EXTREME DECLINATIONS OF THE MOON

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The regression of the lunar nodes on the ecliptic has a period of 6 798 days or 18·61 years. Hence, at intervals of 18·61 years the ascending node of the Moon's orbit coincides with the vernal equinox, and its longitude Ω is zero. Below are the dates in the period A.D. 1920 to 2050 when $\Omega = 0$.

1932 January 6	2006 June 19
1950 August 17	2025 January 29
1969 March 29	2043 September 10
1987 November 8	

Near these epochs, the inclination of the Moon's orbit on the Earth's equator is $23° 27' + 5° 09' = 28° 36'$, where $23° 27'$ is the obliquity of the ecliptic, and $5° 09'$ is the inclination of the Moon's orbit on the ecliptic. Actually, the latter inclination is itself variable, being affected by an inequality whose period is 173·31 days and whose amplitude is 8'. The inclination reaches its greatest value ($5° 17'$) when the line of the nodes is directed to the Sun, that is at each conjunction of the Sun with one of the nodes. When Ω is approximately zero, these conjunctions take place near the times of the equinoxes (about March 21 and September 23). Hence, the extreme value of the geocentric declination of the Moon's centre is not $28° 36'$, but $23° 27' + 5° 17' = 28° 44'$. This occurs near the equinoxes near the times when $\Omega = 0°$, when the Moon's longitude is about 90° or 270°.

The table below contains the greatest values, north and south, of the geocentric declination of the Moon's centre between the years 1920–2050.
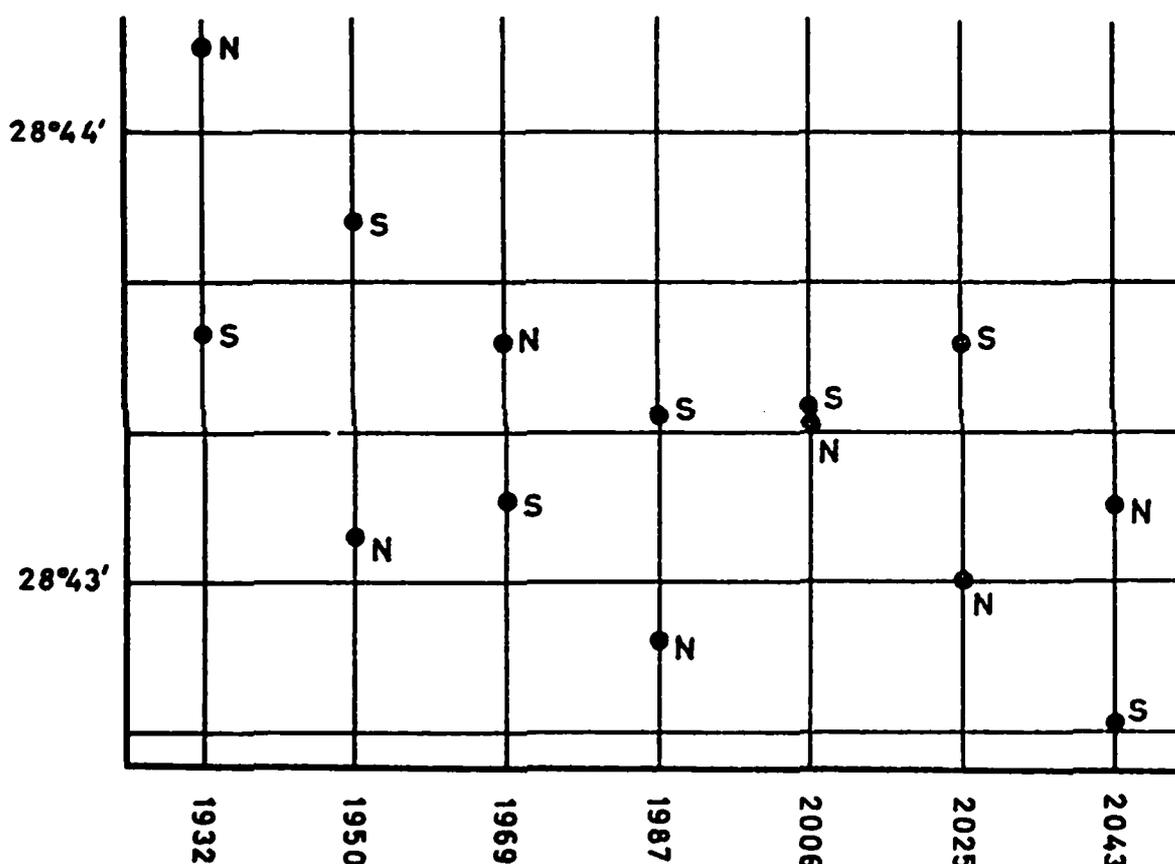
Extreme values, north (N) and south (S) of the
geocentric declination of the Moon.

