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MOONRISE, MOONSET AND MOON PHASES FOR
1975

David J. Novlan

Army Electronics Command
White Sands Missile Range, New Mexico

December 1974

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METEOROLOGICAL DATA REPORT

MOONRISE, MOONSET & MOON PHASES FOR 1975

WHITE SANDS MISSILE RANGE

Including Daily Declinations and Percent Illuminated, and
Times of Eclipses, Equinoxes & Solstices, with Condensed
Tables of Sunrise-Sunset Times &
Beginnings & Endings of Twilight

December 1974

By

David J. Novlan

DR-858

DA Task 1T665702D127-02

ATMOSPHERIC SCIENCES LABORATORY
WHITE SANDS MISSILE RANGE, NEW MEXICO

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TIME OF MOONRISE, MOONSET & MOON PHASES AT WSMR IN 1975

These times were computed for Lat. 32° 23' N, Long. 106° 29' W, (Headquarters, WSMR), from tables in "The American Ephemeris and Nautical Almanac, 1975", published by the U. S. Naval Observatory. Greenwich Time is used in the Almanac, and it is necessary to apply three corrections to obtain the actual time (MST) of moonrise and moonset for the local area. The Times are computed for a level horizon, and mountain ranges will affect the time the moon is observed to rise or set by at least four minutes for every degree of elevation of the mountain tops above the horizontal.

The latitude correction is a simple interpolation for 32.4° between the 30° and 35° latitude columns. The correction to convert from Greenwich to local meridian time is a factor determined by dividing the actual longitude (106.4797°) by 360°, or .295777. After obtaining the difference between moonrise (or moonset) on a given day and the following day from the tables, this difference is multiplied by the foregoing factor. To this result is added the local longitude correction of 5.92 minutes (4 x 1.48°), thereby arriving at the correct time (MST) of moonrise (or moonset). (These values have been tabulated to simplify computations).

Since the moon in its orbital motion around the Earth actually moves from west to east, and completes its orbit in 29 1/2 days, moving eastward through the sky about 12.2° each day, it rises about 50 minutes later each day, on the average, but this time varies from about 24 to 75 minutes during a lunar month due to the eccentricity of the moon's orbit. Besides this, the five-degree inclination of the moon's orbit to the ecliptic produces a north-and-south motion through the sky of from 55 to 57° every lunar month.

DECLINATION gives the position of the moon relative to the Celestial Equator. To obtain the elevation angles of the moon when it is on the meridian (due south), add 57° 37' algebraically to the DECLINATION.

Each month there will be one day near the last quarter when there is no moonrise, and another near the first quarter when there is no moonset. In such cases the time of moonrise or moonset will occur on the following day SHORTLY AFTER MIDNIGHT OF THE DAY MISSED. The moon phases occur about one day earlier each month and 10.9 days earlier each year.

In 1975 there will be four eclipses--two of the sun, and two of the moon.

	<u>ECLIPSES</u>	<u>MAGNITUDE</u>
I. 11 May	Partial eclipse of the sun, not visible in North America	.86
II. 25 May	Total eclipse of the moon, visible in North America except NNW part	1.43
III. 3 November:	Partial eclipse of the sun, not visible in North America	1.0
IV. 18-19 November:	Total eclipse of the moon, not visible in western part of North America	1.07

USE OF SOLAR-LUNAR CHARTS & DECLINATION TABLES

The DECLINATION of the Moon (or Sun) is its angular distance north (+) or south (-) of the Celestial Equator, measured along a great circle passing through the Celestial Poles. It is, then, comparable to geographic latitude. "The Celestial Equator is the projection of the plane of the geographical equator on the celestial sphere."--Glossary of Meteorology, American Meteorological Society, 1959.

For example, when the Sun is on the Celestial Equator--at the times of the Equinoxes, on or about March 21st and September 22nd--its declination is zero ($00^{\circ} 00'$) and its angular elevation at noon at WSMR Headquarters is $57^{\circ} 37'$, which is the difference between $90^{\circ} 00'$ (angular distance between equator and North Pole) and $32^{\circ} 23'$ (latitude of White Sands Missile Range Headquarters).

When the Sun is at its farthest north position (at the Summer Solstice, on or about June 22nd), its declination is $+23^{\circ} 27'$, and its angular elevation at noon is $57^{\circ} 37' + 23^{\circ} 27' = 81^{\circ} 04'$. Conversely, at the Winter Solstice (on or about December 22nd) the Sun is at its farthest south position, its declination is $-23^{\circ} 27'$, and its angular elevation at noon is $57^{\circ} 37' - 23^{\circ} 27' = 34^{\circ} 10'$. The solar Altitude Chart*, Figure 1, gives the Sun's path through the sky, with dates, for every five degrees of declination north and south of the Celestial Equator, as well as its position at the solstices.

The Moon also moves north and south through the sky in a similar manner, but instead of requiring a whole year to accomplish this, the Moon travels this route every lunar month, thus making it rather difficult to show the Moon's position daily on even a large number of charts. Therefore, the daily declinations of the Moon have been tabulated for the times of moonrise and moonset, and at the times of its meridian positions (due south, halfway between moonrise and moonset).

These tables can be used with the Solar Altitude Chart to plot the Moon's position at any time, as its path will be similar to that of the Sun for any declination shown on the chart, and can be interpolated for declinations between these values. Note also that when the Moon rises on one day and sets the following day, the Moon's declination for plotting the position of moonset for that passage of the Moon across the sky must be that of the following day.

See Figure 2 for illustrations of use of the chart for positions of the Moon on two days in January, 1975, shown by the labeled lines. Using the hour lines of the chart as guides, the times of the Moon's position in any part of the sky can be interpolated fairly accurately in relation to its rising and setting times. For more precise determinations of the Moon's position, an astronomer should be consulted.

* From Smithsonian Meteorological Tables, Pages 500-501, 1958.

- DECLINATIONS ***
1. +23° 27', June 22
 2. +20 00 , 5/21, 7/24
 3. +15 00 , 5/1, 8/12
 4. +10 00 , 4/16, 8/28
 5. + 5 00 , 4/3, 9/10
 6. 0 00 , 3/22, 9/22

SOLAR ALTITUDES AND AZIMUTHS
 WHITE SANDS MISSILE RANGE
 LAT. 32°23'N, LONG. 106°29'W

- DECLINATIONS ***
7. - 5° 00', 3/8, 10/6
 8. -10 00 , 2/23, 10/20
 9. -15 00 , 2/9, 11/3
 10. -20 00 , 1/21, 11/21
 11. -23 27 , Dec. 22
 12. H O R I Z O N

