ANCIENT ASTRONOMY

Mankind has always been fascinated by the movements of night sky objects. All cultures world-wide and over the ages shared two common elements:

1. There were always primary celestial objects that dominated their attention, and
2. They always developed a calendar, which was typically based on the easily observed lunar phases with regular solar or primary object corrections. Their calendars were driven by either religious or practical/agricultural considerations.

Egyptian Astronomy

- Most important celestial objects since before 3000 BCE were *Sirius* (*Sothis*), whose heliacal rising (at the same time as the Sun) was used to predict the annual Nile floods.
- Their most important gods were the Sun god Ra and Nut, the goddess of the sky, which was stretched across the sky as the Milky Way.
- Their earliest calendar consisted of 12 months of 29 or 30 days divided into three 4-month seasons of 'inundation', "growth" and 'harvest'. An extra month was added every two or three years to synchronise with the rising of *Sirius*.

Babylonian Astronomy

- Astrology was the main driver behind Babylonian astronomy in order to predict when the crescent Moon would be visible and the future positions of the planets. (Astrology is a pseudoscience used to predict future events from the positions of celestial objects; Astronomy is the science which studies those objects beyond Earth's atmosphere.)
- By the second century BCE their predictions of Jupiter's motions were accurate to within 0.01%. Their analysis produced a sidereal year (the time taken by the Earth to orbit the Sun with respect to the fixed stars) was only 6 minutes too long!
- Their mathematics and science were based on a sexagesimal (base 60) numeral system, which is the source of our current 60-minute hour and 24-hour day, as well as the 360° full circle angular measure.

Greek Astronomy

- The Greeks saw the sky in three dimensions and, as philosophers, wanted to understand its structure.
- Aristarchus suggested that the Sun was centre of the universe in 297 BCE.
- This idea was superseded by Plato and Aristotle's philosophy of celestial perfection: A stationary Earth at the centre of the Universe with perfectly spherical Sun, Moon and Planets moving in circles around the Earth.
- Ptolemy had to introduce smaller epicycles around the circular orbits to match the observed motions of the planets. His famous *Almagest* was a catalogue of over 1,000 stars and was the reference work for over a thousand years.

Chinese Astronomy

- The Chinese developed a lunar based calendar of 12 months of alternatively 29 or 30 days by 1400 BCE. They had to add intercalary days (or month) to keep in step with the solar year.
- The Chinese were keen observers and recorded any unusual celestial event. This left us with the longest unbroken set of astronomical records dating back to about the sixth century BC. These records included solar eclipses, comets and new stars, such as the *Messier 1* (Crab Nebula) supernova explosion in 1054 CE.
- They understood the real causes of eclipses by the first century BCE and were therefore able to predict when they would happen.

South American Astronomy

- The absence of a written language makes their history difficult to interpret.
- A temple which dates back to 2200 BCE has alignments to both the summer and winter solstices near Lima, Peru.
- The Incas were able to link their agricultural calendar to the visibility of the *Pleiades* (Seven Sisters in *Taurus*) by 1200 CE.

Central American Astronomy

- The Mayan civilization dates back to 300 BCE and their written language confirms their interest in analysing their observations to produce numerically based predictions of the movements of celestial objects.
- Venus played an important role in their religion, with human sacrifices on the first appearance after superior conjunction (when Venus and Earth are on opposite sides of the Sun) and wars often started based on the Mayan Venus calendar. They recognised that Venus made its heliacal rising almost exactly on the same date at intervals of eight years in the solar calendar. The thirteenth century Dresden codex made predictions accurate to within one day over 481 years.
- Teotihuaćan 40 km northeast of Mexico City is a large pyramid complex built between 200 BCE and 100 CE and was taken over by the Aztecs around 1300 CE. They also sacrificed their prisoners to Venus on its heliacal rising. The main pyramids were a 66 m Pyramid of the Sun and a smaller Pyramid of the Moon along a 2.5 km Avenue of the Dead, which is aligned with the *Pleiades*.

The Pacific Basin

- The Australian aborigines used the movements of the Sun and rising and setting of various stars to regulate their agricultural calendar. They were particularly interested in the Milky Way, which they called the Emu in the Sky. One tribe recognised the link between the tides and the phases of the Moon and another realised that a total solar eclipse was caused by the Moon passing in front of the Sun.
- The Polynesians progressively colonised the small Pacific islands from 1500 BCE to 400 CE. They navigated by the stars over vast distances by memorising which stars were visible at which locations at which times of the year. It is interesting that they called the Sun Ra – like the Egyptians – although there is no evidence of contact between the two cultures.

Sub-Saharan Africa

- The oldest known lunar calendar is the Ishango bone which was found on the shores of lake Edward and dated between 18,000 and 23,000 BCE.
- An intriguing calendar was developed by the Borana of Ethiopia & Northern Kenya. It was based on the 'conjunction' of seven stars or star groups with the new Moon: *Triangulum*, *Pleiades*, *Aldebaran*, *Bellatrix*, *Orion's belt*, *Saiph* and *Sirius*. 'Conjunction' in this sense meaning rising 'side by side' with the Moon.
- The Great Zimbabwe stone ruin was built between 400 and 1350 CE and has a clear alignment with the rising Sun at the summer solstice, and possible alignments for the equinoxes and Milky Way.

South Africa

- *Orion-Taurus* The unluckiest hunter in the sky is *Aldebaran* who married the sky god's daughters, the *Pleiades*. When he tried to shoot one of the three zebras (*Orion's belt*) with his only arrow (*Orion's sword*), he missed. He doesn't dare go home without any game, and he doesn't dare get his arrow back for fear of the lion (*Betelgeuse*) lurking near the zebras. There he sits still, cold and hungry, while his wives laugh at him around the fire.

- ***Canopus***
  The Horn Star, as the second brightest star, features prominently in folklore.
  – The first Venda person to see *Nanga* in the early morning sky towards the end of May would climb a hill and blow a *phalaphala* (sable antelope) horn and was rewarded with a beast.
  – The Sotho believed that the first person to see *Naka* was also rewarded with a beast and would have good luck for the rest of his life. The sighting heralded the start of winter.
  – For the Tswanas die first morning appearance of *Naka* heralded the start of the breeding season for their sheep.
  – The Zulus knew *Canopus* as *Andulela* or *inKhwenkwesi*, the bright star or messenger that announced the end of autumn and start of the harvesting season.
  – The /Xam bushmen believed that the *Ant-egg Star* was responsible for the availability of ant eggs, which was a very rich food source for them.

- **Milky Way**
  When a mother refused to let her daughter have any of the roots roasting in the fire, the girl became so angry that she threw the roots into the sky, where the red and white roots now glow as stars, and the ashes are the Milky Way.

- ***Pointers & Southern Cross***
  Several of the people of northern South Africa saw the bright stars of the *Pointers* and the *Southern Cross* as giraffes. The Venda called the giraffes *Thlutlwa*, 'rising above the trees'. In October the giraffes would skim over the trees on the southern horizon, reminding people to finish planting.

- ***Pleiades* or *IsiLimela*** dies and is not seen during winter. At the end of winter its stars begin to appear – one first, then three and then more until it becomes a perfectly clear cluster of stars before sunrise. *IsiLimela* is then renewed, the year is renewed and it is time to begin to dig.

- **The Sun**
  Some Tswanas believed that the Sun is swallowed each night by a crocodile and then it emerges from the crocodile every morning.