83.7.	837.0	19
MAY	83.7.	837.0	19
JUN	83.7.	837.0	19
JULY	83.7.	837.0	19
SEPT	83.7.	837.0	19
OCT	83.7.	837.0	19
NOV	83.7.	837.0	19
DEC	83.7.	837.0	19
JAN	83.8.	838.0	19
FEB	83.8.	838.0	19
MAR	83.8.	838.0	19
APR	83.9.	839.0	19
MAY	83.9.	839.0	19
JUN	83.9.	839.0	19
JULY	83.9.	839.0	19
SEPT	83.9.	839.0	19
OCT	83.9.	839.0	19
NOV	83.9.	839.0	19
DEC	83.9.	839.0	19
JAN	84.0.	840.0	19
FEB	84.0.	840.0	19
MAR	84.0.	840.0	19
APR	84.1.	841.0	19
MAY	84.1.	841.0	19
JUN	84.1.	841.0	19
JULY	84.1.	841.0	19
SEPT	84.1.	841.0	19
OCT	84.1.	841.0	19
NOV	84.1.	841.0	19
DEC	84.1.	841.0	19
JAN	84.2.	842.0	19
FEB	84.2.	842.0	19
MAR	84.2.	842.0	19
APR	84.3.	843.0	19
MAY	84.3.	843.0	19
JUN	84.3.	843.0	19
JULY	84.3.	843.0	19
SEPT	84.3.	843.0	19
OCT	84.3.	843.0	19
NOV	84.3.	843.0	19
DEC	84.3.	843.0	19
JAN	84.4.	844.0	19
FEB	84.4.	844.0	19
MAR	84.4.	844.0	19
APR	84.5.	845.0	19
MAY	84.5.	845.0	19
JUN	84.5.	845.0	19
JULY	84.5.	845.0	19
SEPT	84.5.	845.0	19
OCT	84.5.	845.0	19
NOV	84.5.	845.0	19
DEC	84.5.	845.0	19
JAN	84.6.	846.0	19
FEB	84.6.	846.0	19
MAR	84.6.	846.0	19
APR	84.7.	847.0	19
MAY	84.7.	847.0	19
JUN	84.7.	847.0	19
JULY	84.7.	847.0	19
SEPT	84.7.	847.0	19
OCT	84.7.	847.0	19
NOV	84.7.	847.0	19
DEC	84.7.	847.0	19
JAN	84.8.	848.0	19
FEB	84.8.	848.0	19
MAR	84.8.	848.0	19
APR	84.9.	849.0	19
MAY	84.9.	849.0	19
JUN	84.9.	849.0	19
JULY	84.9.	849.0	19
SEPT	84.9.	849.0	19
OCT	84.9.	849.0	19
NOV	84.9.	849.0	19
DEC	84.9.	849.0	19
JAN	85.0.	850.0	19
FEB	85.0.	850.0	19
MAR	85.0.	850.0	19
APR	85.1.	851.0	19
MAY	85.1.	851.0	19
JUN	85.1.	851.0	19
JULY	85.1.	851.0	19
SEPT	85.1.	851.0	19
OCT	85.1.	851.0	19
NOV	85.1.	851.0	19
DEC	85.1.	851.0	19
JAN	85.2.	852.0	19
FEB	85.2.	852.0	19
MAR	85.2.	852.0	19
APR	85.3.	853.0	19
MAY	85.3.	853.0	19
JUN	85.3.	853.0	19
JULY	85.3.	853.0	19
SEPT	85.3.	853.0	19
OCT	85.3.	853.0	19
NOV	85.3.	853.0	19
DEC	85.3.	853.0	19
JAN	85.4.	854.0	19
FEB	85.4.	854.0	19
MAR	85.4.	854.0	19
APR	85.5.	855.0	19
MAY	85.5.	855.0	19
JUN	85.5.	855.0	19
JULY	85.5.	855.0	19
SEPT	85.5.	855.0	19
OCT	85.5.	855.0	19
NOV	85.5.	855.0	19
DEC	85.5.	855.0	19
JAN	85.6.	856.0	19
FEB	85.6.	856.0	19
MAR	85.6.	856.0	19
APR	85.7.	857.0	19
MAY	85.7.	857.0	19
JUN	85.7.	857.0	19
JULY	85.7.	857.0	19
SEPT	85.7.	857.0	19
OCT	85.7.	857.0	19
NOV	85.7.	857.0	19
DEC	85.7.	857.0	19
JAN	85.8.	858.0	19
FEB	85.8.	858.0	19
MAR	85.8.	858.0	19
APR	85.9.	859.0	19
MAY	85.9.	859.0	19
JUN	85.9.	859.0	19