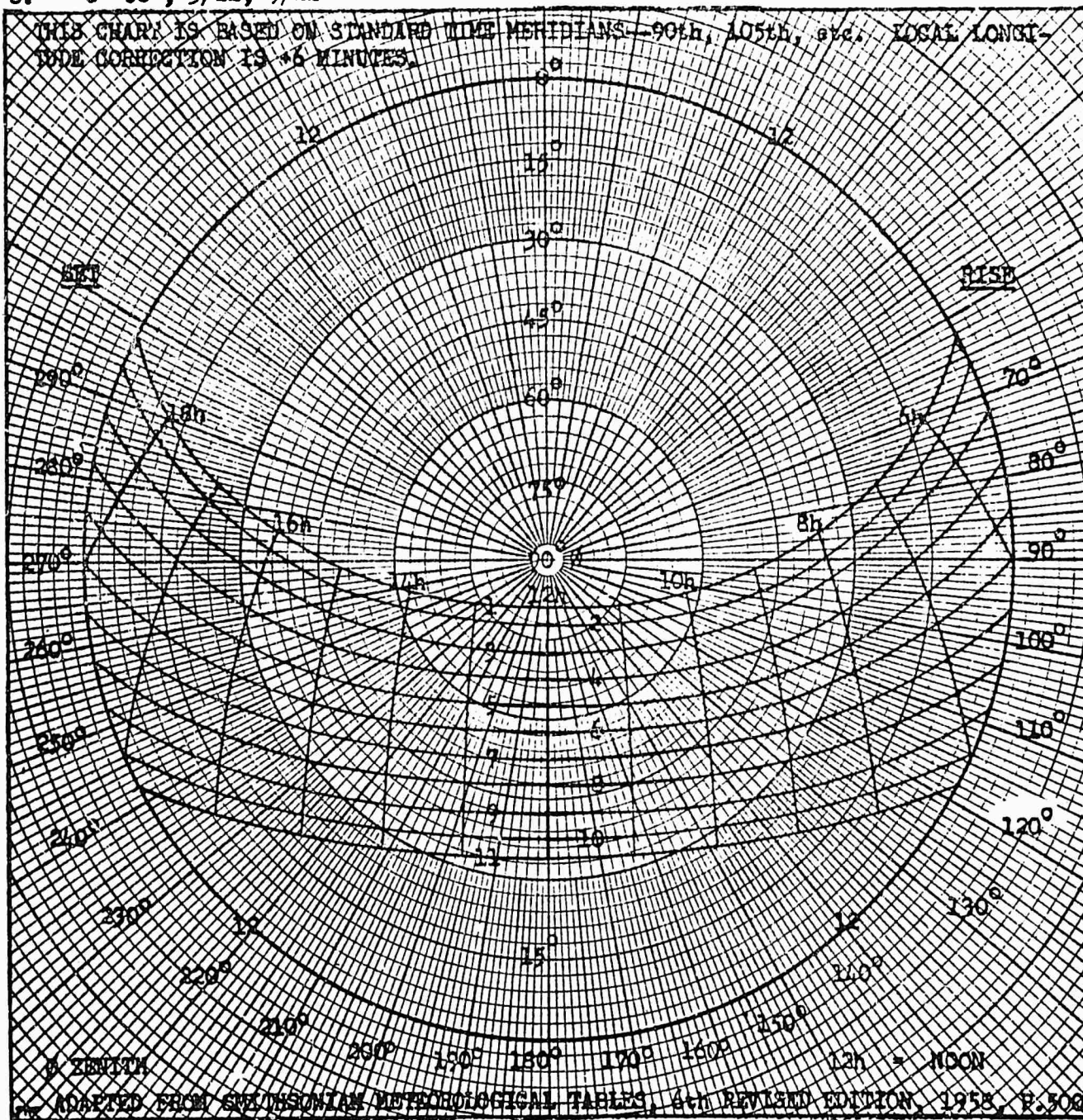


FIGURE 1.

* DECLINATION OF THE SUN ABOVE (+) OR BELOW (-) THE CELESTIAL EQUATOR.

THIS CHART CAN ALSO BE USED AS A BASE FOR DETERMINING THE MOON'S POSITIONS BY USING DAILY DECLINATION TABLES FOUND IN THE AMERICAN EPHEMERIS AND NAUTICAL ALMANAC, ALONG WITH MOONRISE AND MOONSET TABLES. (THE DECLINATION OF THE MOON VARIES FROM ABOUT +25 TO -25 DEGREES EVERY LUNAR MONTH.)

- DECLINATIONS ***
1. +23° 27', June 22
 2. +20. 00 , 5/21, 7/24
 3. +15 00 , 5/1, 8/12
 4. +10 00 , 4/16, 8/28
 5. + 5 00 , 4/3, 9/10
 6. 0 00 , 3/22, 9/22

SOLAR ALTITUDES AND AZIMUTHS
 WHITE SANDS MISSILE RANGE
 LAT. 32°23'N, LONG. 106°29'W

- DECLINATIONS ***
7. - 5° 00', 3/8, 10/6
 8. -10 00 , 2/23, 10/20
 9. -15 00 , 2/9, 11/3
 10. -20 00 , 1/21, 11/21
 11. -23 27 , Dec. 22
 12. H O R I Z O N

