

Ancient Egyptian Astronomy

Ancient Egyptian Astronomy played a different part for that people than it does in many cultures. Their calendar was mostly defined by the yearly flooding of the Nile River. But Astronomy in ancient Egypt was still important. They recognized a number of constellations and other groups of stars. These groups of stars, called decans, were used for telling time at night.

Telling time by the stars

Astronomy in ancient Egypt was the best way to tell the time during the night. Each group of stars rose forty minutes later each night. Observing the position of a group of stars in relation to the day of the year would tell a person what time it was. The ancient Egyptians kept astronomy tables to help them keep track of what decans to use to tell the time. The columns in these tables cover a year's worth of time in ten day intervals. They are placed in the order in which they rise. The ancient Egyptians liked everything, even their astronomy, to be very orderly.

Using Astronomy to track the year

Ancient Egyptian Astronomy was also used in the calendar, to determine when the thirteenth month should be added. The calendar had thirteen months because the twelve lunar months were not enough to make up a whole year. So, when the constellation of Sirius rose very late in the twelfth month, the thirteenth month began. This allowed the ancient Egyptians to use astronomy to accurately keep track of the years. Later on, they moved to a year of twelve thirty day months with five feast days at the end. Since this calendar was not made with reference to the stars, it soon became inaccurate and did not match the seasons.

Ancient Egyptian Astronomy and the pyramids

The stars also helped build the pyramids. Their eastern and western sides run almost due north, and their southern and northern sides run almost due west. This kind of positioning could not have been done without using astronomy to find due north and south. The ancient Egyptians were able to use an instrument called a merkhet, or indicator, to observe the rising and setting of certain stars. It was made of a narrow, horizontal piece of wood with a hole near one end. This let the astronomer look through and determine exactly where the star was.

Osiris and other gods

Astronomy played a part in ancient Egyptian religion, too. The constellation we call Orion was thought to represent Osiris, the god of death and rebirth. The Milky Way was the goddess Nut, who stretched all the way across the sky. She was the mother of Re, the sun god. Other stars represented Seshat, the goddess of writing, and the moon was Thoth, god of wisdom and learning. Most important in their mythology, though, was the horizon. It was over the horizon that the sun disappeared each day, and the sun was associated with Horus, who was thought to be incarnate in the Pharaoh. Religion was definitely very important in Ancient Egyptian Astronomy.

Greek Astronomy

Ancient Greek Astronomy, which also encompasses Roman astronomy, has its earliest references in the writings of Homer, and detailed a flat-earth viewpoint where the stars would rise and fall from the world-spanning ocean at different parts of the year. It was used for astrology and fortune telling, and derived a great deal from the Babylonian Astronomy that came before it. The Greeks invented the "order of magnitude" system for determining the brightness of stars in 135 BC.

The role of the planets

Our very term for celestial bodies, "planets" comes from the Greek word "planetes", meaning "wanderer", and the first ideas of a universe centered on something other than the Earth stem from Greek thought. The five naked-eye visible planets were plotted against a combined solar and lunar calendar by the Greeks, and it was the Pythagoreans who eventually figured out that the Evening Star and the Morning Star were, in fact, the same wandering planet Venus.

The motion of the planets

The science of attempting to determine why the planets move the way they did dates back to ancient Greek Astronomy, and while Eudoxus' model (described above) was the root, it eventually branched out with more spheres, spheres that were slightly off center to one another, and planets that were on rotating circles on spheres that rotated as well – if this is making your head spin, you're not alone. This attempt to mathematically describe how the planets moved was one of the brilliant attempts of the classical age, and is a good example of very smart people putting a lot of work into a detailed science, while missing one critical element – that the planets, including the Earth, rotate around the Sun.

The birth of a sun centered model

It was in ancient Greek Astronomy that a sun centered cosmos was born. Aristarchus proposed a sun-centric model of the cosmos in the 3rd century BC, which was not well received. It wasn't until Copernicus, nearly 2,000 years later, that this idea gained acceptance. Aristarchus also took the lengths of shadows of monuments to derive the curvature of the Earth – measuring the shadow length at noon on the summer solstice for a monument at Alexandria and another at Thebes. From the differences in shadow lengths, and a little bit of experimentation, he was able to derive the degree of curvature of the Earth. By plugging in the distance between the two monuments, he was able to give a rough estimate of the size of the Earth. (Since his initial measurement for the distance between the two monuments was in error, his calculated size of the Earth was too small by almost 40%). He also used these same procedures to estimate the distance between the Sun and Earth, and the Moon and Earth in earth radii.

Ancient Greek Astronomy and Greek Life

Unlike the Babylonians and Egyptians, ancient Greek Astronomy was mathematical, rather than religious in nature. This view of Astronomy was profoundly important in the differentiation between Astronomy and astrology. Greek astronomical thinking formed the foundation of much scientific and mathematical thought that laid the foundations for the world we live in today.

Medieval Astronomy

The Medieval period is also called the Dark Ages. Most people think that this means there was no art, mathematics, or science at all. However, while learning in the medieval period was heavily restricted by the Church, there was still scientific discovery going on.

