CONCEPT OF THE UNIVERSE

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Introduction

Most of the information included in this article has been culled from the audio version of the book: *A Short History of Nearly Everything* written by Bill Bryson. I am compelled to depend on the audio version of his celebrated book on account of my total blindness which prevents me from reading the original book itself. While listening to a part of Bill Byron's book on a CD player I have jotted down in a very complicated form brief facts, dimensions and figures which have impressed me. My repetition of this material was written down in what I hope is in a readable form by my wife. This in itself was an extremely difficult task, and I hope my readers will forgive me for any minor errors that may possibly arise in the printed version of my article.

Science is fast moving into an era where direct observation may not be sufficient in itself to grasp the essence of things. Deductions from other observations and perhaps the assumption of phenomena puzzling to our normal frail minds, may be essential to the understanding of things and particularly of the universe in which we live. From the days of the ancient Greeks and the eras that witnessed the brilliance of men like Galileo and Isaac Newton, we have proceeded by huge leaps and bounds to a time when the scientific method still remains valid, but discoveries may supersede what we in our humble way call "commonsense".

This article is a very brief description of our universe. Perhaps, in the long years to come, much of what I have written here may be replaced by new concepts derived from even more complex procedures than the ones science has utilized to this day. We have still only scratched a minute segment of our universe. Perhaps a complete knowledge of the universe may not be possible to Homo Sapiens or even perhaps to more intelligent forms of life that may evolve in the long years to come. However, in our long march forward, I hope that the great work of Bill Bryson may at least be a microscopic contribution to our knowledge of nature which may perhaps see no end.

Through the scientific method we constantly seek to discover what we call the *truth* about Nature. But will there ever be an end to this process? We shall seek the Truth as long as our species or other species yet to come continue to survive. The truth we seek is about the entirety of Nature itself.

The Origin of the Universe

In the last issue of *Polity*, in an article entitled "Investigating the Universe" I have described briefly the amazing discovery by Edwin Hubble in 1929 that our universe including every star and component of it is in a process of expansion. The rate of this expansion from the observer is proportional to the distance of the stars concerned from the observer himself. The further away the stars are, the faster they seem to be moving away from us. This data was obtained by Hubble by the use of two well known physical phenomena known respectively as spectroscopy and the Doppler Effect. This effect may be observed from any point within our universe. It is like the expansion of a mass of particles in a uniform sense. Each particle will observe the same phenomenon of expansion.

In an expanding universe of this kind there must inevitably be a starting point. Returning to our old concept of "commonsense", such a starting point must be a geometrical point. Such a point can have no *dimensions or mass*. Roughly 13.7 billion years ago this point - scientifically referred to as a Singularity - exploded, spewing forth in a brief time all that we know of the universe today. A geometrical point of this nature and its sudden explosion for reasons as yet unknown, constitute some of those mysteries which we have referred to in our introduction, but which perforce we have to accept even against our notions of "commonsense." This explosion is today referred to as the *Big Bang*. This term was first suggested in a rather facetious and cynical mood by another great astronomer, Fred Hoyle. Fred Hoyle is historically known for what are known today as colossal blunders. For instance, he believed that life arose on our earth through seeding from outer space. He also conjectured that most diseases on the earth such as influenza, the bubonic plague and many other illnesses were due to seeding from extra-terrestrial space. These suppositions today belong to the realm of fantasy, not accepted by any scientist of repute. However, his cynical nomenclature of the Big Bang still remains part of our scientific literature.

I now exhort my readers to prepare themselves for some mind-boggling data which is part of the science of astronomy. Within a period of 10^{-43} of a second the first indications of radiation and some fundamental particles are said to have been emitted. Every 10^{-34} second the size of our universe began to double. (For the benefit of my readers who are not familiar with elementary mathematics, I may state here that 10^{-x} is 10^{-x} is the same as $1/10^{x}$).

Initially, the Big Bang created only very light elements of matter such as hydrogen, helium and lithium. How the heavier elements arose in later eons of time we will describe on a subsequent occasion. Present knowledge indicates that the Big Bang occurred 13.7 billion years ago.

Our Solar System

Through a long history of physical developments, 4.8 billion years ago, a mass of particulate matter accumulated in a certain location of the universe. It must be noted here that all motion in the universe could be either linear or more likely rotational. The reasons for this consist of a fact of physics with which I do not wish to burden my readers. The mass of accumulated matter which we have referred to, rotated at an enormous speed. Ninety eight per cent of this matter conglomerated to form our present Sun. The balance 2%, whilst revolving around this central sun itself conglomerated to form first planetisimals which by further interaction created the planets of our solar system as we call the system today. We hope, and it is a great possibility, that similar processes occurred elsewhere in the universe. Some of the planets so created may have given rise to other forms of life. At least it is my own fervent hope, which is a statistical possibility that this may be so.