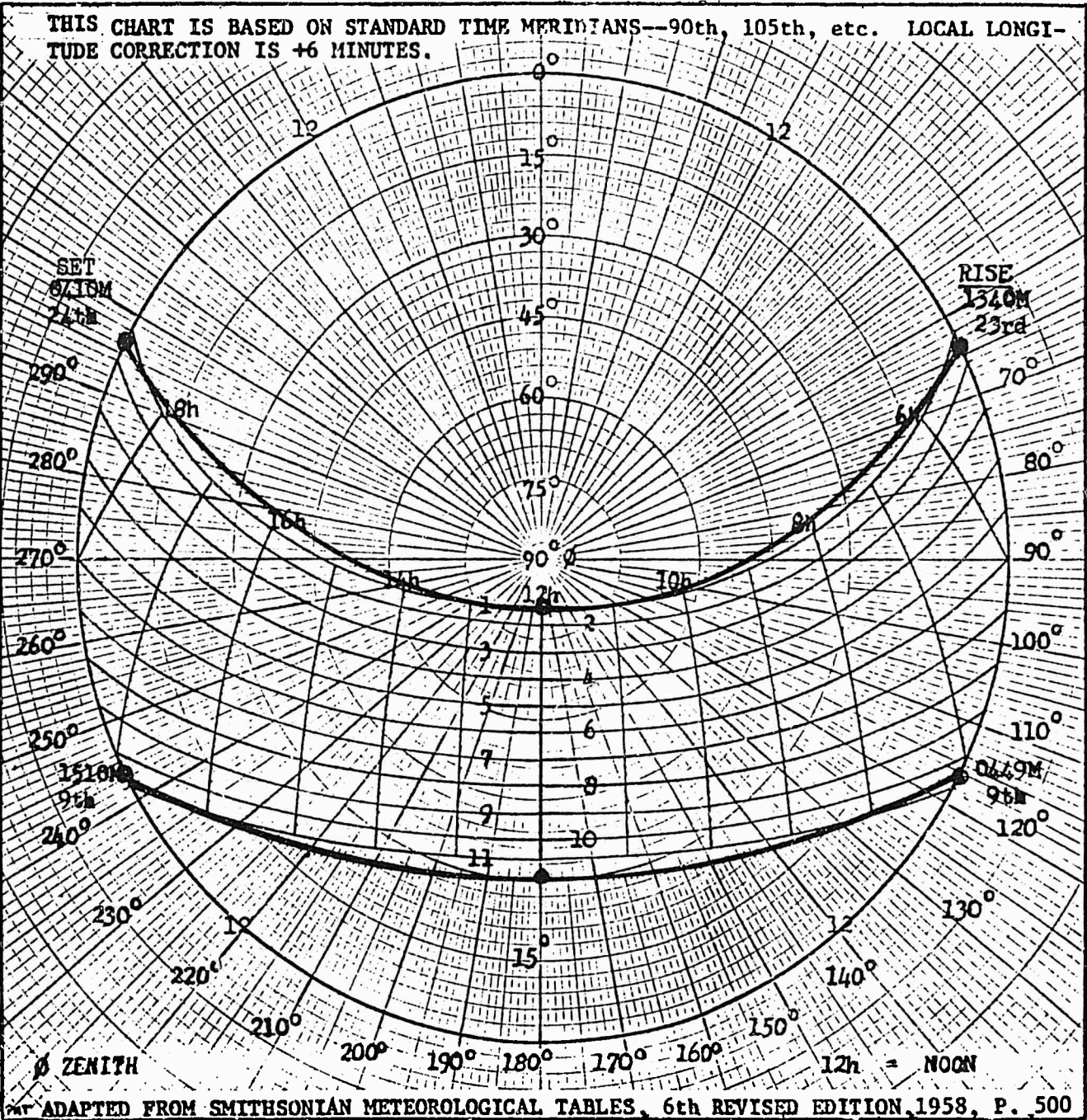


FIGURE 2. BASE FOR PLOTTING LUNAR ALTITUDES AND AZIMUTHS
 MOON'S POSITIONS FOR 9 AND 23 JANUARY, 1975

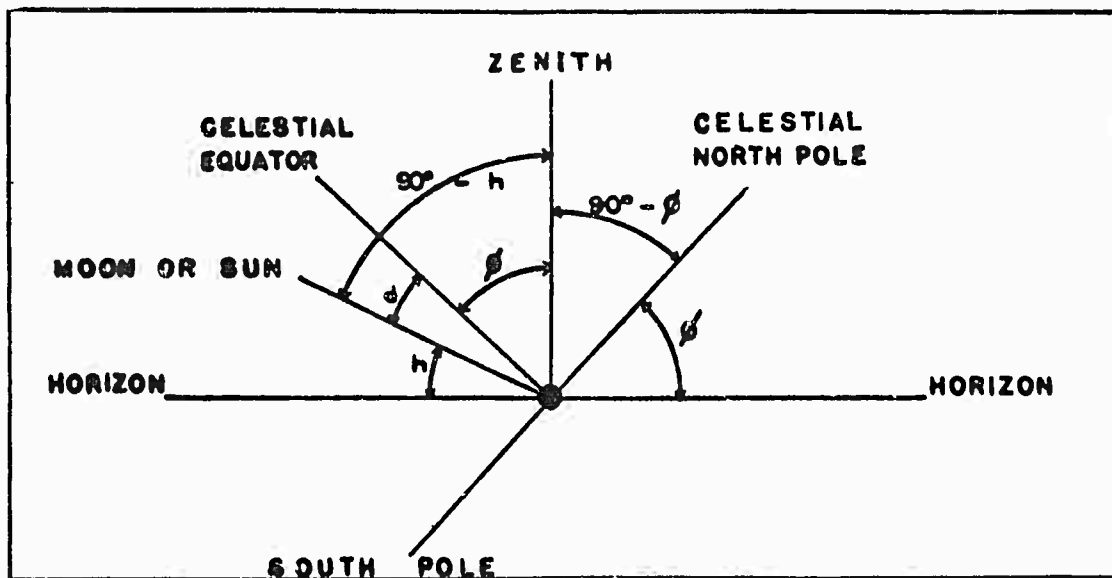


FIGURE 3. THE CELESTIAL SPHERE *

This diagram (Figure 3) shows that the angle from the horizon of the Observer to the Celestial North Pole equals the latitude of the Observer, and since the North Star (Polaris) is at all times within one degree of the Celestial North Pole, it follows that the elevation angle of the North Star approximates the latitude of the Observer.

The angular elevation of the Sun or Moon when on the Meridian (due south) can be determined on any date by the following equation:

$$h = 90 - \phi + d$$

Where

h = Altitude of Sun or Moon when on Meridian

ϕ = Latitude of Observer, and

d = Declination of Sun or Moon.

Example: $h = 90^\circ - 32^\circ 23' + 0^\circ = 57^\circ 37'$, when $d = 0^\circ$ at Equinoxes.

$h = 90^\circ - 32^\circ 23' + 23^\circ 27' = 81^\circ 04'$, when $d = +23^\circ 27'$

AT THE TIME OF THE SUMMER SOLSTICE.

$h = 90^\circ - 32^\circ 23' + (-23^\circ 27') = 34^\circ 10'$, when $d = -23^\circ 27'$

AT THE TIME OF THE WINTER SOLSTICE.

* Adapted from "A Compilation of Solar Data for White Sands Missile Range," March 1965, ERDA-305, by Paul H. Taft.

EQUINOXES AND SOLSTICES, 1975

Vernal Equinox:	2257 MST, 20 March	Autumnal Equinox:	0855 MST, 23 September
Summer Solstice:	1727 MST, 21 June	Winter Solstice:	0446 MST, 22 December
Earth's Perihelion:	4 January	Earth's Aphelion:	6 July