JULY	85.9.	859.0	19
SEPT	85.9.	859.0	19
OCT	85.9.	859.0	19
NOV	85.9.	859.0	19
DEC	85.9.	859.0	19
JAN	86.0.	860.0	19
FEB	86.0.	860.0	19
MAR	86.0.	860.0	19
APR	86.1.	861.0	19
MAY	86.1.	861.0	19
JUN	86.1.	861.0	19
JULY	86.1.	861.0	19
SEPT	86.1.	861.0	19
OCT	86.1.	861.0	19
NOV	86.1.	861.0	19
DEC	86.1.	861.0	19
JAN	86.2.	862.0	19
FEB	86.2.	862.0	19
MAR	86.2.	862.0	19
APR	86.3.	863.0	19
MAY	86.3.	863.0	19
JUN	86.3.	863.0	19
JULY	86.3.	863.0	19
SEPT	86.3.	863.0	19
OCT	86.3.	863.0	19
NOV	86.3.	863.0	19
DEC	86.3.	863.0	19
JAN	86.4.	864.0	19
FEB	86.4.	864.0	19
MAR	86.4.	864.0	19
APR	86.5.	865.0	19
MAY	86.5.	865.0	19
JUN	86.5.	865.0	19
JULY	86.5.	865.0	19
SEPT	86.5.	865.0	19
OCT	86.5.	865.0	19
NOV	86.5.	865.0	19
DEC	86.5.	865.0	19
JAN	86.6.	866.0	19
FEB	86.6.	866.0	19
MAR	86.6.	866.0	19
APR	86.7.	867.0	19
MAY	86.7.	867.0	19
JUN	86.7.	867.0	19
JULY	86.7.	867.0	19
SEPT	86.7.	867.0	19
OCT	86.7.	867.0	19
NOV	86.7.	867.0	19
DEC	86.7.	867.0	19
JAN	86.8.	868.0	19
FEB	86.8.	868.0	19
MAR	86.8.	868.0	19
APR	86.9.	869.0	19
MAY	86.9.	869.0	19
JUN	86.9.	869.0	19
JULY	86.9.	869.0	19
SEPT	86.9.	869.0	19
OCT	86.9.	869.0	19
NOV	86.9.	869.0	19
DEC	86.9.	869.0	19
JAN	87.0.	870.0	19
FEB	87.0.	870.0	19
MAR	87.0.	870.0	19
APR	87.1.	871.0	19
MAY	87.1.	871.0	19
JUN	87.1.	871.0	19
JULY	87.1.	871.0	19
SEPT	87.1.	871.0	19
OCT	87.1.	871.0	19
NOV	87.1.	871.0	19
DEC	87.1.	871.0	19
JAN	87.2.	872.0	19
FEB	87.2.	872.0	19
MAR	87.2.	872.0	19
APR	87.3.	873.0	19
MAY	87.3.	873.0	19
JUN	87.3.	873.0	19
JULY	87.3.	873.0	19
SEPT	87.3.	873.0	19
OCT	87.3.	873.0	19
NOV	87.3.	873.0	19
DEC	87.3.	873.0	19

Table 12

MONTHLY AVERAGE ON PATH	UT	AVER NO	DAY	MIN		MIN
				2	2	
00	683.	57.24	698.0	705.20	698.	704.
01	749.	56.24	735.19	767.19	722.	730.
02	777.	56.24	783.20	787.21	759.	772.
03	788.	55.24	794.20	795.20	759.	786.
04	806.	48.23	801.19	806.20	759.	796.
05	813.	48.23	811.20	817.20	759.	806.
06	833.	46.24	834.20	835.21	759.	806.
07	833.	42.24	834.21	835.21	759.	806.
08	832.	41.24	834.21	835.21	759.	806.
09	833.	41.24	834.21	835.21	759.	806.
10	822.	30.23	830.23	832.23	759.	806.
11	822.	30.23	829.23	830.23	759.	806.
12	735.	24.22	724.22	727.22	724.	727.
13	652.	24.22	680.22	692.22	652.	692.
14	604.	22.22	622.22	650.22	604.	650.
15	580.	20.19	580.19	596.19	580.	596.
16	534.	20.19	543.19	554.19	534.	554.
17	520.	17.18	519.18	528.18	520.	528.
18	502.	15.17	501.17	518.17	502.	518.
