Claudius ptolemy's contributions to science

Claudius Ptolemy

The ancient world can be traced back to times of mysterious and enigmatic people. Some mysteries, however, remained unfathomed till date. Life, during those times, was very different; humans performed activities and tasks that gave a lot of prominence to the Gods and were primarily based on the cycle of nature. On the contrary, today, life has taken 360 degrees turn. Our life today is almost dependent on technological gadgets. The transition from then to now has been enormous. There is a stark difference observed in the lifestyles of both the ages. And it is not just the lifestyle there is a vast difference even in the thinking. Since ages, many questions have often been accumulating in the human mind such as, what are the dimensions of the earth, how many continents are there on the Earth, and what are the functions of the Moon and the Sun in our day-to-day lives. Now, the answers to these questions are just a click away. But when a similar scenario must have emerged during ancient times, people might have associated it with some myth or an old wives' tale.

The transformation of people from an ancient era to the modern one was really a lengthy process where philosophers, thinkers, mathematicians, astronomers and geographers must have put across their observations and theories to the general public. However, change is never easy. Their ideas and concepts were not accepted instantly. In fact, they were all rejected outright and they were ridiculed as well as humiliated because of their beliefs and concepts. But all of them stood their ground and fought for what they believed was right. After a series of untiring efforts, they were rewarded and were proved right years after they passed away. It was the observation

and contribution of these people which have now evolved into theories and concepts that help us simplify and demystify our lives.

Let us shed light on the life of one such person who made a significant contribution in changing our lives. His name was Claudius Ptolemy. He was a Greek-Roman citizen, who displayed multiple talents of astronomy, mathematics, georgraphy, astrology and poetry.

Decoding the Enigma

In a distant town of Ptolemais Hermiou in Thebaid, Egypt, a child was born into the family of Ptolemies. The family was the descendant of Ptolemy Soter, a mighty General from the army of Alexander the Great in 90 AD. Although the family was rooted in Egypt, the Roman influence on the family was such that the infant was given a Roman name, Claudius. The nameClaudiusis a Romannomen(Roman naming system) and the fact that Ptolemy bore it, indicates that he lived in Egypt under the rule of Romans . Nothing much is known about Claudius Ptolemy’s upbringing or his family. “ Where did Ptolemy come from?”, “ Where was he born?” are the questions which are still asked today but the answers have been lost with time.

All that is known is Ptolemy started becoming renowned as someone who had a keen mathematical and astronomical sense. He became popular in Thebaid and later, in Alexandria, where he began to reside in his adulthood.

Star Gazing

Nothing much is known about Ptolemy’s ancestry, apart from what can be deciphered from the details of his name. However, the modern researchers

are sure of one fact, that it was Ptolemy who wrote the great edict called Almagest at around 150 AD. Ptolemy wrote inGreekand utilisedBabylonian astronomical data. In spite of being a Roman citizen, most of the scholars came to a common understanding that Ptolemy was ethnically Greek, although some others also had the opinion that he was aHellenisedEgyptian. In most of the later Arabic sources, he is referred to as, ‘ theUpper Egyptian’, which means that he may have belonged to southern Egypt. Hence, the Arabicgeographersandphysicistsreferred to him by his Arabic name Batlaymus. Ptolemy built his reputation owing to his astronomical works, wherein he had recorded the existence of 1000 stars, out of which 300 were his finds. He is also credited with coming up with the first practical theory of Refraction of Light. He was precise in his discussions about the dimensions of the planet. Ptolemy came up with a compilation of the ancient view of astronomy in an astronomical manual called Almagest. He used the 800-year-old astronomical observations by his predecessors as a reference point for this purpose. He also added his conclusions on the basis of this reference as his vision of the universe. Ptolemy’s successors considered the Almagest to be the Gospel of astronomy for many centuries throughout medieval Europe. The ancient Greeks believed in the theory that the path of the planets was completely spherical, were discarded later as it was proved later that the orbits of the planets are elliptical. Even Ptolemy had been convinced by this earlier belief.

