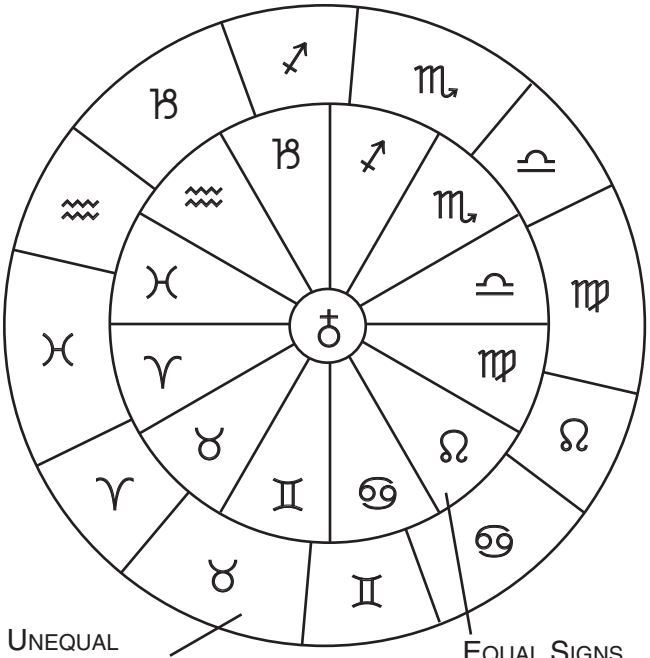
A Brief Outline of Basic Astronomy



WHEN WE LOOK out into the heavens, be it day or night, there is movement and change. The Sun rises in the east and sets in the west each day. The stars likewise follow in this daily arc and change in terms of their visibility over the course of the year. Far slower is the annual west to east migration of the "traveling stars," the planets. To help us understand these movements better, we can imagine, as our ancestors did, that the globe of our Earth is nested inside a *celestial* globe or *sphere* upon which are etched the stars, and around which the planets travel. This heavenly sphere has a *North* and *South Pole* as well as an *equator*, taking their positions from the same locations on the Earth, projected out into space.

The celestial sphere makes one complete rotation on its poles every 24 hours, carrying with it all the stars, the Sun, Moon and planets, giving us night and day. As the Sun moves across this sphere, it rises 4 minutes later than the stars which accompanied it the previous day. The Sun, Moon, and planets have their own independent movement from west to cast. The path of the Sun across the celestial sphere is called the *ecliptic* (because on it, eclipses can occur). The Moon and all the planets closely follow this path.

When we observe the progression of the seasons, we may notice that the point where the Sun rises moves north of east in the summer, and south of east in the winter. When the Sun reaches that part of the ecliptic which crosses the celestial equator, sunrise is due east and sunset due west, and day and night are of equal length. This takes place twice a year: around Easter, about March 21st, and around Michaelmas, about September 21st. Because of the equal night all over the world, this event is called *equinox*. In between these dates, the Sun moves above the celestial equator, giving the Northern Hemisphere summer, then back to the equinox in autumn and below the celestial equator, giving the Norther Hemisphere winter.

At the furthest extremes of its northerly and southerly movement, the Sun seems to stand still before moving back to the celestial equator for the equinoxes. These moments occur around St. John's time, about June 21 st and around Christmastime, about December 21st. Because the Sun appears to stand still on these days, each day is called the *solstice* (*sol*=Sun, *stice*=make stand). At the summer solstice, the day is longer than the night. In winter,