Astronomy in the Dark ages

People in the Middle Ages cared about astronomy for a number of reasons. Religion was one of the most important. Medieval astronomy was used to figure out when holy days would occur, such as Easter. This holiday was particularly hard to place on the calendar every year. This is because the original date of Easter was determined by Passover, a Jewish holiday. The Jewish calendar is based on a lunar, or moon cycle. The medieval calendar, however, was based on the movement of the sun. Therefore, observation of the sky was needed to figure out when this very important holiday would occur.

The Sun and the Moon

Medieval astronomy was based on four main kinds of celestial bodies. The first was the Sun. The Sun was the most important object in the sky. At the time, people thought that it went around the Earth. However, they still needed to watch it to figure out how long the year was and when certain times, like planting, should happen. The second most important body in the sky was the Moon. Its phases were used to determine holy days and other important events. It, too, was thought to go around the earth. The stars came next in importance. It was not known that the sun is a star in the Medieval period. Instead, the stars were considered to be fixed lights in the sky. Medieval people were aware of all of the constellations we recognize in the Northern Hemisphere today. Most medieval astronomers used Aristotle's vision of the sky, which was made up of concentric crystal spheres. The planets, stars, and other bodies were each held in their own sphere. Thomas Aquinas, an early Church philosopher, blended this idea with those of Ptolemy to come up with the astronomy recognized by the church for hundreds of years.

Last, but not least - the planets

Last in importance were the planets. Not all of the planets we recognize today had been discovered by Medieval astronomy. They were not aware of the existence of Uranus and Pluto. It is important to remember that to medieval astronomers, the planets were only visible as lights, not as the objects we think of them as today. Towards the end of the medieval period, many astronomers began to make changes to the official science approved by the Church. These took the form of comments about Aristotle's theories. As long as the comments ended by saying that Aristotle was correct, no one paid much attention to changes in the theories.

A final word

Most people in the medieval period still believed that the Earth was the center of the universe. However, astronomers were able to observe the movements of the stars and sun in relation to the Earth and chart them down. It was irregularity in these movements that eventually caused people to believe that the Earth went around the sun, not the other way around.

Islamic Astronomy

This article gives a brief overview of **Islamic astronomy**, also called **Arabic astronomy**. The pre-Islamic Arabs had no knowledge of astronomy as a science and relied on their empirical knowledge of stars. A great deal of importance is given to the genesis and development of Islamic astronomy, however, in the history of astronomical sciences/disciplines, particularly to its developments from the 8th to the 14th centuries. Places like the Middle East, North Africa and then Moorish Spain are said to have made a great deal of progress in astronomy during this period, while Europe was groping its way through the Dark Ages.

Early Influences

It's also known as Arabic astronomy due to its script, Islamic astronomy was influenced by and assimilated and amalgamated several foreign elements, notably Sassanid, Hellenistic and Indian, to enhance its development. The Indian influence on Arabic astronomy can be seen in translation and/or adaptation of Sanskrit works. Texts like the Zij al- Sindhind, for instance, was inspired by the Surya Siddhanta and philosophers like Muhammad al-Fazari and Yaqub ibn Tariq translated the works of Brahmagupta in 777, after an Indian astronomer is said to have visited the court of Caliph Al-Mansur. The translation of Zij al-Shah, a collection of astronomical tables compiled over two centuries in Persia shows the strong Persian influence on Islamic astronomy.

Development of Mathematics

Seeing the importance of mathematics in astronomy, it is hardly surprising that the spread of Arabic astronomy was rivaled only by the focus on mathematics. Apart from its proximity to the ancient centers of civilization, Arabic astronomy was prompted to look to other cultural influences due to a host of problems posed by their religious observances, mostly related to timekeeping. Therefore, it's not surprising that Ptolemy's Almagest was a landmark achievement in Islamic astronomy, with its focus on Assyrian, Greek, Persian and Roman chronological tables for timekeeping with reference to astronomical events. It incorporates the knowledge of astronomy and geometry in one text, much like Euclid's Elements and demonstrates the extent of Arabian astronomy at the time and is still referred to for its discussion on astrology. It came to be known as The Greatest Astronomer or the "Al-megiste". Besides these, textual evidence shows that Arabian astronomy and mathematics were influenced by Indian methods and replaced the Hellenic chords of arc by the sine function. Yet another Indian influence was the use of the approximation technique for timekeeping.

The Legacy

Islam has made considerable contributions to the fields of mathematics and astronomy in the form of discoveries like the Equatorium or the analog computer, planisphere, mechanical lunisolar calendar computer, spherical astrolabe, Plate of Conjunctions, armillary sphere, compass dial, mural instruments, cartographic qibla instruments etc. Though not all of them survive, these discoveries aided the development of astronomy and traces of Arabic astronomy can still be seen in our use of astronomical terms like the Alhidade, Azimuth, Almucantar, the stars of the Summer Triangle- the Vega, Altair and the Deneb, which are still recognized by their Arabic names.