Galaxies

To primitive man the shining stellar objects visible in the sky appeared to be randomly distributed. He assumed that they were embedded in a massive sphere concentric with our sun and far away from the planets of the solar system. Basing himself on objects familiar to him upon the earth and upon legends which he took for granted, primitive man isolated groups of stars which he labelled constellations. These Constellations constitute the fictitious belief, still rampant among sectors of our people and known to the naïve as Astrology.

Today, astronomy has established the fact, particularly by telescopic observation, that the stars exist in isolated clusters known as *Galaxies*. These galaxies may occur in different forms and shapes. For instance, the galaxy to which our own sun belongs is known as the *Milky Way*. There are also galaxies which are elipsoidal in form. Our galaxy consists of between 100-400 billion stars. These stars appear to be arranged in a spiral form. Hence our own galaxy is referred to as a Spiral Galaxy. Another spiral galaxy close to the Milky Way and somewhat similar to it in formation and the number of stars it contains is the galaxy named ANDROMEDA. Every galaxy consists well over a 100 billion stars. What will now perhaps astound my readers is the fact, established by modern astronomy, that there are in the universe over 140 billion such galaxies. One can now imagine the amazing number of stars that exist in our universe, contrary to the view of early man. The universe is indeed vast and virtually beyond our simple imagination.

Supernova and the Creation of New Elements

As we mentioned at the beginning of this article, the original Big-Bang from which our universe evolved in an inflationary manner, created enormous quantities of heat and light. In this environment certain elements of matter were also formed. But these were only the very light gaseous elements such as Hydrogen, Helium and Lithium. How then did the very heavy elements in the Periodic Table arise? This remained a puzzle until the last century when on rare occasions stars were observed to explode emitting enormous flares consisting of huge quantities of heat and light. It was an astronomer born in Bulgaria, and working in the U.S.A. who named such occurrences SUPER-NOVAE. The name of this astronomer was Zwicky. Zwicky studied further the nature of these flares and how they emerged from very massive stars in the universe. He discovered that such flares were due to the explosion of these massive stars. Such explosions resulted in the swift contraction of these stars. Protons were compressed against electrons to produce electrically neutral neutrons. The result of such explosions would be, according to Zwicky and his collaborator Bader, the formation of what are now known as *Neutron Stars*. Such stars continue to contract, forming eventually what we now refer to as *Black Holes*. These are so dense that due to their gravitational effect even light cannot escape through them. Zwicky and Bader went one stage further and postulated that in the heat generated within such flares, somewhat akin to the heat of the Big-Bang itself, heavier elements themselves would be formed. However, Zwicky was so unpleasant in

his manner that the papers written by himself and Bader were hardly noticed in the world of astronomy.

However, the ideas of Zwicky and Bader were ultimately proved to be correct. Through their suggestions we now know how the myriads of heavy elements exist in the universe today. Another conjecture, which would be accepted in later years, was the formation of Black Holes. In fact, it is surmised today that at the centre of our own Milky Way galaxy there exists a rather significant Black Hole.

Dark Matter

In 1965 two astronomers – *Perzias* and *Wilson* were attempting to set up a communications antenna at an astronomical centre somewhere in New Jersey, U.S.A. However, they were faced with a seemingly unsolvable problem. Along with the communications they received and transmitted through their antenna a strong and continuous hiss was always present. They tried every method at their disposal to eliminate this hiss. However, nothing seemed to work.

Thirty miles away from New Jersey, at the Princeton University, a team of researchers led by a well known astronomer called *Bob Dicky* had been working for some time on the leftovers of the primitive Big-Bang. Meanwhile *George Gamow*, in the Soviet Union was also working on the leftovers of the Big-Bang. Apart from the material objects that resulted, Gamow surmised that most of these leftovers would consist of microwave radiation. Desperate in their attempts to isolate the hiss from their communication antenna, Penzias and Wilson, unaware of the work being done thirty miles away by Dicky, telephoned the latter hoping to receive some viable advice from him. Dicky immediately realized that Pensias and Wilson had in fact discovered what he and his collaborators had been working on. Hanging up his telephone receiver, Dicky announced to his colleagues: "Boys, we have been scooped." For this work Penzias and Wilson received the Nobel Prize while, according to Bill Bryson, the Princeton workers only got sympathy. Today it is a well known and accepted fact that throughout our universe there swarm these remnants from the Big-Bang, now known as *Dark Matter*. It is known today that without the gravitational pull of this Dark Matter, these galaxies of the universe would disperse very rapidly, bringing an end to the universe itself.