Going Into the Orbit

In Ptolemy’s manual, it was clearly seen that he followed the steps of Aristotle, whom he considered his ideal. Aristotle had come up with a theory

that the planets moved in a continuous and uniform motion in perfect circles. As per Ptolemy’s observation he concluded that earth is a spherical object which remains freely suspended in the centre of the Universe. One of the studies revealed the stars to be bodies which were fixed to a strong exterior of the Universe which lay beyond the orbit of Saturn. A large number of these studies were based on Aristotle’s philosophy but Ptolemy added his inputs by calculating the motion of each planet in great detail and thus came up with his contribution to astronomy. One of his early works, the ‘ Almagest’ provided a detailed study of the Mathematical theory of the movements of the Sun, the Moon and other planets. Ptolemy’s theory that the planets move in circular epicycles along their orbits, which was well-received during those days.

The Almagest was preserved inArabicmanuscripts, like most of the Classical Greek Science. By the 12 th century, it gained the desired reputation and was widely sought after. Due to its popularity, it was translated twice into Latin, once into Sicilian and then into Spanish.

Like Ptolemy’s predecessors, his model was geocentric and received almost complete acceptance universally until simplerheliocentricmodels were introduced during thescientific revolution.

Ptolemy’s theory of Planetary Hypotheses extended beyond the explanation given in the Mathematical model of the Almagest. The Planetary Hypotheses depicted the physical realisation of the Universe in the form of nestled spheres and used the epicycles of this planetary model to portray the dimensions of the Universe. According to his calculations, the sun was at an

average distance of 1, 210 earth radii, while the radius of the sphere of the fixed stars was 20, 000 times the radius of the Earth.

To calculate astronomical calculations in Handy Tables, Ptolemy introduced an efficient tool which tabulated all the data required to calculate the positions of the Sun, the Moon and the planets, as well as the rising and setting of the stars and the eclipses of the Sun and Moon. This Handy Tables became the basic model which was improvised later as astronomical tables or zijes. Ptolemy also worked on a star calendar or Almanac, which he prepared with the help of the positions of the hands and disappearances of stars during the solar year. This was presented in the Phaseis (Risings of the Fixed Stars).

His observations made a huge impact in those days and made Ptolemy somewhat of a seer or scholar.

Mapping it Out

Apart from Ptolemy’s tremendous contribution to the understanding of astronomy throughout the world, he also laid down the groundwork to the future cartography or the study of maps. He wrote another treatise on the lines of the Almagest, compiling his knowledge of Geography, along with what was already known through the Roman Empire. An important source of information for the book, Geographia, written by Marinos of Tyre, an earlier geographer and the gazetteers of Roman and ancient Persian Empire.

Ptolemy began the book with a discussion of the data and the methods used by him to write down the book. The book was written in a much organised

pattern on the lines of following a grand scheme. He assigned co-ordinates to all the places and geographic features he knew in a grid that spanned the globe which was quite similar to the work of Marinos. The Latitude that we know of today and is measured from the equator was done by Ptolemy but he named it as climata, which was the length of the longest day rather than degrees of arc. For example, the length of the mid-summer day increased from 12 to 24 hours as one moved from the equator to the polar circle.

In books 2 through 7, Ptolemy used degrees. He assigned 0 degrees longitude to the Blessed Islands or the Canary Islands, which was the most western land on the extreme left of blue sea of Ptolemy’s map. This was identified by the six dots that were also labelled as Fortunata islands. Most medieval mapmakers followed the instructions that Ptolemy had devised and mentioned it in the Geographia.

The second part of the Geographia contained Ptolemy’s Oikoumene or the map of the whole world. The area of Oikoumene extended from 180 degrees of longitude from the ‘ Blessed Islands’ in the Atlantic Ocean to the middle of China and about 80 degrees of latitude from Shetland to anti-Meroe or the east coast of Africa. His map indicated he knew only about the quarter of the globe. He improved the projections of his maps than they were since the third century BC. However, Ptolemy’s maps were inaccurate as compared to the modern maps because he took the size of the Earth as being only 500 stadia for a great circle degree on the globe.

The Bible of Astrology

Along with the Almagest which spoke at lengths about astronomy, it is believed by some that Ptolemy also wrote a 4-part treatise on astrology called the Tetrabiblos, which in Greek terms means, Four Books. But there are others who believe that Tetrabiblos wasn’t written by Ptolemy. In fact, many scholars state that he must have just given the term Apotelesmatika, meaning Astrological Outcomes, as it was found in some Greek manuscripts.