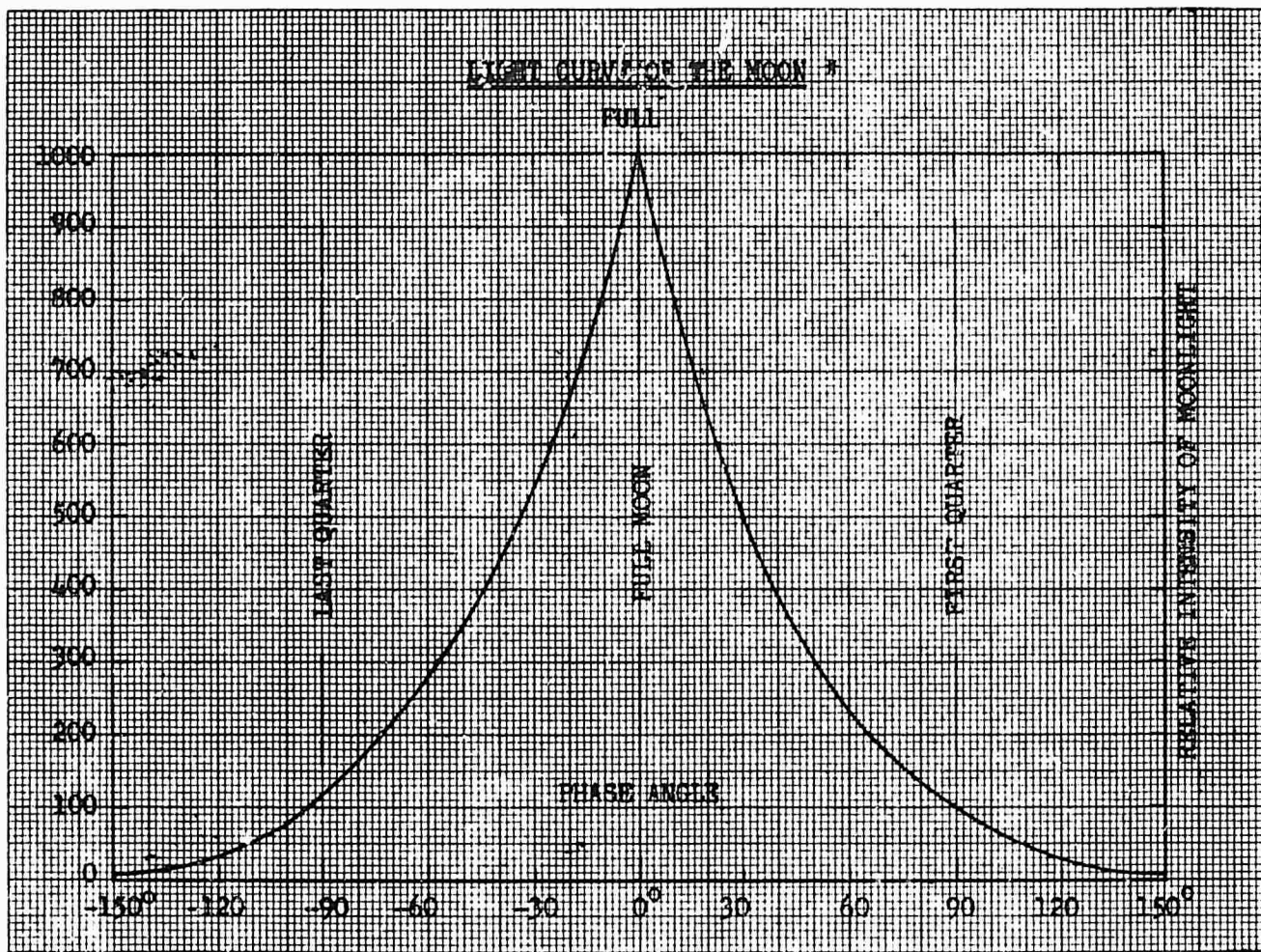


Figure 4.

ILLUMINATION DUE TO THE MOON *

The illumination due to the moon may be estimated roughly from its altitude and phase in the following manner. When the altitude of the full moon is 65° on a clear night, the illumination on a horizontal plane is approximately 0.03 foot-candles.

When the sun's altitude is 65 degrees, the illumination on a horizontal plane is 10,000 foot-candles. The ratio of full moon to sun-plus-sky-light is then roughly three to 1,000,000. Other values for full moonlight follow the same proportion.

*--"Natural Illumination Charts"
 By Com. Dayton R. E. Brown
 Dept. of the Navy, Bureau of Ships
 Report No. 374-1, September 1952

TABLE I

TIMES OF SUNRISE AND SUNSET, AND BEGINNINGS AND ENDINGS
OF CIVIL, NAUTICAL AND ASTRONOMICAL TWILIGHT
WHITE SANDS MISSILE RANGE, NEW MEXICO
LAT. 32° 23' N; LONG. 106° 29' W.

D A T E	SUN- RISE	BEGINNINGS—SDA			SUN- SET	ENDINGS—SDA		
		6°	12°	18°		6°	12°	18°
JAN. 1	0707	0640	0610	0540	1712	1739	1809	1839
JAN. 11	0707	0641	0611	0542	1722	1748	1818	1847
JAN. 21	0706	0640	0610	0541	1731	1757	1826	1854
JAN. 31	0700	0634	0606	0538	1740	1806	1834	1902
FEB. 10	0652	0627	0559	0531	1749	1814	1842	1910
FEB. 20	0642	0617	0550	0522	1758	1823	1850	1918
MAR. 2	0631	0607	0540	0511	1806	1831	1857	1926
MAR. 12	0618	0555	0528	0500	1813	1838	1905	1933
MAR. 22	0607	0543	0515	0447	1820	1844	1912	1941
APR. 1	0553	0529	0500	0433	1826	1851	1919	1949
APR. 11	0541	0516	0447	0418	1834	1858	1928	1958
APR. 21	0529	0504	0434	0404	1840	1905	1936	2007
MAY 1	0519	0453	0422	0350	1847	1913	1945	2017
MAY 11	0510	0443	0411	0338	1855	1921	1954	2027
MAY 21	0505	0436	0402	0328	1901	1928	2002	2037
MAY 31	0500	0432	0357	0321	1907	1934	2010	2046
JUNE 10	0459	0430	0354	0317	1913	1940	2016	2053
JUNE 20	0500	0431	0354	0317	1915	1942	2019	2057
JUNE 30	0503	0434	0357	0320	1916	1943	2020	2057
JULY 10	0508	0438	0403	0326	1915	1942	2019	2056
JULY 20	0514	0444	0410	0334	1911	1937	2013	2050
JULY 30	0520	0453	0418	0343	1904	1930	2004	2040
AUG. 9	0527	0501	0427	0353	1855	1920	1954	2028
AUG. 19	0534	0508	0436	0403	1845	1910	1942	2015
AUG. 29	0540	0515	0444	0412	1833	1858	1929	2001
SEP. 8	0546	0521	0451	0421	1820	1844	1915	1946
SEP. 18	0552	0528	0459	0428	1807	1831	1901	1931
SEP. 28	0558	0534	0505	0436	1755	1819	1848	1918
OCT. 8	0605	0541	0512	0442	1741	1806	1835	1904
OCT. 18	0612	0548	0518	0449	1729	1754	1823	1853
OCT. 28	0620	0555	0526	0456	1719	1745	1814	1843
NOV. 7	0629	0604	0534	0504	1710	1736	1806	1835
NOV. 17	0637	0612	0542	0511	1704	1731	1800	1830
NOV. 27	0646	0620	0550	0519	1702	1730	1758	1827
DEC. 7	0655	0628	0557	0526	1701	1729	1758	1828
DEC. 17	0701	0634	0603	0533	1705	1732	1800	1830
DEC. 27	0706	0639	0608	0538	1710	1736	1805	1835

SDA = SUN'S DEPRESSION ANGLE. SDA OF 6° = BEGINNING OR ENDING OF CIVIL TWILIGHT. SDA OF 12° = BEGINNING OR ENDING OF NAUTICAL TWILIGHT. SDA OF 18° = BEGINNING OR ENDING OF ASTRONOMICAL TWILIGHT.

VALUES WERE DERIVED FROM THE AMERICAN EPHEMERIS & NAUTICAL ALMANAC, AND THE AIR ALMANAC, WHICH ARE PUBLISHED BY THE U.S. NAVAL OBSERVATORY.

FOR DEFINITIONS OF THE THREE TWILIGHTS, SEE "GLOSSARY OF METEOROLOGY."