Indian Astronomy

Indian astronomy has had a huge impact on the science of astronomy. In fact, the study of astronomy in India dates back over four thousand years, and early Indian astronomers are amongst some of the most influential in their field. One of the earliest recorded references to the study of the stars in India can be found in the 'Rigveda', a collection of hymns dating back to around 2000 B.C.

The History of Astronomy in India

Indian astronomy and astrology were closely related. The ancient Indians believed that the position of the planets determined our fortunes, particularly Saturn and Mars. These beliefs formed the basis of modern astrology and horoscopes. However, they held a far more religious significance and one of the earliest texts devoted to astronomy, the Laghada's Vedanga Jyotisha, stated rules for tracking the movement of the Sun and the Moon for ritualistic purposes. Early Indian astronomy use sidereal calculations. These calculations are based on the stars, and the sidereal period is defined as the time that it takes the object to make one full orbit around the Sun, relative to the stars.

Early Indian Astronomers and their Discoveries

Many of the earliest Indian astronomers made discoveries that were far ahead of their western counterparts.

Aryabhata - was born in 476 A.D., and is widely recognized as the father of Indian astronomy. When he was about 25 years old, he presented astronomical and mathematical theories in which the Earth was taken to be spinning on its axis and the periods of the planets were given with respect to the Sun, rather than the stars. These calculations laid the foundations for what we now call the Solar System, with the Sun being at its center. In this, he was way ahead of his time. Aryabhata also gave numerous measurements that were remarkably accurate for the time, including the Earth's circumference and diameter. He also calculated that the radius of the orbits of planets, in relation to the radius of the Earth and Sun orbit were equal to the length of time it took them to rotate around the Sun, and was the first astronomer to realize that the orbits of the planets around the Sun are ellipses. His studies also led to discovering how lunar and solar eclipses happen and provided calculations to predict their occurrence. Not only was he the first Indian astronomer, but Aryabhata was also a master mathematician and devised the number 'zero', and accurately calculated pi (π) to 4 decimal places. On April 19, 1975, India sent its first satellite into orbit, named 'Aryabhata'.

Brahmagupta - was born in 598 A.D. and was the head of the Indian astronomical observatory at Ujjain. He was the first to use algebra in solving astronomical problems. Brahmagupta developed methods for calculating the movements and positions of numerous planets. He also calculated the circumference of Earth as the equivalent of 36,000 kilometers, which is remarkably close to modern calculations of 40,000 kilometers.

Bhaskara - was born in 1114 A.D. and also became the head of the Ujjain observatory. He followed in the footsteps of Brahmagupta with his mathematical genius too, and developed numerous planetary calculations, including the time taken for the Earth to orbit the Sun to 9 decimal places.

Madhava - was born in 1340 A.D. He founded the Kerala School of astronomy and mathematics. This spawned a number of notable astronomers and helped establish Indian astronomy as a world leader in the field between the 14th and 16th centuries.

Native American Astronomy

This article gives a quick overview of **Native American astronomy**. Every culture has its own beliefs about the night sky and every tribe, group, and nation has had its own beliefs as to what the stars are and what they mean. The Native American tribes had their own beliefs regarding what the stars signified and these beliefs varied from tribe to tribe.

Who was watching the sky?

Native American astronomy was something that was often left to the elders of the tribe, or those who were concerned with spiritual or religious affairs. Much like in the west, some tribes believed that the motion of the stars would affect the way things turned out on Earth, whether that meant predicting a terrible drought or whether a raid would be successful. Several Native American tribes held the four cardinal directions, north, south, east and west, as sacred and said that there were stars that presided over each one as gods.

Some of the astronomical events were observed by everyone. The stars were used to navigate, and, in the sense that the stars could be observed by everyone as a way to coordinate travels. For the Native Americans, astronomy was another important factor of day to day life.

The Stories

Native American tribes had different explanations for why the stars moved and were grouped the way they were, and these stories were quite different, indicating the vast variety of beliefs that were found among the various tribes. For example, the Western Mono tribe of California believed that the Pleiades were a group of six women who had been evicted from their homes due to having bad breath from eating onions, while to the Blackfoot tribe of Montana and South Dakota, the Pleiades were six orphaned brothers who had become stars due to the neglect of their clan. The stories that are found in Native American astronomy do their best to explain what the stars were and the explanations were as varied as eyeballs, dogs, spider gods and grizzly bears.

It is always interesting to note similarities between cultures. For instance, the West has long thought of Canis Major and Canis Minor as the dog stars. For the Cherokee of Tennessee, the stars were also the two dogs that one needed to journey past to enter the afterlife.

The Importance of Native American Astronomy

Native American astronomy was very important in a number of respects. The stars provided a method of navigation to those traveling at night, and for nomadic tribes or tribes that often participated in long raiding trips, this was quite important. Similarly, the stars also served as a method of time management. Unlike the present day, where time is kept to the precise minute, most of the Native American tribes saw time as divided into segments of action. Their actions were directed by things like the flow of the tides, the changing colors of the leaves and by the movement of the stars across the sky. For many Native American nations, the year was counted by the number of full moons that had passed.