



DEPARTMENT OF THE NAVY
U.S. NAVAL OBSERVATORY
34TH AND MASSACHUSETTS AVE., NW
WASHINGTON, DC 20390-5000

IN REPLY REFER TO

3162/3
Ser NA/1125
23 Feb 1993

TO WHOM IT MAY CONCERN:

The following information is provided for New York,
New York:

17 July 1990 Eastern Daylight Time

SUN

Beginning of civil twilight	5:06 a.m.
Sunrise	5:39 a.m.
Sunset	8:24 p.m.
End of civil twilight	8:57 p.m.

MOON

(Moonset 3:01 p.m. on previous day)

Moonrise	12:50 a.m.
Moonset	4:18 p.m.

(Moonrise 1:35 a.m. on following day)

On 17 July the phase of the Moon: waning crescent with
26 percent of the Moon's surface illuminated.

Last quarter phase of the Moon on 15 July 1990 at 7:04 a.m.,
Eastern Daylight Time.

L.E. Doggett
Chief Astronomer
Nautical Almanac Office

I certify that the above statement is the result of a true and accurate
computation by the Nautical Almanac Office of the U. S. Naval Observatory.

L.S. *Pm Janigek*
P.M. JANIGEK
By direction of
the Superintendent

CONCERNING THE AUTHORITY AND DEFINITIONS

for Statements by

THE UNITED STATES NAVAL OBSERVATORY

Times of sunrise, sunset, twilight and certain celestial phenomena depend upon the geographic location (latitude and longitude) for which those times are considered. Consequently, observations of such events are not regularly conducted; neither are records made nor kept, for any such observations and records compiled at a specific location would be valid for the immediate vicinity of that location only and not applicable to other locations.

Accordingly, it is not possible to transmit an affidavit regarding the making, authority over, or custody of records. It is also not possible to provide any statement which could establish that, upon a search, no record was found.

Data which set forth the quantitative circumstances of celestial phenomena at a specific location, and provided by signed statement bearing the seal of the United States Naval Observatory, are the result of a calculation. Authority to make and publish such calculations derives from Title 10, U. S. Code, Sec.7395(c):

"The Secretary of the Navy may detail any officer of the Navy, competent for that duty, to supervise the *Nautical Almanac*."

The *Nautical Almanac* is published annually as a Document under 44 U.S.C., 1314, is made publicly available by the Superintendent of Documents, and may be found also at some Federal Depository Libraries, public libraries and book dealers.

The computational basis for the information furnished by statement is identical to that used in preparation of the *Nautical Almanac*. Therefore, the information may be duplicated, using the tables, precepts and examples in that almanac, by any person competent to make such calculations.

Data for litigation are regularly provided by the Naval Observatory. Acceptance by a court may vary according to applicable rules of evidence, but frequently is accomplished *via* judicial notice under Federal Rules of Evidence and requests for admission of facts under Federal Rules of Civil Procedure, or by state law counterparts, or by stipulation of admissibility.

(Definitions and discussion of terms follow)

RISE, SET AND TWILIGHT

Horizon: Wherever one is located on or near the Earth's surface, the Earth is perceived as essentially flat and, therefore, as a plane. The sky resembles one-half of a sphere or dome centered at the observer. If there are no visual obstructions, the apparent intersection of the sky with the Earth's (plane) surface is the horizon, which appears as a circle also centered at the observer.

Rise, Set: During the course of a day the Earth rotates once on its axis causing the phenomena of rising and setting. All celestial bodies, stars and planets included, seem to appear in the sky at the horizon to the East of any particular place, then to cross the sky and again disappear at the horizon to the West. The most noticeable of these events, and the most significant in regard to ordinary affairs, are the rising and setting of the Sun and Moon. Because the Sun and Moon appear as circular disks and not as points of light, a definition of rise or set must be very specific, for not all of either body is seen to rise or set at once.

Sunrise and sunset conventionally refer to the times when the upper edge of the disk of the Sun is on the horizon, considered unobstructed relative to the location of interest. Atmospheric conditions are assumed to be average and the location is in a level region on the Earth's surface.

Moonrise and moonset times are computed for exactly the same circumstances as for sunrise and sunset. However, moonrise and moonset may occur at any time during a 24 hour period and, consequently, it is often possible for the Moon to be seen during daylight, and to have moonless nights. It is also possible that a moonrise or moonset does not occur relative to a specific place on a given date.

Twilight: Before sunrise and again after sunset there are intervals of time, twilight, during which there is natural light provided by the upper atmosphere, which does receive direct sunlight and reflects part of it toward the Earth's surface. Some outdoor activities may be conducted without artificial illumination during these intervals, and it is useful to have some means to set limits beyond which a certain activity should be assisted by artificial lighting. The major determinants of the amount of natural light during twilight are the state of the atmosphere generally and local weather conditions in particular. Atmospheric conditions are best determined at the actual time and place of events. Nevertheless, it is possible to establish useful, though necessarily approximate, limits applicable to large classes of activities by considering only the position of the Sun below the local horizon. Reasonable and convenient definitions have evolved.

