Astronomy and Humanism

by

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A. EARLY ASTRONOMY.

Among the earliest civilisations the earth was regarded as the centre of the universe, with the stars, sun, moon and planets on one or more celestial, crystalline spheres surrounding it, and not very far away. The Chinese, the Egyptians and the Babylonians observed and tracked the heavenly objects and were able to determine quite accurate solar and lunar calendars based on their observations. In those days, because of the earth-centered nature of their ideas, there was no real difference between Astrology and Astronomy. There is also fairly clear evidence that such concepts were common as far back as 5000 years ago. Two examples of this are the Egyptian pyramids and Stonehenge, both of which have an astronomical orientation.

B. THE GREEKS.

"Planets" is a Greek word meaning "Wanderer" and, in the early days was also applied to the sun and the moon. It was also the early Greeks who named the constellations and created the Zodiak. Eudoxus (408-355BC) postulated 24 rotating spheres surrounding a stationary earth. Aristotle (384-322BC) regarded the earth as spherical because of changes in the position and visibility of constellations with latitude. He also explained lunar phases by reflected sunlight. However, he rejected a heliocentric system because of the absence of stellar parallax. Aristarchus (310-230BC) used trig. to obtain the relative distances and sizes of the sun and moon. His measurements were 20X too small but not bad for a first try! He accepted the heliocentric theory however, and insisted that the lack of stellar parallax proved that the stars were extremely far away. Eratosthanes (276-196BC) is noted for first measuring the size of the spherical earth. Using the angular position of the sun at noon at two places on a north/south line he came up with a value within 1% of the true one! Then Hipparchus (160-127BC?) calculated that the moon's distance was 29 1/2 times the earth's diameter. The true value is 30 times. Finally we come to Ptolemy, who lived in the second century AD (exact dates not known). He wrote a work in 13 volumes called the Almagest, a summary of the current theories of cosmology. It described an earth-centred system in which epicycles were used to account for the planetary retrograde motions. The Almagest was regarded as the absolute authority on such matters throughout the middle ages.

C. CHRISTENDOM & THE MEDIEVAL PERIOD.

Constantine the Great (288-337AD) is considered to be the founder of what came to be known as "Christendom" as he was the first Roman emperor to convert to Christianity. He was an autocrat of the extremest kind and organised the Council of Nicea (325AD) which set out a series of eternal and incontrovertible truths with which all Christians must agree, and which included belief in an earth centred universe created for our benefit by the Gaseous Vertebrate. He regarded himself as the agent of what H.G.Wells (in the Outline of History) calls "Divine World Government". From the fifth to the fifteenth centuries this was the dominant view and led to the period being called the Dark Ages. During this time, there was not only no astronomical progress whatever, but it was a period of extreme and centralised authority and religious dogma. It was also a period during which the number of people slaughtered in the name of God rivalled that of Hitler's Holocaust.

D. RENAISSANCE & REFORMATION.

It was during the fifteenth century that more and more creative minds began to react negatively to what was essentially a totalitarian and orthodox approach to life. They turned instead to a rediscovery of the philosophy and science of the early Greeks, and concentrated less and less on the mysteries of the "Other World" and more and more on life in the here and now, its mysteries, its injustices and its triumphs. This led in time to the movement called "Humanism" as opposed to "Celestialism", the old-fashioned brand of orthodoxy. At the same time there came about increasing opposition to the church's dictatorial approach to matters of faith and belief. These brave souls were labelled "protesters" and the new branch of religion they created became known as "Protestant". Martin Luther led they way, but after him there were many others who originated a variety of different ways of practicing the Christian religion.

One result of these changes was a genuine re-birth of Science, including Astronomy. The earliest big name in this development was that of Nicolas Copernicus (1473-1543). Although his formal training was in law and medicine, he had a great interest in both astronomy and mathematics. His greatest contribution in these fields was his theory of the solar system. He not only included the earth as one of the planets orbitting the sun; he placed the planets in the correct order and calculated their relative distances from the sun. His values were very close to the actual values. His work was summarised in his book De Revolutionibus Orbium, published in the year of his death.