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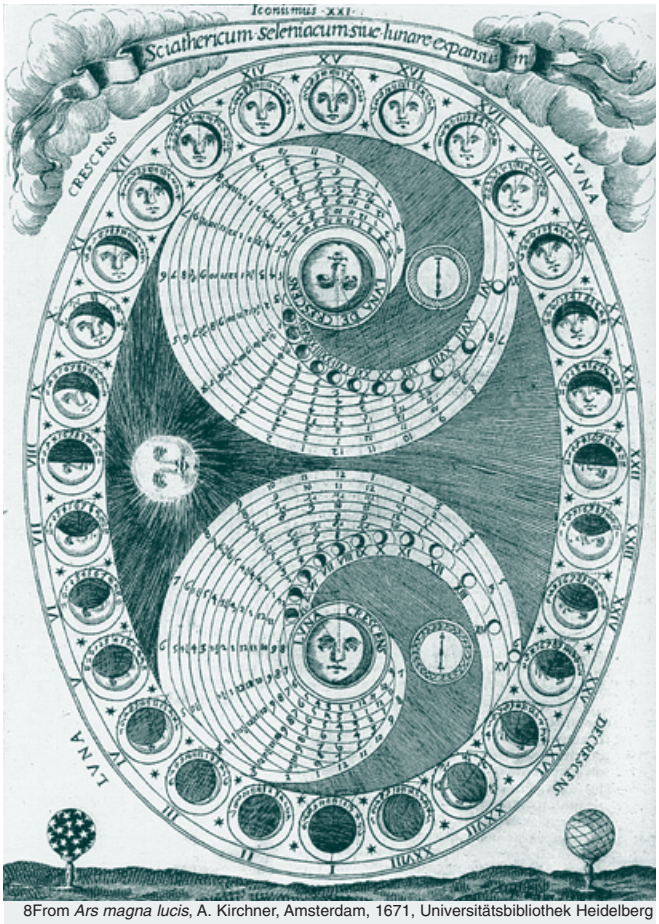
the day is short and the night long.

As the Sun moves across the sky, it travels through the 12 traditional zodiacal constellations. A *constellation* is a grouping of stars usually identified with a being or attribute recognized by our ancestors. They didn't "connect the dots" to form a picture as we often do, but experienced the presence of the being standing behind the stars. The stars were viewed as markers to indicate that place where Orion or Hercules, etc., dwelt. Twelve of these dwelling places are spread out along the ecliptic and form the zodiac—the circle of living things (since all but one of these constellations, Libra, represent living things.)

The traditional visible zodiac constellations vary in size and mark the place through which the Sun passes during the course of the year. At the present time the Sun enters Pisces in mid-March so that this is the constellation in which the Sun stands on March 21st. However this position is not permanently fixed, for the Sun moves backwards through the zodiac 1° every 72 years. This movement is called the *precession of the equinox*. By the year 2375, the Sun will enter the constellation Aquarius at the equinox [the current sidereal vernal point is 5°15′35″)(].

The astrological *signs* of the zodiac have the same names as the constellations but are an ideal arrangement in which each takes up 30° of the ecliptic. The signs are based on the passage of the Sun through the year as recorded by the early Greeks, always beginning with 0° Aries at the point where the Sun stands at the spring equinox, continuing with Taurus on about April 21st, and so on. Thus it is that the signs do not coincide with the visible constellations.

The constellations of the zodiac appear in the heavens at different heights from the southern horizon of the Earth. Each constellation appears to follow an arc as it passes across the southern sky. Gemini, for example, traverses the highest arc. At the middle of its crossing, the *meridian*, it is high in the south for those of us living in the northern hemisphere. Sagittarius makes the lowest arc. When the Sun is shining in front of the constellation of Gemini it is June and the Sun is high in the south, shining almost directly down on us, giving us the warmth of summer. When the Sun passes in front of Sagittarius, it is December and the Sun appears low on the horizon, shining with slanted rays, giving us the cold of winter.



8From *Ars magna lucis*, A. Kirchner, Amsterdam, 1671, Universitätsbibliothek Heidelberg

This chart assists in calculating the daily rising and setting of the moon and the degree of its waxing and waning. The outer circle illustrates the lunar cycle of twenty-eight days.

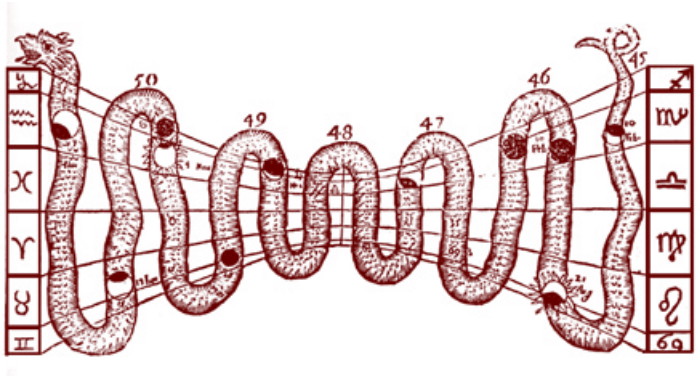
Accordingly, if we see the Moon high in the sky we say that it is *running high*. We can also know from this observation that it must be in Gemini. If the Moon appears to skim across the horizon, we say it is *running low*. It is then in Sagittarius, imitating the Sun's winter activity. (◠ ◡)