TIMES OF MOONRISE, MOONSET AND MOON PHASES FOR 1975
INCLUDING DECLINATIONS AND PERCENT ILLUMINATED

JANUARY 1975

DAY	MOONRISE MST	D ₁	D ₂	D ₃	MOONSET MST	PHASES MST	* PERCENT ILLUMINATED
1	2137	+4.2	8.3	+6.9	0938		89
2	2243	-1.5	2.7	+1.2	1016		80
3	2348	-6.9	-2.8	-4.1	1052		70
4	----	----	-8.1	-9.3	1129	LAST 1/4, 1204	59
5	0052	-11.9	-12.9	-13.8	1207		48
6	0154	-16.0	-16.8	-17.5	1247		37
7	0255	-19.2	-19.8	-20.3	1331		27
8	0354	-21.3	-21.6	-21.8	1419		18
9	0449	-22.1	-22.1	-22.1	1510		11
10	0539	-21.8	-21.6	-21.3	1604		06
11	0625	-20.4	-19.9	-19.4	1659		07
12	0706	-17.9	-17.3	-16.7	1755	NEW, 0320	00
13	0742	-14.7	-13.9	-13.1	1850		00
14	0816	-10.8	-9.9	-8.9	1944		02
15	0847	-6.8	-5.7	-4.5	2038		06
16	0917	-2.1	-1.1	0.0	2131		11
17	0946	+2.3	+3.5	+4.6	2224		18
18	1016	+6.8	+8.0	+9.1	2318		26
19	1048	+11.0	+12.1	----	----		34
20	1123	+14.9	+15.9	+13.2	0014	FIRST 1/4, 0814	44
21	1202	+18.2	+19.0	+16.8	0112		54
22	1247	+19.7	+20.5	+19.7	0211		64
23	1340	+21.9	+22.0	+21.2	0311		73
24	1439	+21.8	+21.4	+22.1	0410		83
25	1545	+20.6	+19.6	+20.9	0507		90
26	1654	+16.9	+15.8	+18.6	0559		96
27	1805	+12.1	----	+14.7	0648	FULL, 0809	99
28	1917	+6.9	+10.9	+9.6	0731		100
29	2026	+1.1	+5.4	+3.9	0811		97
30	2134	-4.6	-.3	-1.7	0850		91
31	2241	-10.0	-5.9	-7.2	0928		84
/1							

D₁ = Declination of Moon at time of Moonrise.

D₂ = Declination of Moon when it is on the Meridian (Due South).

D₃ = Declination of Moon at time of Moonset.

Declination is given in degrees north (+) or south (-) of the Celestial Equator. * Illumination values are for midnight, Greenwich (Zulu) Time.

TIMES OF MOONRISE, MOONSET AND MOON PHASES FOR 1975
INCLUDING DECLINATIONS AND PERCENT ILLUMINATED

FEBRUARY 1975

DAY	MOONRISE MST	D ₁	D ₂	D ₃	MOONSET MST	PHASES MST	* PERCENT ILLUMINATED
1	2346	-14.5	-11.0	-12.1	1007		74
2	-----	-----	-15.3	-16.1	1047	LAST 1/4, 2323	64
3	0049	-18.1	-18.7	-19.3	1131		53
4	0149	-20.5	-20.9	-21.3	1217		42
5	0245	-21.8	-21.9	-22.0	1307		32
6	0337	-21.8	-21.5	-21.3	1400		23
7	0423	-20.8	-20.4	-20.1	1454		16
8	0505	-18.7	-18.2	-17.6	1549		09
9	0543	-15.9	-14.9	-14.1	1644		05
10	0618	-12.2	-11.2	-10.3	1738	NEW, 2217	01
11	0650	-8.3	-7.2	-6.1	1832		00
12	0720	-3.7	-2.7	-1.7	1925		01
13	0749	+0.6	+1.2	+2.9	2018		03
14	0819	+5.9	+6.7	+7.5	2112		07
15	0850	+9.2	+10.5	+11.7	2206		12
16	0923	+13.4	+14.5	+15.5	2302		19
17	1000	+16.9	+17.4	-----	-----		28
18	1042	+19.5	+20.0	+17.7	0000		37
19	1129	+21.3	+21.5	+20.7	0058	FIRST 1/4, 0039	47
20	1223	+21.9	+21.7	+21.8	0155		57
21	1324	+21.0	+20.4	+21.5	0251		68
22	1429	+18.7	+17.7	+19.8	0344		78
23	1538	+15.0	+13.7	+16.8	0434		86
24	1649	+10.1	+8.5	+12.3	0519		93
25	1800	+4.3	-----	+7.0	0602	FULL, 1815	98
26	1911	-1.5	+2.9	+1.5	0642		100
27	2020	-7.1	-2.9	-4.3	0721		98
28	2128	-12.4	-8.5	-9.8	0801		94
/1							

D₁ = Declination of Moon at time of Moonrise.
D₂ = Declination of Moon when it is on the Meridian (Due South).
D₃ = Declination of Moon at time of Moonset.
Declination is given in degrees north (+) or south (-) of the Celestial Equator. * Illumination values are for midnight, Greenwich (Zulu) Time.

TIMES OF MOONRISE, MOONSET AND MOON PHASES FOR 1975
INCLUDING DECLINATIONS AND PERCENT ILLUMINATED

MARCH 1975

DAY	MOONRISE MST	D ₁	D ₂	D ₃	MOONSET MST	PHASES MST	* PERCENT ILLUMINATED
1	2235	-16.5	-13.4	-14.4	0843		87
2	2338	-19.5	-17.3	-18.0	0927		79
3	----	----	-20.0	-20.4	1014		69
4	0037	-21.3	-21.5	-21.6	1103	LAST, 1320	59
5	0132	-21.7	-21.6	-21.5	1156		48
6	0221	-21.0	-20.7	-20.4	1250		38
7	0305	-19.2	-18.7	-18.2	1345		29
8	0344	-16.2	-15.8	-15.3	1439		21
9	0419	-13.3	-12.5	-11.6	1533		14
10	0452	-9.6	-8.7	-7.7	1627		08
11	0522	-5.1	-4.1	-3.1	1720		04
12	0552	-.3	+6	+1.4	1813	NEW, 1647	01
13	0622	+3.6	+4.8	+5.9	1907		00
14	0653	+7.8	+9.3	+10.8	2002		01
15	0726	+12.0	+13.0	+14.0	2057		04
16	0802	+15.6	+16.5	+17.4	2154		08
17	0842	+18.4	+19.6	+20.8	2251		14
18	0926	+20.3	+20.8	+21.3	2347		22
19	1017	+21.6	+21.6	----	----		31
20	1113	+21.2	+20.9	+21.5	0042	FIRST 1/4, 1305	41
21	1214	+19.5	+18.6	+20.5	0135		52
22	1319	+16.6	+15.5	+17.6	0224		63
23	1427	+12.4	+11.2	+14.3	0309		73
24	1535	+7.4	+6.0	+9.9	0351		83
25	1645	+1.8	+4	+4.5	0432		91
26	1755	-4.0	-5.5	-1.1	0511		97
27	1904	-9.6	----	-6.9	0551	FULL, 0336	100
28	2013	-14.1	-10.7	-11.8	0633		99
29	2119	-18.4	-14.1	-14.1	0716		96
30	2223	-20.4	-18.8	-19.3	0804		91
31	2321	-21.4	-20.7	-21.0	0854		83
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D₁ = Declination of Moon at time of Moonrise.

D₂ = Declination of Moon when it is on the Meridian (Due South).

D₃ = Declination of Moon at time of Moonset.