Tycho Brahe was born three years after Copernicus died (1546-1601). A Danish nobleman, Tycho became interested in astronomy and set up an elaborate observatory called Uraniborg on the island of Hveen. No telescopes, of course, but a good supply of large and extremely accurate tracking instruments. Apart from his records of the positions of the sun moon and planets and his calculation of the length

of the year to an accuracy of 1 second, his most notable achievement was his suggestion that comets are not clouds of vapour in the earth's atmosphere (the accepted theory at the time) but were, like the planets, in orbit about the sun.

E. REAL ASTRONOMY.

The first person to fall into this class was actually hired by Tycho as his assistant. Johannes Kepler (1571-1630), a protestant, started out as a theological student but changed his mind and concentrated on mathematics, which is why Tycho needed his help with the reduction of the mountain of observations that had accumulated at Uraniborg. After Tycho's death, Kepler succeeded him as the Emperor's mathematician, obtained all of Tycho's records and spent the next 25 years working on them. The result of this was one of the first real break-throughs in the science of astronomy. Kepler discovered that the orbits of the planets are not circular but conic sections (ellipses) with the sun at one of the two foci. Epicycles were no longer required!

Galileo Galilei (1564-1642) once more emphasises the humanistic aspect of astronomy because the Christian's God did not pluck another rib from Adam's body and turn it into a telescope. The first one is thought to have been created by Hans Lippershey, a Dutch spectacle maker, in 1608. Galileo heard about it, and in 1609 he started making telescopes himself. But, unlike Lippershey, he used them to study the night sky. What resulted set astronomy off on an entirely new path. He found that

(a) many more stars are visible in the telescope than to the naked eye;
(b) the Milky Way was made up entirely of stars;
(c) Jupiter had four moons that orbitted it;
(d) Venus exhibitted phases like the moon;
(e) the sun had spots on it and obviously rotated;
(f) the moon was covered in what looked like volcanic craters.

Unfortunately the humanist point of view was not sufficiently established yet to reward Galileo for his discoveries. A papal decree of 1616 had termed all heliocentric theories as "false and absurd" as well as being "contrary to Divine Scriptures". He was tried before the equally "Divine" Inquisition and found guilty. Luckily he was not burnt alive on top of a bonfire. His sentence was ten years imprisonment, fortunately under guard in his own home!

Which brings us to one of the biggest names in the new science, Isaac Newton (1643-1727), born the year after Galileo died. A graduate of Trinity College, Cambridge, for most of his life he was a professor of mathematics at that college. His interests, however, were wide and included astronomy. The commonest type of reflecting telescope was invented by and named after him - the Newtonian. But his greatest achievement was actually a continuation and culmination of some of the experiments investigated by Galileo, the matter of the behaviour of

falling bodies. Without going into details, the concept associated with Newton's name is that of gravity. He explained such things as the laws of motion, momentum, velocity, mass, force, equilibrium, and reaction. Finally he recognised that the law of gravity applied throughout the entire universe, an idea which solved many of the problems facing the early astronomers. He was also the first person to find a method of weighing the earth. Finally, it was Newton who first investigated the spectrum of light and initiated spectroscopy which has been a vital part of astronomical research ever since.

The next "real" astronomer of note was William Herschel (1738-1822). Like myself he was, by profession, a musician whose hobby was astronomy. He was the son of a Hanoverian army bandsman and, in 1757, immigrated into England to take on an organist's job in Bath. Here he pursued his hobby as telescope maker and sky gazer. He was the first astronomer to recognise that many of the nebulae are actually other galaxies and that the sun was certainly a star in the Milky Way galaxy. He was also interested in pairs of stars that were close together and verified that, in many cases, they were actually orbitting one-another and were indeed double star systems. Finally his crowning achievement was the discovery of a seventh planet in the solar system - Uranus. Later in life he was made astronomer to George III. His son John (1792-1871) continued his father's work, concentrating on the skies of the southern hemisphere and working in South Africa.