Among the other movements in the heavens are those made by the Moon and planets as they relate to the Sun, the Earth and one another. All of these movements and their variations reoccur at rhythmical intervals ranging from days to centuries. The repetition of these events over the years can be observed as established patterns which can be calculated in advance with a great degree of accuracy. The time it takes the Sun, Moon and planets to

make one complete circuit around the celestial sphere as seen from the Earth is known. This period, different for each, is its geocentric *sidereal period* since it is measured from the time it takes the Sun, Moon, or planet to come back to the same star (*sider*) in the zodiac where it began.

It takes the Sun 1 year to make its full circuit of the celestial sphere. The same journey takes the Moon 27-1/3 days, Mercury 88 days, Venus 225 days, Mars 1.9 years, Jupiter 11.9 years, Saturn 29.1 years, Uranus 84.01 years, Neptune 164.79 years, and Pluto 247.69 years.

Another period is marked when the planet returns to the same relationship it had with the Sun; e.g., full moon to full moon. This is called the *synodic period* (*syn*=with). The Moon runs ahead of the Sun around the zodiac spending about 2.5 days in each constellation, while the Sun spends about 1 month in each. As the Moon moves and its relation to the Sun changes, our perception of the Moon also changes.



A. Kircher, *Ars magna lucis*, Amsterdam, 1671, personal archives of Alexander Roob

Eclipses and the Lunar Dragon

Diagram for the calculation of solar and lunar eclipses. According to ancient legends, these eclipses were due to a dragon swallowing the heavenly bodies and spewing them out again. A lunar nodal cycle occurs every 19 years. Chart is reversed, for the Moon's most northern and southern points are in Cancer and Capricorn, respectively.

When it is *new*, the Moon stands in front of the Sun, whose brightness conceals the Moon from our view. A few days later, the Moon has moved ahead of the Sun along the zodiac. As the Sun sets, a thin sliver of the Moon appears in the west, then slips out of view as night approaches. One week after the new Moon, the Moon has moved to its next phase. It is growing larger, *waxing*, and now half of its disk is illuminated. This *first quarter* [*half "full"*] Moon rises about midday and sets about midnight. One week later [second quarter], the Moon stands opposite the Sun, having gone about half way around the zodiac. Its disk fully lit, the *full Moon* rises when the Sun sets and sets when the Sun rises—the kingdom of the full Moon is the night sky.

After another week the Moon loses some of its light, *waning* as it approaches the Sun. It is in its *last quarter*, and rises around midnight to set around midday. Its illumined side always faces toward the Sun. In another week, the Moon meets the Sun and is lost to view as a new Moon again after its 29.5 day synodic journey.

The Moon's orbit around the Earth is elliptical, causing it to be nearer to Earth at some times and farther away at others. This can be compared with the Sun's apparent passage around the Earth, drawing nearer in winter and farther away in summer. When the Moon reaches its nearest point, it is *perigee* (*peri*=near, *geo*=earth). Likewise, when the Moon is most distant, it is *apogee* (*ap*=away from).

The path of the Moon and each of the planets around the celestial sphere intersects the path of the Sun at different points. These points are called *nodes*, and there are two nodes for each orbit. The point at which the planet's orbit crosses the ecliptic and moves northward is called its *ascending node* (☊), and the crossing point heading southward is called its *descending node* (☋). When the Sun meets the Moon at one of the Moon's nodes, an *eclipse* can occur.

Similarly, other planets or stars can have all or part of their light covered by the Moon or another planet. This is called an *occultation* (*occult*=hidden). When two or more planets occupy the same degree [astrology allows an orb between 6° and 8°] along the ecliptic (e.g., the Sun and the New Moon) they are in *conjunction* (☌) (*con*=with, *junctio*=join). When two planets are 180° [± 6-8°] apart from each other in the zodiac (e.g., the Sun and the full Moon) it is called an *opposition* (☍). ❒

—Richard Moeschl and Sherry Wildflower