Declination is given in degrees north (+) or south (-) of the Celestial Equator. * Illumination values are for midnight, Greenwich (Zulu) Time.

TIMES OF MOONRISE, MOONSET AND MOON PHASES FOR 1975
INCLUDING DECLINATIONS AND PERCENT ILLUMINATED

APRIL 1975

DAY	MOONRISE MST	D ₁	D ₂	D ₃	MOONSET MST	PHASES MST	* PERCENT ILLUMINATED
1	----	----	-21.4	-21.5	0947		75
2	0014	-21.1	-20.9	-20.7	1042		65
3	0100	-19.8	-19.3	-18.9	1138	LAST, 0525	55
4	0142	-17.5	-16.8	-16.1	1233		45
5	0219	-14.3	-13.5	-12.8	1327		36
6	0253	-10.7	-9.8	-8.8	1421		27
7	0324	-6.7	-5.6	-4.5	1515		19
8	0354	-2.3	-1.2	0.0	1608		12
9	0424	+2.1	+3.2	+4.3	1701		07
10	0455	+6.4	+7.3	+8.7	1756		03
11	0527	+10.7	+11.7	+12.7	1851	NEW, 0939	01
12	0603	+14.5	+15.3	+16.2	1948		00
13	0642	+17.5	+18.2	+19.0	2045		02
14	0725	+19.8	+19.3	+20.8	2143		05
15	0814	+21.1	+21.2	+21.3	2238		11
16	0908	+21.3	+21.0	+20.8	2331		18
17	1007	+20.0	+19.4	----	----		27
18	1109	+17.5	+16.6	+18.8	0020	FIRST, 2141	37
19	1214	+13.8	+12.7	+15.6	0105		48
20	1320	+9.3	+8.0	+11.6	0147		59
21	1426	+4.0	+2.6	+6.7	0227		70
22	1534	-1.5	-2.8	+1.2	0305		80
23	1641	-7.0	-8.3	-4.1	0344		89
24	1750	-12.0	-13.0	-9.5	0423		95
25	1857	-16.1	----	-14.1	0506	FULL, 1255	99
26	2003	-19.3	-16.9	-17.7	0552		100
27	2105	-21.0	-19.7	-20.1	0641		98
28	2202	-21.3	-21.2	-21.3	0734		94
29	2252	-20.3	-21.2	-21.0	0830		88
30	2337	-18.3	-20.0	-19.7	0926		80

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Declination is given in degrees north (+) or south (-) of the Celestial Equator. * Illumination values are for midnight, Greenwich (Zulu) Time.

TIMES OF MOONRISE, MOONSET AND MOON PHASES FOR 1975
 INCLUDING DECLINATIONS AND PERCENT ILLUMINATED

MAY 1975

DAY	MOONRISE MST	D ₁	D ₂	D ₃	MOONSET MST	PHASES MST	* PERCENT ILLUMINATED
1	----	----	-17.8	-17.3	1023		71
2	0017	-15.5	-14.7	-14.0	1119	LAST 1/4, 2244	67
3	0052	-12.1	-11.1	-10.1	1214		52
4	0124	-8.1	-7.0	-6.0	1307		43
5	0155	-4.0	-3.0	-1.7	1400		34
6	0225	+5	-1.1	-2.7	1453		25
7	0225	+4.7	+5.9	+7.1	1547		17
8	0327	+9.1	+10.2	+11.3	1643		11
9	0411	+13.1	+14.0	+15.0	1739		05
10	0439	+16.5	+17.3	+18.1	1837		02
11	0522	+19.1	+20.0	+20.2	1935	NEW, 0005	00
12	0610	+20.8	+21.0	+21.2	2033		01
13	0703	+21.3	+21.1	+21.0	2127		03
14	0801	+20.5	+19.8	+19.3	2218		08
15	0903	+18.3	+17.4	+16.6	2304		15
16	1007	+15.0	+13.9	+12.8	2347		24
17	1112	+10.7	+9.4	----	----		34
18	1217	+5.7	+4.4	+8.1	0026	FIRST 1/4, 0329	45
19	1322	+3	-.9	+3.0	0105		56
20	1428	-5.0	-6.2	-2.1	0142		68
21	1533	-10.0	-11.0	-7.5	0220		78
22	1639	-14.6	-15.3	-12.0	0259		87
23	1745	-18.0	-18.5	-16.1	0342		94
24	1849	-20.3	----	-19.1	0429	FULL, 2251	98
25	1948	-21.2	-20.6	-20.9	0521		100
26	2042	-20.8	-21.2	-21.2	0616		99
27	2130	-19.3	-20.5	-20.3	0712		96
28	2212	-16.7	-18.8	-18.3	0810		91
29	2249	-13.6	-16.0	-15.4	0907		85
30	2323	-9.7	-12.7	-11.8	1003		77
31	2355	-5.6	-8.8	-7.8	1057		68
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D₁ = Declination of Moon at time of Moonrise.

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D₃ = Declination of Moon at time of Moonset.

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TIMES OF MOONRISE, MOONSET AND MOON PHASES FOR 1975
 INCLUDING DECLINATIONS AND PERCENT ILLUMINATED

JUNE 1975

DAY	MOONRISE MST	D ₁	D ₂	D ₃	MOONSET MST	PHASES MST	* PERCENT ILLUMINATED
1	----	----	-4.1	-3.5	1151	LAST 1/4, 1623	59
2	0025	-1.1	0.0	+1.0	1244		50
3	0055	+3.0	+4.2	+5.5	1338		40
4	0126	+7.5	+8.6	+9.6	1432		31
5	0159	+11.5	+12.6	+13.7	1528		23
6	0235	+15.1	+16.0	+17.0	1625		15
7	0316	+18.2	+18.9	+19.6	1724		08
8	0402	+20.3	+20.6	+21.0	1822		04
9	0453	+21.2	+21.2	+21.2	1919	NEW, 1149	01
10	0551	+21.0	+20.6	+20.1	2012		00
11	0653	+19.3	+18.3	+17.6	2101		02
12	0758	+16.2	+15.1	+14.1	2146		06
13	0904	+12.2	+10.4	+9.6	2228		13
14	1010	+7.3	+5.9	+4.6	2306		21
15	1115	+2.0	+7	-.5	2343		32
16	1220	-3.3	-4.5	----	----	FIRST 1/4, 0758	43
17	1325	-8.5	-9.6	-5.8	0020		54
18	1429	-13.0	-13.9	-10.7	0058		66
19	1534	-16.8	-17.5	-14.8	0139		76
20	1636	-19.6	-20.0	-18.1	0224		85
21	1736	-21.0	-21.1	-20.4	0313		92
22	1832	-21.3	-21.1	-21.3	0405		97
23	1922	-20.2	----	-20.9	0500	FULL, 0954	99
24	2006	-18.0	-19.8	-19.5	0557		100
25	2046	-15.1	-17.5	-16.9	0655		98
26	2122	-11.4	-14.3	-13.5	0751		94
27	2155	-7.5	-10.5	-9.5	0847		89
28	2225	-3.1	-6.4	-5.4	0941		82
29	2255	+1.1	-1.9	-.7	1035		74
30	2326	+5.5	+2.3	+3.5	1128		66
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TIMES OF MOONRISE, MOONSET AND MOON PHASES FOR 1975
 INCLUDING DECLINATIONS AND PERCENT ILLUMINATED

