a horizon

ecliptic

Feb 26 Feb 25 Feb 24 Feb 23

Feb 27 Feb 22

Feb 28 Feb 21

Feb 1 **1980**

full

Feb 2

ascending node first quarter equator

Feb 3

Feb 20

Feb 4 Milky Way

Feb 19

apogee ♈

Earth descending node perigee Feb 18

Feb 5

Feb 6 ECLIPTIC PLANE total solar eclipse new Feb 17

Feb 16

Feb 7 10 Earth-radii

Feb 8 Feb 15

last quarter

Feb 9 Feb 14

Feb 10 Feb 13

Feb 11 Feb 12

**Sphere radius 406,700 kilometers
or about 63.8 Earth-radii
(the extreme distance of the Moon).
Grid lines on ecliptic plane 10 Earth-radii apart.**

*The Moon is shown, to scale,
at the beginning of each day in one month, Feb. 1980.*

ascending node again 2.6 hours earlier, in only 27.21222 days. This is called the *nodical* (or *nodal* or *draconic*) month.

As we look out at the Moon, and map it against the sky, we see it each month cross the ecliptic 1.44° farther back. Of course, both the ascending node and the descending node move back this way; so do the points where the Moon is at its full 5.145° (±.15°) north or south of the ecliptic.

Mapping it in our more usual way with the equator straight and the ecliptic curving north and south, we see that at one time the Moon is reaching its most northerly and southerly possible declinations each month, 5° north and south of the northernmost and southernmost points of the ecliptic. (At the northernmost swing it can actually enter the constellation Auriga.) 4.65 years later (a quarter of the nutation-period) the Moon travels just as far north and south as the ecliptic does; and 4.65 years later again, the ascending node of the ecliptic coincides with the Moon's descending node, so the Moon ventures only a little over 18° north and south of the equator.

Between these extremes, the Moon's path grinds slowly backward, each month's path being slightly different from the last, so that over the 18.6 years it sweeps all of the band about 5° north and south of the ecliptic. It keeps occulting a certain star at intervals of a sidereal month, a longer series of such occultations if the star is closer to the ecliptic; the series ends, and then takes place again 18.6 years

ecliptic
1.44°
equator ecliptic Moon AURIGA ORION
SAGITTARIUS 1969

1973 arc node

1978
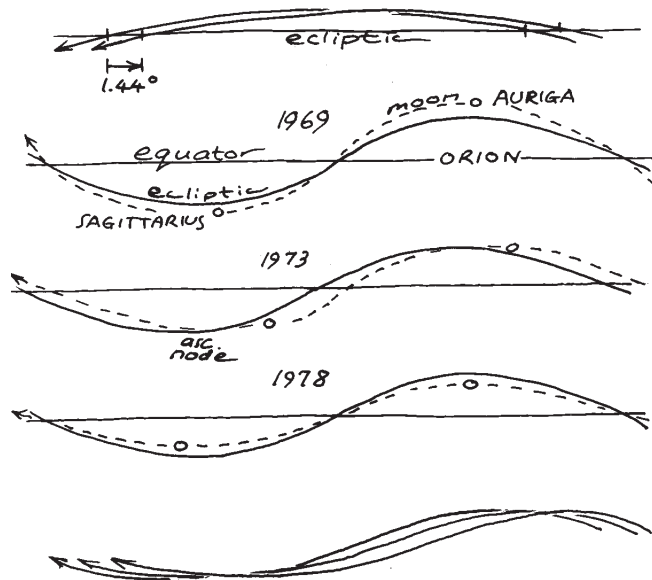
later; sometime in the 18.6 years, every star in the 10° band will be occulted.

Most of these main components of the Moon's motion were discovered by Hipparchus in the 2nd century B.C. Most of them turn out to vary because of interference from each other and from the Sun, the shapes of the Earth and Moon, the tides, the planets . . . There are other featurs not dealt with here: the "evection," the "variation," the "empirical term" . . . The subject of the Moon's motion is a multidimensional maze. Newton said that thinking about it gave him a headache. But from this headache——from his determination to find what it is that must explain the motion of both the dropping apple and the soaring Moon——was born universal gravitation. After his time the theory of the Moon has not ceased to grow, till the solution of the "main problem" (the simple part, with the Sun, Earth, and Moon treated as points and the orbit of the barycenter as a fixed ellipse) contains more than 6,000 algebraic terms!

Yet it cannot be that the Moon's motion is uniquely complicated. It must be less so than those of two or more satellites, of stars in a cluster, of particles in any fluid or cloud. It is just that the Moon has served as the great laboratory particle. With no Moon, Newton might not have begun; with more than one, he might have had to give up. The Moon will have trained us to deal with the motions of other systems when we get out to them.