The times are expressed in Ephemeris Time (E.T.). Note that the difference E.T. minus U.T. is presently less than one minute, and is expected to be +3 minutes near A.D. 2040.

The values for the years 1932, 1950 and 1969 have been taken from published ephemerides (*Nautical Almanac, Astronomical Ephemeris*). The values for the future years were found in two steps. Firstly, one of us (G.P.K.) wrote a computer programme, using formulae provided by the second author. It thus was possible to have the geocentric co-ordinates of the Moon (ecliptic longitude and latitude, right ascension and declination) at one day intervals, from A.D. 1975 to 2050, with an accuracy of about 0°·002.

A search was then made for the greatest declinations of the Moon, and the corresponding dates were sent to the Royal Observatory at Uccle (Belgium), where Dr P. Pâquet was kind enough to calculate the co-ordinates with high precision, using an available computer programme based on Brown's theory for the motion of the Moon.

TABLE

EXTREME GEOCENTRIC DECLINATIONS, NORTH AND SOUTH, OF THE MOON
1920 TO 2050

North Declination			South Declination		
Date	E.T.	Decl.	Date	E.T.	Decl.
1932 Mar. 15	21ʰ 32ᵐ	+28° 44′ 11″	1932 Mar. 28	11ʰ 59ᵐ	−28° 43′ 33″
1950 Oct. 3	10ʰ 24ᵐ	+28° 43′ 06″	1950 Sept. 19	4ʰ 20ᵐ	−28° 43′ 48″
1969 Mar. 25	14ʰ 24ᵐ	+28° 43′ 32″	1969 Mar. 11	23ʰ 46ᵐ	−28° 43′ 11″
1987 Sept. 15	17ʰ 12ᵐ	+28° 42′ 52″	1987 Sept. 29	23ʰ 50ᵐ	−28° 43′ 22″
2006 Sept. 15	1ʰ 28ᵐ	+28° 43′ 21″	2006 Mar. 22	16ʰ 55ᵐ	−28° 43′ 23″
2025 Mar. 7	15ʰ 44ᵐ	+28° 43′ 00″	2025 Mar. 22	6ʰ 39ᵐ	−28° 43′ 32″
2043 Sept. 25	14ʰ 10ᵐ	+28° 43′ 10″	2043 Sept. 12	11ʰ 31ᵐ	−28° 42′ 41″

The extreme values given in the table are plotted in the figure, from which it can be seen that the value of the greatest declinations of the Moon, reached at intervals of 18·61 years, is generally decreasing with time. This decrease is due to the secular diminution of the obliquity of the ecliptic. At present, this diminution is 8″·7 per 18·61 years. The mean obliquity was 23° 26′ 53″ in 1932, and will be 23° 26′ 01″ in 2043.

It should be noted that before 200 B.C. the obliquity of the ecliptic was greater than 23° 43′, and the Moon's declination could then exceed 29°.

We further see that in 1969, although $\Omega = 0$ occurred on March 29, very close to the date of the equinox, this produced no particularly high peak. On 2025 March 22, the absolute value of the declination will be the same as that of 1969 March 25, although $\Omega = 0$ *will occur seven weeks before the equinox*, and although the obliquity of the ecliptic will be less by 26″ than in 1969.

In A.D. 2006, the greatest northern declination and the greatest southern one will take place six months apart. For the six other cases listed here, they occur with an interval of one-half sidereal month.