JULY 1975

DAY	MOONRISE MST	D ₁	D ₂	D ₃	MOONSET MST	PHASES MST	* PERCENT ILLUMINATED
1	2358	+9.7	+6.7	+7.8	1221	LAST 1/4, 0937	57
2	-----	-----	+10.7	+11.8	1316		47
3	0032	+13.5	+14.5	+15.5	1412		38
4	0110	+16.9	+17.7	+18.5	1509		28
5	0153	+19.3	+19.8	+20.5	1607		20
6	0241	+20.9	+21.0	+21.3	1705		12
7	0337	+21.2	+21.0	+20.8	1801		06
8	0437	+20.3	+19.6	+19.0	1853	NEW, 2110	02
9	0543	+17.6	+16.7	+15.8	1941		00
10	0650	+14.0	+12.8	+11.5	2025		01
11	0758	+9.3	+8.4	+6.5	2105		05
12	0905	+4.0	+2.6	+1.3	2144		11
13	1012	-1.5	-2.8	-4.0	2222		20
14	1117	-6.8	-8.0	-9.2	2300		30
15	1223	-11.6	-12.5	-13.5	2340	FIRST 1/4, 1247	41
16	1327	-15.7	-16.4	-----	-----		52
17	1429	-18.7	-19.2	-17.1	0023		63
18	1529	-20.7	-20.9	-19.8	0109		73
19	1625	-21.2	-21.1	-21.1	0200		82
20	1717	-20.7	-20.4	-21.1	0253		89
21	1803	-18.5	-19.3	-20.1	0349		95
22	1844	-16.3	-----	-18.0	0446	FULL, 2228	98
23	1921	-13.0	-15.6	-15.0	0542		100
24	1955	-9.0	-12.1	-11.3	0638		99
25	2027	-5.0	-8.0	-7.1	0733		97
26	2057	-.5	-3.9	-2.8	0824		93
27	2127	+3.8	+6	+1.7	0919		87
28	2158	+7.9	+4.9	+6.0	1012		80
29	2230	+11.8	+9.0	+10.1	1106		72
30	2306	+15.4	+12.9	+14.0	1200		63
31	2346	+18.1	+16.3	+17.2	1257		54
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TIMES OF MOONRISE, MOONSET AND MOON PHASES FOR 1975
 INCLUDING DECLINATIONS AND PERCENT ILLUMINATED

AUGUST 1975

DAY	MOONRISE MST	D ₁	D ₂	D ₃	MOONSET MST	PHASES MST	* PERCENT ILLUMINATED
1	----	----	+18.8	+19.5	1353		44
2	0031	+20.3	+20.6	+20.9	1450		34
3	0122	+21.1	+21.0	+21.0	1546		24
4	0219	+20.7	+20.3	+20.0	1639		16
5	0322	+19.1	+18.3	+17.5	1730		09
6	0429	+16.0	+15.0	+13.7	1816		03
7	0538	+11.7	+10.7	+9.1	1859	NEW, 0457	01
8	0647	+6.6	+5.4	+3.9	1940		01
9	0756	+1.0	-.4	-1.8	2019		04
10	0905	-4.6	-6.0	-7.0	2059		09
11	1012	-9.8	-11.0	-11.9	2140		17
12	1118	-14.3	-15.1	-15.9	2222		27
13	1222	-17.6	-18.2	-18.9	2303	FIRST 1/4, 1924	38
14	1324	-20.0	-20.3	-20.6	2358		49
15	1421	-21.0	-21.0	----	----		60
16	1514	-20.8	-20.6	-21.1	0050		70
17	1601	-19.5	-19.1	-20.4	0144		79
18	1644	-17.3	-16.6	-18.7	0240		86
19	1722	-14.1	-13.3	-16.0	0336		92
20	1756	-10.6	-9.6	-12.5	0432		97
21	1829	-6.5	-5.4	-8.6	0526	FULL, 1248	99
22	1859	-2.3	----	-4.3	0620		100
23	1929	+2.1	-1.1	±0	0713		99
24	2000	+6.4	+3.3	+4.4	0806		96
25	2032	+10.3	+7.4	+8.4	0859		91
26	2106	+14.0	+11.3	+12.3	0953		85
27	2144	+17.0	+14.8	+15.7	1048		78
28	2225	+19.3	+17.6	+18.3	1143		69
29	2313	+20.7	+19.7	+20.1	1238	LAST 1/4, 1620	60
30	----	----	+20.8	+20.9	1333		50
31	0006	+20.9	+20.7	+20.5	1426		39
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D₃ = Declination of Moon at time of Moonset.

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TIMES OF MOONRISE, MOONSET AND MOON PHASES FOR 1975
INCLUDING DECLINATIONS AND PERCENT ILLUMINATED

SEPTEMBER 1975

DAY	MOONRISE MST	D ₁	D ₂	D ₃	MOONSET MST	PHASES MST	* PERCENT ILLUMINATED
1	0104	+19.9	+19.3	+18.7	1517		29
2	0207	+17.6	+16.6	+15.7	1604		20
3	0314	+14.0	+12.8	+11.6	1649		11
4	0423	+9.3	+8.0	+6.6	1731		05
5	0533	+3.9	+2.5	+1.2	1812	NEW, 1219	01
6	0643	-1.7	-3.1	-4.5	1853		00
7	0753	-7.3	-8.5	-9.7	1934		02
8	0902	-12.2	-13.2	-14.2	2018		07
9	1009	-16.3	-16.9	-17.6	2104		15
10	1114	-19.1	-19.4	-19.8	2153		24
11	1214	-20.6	-20.7	-20.8	2245		34
12	1309	-20.8	-20.7	-20.5	2340	FIRST 1/4, 0459	45
13	1358	-19.8	-19.5	----	----		55
14	1442	-17.9	-17.3	-19.1	0036		65
15	1522	-15.1	-14.4	-16.7	0132		74
16	1558	-11.6	-10.8	-13.6	0227		82
17	1630	-7.8	-6.9	-9.9	0322		89
18	1702	-3.7	-2.6	-6.0	0415		94
19	1732	+0.6	+1.7	-1.5	0508		98
20	1803	+4.9	----	+2.8	0602	FULL, 0450	100
21	1834	+8.9	+6.0	+7.1	0655		100
22	1908	+12.7	+9.9	+10.8	0748		98
23	1944	+15.9	+13.9	+14.1	0842		94
24	2025	+18.4	+16.7	+17.4	0937		89
25	2109	+20.1	+19.0	+19.5	1031		83
26	2159	+20.7	+20.3	+20.6	1126		74
27	2254	+20.2	+20.7	+20.6	1218		65
28	2353	+18.5	+19.8	+19.4	1308	LAST 1/4, 0446	55
29	----	----	+17.8	+17.0	1355		45
30	0056	+15.6	+14.6	+13.5	1440		34
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TIMES OF MOONRISE, MOONSET AND MOON PHASES FOR 1975
INCLUDING DECLINATIONS AND PERCENT ILLUMINATED