19	498.	10.20	498.10	501.10	498.	501.
20	493.	10.20	496.10	501.10	493.	501.
21	497.	13.23	497.13	501.13	497.	501.
22	503.	16.22	499.16	506.16	503.	506.
23	542.	37.23	532.17	552.17	542.	552.
	632.	32.23	633.17	645.15	632.	645.
						693.18
						692.
						683.
						614.
						534.
						505.
						510.
						508.
						523.
						515.
						615.
						32.23
						31.23

Table 13

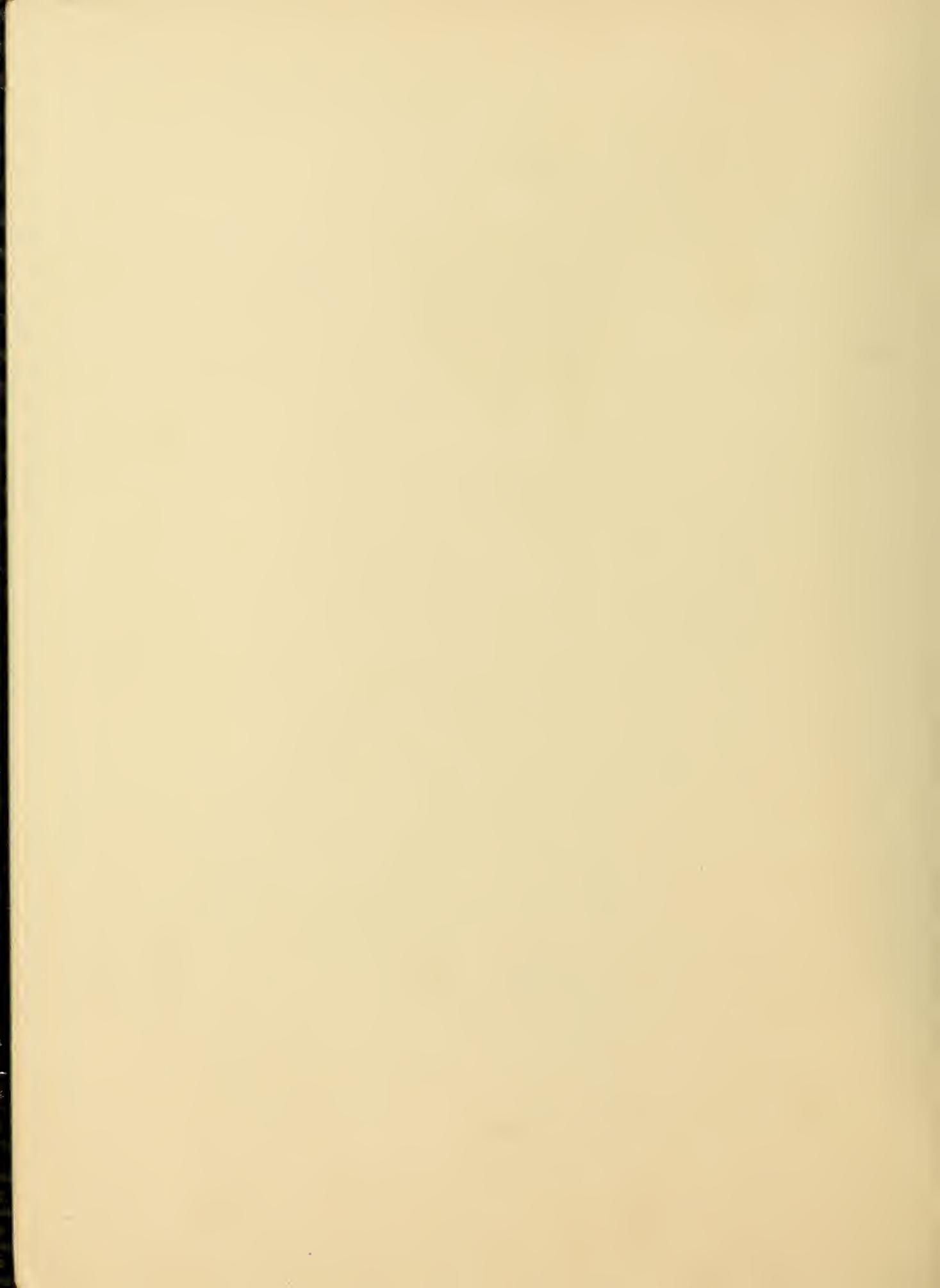
Monthly mean diurnal phase change
(NBA-College path)

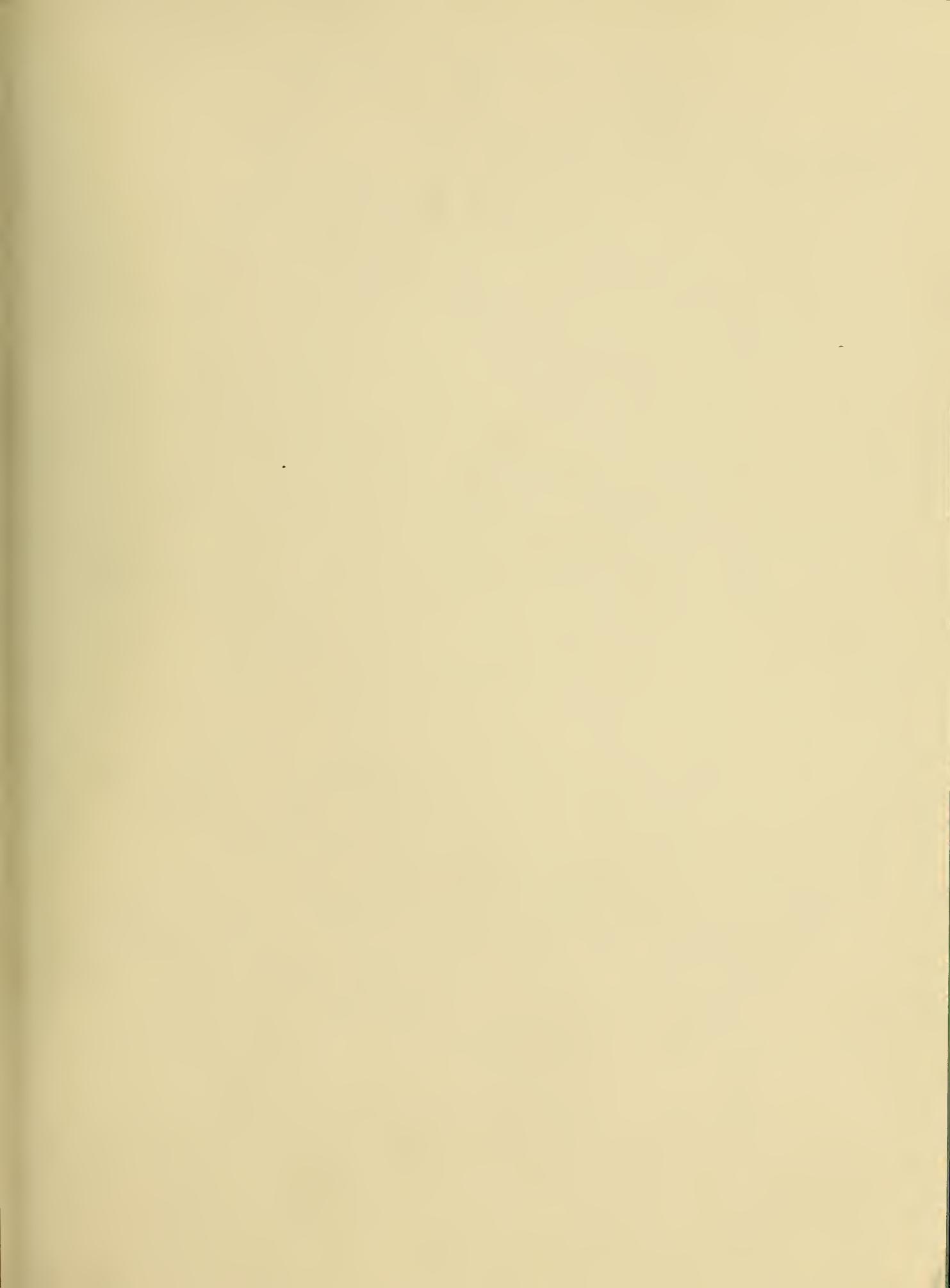
Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1962	332	320	335	322	300	272	302	310	337	352	320	342

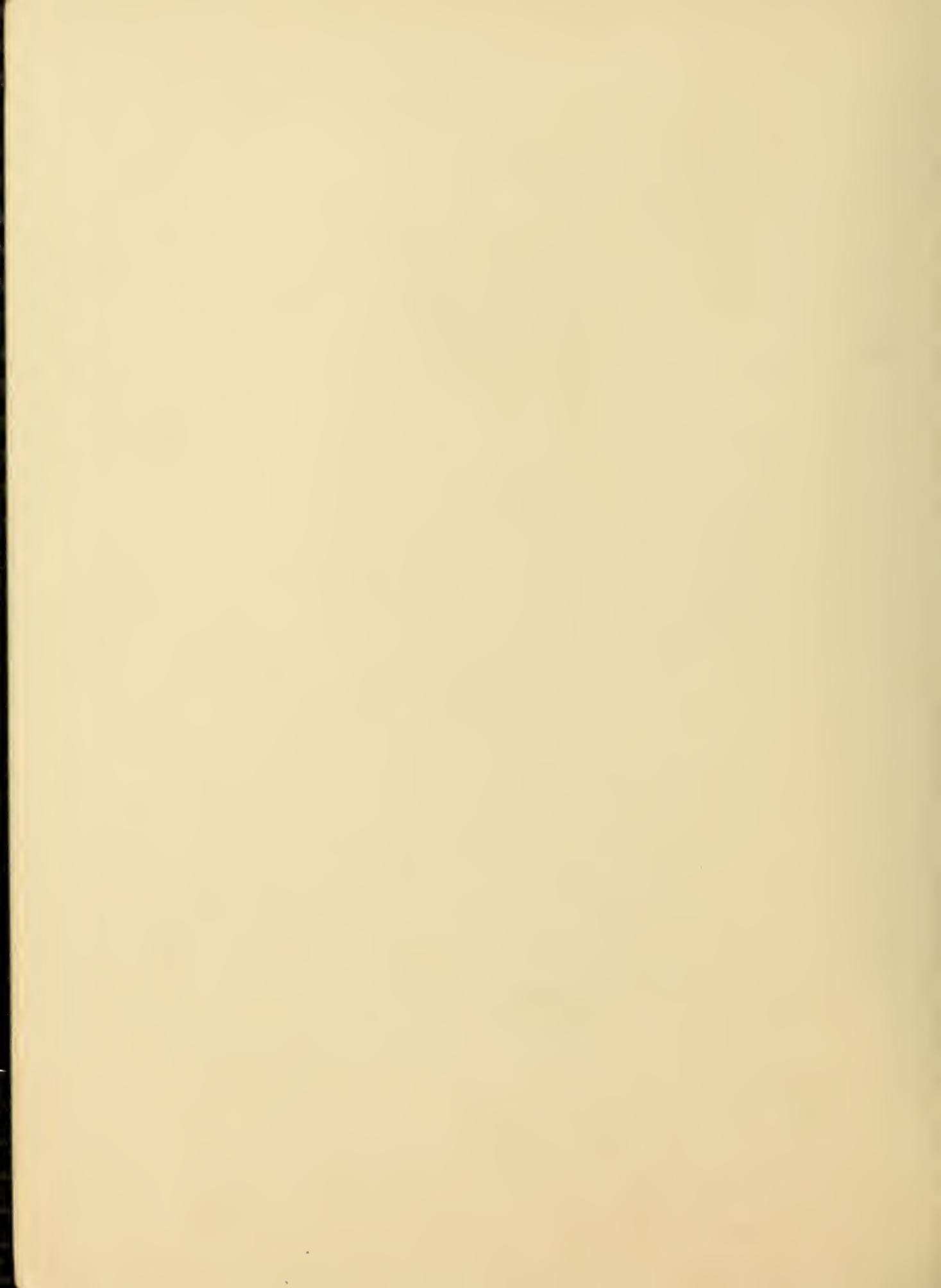
Table 14

RMS phase difference between observations
separated by time T (NBA-College path)

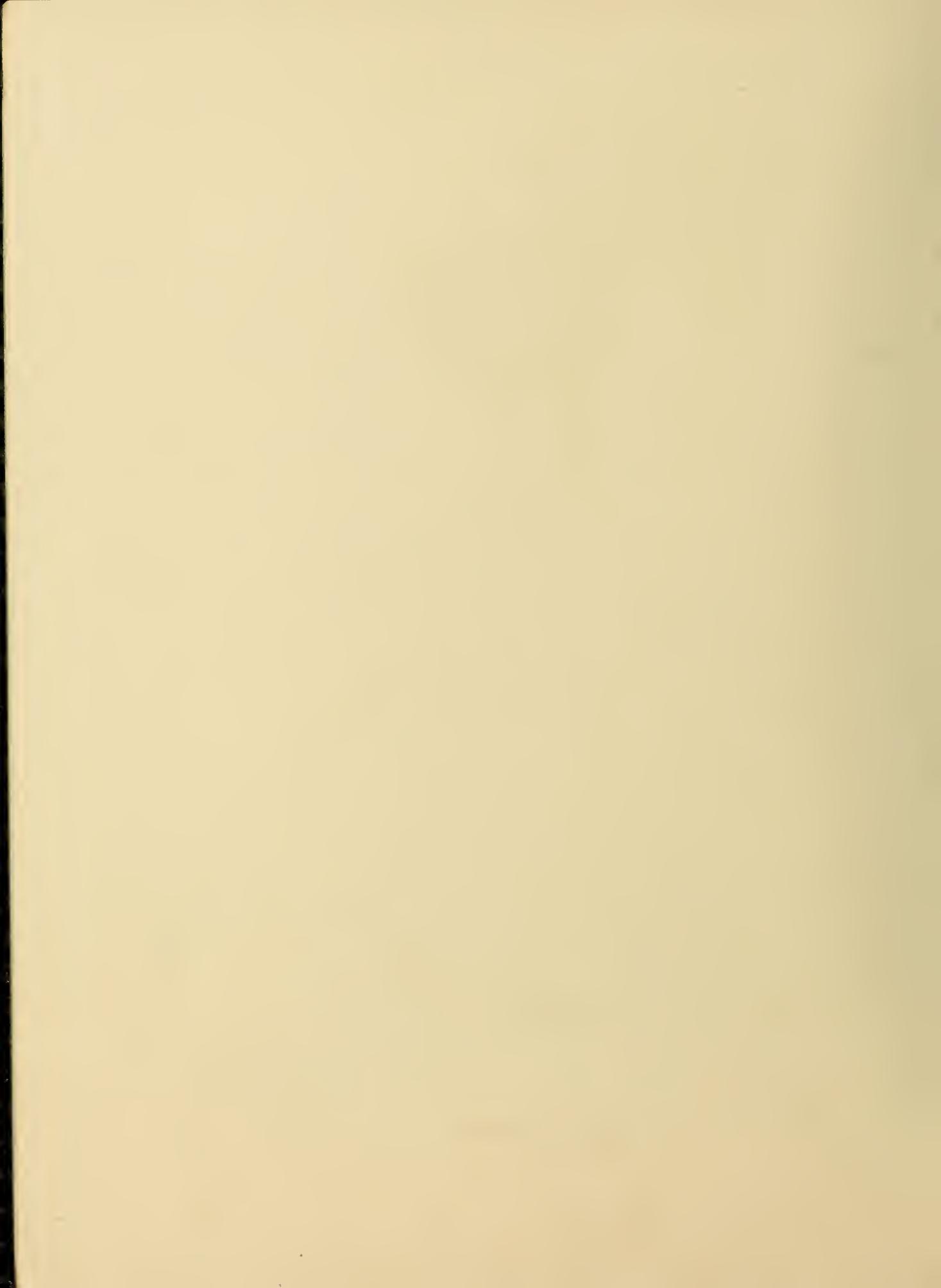