Home Sweet Home

The Ninth Planet. Proceeding outwards from our central sun, until the middle of the last century, the planets of the solar system known to us were as follows: (1) Mercury (2) Venus (3) Earth (4) Mars (5) Saturn (6) Jupiter (7) Uranus (8) Neptune. Around the middle of the last century Percival Lowell in the U.S.A. predicted the existence of a ninth planet, far outside the orbit of Neptune. However, no such planet had been hitherto discovered. Percival Lowell, in the meantime directed his attention to what he believed was a network of canals on the surface of Mars, built by industrious Martians. This of course, has been proved to be completely false today. Even unmanned spacecraft landing on Mars have reported no such canals.

In 1960 another astronomer, Tombaugh, searched the space beyond Neptune for the ninth planet predicted by Lowell. Around 1960 to his great surprise Tombaugh, discovered a small lump of matter which he surmised might be the planet predicted by Lowell. He named it PLUTO where the first two letters were a tribute to Percival and Lowell. Astronomy was agog with this discovery. Percival Lowell was heaped with honours for his prediction. Unfortunately the world of astronomy did not give the same honours to Tombaugh who had actually discovered the ninth planet. However, among planetary astronomers Tombaugh instantly became a hero.

Some years later, James Christie, scanning the planet Pluto made an equally amazing discovery. As I have said before, Pluto itself was vague in appearance. But at one point of he new planet James Christie discovered an equally vague cotton wooly projection on its surface. He surmised this projection to be a moon of Pluto.

Towards the end of the 20th century all doubts of astronomers were set at rest by the authoritative decision of the International Astronomical Union that Pluto indeed was a planet and that the projection observed by Christie was definitely a moon of the ninth planet. It is an interesting fact that Tombaugh had discovered the new found ninth planet Pluto at Flagstaff in the U.S.A. James Christie's findings of its moon also occurred at Flagstaff.

Today, our solar system consists definitely of at least nine planets. The distance of Pluto from Earth can be decided by the fact that any space vehicle projected from Earth to the ninth planet Pluto at the speed of light (which of course is impossible according to Einstein's Special Theory of Relativity) would take a minimum of 7 hours.

Comets and Asteroids

Far away beyond the outskirts of our planetary system there appears to be an object bright and glowing which early astronomers thought was an unusual star. Today we know that it is a vast cluster of icy or snowy spheres, which is the home of what we now recognize to be comets. This vast cluster is known as the Dark Cloud. It contains well over 15 million such spheres.

Occasionally, due to gravitational effects such as the passage of a distant star, a few of these spheres may be pulled out of the Dark Cloud. Some are directed to outer space where they are lost to us forever. A very few may come under the gravitational pull of our sun. The latter travels in enormous elliptical orbits around the sun and eventually return to their starting point and when they are far away from the sun these spheres tend to be coated with cosmic dust. Hence astronomers refer to them at this stage as "dirty snowballs."

Travelling through one planetary system, at the further end of their trajectory, they are relatively close to the sun. Due to the enormous gravitational pull of the sun, they turn around and proceed in elliptical fashion to the vicinity of the Dark Cloud. These journey snowball to snowball. As they approach the sun, the intense light of the sun dislodges a few surface layers of the dirty snowball which stream for huge distances behind the snowball under the pressure of solar light. It might be worthwhile at this juncture to remind my readers that according to current Physics, streams of light themselves can exert pressure on minute particles in their work. The original snowball together with its light induced tail is now referred to as a comet. On its return journey, at a certain distance from the sun, these tails disappear and the comet acquires its pristine character as a "dirty snowball."

Periodically earth has witnessed many such comets in the night sky above. The most famous of these was witnessed in 1911. This bears the name Halley's Comet. The interesting fact is that Edmund Halley himself observed only the periodic appearance of this comet. It came to be known as Halley's Comet many years after Halley himself had passed away.

From comets I draw my reader's attention to what are known as ASTEROIDS. These are objects that revolve around our sun in an orbit between the planets Mars and Saturn. They may consist of particles as small as grains of sand or enormous objects even larger than some of the hills we see on earth. What their origin is we still do not know. Could they be the debris resulting from a planet that once existed and disintegrated for some reason eons ago? We still do not know.

On rare occasions such objects from what is known as the asteroid belt, may be deflected from its course and make a disastrous impact with our earth. A very few such impacts have in fact been recorded. The impact of comets on our earth is extremely rare indeed. Thus far apart from a few negligible consequences, our earth has been relatively free from cosmic debris. This itself is testimony to the vastness of our solar system and even more so of the universe itself.

References

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Courtesy *International Herald Tribune*, 9 June 2006.