Civil twilight begins in the morning and ends at sunrise, and begins at sunset and ends in the evening, when the center of the Sun is geometrically six degrees below the local horizon. In the morning before the beginning of civil twilight and in the evening after the end of civil twilight, artificial illumination is normally required to carry on ordinary outdoor activities. However, the amount of available light during twilight periods and the visibility of objects and movements are so greatly dependent upon weather conditions and other local circumstances that they can be established for any specific time and place only by the testimony of eye witnesses.

From any location on the Earth, the Moon can be regarded as a circular disk which, at any specific time, is illuminated to some degree by direct sunlight. The geometric shape of the illuminated part and its size, relative to the entire lunar hemisphere which faces the Earth, are continuously changing entities as the Moon varies from not visibly illuminated to fully illuminated, then to not illuminated again. Although this cycle is a continuous process, there are eight distinct, traditionally recognized stages, called phases, which are ordinarily adequate to designate both the degree to which the Moon is illuminated and the geometric appearance of the illuminated part, to the extent that Moon visibility has relevance to everyday human activities. These phases of the Moon, defined in the sequence of their occurrence, are:

New Moon -- the Moon is not illuminated by direct sunlight.

Waxing Crescent -- the visible Moon is partly but less than one-half illuminated by direct sunlight while the illuminated part is increasing.

First Quarter -- one-half of the Moon appears illuminated by direct sunlight while the illuminated part is increasing.

Waxing Gibbous -- the Moon is more than one-half but not fully illuminated by direct sunlight while the illuminated part is increasing.

Full Moon -- the visible Moon is fully illuminated by direct sunlight.

Waning Gibbous -- the Moon is less than fully but more than one-half illuminated by direct sunlight while the illuminated part is decreasing.

Last Quarter -- one-half of the Moon appears illuminated by direct sunlight while the illuminated part is decreasing.

Waning Crescent -- the Moon is partly but less than one-half illuminated by direct sunlight while the illuminated part is decreasing.

Following Waning Crescent is a New Moon, beginning a repetition of the complete phase cycle of 29.5 days average duration.

The Crescent and Gibbous phases are descriptive of the appearance of the illuminated part of the Moon during the intervals between the New, First Quarter, Full and Last Quarter phases. The latter are strictly instantaneous phenomena for which dates and times of occurrences are provided by many calendars and almanacs. However, the instantaneous events are not distinguishable within a slowly changing continuum such that they can be determined accurately by observation. Therefore, it is not unusual for a person to state that the Moon was Full, or at First or Last Quarter, on dates that are a few days removed from the instants when these phenomena actually occurred. Generally, such a statement may be regarded as an adequate observation, provided that the Moon was in fact visible at the place and time specified.

The percent of the Moon's surface illuminated is a more refined, quantitative description of the Moon's appearance than is the phase. Considering the Moon as a circular disk, the ratio of the area illuminated by direct sunlight to its total area, multiplied by 100, is the percent of the Moon's surface illuminated. At New Moon the part of the Moon illuminated by direct sunlight is zero percent; it is 50 percent at First and Last Quarters, and 100 percent at Full Moon. During Crescent phases the percent illuminated is between 0 and 50 percent and during Gibbous phases it is between 50 and 100 percent.

For practical purposes, phases of the Moon and the percent of the Moon illuminated are independent of the location on the Earth from where the Moon is observed.

RELATIVE POSITIONS OF THE SUN AND MOON

In order to unambiguously establish the position of the Sun or Moon relative to a particular place on the Earth, two quantities are required. The most convenient and easily visualized quantities are:

1. The angular distance of the center of the Sun or Moon above the local horizon. This quantity is zero when the object appears at the horizon and is 90 degrees when the object is directly overhead.
2. The angular distance of the center of the Sun or Moon from a cardinal direction. When stated, this quantity is referred to true North, true East, etc. The use of magnetic North, etc. is not appropriate, since directions determined by magnetic compass are variable and subject to local disturbances and anomalies in the Earth's magnetic field.

Positions of the Sun and Moon relative to any place on the Earth continuously change and must be stated for a specific time of day as well as for the date.

For purposes of reconstructing the physical circumstances of an event in which the position of the Sun relative to a given location at a particular time of day is a factor, it is possible to find another date or several dates for which the Sun will be practically at the same relative position at about the same time of day. The day following the event is an obvious example. It is not possible to find a date for which the relative position and phase of the Moon, at the same time of day as the original event, are duplicated with the same precision as is possible for the Sun. Some compromise of position, phase and time of day must be allowed.

AUTHORITIES FOR ADDITIONAL INFORMATION

Weather information is not available from the Naval Observatory. Official weather records (cloud cover, precipitation, etc.) compiled throughout the United States are available from:

Climatological Services Section
National Climatic Data Center, NOAA
Asheville, NC 28801

Time (zone time, daylight time) legally in effect at locations within the United States is determined by the Secretary of Transportation. Information may be obtained from:

Office of the General Counsel
Department of Transportation
Room 10424
400 7th Street, S.W.
Washington, D.C. 20590