1962 Month	Time of Day	T								
		10	20	30	40	50	60	70	80	minutes
Feb.	Night	6.4	8.4	10.0	11.4	12.1	12.6	13.6	14.3	14.4 degrees
"	Day	5.2	8.4	11.2	13.8	16.4	18.7	21.4	21.7	23.2 "
Apr.	Night	7.4	12.2	15.6	18.8	20.6	20.2	19.0	17.5	17.4 "
"	Day	5.9	10.4	14.0	17.1	19.6	22.0	24.4	27.1	29.0 "
June	Night	10.4	19.8	28.6	34.4	45.4	53.1	61.4	69.0	76.7 "
"	Day	3.3	5.2	6.3	7.5	8.9	9.9	10.5	11.1	11.6 "
Aug.	Night	11.7	16.5	20.7	24.2	28.5	30.6	32.3	35.9	38.8 "
"	Day	2.6	3.8	5.8	6.5	7.6	8.8	9.8	10.9	11.9 "
Oct.	Night	11.9	15.7	16.5	14.2	13.5	15.9	17.3	19.7	18.6 "
"	Day	5.3	7.5	9.5	11.4	13.1	14.5	16.1	17.1	18.7 "
Dec.	Night	9.7	13.7	17.1	18.7	20.1	21.1	22.3	23.4	24.0 "
"	Day	6.2	10.8	13.7	17.2	20.0	22.7	25.3	27.9	30.7 "













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