It is said that Tetrabiblos was revered as much as the authority of a Bible by the astrological writers for more than thousand years. It is an extensive database based on the ancient principles of horoscopic astrology and as a result has been continuously reprinted. However, it could not come up to the level of Almagest as it did not touch upon some popular areas of the subject such as medical astrology and event astrology which was interpreting astrological charts for a particular moment to determine the outcome of a course of action to be initiated at that time. However, these were later incorporated into the treatise.

Ptolemy was of the belief that astrology was a science which tried to describe the physical effects of the heavenly bodies on the terrestrial life but unsuccessfully. Although he had no issues with the basic validity of the traditional astrological doctrines but he worked at modifying the details so that aligns with the Aristotelian conception of nature, matter and change. Ptolemy had a practical view of astrology. He believed that astrology was conjectural like medicine as many variable factors had to be taken into account. While to assess the requirement of the medicine factors such as the race, country and upbringing of a person had been taken into account for

astrology the deciding factors were the position of the Sun, Moon and the planets at the precise moment of their birth.

So he considered astrology to be useful in life, but in no way, relied upon it completely. A later pseudepigraphical composition known as Centiloquium, a collection of 100 aphorisms ascribed to Ptolemy, was commented upon by the Arabic, Hebrew and Latin scholars.

Striking a Chord

Ptolemy had resided in the Roman Empire, where music was given a high status as an art form. His work called ‘ Harmonics’, is an observation on Music theory and mathematics of music. Ptolemy was very critical of his predecessors’ approach to the Musical theory. As per his theory he based the musical intervals on mathematical ratios, which was contrary to the belief followed by Aristoxenus and in sync with the belief accepted by the followers of Pythagoras.

Ptolemy further propounded the theory which was first spoken about by Pythagoras about the musical notes being translated into mathematical equations and vice versa in Harmonics. He also wrote at length about an intense diatonic scale, which was later incorporated by many musicians.

Another commendable contribution of Ptolemy’s work is Optics. However today, the only Optics that has survived is in poor Arabic translations and in around 20 manuscripts of a Latin version of the Arabic, translated by Eugene of Palermo, Circa 1154. Ptolemy wrote about the properties of light, including reflection, refraction and the colour in it.. The work is a significant part in the

earlyhistory of optics. The more famous Eleventh Century Optics by Alhazn (Ibn al-Haytham) was majorly influenced by this work.

It contained the earliest surviving table of refraction from air to water, for which the values (with the exception of the 60 degree angle of incidence), although historically praised as experimentally derived, it seemed to have been obtained from an arithmetic progression. It had the earliest surviving table of refraction from air to water for the values with the exception of the 60 degree angle of incidence. It seemed to have been obtained from an arithematic progression although it is said to be derived experimentally.

Ptolemy’s work is based on the combination of mathematical, philosophical and physiological traditions. His theory of vision was based on extramission-intromission theory; the rays (or flux) from the eye formed a cone, the vertex being with the eye and the base defining the visual field. The rays were sensitive and conveyed information back to the observer’s intellect about the distance and orientation of surfaces. The size and shape of the object get determined by the visual angle subtended at the eye, combined with perceived distance and orientation. This was one of the initial statements of size-distance invariance as a cause of perceptual size and shape constancy, which was a view supported by the stoics. Ptolemy provided explanations for many phenomena concerned with illumination, and colour, size, shape, movement and binocular vision. He also classified illusions according to those caused by factors such as physical, optical and judgmental. However, his explanation of the Sun or Moon illusion was obscure (the enlarged size on the horizon) which was the difficulty of looking upwards.

Footprints in the Sand

It is believed that Ptolemy died around 168 AD in Alexandria, the city where his work flourished. He left a lasting impression on most of the researchers existing during that time. Although his works were controversial, in recent times, it has been discovered that his studies still contain important clues and observations that are practical.

Many objects or characters have been named after Ptolemy as a tribute to his immense contribution to the modern day Astronomy, Astrology and Geography. Some of them include, the craterPtolemaeuson theMoon, the craterPtolemaeusonMars, the Asteroid4001 Ptolemaeus, A Character in the Fantasy series, The Bartimaeus Trilogy, Track number 10 onSelected Ambient Works 85–92byAphex Twin, thePtolemy Stoneused in the Mathematics courses at both theSt. John’s Collegecampus. Sir Patrick Moore, an English astronomer and TV presenter called his cat by the name of Ptolemy and the name of a music magazine was calledPtolemaic Terrascope. With the information of Ptolemy’s life being virtually unknown, it is only his work and legacy that do justice to his biography.