Friedrich Bessel (1784-1846), director of the Konigsberg Observatory in Germany, gained fame by solving one of the oldest problems in astronomy: just how far away are the stars? Stellar parallax is present when we observe a star from opposite ends of the earth's orbit. The star's apparent position changes, but very, very slightly. The angular change is less than a second of arc. But in 1838 Bessel was able to measure this tiny angle for the star 61 Cygni. This meant that, for the first time in history, the star's distance could be calculated by solving the resulting long and narrow triangle.

Albert Michelson (1852-1931) was a physicist, not an astronomer but he also accomplished something of great importance for astronomers. In 1878 he measured the speed of light (299.91 km/sec). This resulted in the creation of a new unit suitable for measuring the immense distances which were now turning up in astronomy - the light year: the distance travelled by a photon of light in one year, which happens to be 946 billion kilometers! The nearest star to the sun (Proxima Centauri) is 4.22 light years away.

So far all of the participants in this story have been men. But finally we are arriving at another of the influences of humanism as opposed to the dogmatic masculine religiosity of the previous centuries. Our next person of note, this time in the twentieth century, was Henrietta Leavitt, a woman astronomer! She was a member of the staff at the Harvard College Observatory in Cambridge, Mass., a facility which I have done work at myself. She had been studying variable stars (my own field) of the Cepheid type and, in 1912, she discovered a connection

between the length of the period of these stars and their intrinsic brightness. It is easy to measure the period of a variable star. But if this also tells you the star's intrinsic brightness, by simply comparing the intrinsic brightness with its apparent brightness you can easily calculate its distance. What made this discovery so vitally significant was the fact that Cepheid variables could often be seen in distant galaxies. For the first time galactic distances could be obtained and it became clear just how enormous the universe was!

This brings us to Edwin Hubble of Mount Wilson Observatory who concentrated on determining the distances to numerous galaxies using Henrietta's discovery. However, he made one further discovery in 1924. Using spectroscopy (introduced, you remember, by Newton) he noticed that the spectra of very distant stars were much redder than they should be when the spectral class of the star was taken into account. In addition, the further away the objects were, the more pronounced was the move into the red end of the spectrum. Only one thing could explain this. The objects were moving away from us, and the farther away they were, the faster they were moving. Hubble's claim to fame is obvious - he had discovered the expanding universe.

Finally we come to Albert Einstein (1879-1955) relativity and the quantum theory. At this point I have to confess that I do NOT have the mathematical background to fully understand Einstein's theories, though I can appreciate the general drift of his ideas.

My own work in astronomy consisted of photoelectric photometry of small amplitude semi-regular variable stars, looking for evidence of period changes, mode switching or other irregularities. I had nine papers published in various scientific journals and was included as co-author in numerous others published by professionals. I received many awards for this work and ended up in Canadian Who's Who. But I have always steered clear of anything to do with cosmology because work in this field really requires a solid grasp of quantum mathematics, something I do not possess. I have in my library a copy of Stephen Hawking's book "A Brief History of Time" which I have read but find so far out in its ideas that to me it is more like fantasy than science. For example, Hawking postulates that the universe, when it stops expanding, will start to contract at which point time will start to run backwards! To me this sounds too much like Harry Potter to be believed.

So we are left with today's certain knowledge of the universe as a vast assemblage of galactic clusters containing untold zillions of stars with no clear evidence that there is anyone else like us - anywhere! This is the ultimate humanistic mystery. Furthermore when other stars have been found with attendant planets, they have always been of the Jupiter variety - no place at all for life to develop. In addition both SETI (Search for Extra-terrestrial Intelligence) and META (Megachannel Extra Terrestrial Array) have so far found nothing. Add to this the fact that no reputable scientist has ever accepted the evidence for UFO's and you begin to wonder if there is indeed anyone else like us in all that one million, trillion, trillion cubic light

years of space. If so we are very unique - another humanistic surprise.
Or could it be that life is the beginning of a type of cancer attacking
an otherwise entirely inanimate universe?

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