OCTOBER 1975

DAY	MOONRISE MST	D ₁	D ₂	D ₃	MOONSET MST	PHASES MST	* PERCENT ILLUMINATED
1	0201	+11.7	+10.4	+9.1	1521		24
2	0309	+6.7	+5.3	+3.9	1602		14
3	0418	+1.2	-0.1	-1.5	1643		07
4	0527	-4.4	-5.7	-7.0	1724	NEW, 2023	02
5	0638	-9.7	-10.8	-11.9	1807		00
6	0747	-14.3	-15.1	-15.9	1853		01
7	0855	-17.6	-18.2	-18.8	1943		05
8	1000	-19.9	-20.1	-20.4	2036		11
9	1059	-20.5	-20.5	-20.6	2131		20
10	1152	-20.1	-19.8	-19.5	2228		29
11	1239	-18.4	-17.9	-17.4	2325	FIRST 1/4, 1815	39
12	1321	-15.9	-15.2	----	----		49
13	1358	-12.7	-11.9	-14.5	0021		59
14	1432	-9.0	-8.0	-11.0	0116		69
15	1504	-4.9	-3.9	-7.0	0210		77
16	1534	-0.7	+0.4	-2.8	0303		85
17	1605	+3.6	+4.8	+1.5	0356		91
18	1636	+7.7	+8.7	+5.9	0449		96
19	1709	+11.6	+12.5	+9.7	0543	FULL, 2206	99
20	1745	+14.9	----	+13.4	0637		100
21	1825	+17.6	+15.7	+16.5	0732		99
22	1908	+19.6	+18.2	+18.8	0827		97
23	1956	+20.5	+19.9	+20.2	0922		93
24	2049	+20.4	+20.5	+20.6	1014		87
25	2145	+19.0	+20.1	+19.7	1104		79
26	2246	+16.6	+18.4	+17.8	1152		70
27	2348	+13.1	+15.7	+14.8	1235	LAST 1/4, 1507	60
28	----	----	+11.0	+10.8	1316		49
29	0052	+8.7	+7.5	+6.2	1356		38
30	0158	+3.7	+2.3	+1.0	1435		27
31	0305	-1.7	+3.0	-4.3	1514		17
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D₃ = Declination of Moon at time of Moonset.

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**TIMES OF MOONRISE, MOONSET AND MOON PHASES FOR 1975
INCLUDING DECLINATIONS AND PERCENT ILLUMINATED**

NOVEMBER 1975

DAY	MOONRISE MST	D ₁	D ₂	D ₃	MOONSET MST	PHASES MST	* PERCENT ILLUMINATED
1	0413	-7.0	-8.2	-9.4	1556		09
2	0522	-11.6	-12.7	-13.9	1640		04
3	0631	-16.0	-17.1	-17.4	1728	NEW, 0605	00
4	0739	-18.8	-19.3	-19.7	1821		00
5	0842	-20.4	-20.5	-20.6	1916		03
6	0940	-20.4	-20.3	-20.1	2014		08
7	1031	-19.2	-18.8	-18.4	2113		15
8	1116	-16.8	-16.1	-15.4	2211		24
9	1156	-13.9	-13.1	-12.3	2308		33
10	1231	-10.3	-9.4	----	----	FIRST 1/4, 1121	43
11	1304	-6.3	-5.3	-8.5	0003		52
12	1335	-2.2	-1.1	-4.3	0057		62
13	1406	+2.1	+3.1	-0.1	0150		71
14	1437	+6.1	+7.2	+4.2	0242		79
15	1509	+10.2	+11.1	+8.4	0335		86
16	1544	+13.7	+14.6	+12.2	0439		92
17	1622	+16.7	+17.4	+15.5	0525		96
18	1705	+19.0	----	+18.1	0620	FULL, 1528	99
19	1752	+20.3	+19.4	+19.9	0716		100
20	1844	+20.5	+20.5	+20.6	0810		99
21	1941	+19.5	+20.3	+20.1	0901		96
22	2040	+17.4	+19.0	+18.5	0950		90
23	2141	+14.2	+16.6	+15.8	1035		83
24	2244	+10.2	+13.1	+12.1	1117		74
25	2348	+5.4	+8.9	+7.7	1156	LAST 1/4, 2352	64
26	----	----	+4.2	+2.9	1234		53
27	0052	+0.3	-1.0	-2.2	1311		42
28	0157	-4.8	-6.0	-7.3	1350		31
29	0304	-9.8	-9.9	-11.9	1431		21
30	0411	-14.2	-15.1	-15.9	1516		12
/1							

D₁ = Declination of Moon at time of Moonrise.

D₂ = Declination of Moon when it is on the Meridian (Due South).

D₃ = Declination of Moon at time of Moonset.

Declination is given in degrees north (+) or south (-) of the Celestial Equator. * Illumination values are for midnight, Greenwich (Zulu) Time.

TIMES OF MOONRISE, MOONSET AND MOON PHASES FOR 1975
INCLUDING DECLINATIONS AND PERCENT ILLUMINATED

DECEMBER 1975

DAY	MOONRISE MST	D ₁	D ₂	D ₃	MOONSET MST	PHASES MST	* PERCENT ILLUMINATED
1	0517	-17.6	-18.1	-18.7	1605		05
2	0622	-19.8	-20.0	-20.3	1659	NEW, 1750	01
3	0723	-20.6	-20.5	-20.3	1757		00
4	0818	-20.0	-19.7	-19.4	1856		01
5	0908	-18.1	-17.6	-17.1	1956		05
6	0950	-15.4	-14.6	-13.9	2055		10
7	1028	-12.0	-11.1	-10.2	2151		18
8	1103	-8.1	-7.1	-6.1	2247		26
9	1135	-3.9	-2.8	-1.8	2340		35
10	1206	+0.3	+1.4	----	----	FIRST. 1/4, 0739	44
11	1237	+4.5	+5.5	+2.5	0033		54
12	1308	+8.4	+9.4	+6.5	0126		63
13	1342	+12.3	+13.3	+10.5	0220		72
14	1419	+15.5	+16.3	+14.2	0314		80
15	1459	+18.2	+18.7	+17.1	0410		87
16	1545	+19.9	+20.2	+19.3	0506		93
17	1636	+20.6	+20.6	+20.5	0601		97
18	1731	+20.1	----	+20.5	0655	FULL, 0740	100
19	1831	+18.4	+19.7	+19.3	0746		100
20	1933	+15.5	+17.6	+16.9	0833		98
21	2037	+11.6	+14.5	+13.5	0917		93
22	2141	+7.0	+10.4	+9.2	0957		87
23	2245	+2.0	+6.7	+4.5	1035		78
24	2349	-3.2	+0.8	-0.5	1113		68
25	----	----	-4.4	-5.6	1151	LAST 1/4, 0752	57
26	0054	-8.1	-9.2	-10.3	1230		46
27	0159	-12.6	-13.7	-14.4	1312		34
28	0304	-16.4	-17.0	-17.6	1358		24
29	0408	-19.0	-19.3	-19.7	1448		15
30	0509	-20.4	-20.5	-20.6	1543		08
31	0606	-20.4	-20.3	-20.1	1641		03
/1							

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